BRISTOL WATER – WATER RESOURCES MANAGEMENT PLAN 2024

INNS Risk Assessment Report

Report for: Bristol Water

Ref. WRMP24 INNS Risk Assessment Report

Ricardo ref. ED15765 Issue: 4 18/10/2024

Ricardo Energy & Environment, Gemini Building, Fermi Avenue, Harwell, Oxfordshire, OX11 0QR, UK | +44(0)1235 75 3000 | ee.ricardo.com
Registered company no. 08229264 | VAT no. GB 212 8365 24

Customer:
Bristol Water

Customer reference:
3500077343

Contact:
Dr Stuart Ballinger, Ricardo Energy & Environment, First Floor North, 21 Prince Street, Bristol, BS1 4PH UK

T: +44 (0) 1235 753 353
E: stuart.ballinger@ricardo.com

Author:
Ryan Forshaw, Tom Clayton

Approved by:
Stuart Ballinger

Signed

Date:
18/10/2024

Ref: ED15765

Table of Contents

1. INTRODUCTION

This report provides an assessment of the risks posed by the proposed schemes encompassed within Bristol Water's final Water Resource Management Plan 2024 (WRMP24) in relation to Invasive Non-Native Species (INNS).

1.1 BACKGROUND AND PURPOSE OF REPORT

The report aims to provide a detailed assessment of the INNS risk associated with the construction and operation of the Bristol Water WRMP options in view of the latest scheme understanding and methodologies.

INNS flora and fauna are considered a significant threat to biodiversity worldwide and have been identified as one of the most serious and rapidly growing threats to biodiversity, ecosystem services and food, health, and livelihood security. The annual cost of INNS to the British economy was estimated in 2010 to be £1.7billion per year, of which around £5 million was attributed to water industry management of INNS. New and existing INNS also pose a threat to achieving Water Framework Directive (WFD) objectives. The UKWIR project completed by Ricardo Energy & Environment (UKWIR, 2016), provided further evidence of the implications of INNS to the water industry.

Subsequently, the Environment Agency (EA) (2017) set out a position paper on the assessment of the risks of spreading INNS through existing water transfers. The position paper set out the scope, outcomes and timelines expected for risk assessments of raw water transfers and options appraisal that water companies should deliver in Asset Management Plan (AMP)7.

As a result, INNS became a new "driver" within the 2019 Price Review (PR19). In previous price reviews, there was some scope for limited INNS work, justified within the biodiversity drivers. Having a separate driver recognised the increasing evidence and understanding of the risks posed by INNS. The guidance supporting this driver is explicit in stating that "the most cost-beneficial and least damaging way to manage invasive species is to prevent their arrival and spread." This highlights the need to understand the pathways by which INNS can be transferred and hence spread. Furthermore, the EA has specifically identified raw water transfers (RWTs) as a subgroup of pathways that should have priority risk assessments (RAs) to assess the potential for INNS to spread.

The INNS guidance indicates that all water companies will need to consider:

- Pathways of spread (understanding and reducing the risk from different pathways).
- Preventing spread (controlling, eradicating, or managing INNS to prevent spread where this will contribute to WFD prevention of deterioration); and
- Action on INNS to achieve conservation objectives of Sites of Special Scientific Interest (SSSI) and sites protected under the Habitats Directive.

This has led to INNS being considered in the Water Industry National Environmental Programme with a particular focus on investigating the risks of spreading INNS through options appraisal for mitigation and companywide biosecurity plans to reduce the risk of distributing INNS through existing activities and operations.

In April 2022 the EA set out a further INNS position paper in relation to the management of risk during new and existing raw water transfers. The position paper set out the levels of assurance required to prevent the spread of INNS during new and existing transfers between isolated and connected catchments. The paper states that mitigation between watercourses should "be fail safe, resilient and completely effective for all life stages (large fragments/animals/microscopic organisms and larval stages)".

1.2 BRISTOL WATER'S WATER RESOURCE MANAGEMENT PLAN 2024

In line with regulatory requirements, Bristol Water has prepared a WRMP, alongside which is published this INNS risk assessment report. In developing its plan, there are several key future challenges faced by Bristol Water in providing a reliable and sustainable water supply over the next 25 years. These

include potential effects of climate change, risks of raw water quality deterioration and measures to improve the environment and/or help watercourses achieve good ecological status or potential under the Water Framework Directive.

As a result of these various pressures, action will be required to ensure that sustainable and secure supplies to customers continue to be maintained over the 25-year planning horizon. Full details are provided in the WRMP.

The temporal scope of the plan covers a planning period of twenty-five years between 2024/5 and 2049/50. However, as WRMPs are required to be updated every five years, the options and programmes for balancing supply and distribution will be reviewed and subject to an INNS risk assessment again during the period 2029/30.

1.2.1 Bristol Water's WRMP24 Constrained Option List

Bristol Water investigated an unconstrained list of potential options to balance future supply and demand. Unconstrained options include all options that could technically be used to meet any deficit. To identify which of the options included in the unconstrained list should be investigated further, Bristol Water reviewed the technical, environmental, carbon and social attributes of each option at a high level. This included INNS high-level screening of the unconstrained list. This resulted in a sub-set of the unconstrained list of options, which is referred to as the "feasible" list. The feasible list was further refined to establish a "constrained list of options".

The resource management options included in the constrained list are included in Table 1.1. For INNS risk assessment only resource management (supply) options are assessed, as other option categories do not present INNS transfer risk. For each supply option, baseline information was collated to allow INNS risk assessments to be completed.

Due to the scheme type, the INNS risk relating to option P06 (Catchment Management) has not been assessed. The aim of the scheme is to improve catchment water quality and consists of various catchment management initiatives centred around improving agricultural practices including clean and dirty water separation, and cultivation practices. As such the scheme itself does not constitute an INNS transfer risk.

Table 1.1 Bristol Water WRMP24 Constrained List of Supply Options

Reference	Option Name/Brief	Option Category	Maximum Resource Value
P01-01	Charterhouse – Increase performance of existing sources to increase DO near to licensed quality	Resource Management (Water treatment works (WTW) capacity increase)	0.74Ml/d
P01-02	Forum – Increase performance of existing sources to increase DO near to licensed quality	Resource Management (WTW capacity increase)	1.59Ml/d
P06	Catchment Management of the Mendip Lakes (Chew, Blagdon and Cheddar) to manage outage risk from algal blooms	Resource Management (Catchment management)	0.7Ml/d
P08	Alderley WTW – Increase performance of existing sources (Alderley WTW) to increase DO	Resource Management (WTW capacity increase)	7.00Ml/d

Reference	Option Name/Brief	Option Category	Maximum Resource Value
R005	Cheddar 2 Reservoir[1]	Resource Management (New Reservoir)	13.5Ml/d
R007	Pumped Refill of Chew Valley Reservoir	Resource Management (Reservoir enlargement)	25Ml/d
R08-02	Bathford – New water sources within Bristol Water CAMS area for the location Middle River Avon at Bathford	Resource Management (New surface water)	1.4Ml/d
R08-03	Frome at Frenchay - New water sources within Bristol Water CAMS area for the location Bristol Frome at Frenchay	Resource Management (New surface water)	1.1Ml/d
R014	Avonmouth Wastewater Treatment Works (WwTW) Direct Effluent Reuse	Resource Management (Water reuse)	10Ml/d
R016	Huntspill Transfer	Resource Management (Internal raw water transfer)	20Ml/d
R24	Honeyhurst – Bring Honeyhurst source back into supply	Resource Management (New groundwater)	2.4Ml/d

[1] Since the Draft WRMP24, it has been shown that there is not the need, in Bristol Water's supply area for an additional reservoir at the present time and as a result the option has been removed from Bristol Water's feasible options list. However, this option has been selected as a preferred option within the WCWR regional plan and is being developed within Bristol Water's supply area to serve the wider region as part of the RAPID gated process. Information concerning the Cheddar 2 option as assessed at the Draft WRMP24 stage has been retained in this report for reference.

2. INNS ASSESSMENT METHODOLOGY

2.1 STAGE 1 - INNS BASELINE REVIEW

The baseline data review considered INNS occurrence records stored within the NBN Atlas[2] and NBN Atlas Wales INNS Portal covering a period of 11 years (1 January 2009 - 31 December 2019) of data.

INNS species listed under; Schedule 9 of the Wildlife and Countryside Act, WFD UKTAG Aquatic Alien Species, EU Invasive and Alien Species Regulation, Wales Priority Species for Action, MSFD – UK priority species, WFD UKTAG alarm species, GB NNSS Alert species have been identified from the datasets for consideration.

The purpose of the data review was to establish which species are currently known to be present within the waterbodies/reaches associated with the WRMP24 constrained list options. Species records were assessed to identify which species are likely to be facilitated by a raw water transfer by becoming entrained and transported to new sites and/or the associated construction activities of the individual components.

A Kernel Density estimation algorithm was applied to the data captured during the NBN Atlas data review using geographical imaging software (GIS). The algorithm provides a visual representation of occurrence record densities of INNS located within 500m of the watercourse and associated option or option components (e.g. pipeline). This allows for the identification of regions with a higher density of recorded INNS occurrences based upon the number of records within a 250m radius of each record. Though the heatmaps are able to show where a high number of occurrences have been recorded, their accuracy in determining the actual density of INNS is dependent upon sampling effort, therefore, the heatmaps only provide an indication of where INNS have been recorded and do not indicate actual INNS density.

2.2 STAGE 2 - SAI-RAT

Following a process of stakeholder review including input from internal experts within Ricardo, the EA released an INNS risk assessment tool which they indicated should be used at Gate 2 of the RAPID process for assessing INNS risks of strategic resource options (SRO)[3]. The tool, named the “SRO Aquatic INNS Risk Assessment Tool”, or SAI-RAT has been adopted to assess the Bristol Water WRMP24 list of constrained options.

The SAI-RAT was developed to account for the diversity of assets and RWTs which may comprise any one solution and uses a single assessment process via a modular approach, to provide a quantitative score of relative risk.

The assessment of RWTs using the SAI-RAT takes a pragmatic pathway and source-pathway-receptor model approach respectively, building upon other assessment tools such as the Northumbrian Water Group (NWG) RWT assessment tool and the Wessex Water asset assessment tool, adopting similar approaches to the quantification of INNS risk. Similar to these tools, an extended functional group mechanism has been incorporated to account for future risks rather than only examining species known to be currently present.

[2] The NBN Atlas is the UK’s largest repository of publicly available biodiversity data

[3] Environment Agency (2021). EA SRO assessment tool handbook v1 – Final. November 2021.

3. STAGE 1 – INNS BASELINE ASSESSMENT OUTCOMES

3.1 OPTION P01-01: CHARTERHOUSE

No INNS of interest were recorded within 500m of the scheme infrastructure during the baseline period within the NBN atlas as presented in Figure 3.1.

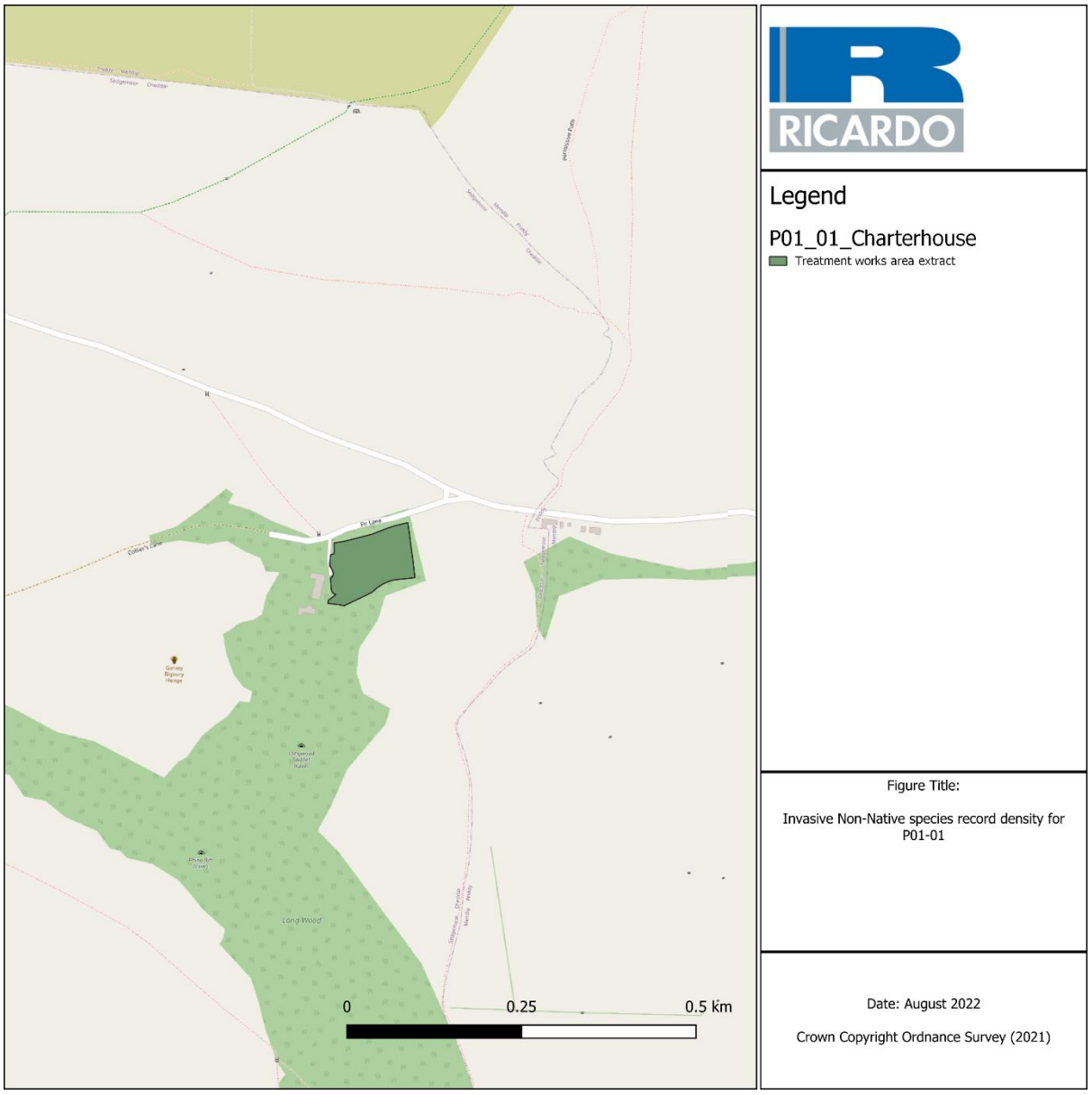

Figure 3.1 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option P01-01.

3.2 Option R005: Cheddar 2 Reservoir

A total of 3 INNS of interest were recorded within 500m of the scheme infrastructure during the baseline period within the NBN atlas, as can be seen within Table 3.1 below. Both terrestrial and aquatic INNS species were recorded within the area. The most common INNS found was Nuttall's waterweed (*Elodea nuttallii).* A heatmap representation of data visible in Figure 3.2 indicates mixed INNS density records across the reach. A moderate density of INNS was recorded south of Cheddar close to the location of the proposed Cheddar 2 reservoir.

Table 3.1 INNS recorded within 500m of the Option R005 components between 2010 and 2022, inclusive of NBN records.

Common Name	*Scientific Name*	Occurrences
Nuttall's waterweed	*Elodea nuttallii*	33
New Zealand Mudsnail	*Potamopyrgus antipodarum*	9
Spanish Bluebell	*Hyacinthoides hispanica*	1

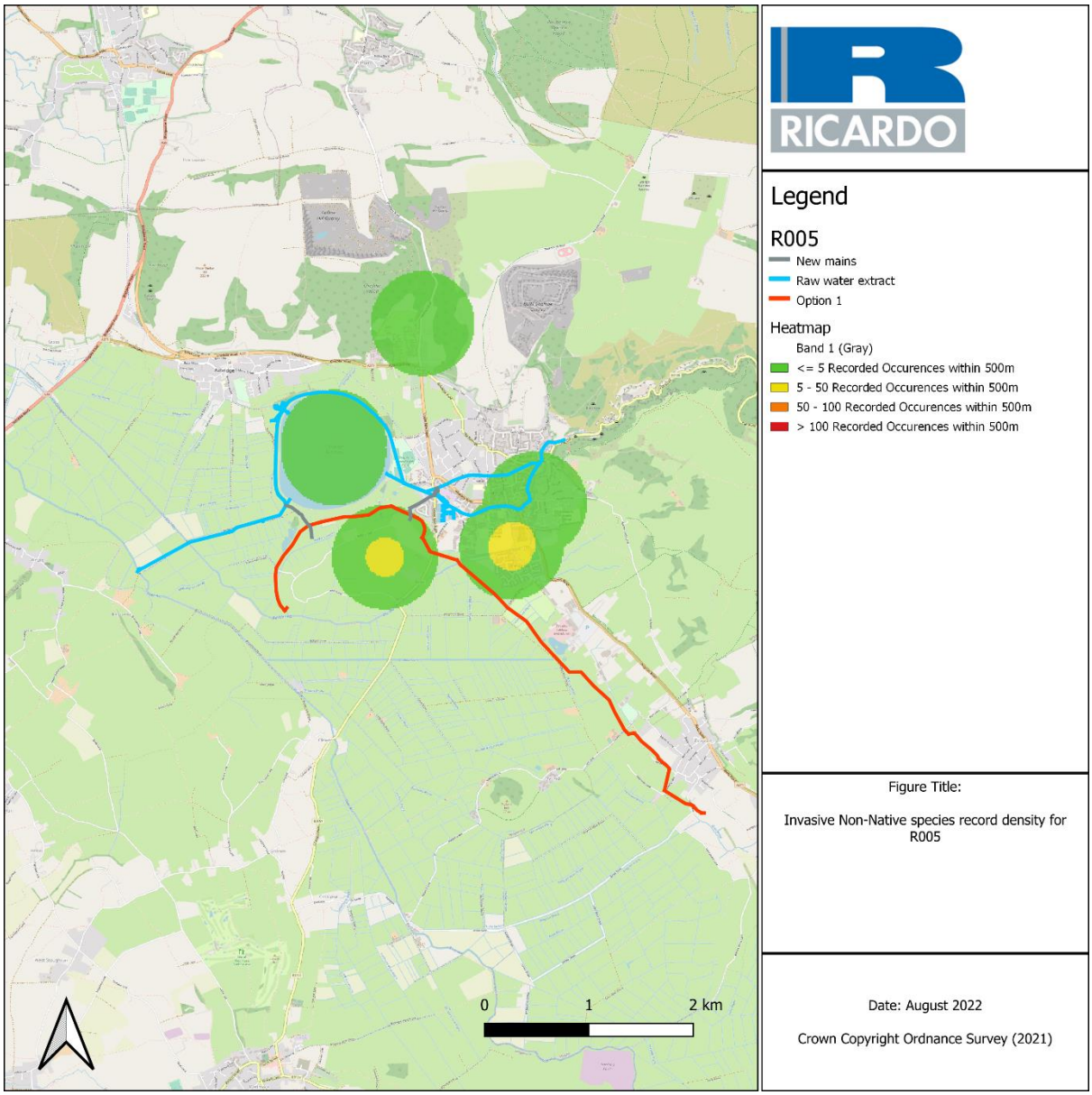

Figure 3.2 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option R005

3.3 OPTION R007: PUMPED REFILL OF CHEW VALLEY RESERVOIR

A total of 22 INNS of interest were recorded during the baseline period within the NBN atlas, as shown in Table 3.2 below. A multitude of terrestrial and aquatic species were recorded within the study area. The most common INNS found was the terrestrial plant species Himalayan Balsam (*Impatiens glandulifera)* followed by Japanese Knotweed (*Fallopia japonica*). Several aquatic animal and plant species were also recorded in the study area including Signal Crayfish (*Pacifastacus leniusculus)* and Canadian Pondweed (*Elodea canadensis)*. A heatmap representation of data provided in Figure 3.3 indicates low to medium INNS density records across the reach. A particular hotspot was along the River Avon where a higher density of INNS occurrences was recorded within 500m of the watercourse.

Table 3.2 INNS recorded within 500m of the Option R007 components between 2010 and 2022, inclusive of NBN records.

Common Name	*Scientific Name*	Occurrences
Himalayan Balsam	*Impatiens glandulifera*	129
Japanese Knotweed	*Fallopia japonica*	11
Caspian Mud Shrimp	*Chelicorophium curvispinum*	8
Zebra Mussel	*Dreissena polymorpha*	8
Cherry Laurel	*Prunus laurocerasus*	8
Dikerogammarus haemobaphes	*Dikerogammarus haemobaphes*	7
Butterfly Bush	*Buddleja davidii*	7
Ponto-Caspian Polycheate Worm	*Hypania invalida*	5
Nuttall's waterweed	*Elodea nuttallii*	3
Lesser Periwinkle	*Vinca minor*	3
New Zealand Mudsnail	*Potamopyrgus antipodarum*	2
Spanish Bluebell	*Hyacinthoides hispanica*	2
Signal Crayfish	*Pacifastacus leniusculus*	2
Giant Hogweed	*Heracleum mantegazzianum*	2
Variagated Yellow Archangel	*Lamiastrum galeobdolon subsp. argentatum*	2
Swamp Stonecrop	*Crassula helmsii*	2
Canadian Pondweed	*Elodea canadensis*	1
sea-buckthorn	*Hippophae rhamnoides*	1
Few-flowered Garlic	*Allium paradoxum*	1
Wall Cotoneaster	*Cotoneaster horizontalis*	1
Perennial Pea	*Lathyrus latifolius*	1
Rhododendron	*Rhododendron ponticum*	1

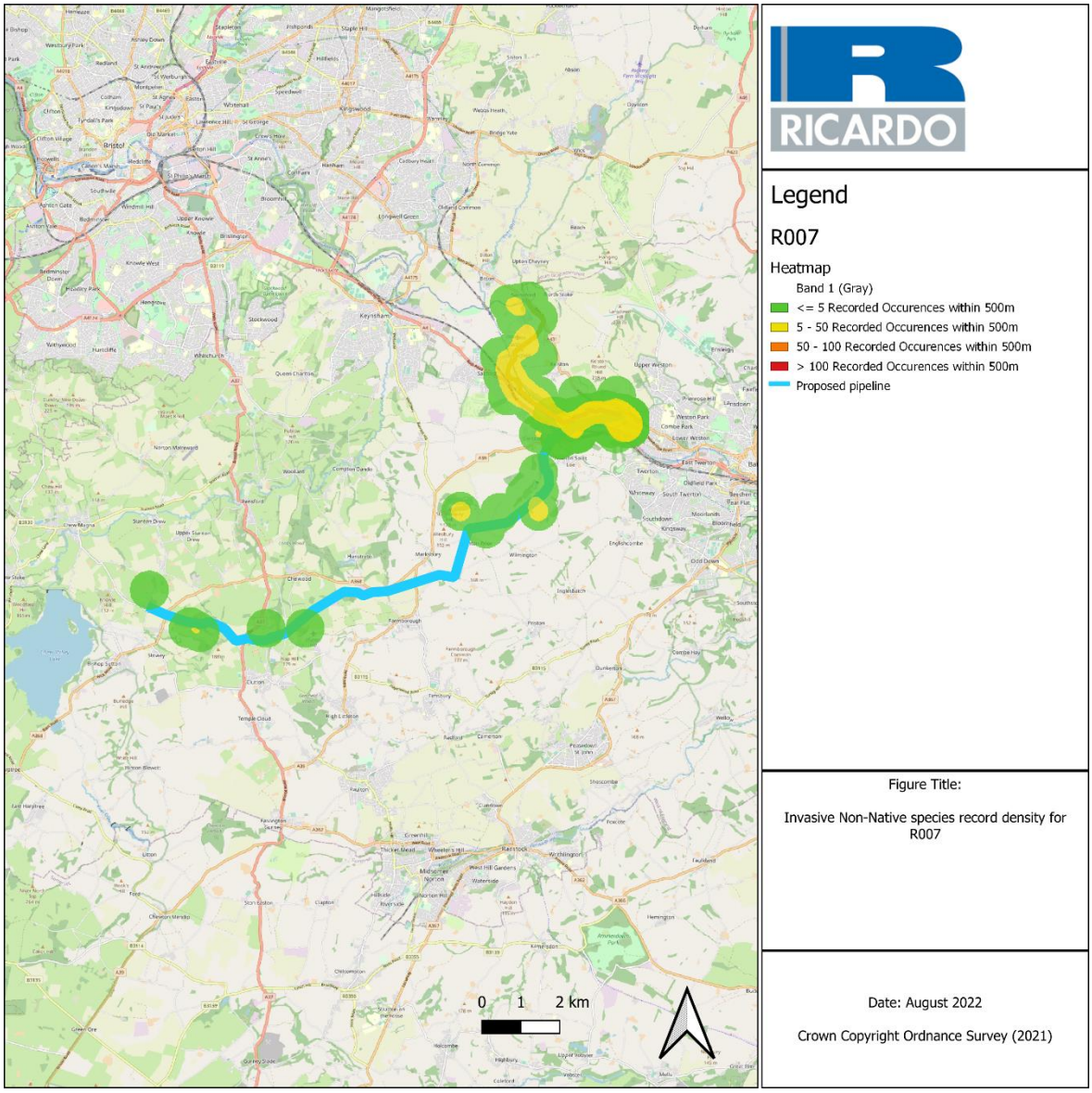

Figure 3.3 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option R007

3.4 OPTION R014: AVONMOUTH WWTW DIRECT EFFLUENT REUSE

A total of 23 INNS of interest were recorded during the baseline period within the NBN atlas, as can be seen within Table 3.3 below. A multitude of terrestrial and aquatic species were recorded within the study area. The most common INNS found include the terrestrial plant species Butterfly Bush (*Buddleja davidii*) and Common Cord-grass (*Spartina anglica*). Several aquatic animal and plant species were also recorded in the study area including New Zealand Mudsnail (*Potamopyrgus antipodarum*) and Canadian Pondweed (*Elodea canadensis)*. A heatmap representation of data visible in Figure 3.4 indicates several moderate to high density areas within the study area particularly around Redwick and Pilning.

Table 3.3 INNS recorded within 500m of the Option R014 components between 2010 and 2022, inclusive of NBN records.

Common Name	*Scientific Name*	Occurrences
Butterfly Bush	*Buddleja davidii*	47
Common Cord-grass	*Spartina anglica*	43
Himalayan Balsam	*Impatiens glandulifera*	10
Least Duckweed	*Lemna minuta*	8
Japanese Knotweed	*Fallopia japonica*	6
New Zealand Mudsnail	*Potamopyrgus antipodarum*	5
Parrot's Feather	*Myriophyllum aquaticum*	5
Montbretia	*Crocosmia pottsii x aurea = C. x crocosmiiflora*	4
Perennial Pea	*Lathyrus latifolius*	4
Canadian Pondweed	*Elodea canadensis*	3
Greater Periwinkle	*Vinca major*	3
Three-cornered Garlic	*Allium triquetrum*	3
Wall Cotoneaster	*Cotoneaster horizontalis*	3
Nuttall's waterweed	*Elodea nuttallii*	2
Spanish Bluebell	*Hyacinthoides hispanica*	2
Water Fern	*Azolla filiculoides*	2
Variagated Yellow Archangel	*Lamiastrum galeobdolon subsp. argentatum*	2
Cherry Laurel	*Prunus laurocerasus*	1
Common Carp	*Cyprinus carpio*	1
Sitka Spruce	*Picea sitchensis*	1
Benthic Ostracod	*Eusarsiella zostericola*	1
Swamp Stonecrop	*Crassula helmsii*	1
Giant Knotwood	*Fallopia sachalinensis*	1

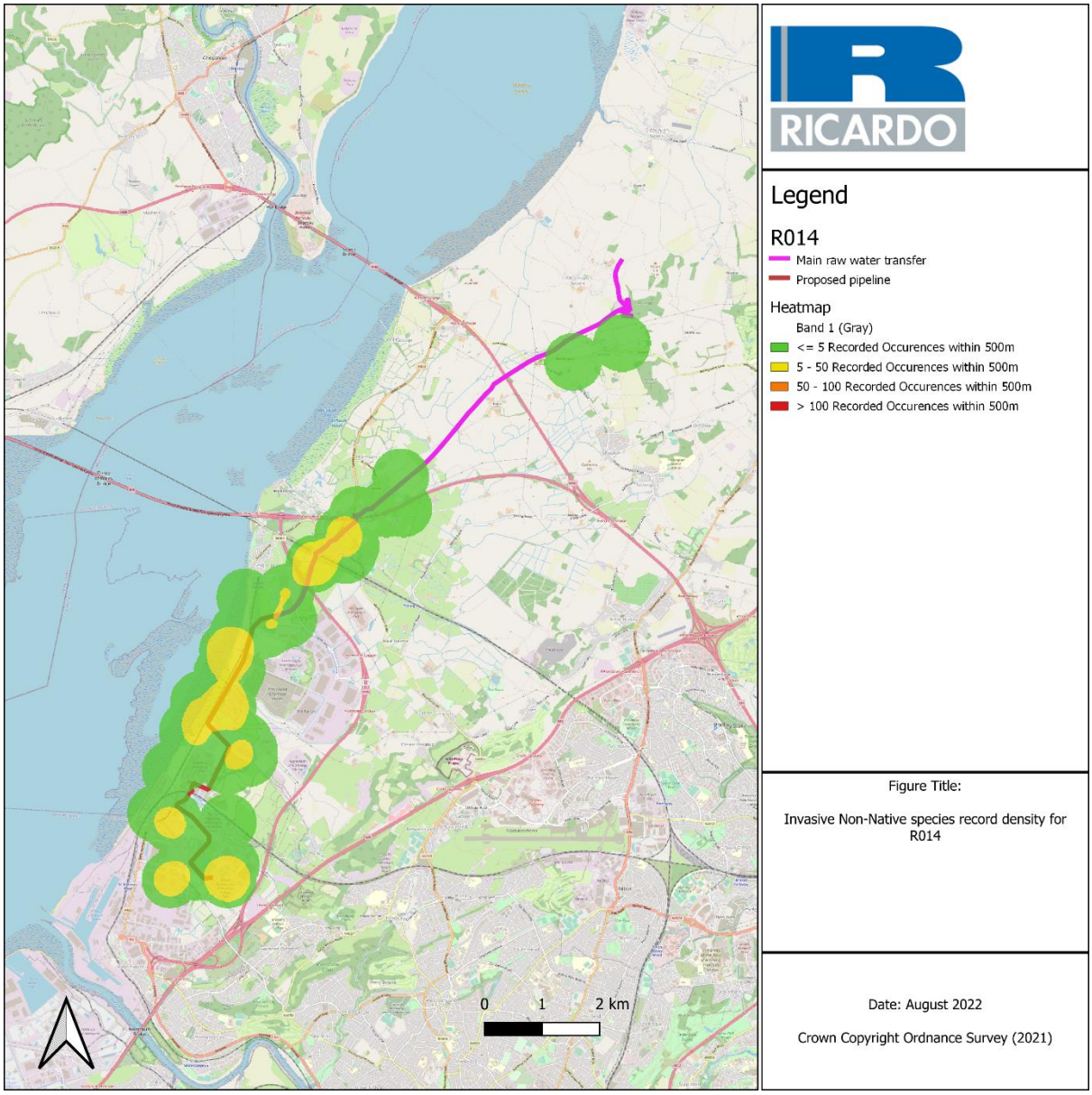

Figure 3.4 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option R014

3.5 OPTION R016: HUNTSPILL TRANSFER

A total of 5 INNS of interest were recorded during the baseline period within the NBN atlas, as can be seen within Table 3.4 below. Both terrestrial and aquatic INNS were recorded within the study area. The most common INNS found include the aquatic plant species Nuttall's waterweed (*Elodea nuttallii*) and the terrestrial species Himalayan Balsam (*Impatiens glandulifera)*. A heatmap representation of data visible in Figure 3.5 indicates several low-density areas with a moderate density of INNS occurrences recorded around River Bridge.

Table 3.4 INNS recorded within 500m of the Option R016 components between 2010 and 2022, inclusive of NBN records.

Common Name	*Scientific Name*	Occurrences
Nuttall's waterweed	*Elodea nuttallii*	8
Himalayan Balsam	*Impatiens glandulifera*	4
Least Duckweed	*Lemna minuta*	2
Water Fern	*Azolla filiculoides*	2
Spanish Bluebell	*Hyacinthoides hispanica*	1

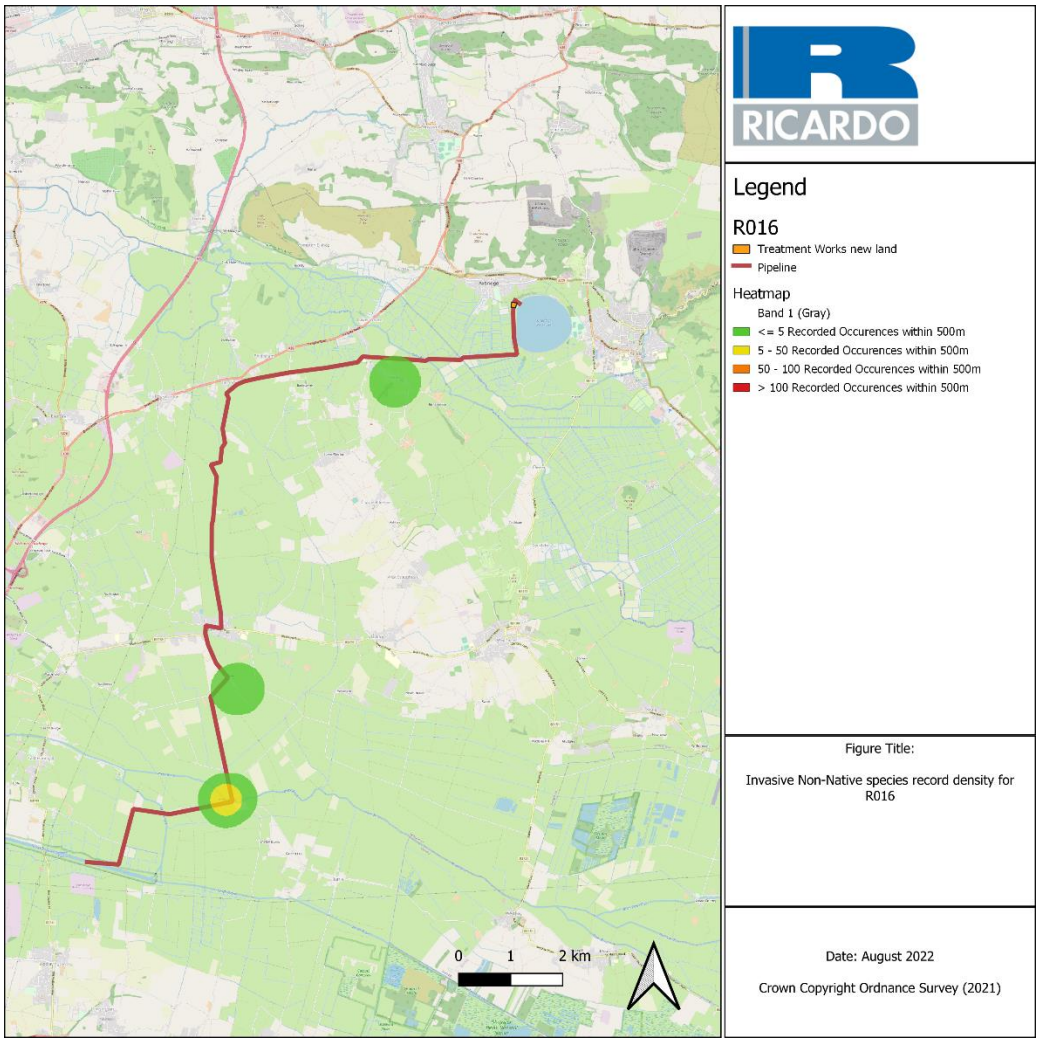

Figure 3.5 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option R016.

3.6 OPTION R24: HONEYHURST

A total of 3 INNS of interest were recorded during the baseline period within the NBN atlas, as can be seen within Table 3.5 below. Both terrestrial and aquatic INNS were recorded within the study area. The most common INNS found was the aquatic plant species Nuttall's waterweed (*Elodea nuttallii*) and the New Zealand Mudsnail (*Potamopyrgus antipodarum*). A heatmap representation of data visible in Figure 3.6 indicates a high density of INNS occurrences recorded south of Cheddar.

Table 3.5 INNS recorded within 500m of the Option R024 components between 2010 and 2022, inclusive of NBN records.

Common Name	*Scientific Name*	Occurrences
Nuttall's waterweed	*Elodea nuttallii*	33
New Zealand Mudsnail	*Potamopyrgus antipodarum*	9
Spanish Bluebell	*Hyacinthoides hispanica*	1

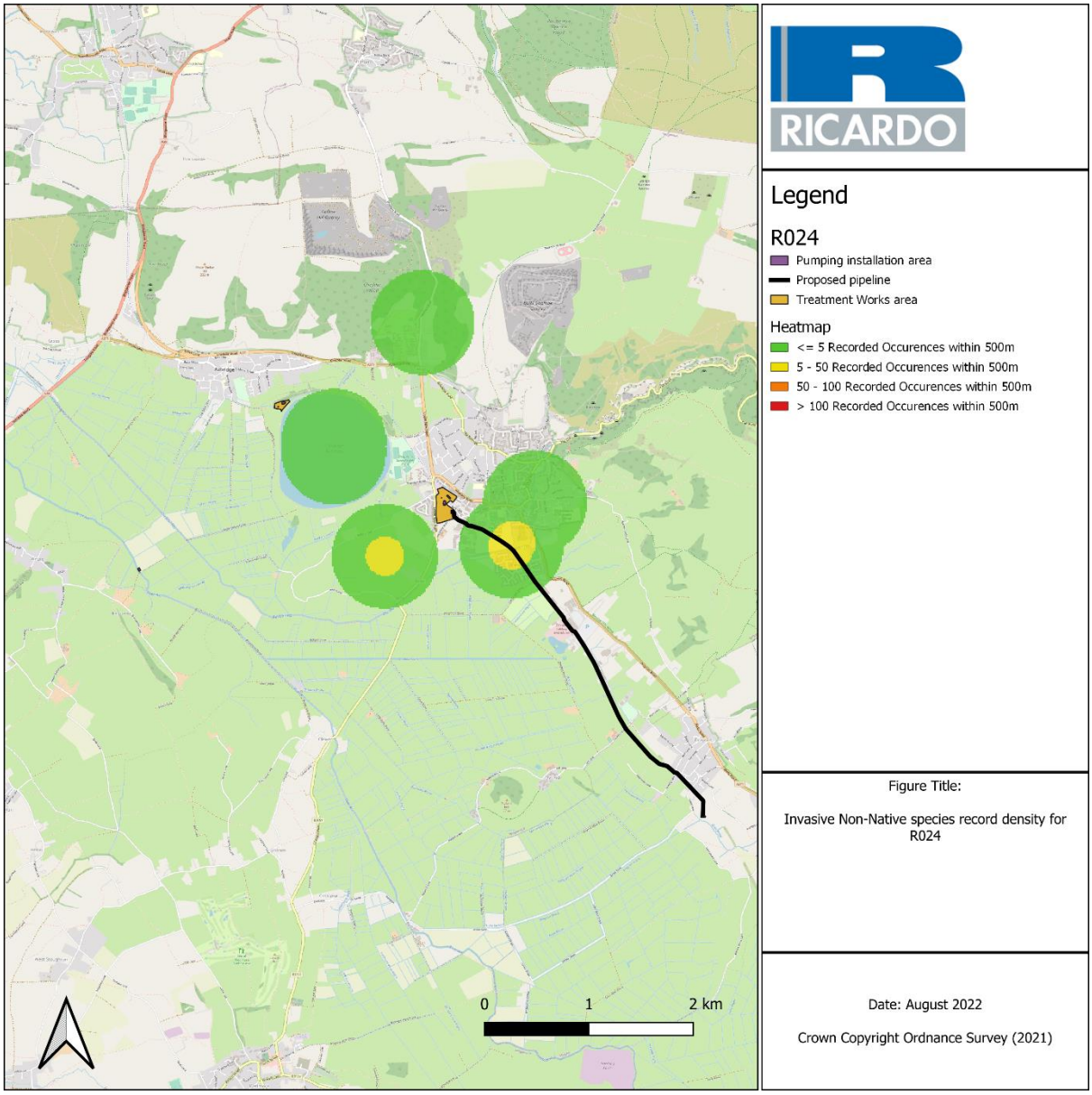

Figure 3.6 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option R024.

3.7 OPTION P01-02: FORUM

No INNS of interest were recorded within 500m of the scheme infrastructure during the baseline period within the NBN atlas as can be seen in Figure 3.7.

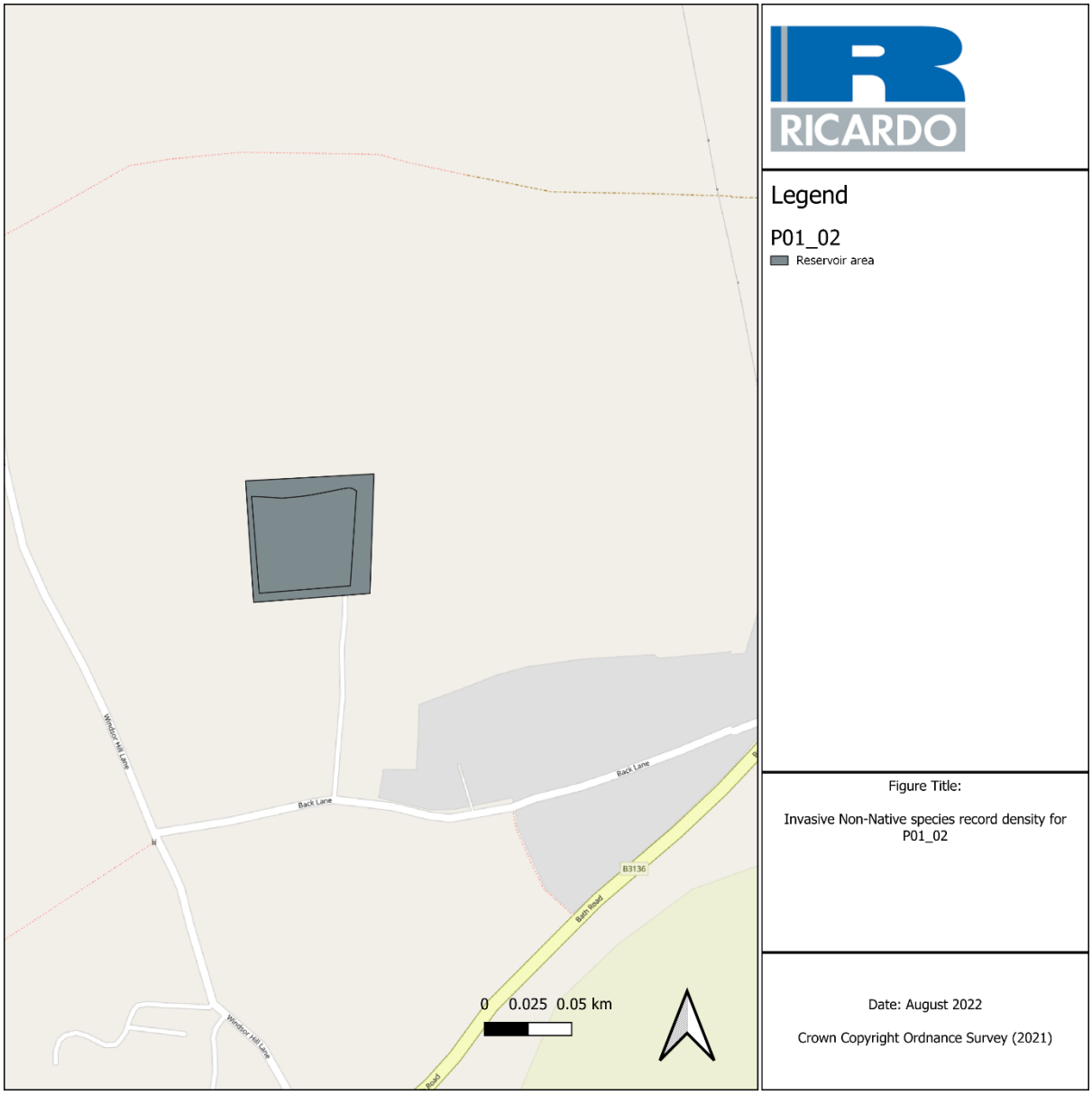

Figure 3.7 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option P01-02.

3.8 OPTION P08: ALDERLEY WTW

No INNS of interest were recorded within 500m of the scheme infrastructure during the baseline period within the NBN atlas as can be seen in Figure 3.8.

Figure 3.8 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option P08.

3.9 OPTION R08-02: BATHFORD

A total of 16 INNS of interest were recorded during the baseline period within the NBN atlas, as can be seen within Table 3.6 below. The most common INNS found was Himalayan Balsam *Impatiens glandulifera.* A heatmap representation of data visible in Figure 3.9 indicates low to medium INNS density records across the reach. A particular hotspot was identified around Bathford.

Table 3.6 INNS recorded within 500m of the Option R08-02 components between 2010 and 2022, inclusive of NBN records.

Common Name	*Scientific Name*	Occurrences
Himalayan Balsam	*Impatiens glandulifera*	23
Giant Hogweed	*Heracleum mantegazzianum*	12
Butterfly Bush	*Buddleja davidii*	12
Signal Crayfish	*Pacifastacus leniusculus*	11
Cherry Laurel	*Prunus laurocerasus*	9
Few-flowered Garlic	*Allium paradoxum*	7
New Zealand Mudsnail	*Potamopyrgus antipodarum*	4
Japanese Knotweed	*Fallopia japonica*	3
Spanish Bluebell	*Hyacinthoides hispanica*	3
Variagated Yellow Archangel	*Lamiastrum galeobdolon subsp. argentatum*	3
Wall Cotoneaster	*Cotoneaster horizontalis*	3
Spotted touch-me-not	*Impatiens capensis*	2
Lesser Periwinkle	*Vinca minor*	2
Rhododendron	*Rhododendron ponticum*	2
Greater Periwinkle	*Vinca major*	1
Three-cornered Garlic	*Allium triquetrum*	1

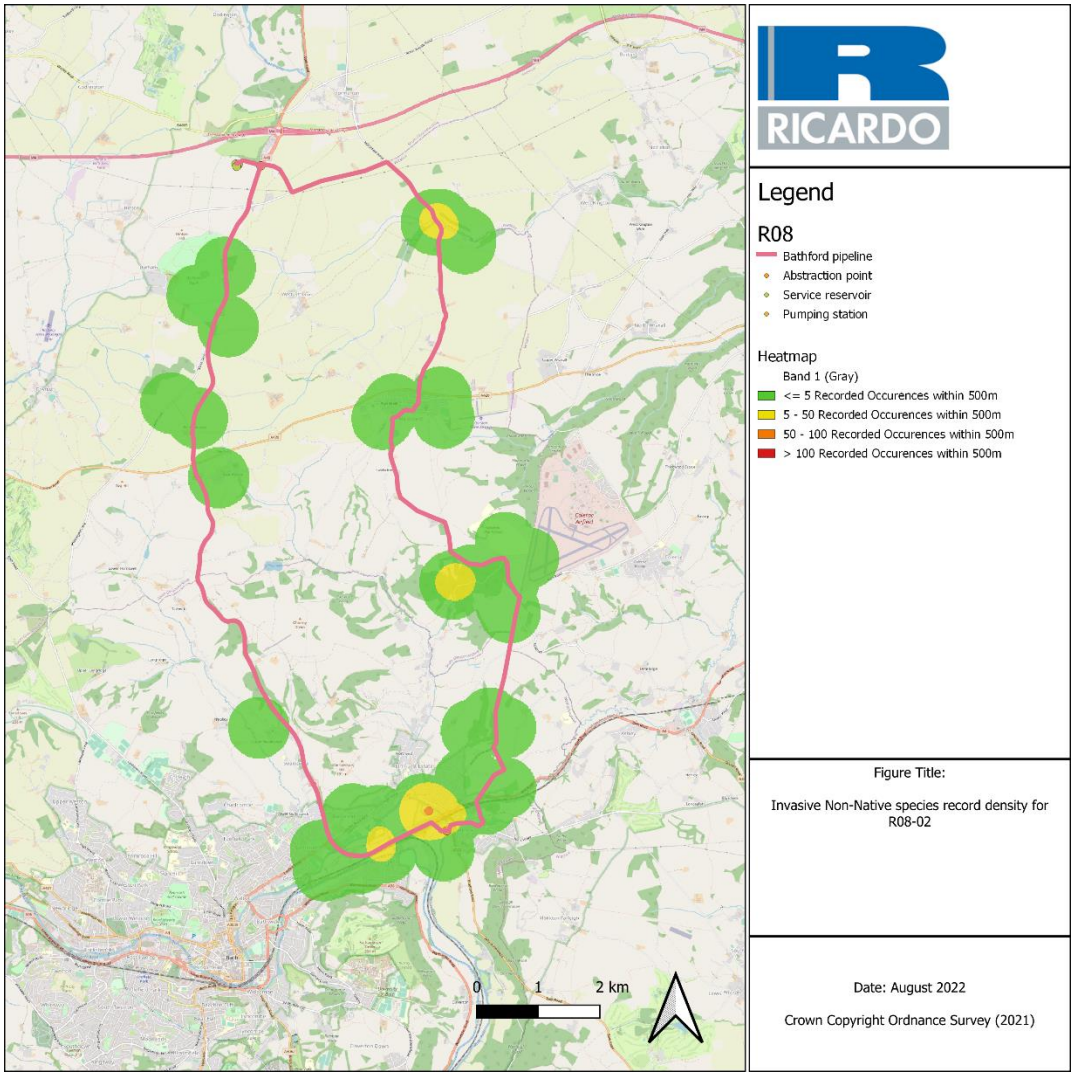

Figure 3.9 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option R08-02.

3.10 OPTION R08-03

A total of 19 INNS of interest were recorded during the baseline period within the NBN atlas, as can be seen within Table 3.7 below. A multitude of terrestrial and aquatic species were recorded within the study area. The most common INNS found was the terrestrial plant species Himalayan Balsam (*Impatiens glandulifera*) and Butterfly bush (*Buddleja davidii*). Several aquatic animal and plant species were also recorded in the study area including New Zealand Mudsnail (*Potamopyrgus antipodarum*) and Canadian Pondweed (*Elodea canadensis)*. A heatmap representation of data visible in Figure 3.10 indicates several areas with a moderate density of occurrences within the study area particularly around Emerson Green and Olveston.

Table 3.7 INNS recorded within 500m of the Option R08-03 components between 2010 and 2022, inclusive of NBN records.

Common Name	*Scientific Name*	Occurrences
Himalayan Balsam	*Impatiens glandulifera*	89
Butterfly Bush	*Buddleja davidii*	7
Cherry Laurel	*Prunus laurocerasus*	6
New Zealand Mudsnail	*Potamopyrgus antipodarum*	5
Giant Knotwood	*Fallopia sachalinensis*	5
Japanese Knotweed	*Fallopia japonica*	4
Lesser Periwinkle	*Vinca minor*	4
Variagated Yellow Archangel	*Lamiastrum galeobdolon subsp. argentatum*	4
Wall Cotoneaster	*Cotoneaster horizontalis*	3
Spanish Bluebell	*Hyacinthoides hispanica*	2
Canadian Pondweed	*Elodea canadensis*	2
False acacia	*Robinia pseudoacacia*	2
Greater Periwinkle	*Vinca major*	2
Montbretia	*Crocosmia pottsii x aurea = C. x crocosmiiflora*	2
Giant Hogweed	*Heracleum mantegazzianum*	1
Common Carp	*Cyprinus carpio*	1
Three-cornered Garlic	*Allium triquetrum*	1
Perennial Pea	*Lathyrus latifolius*	1
Rhododendron	*Rhododendron ponticum*	1

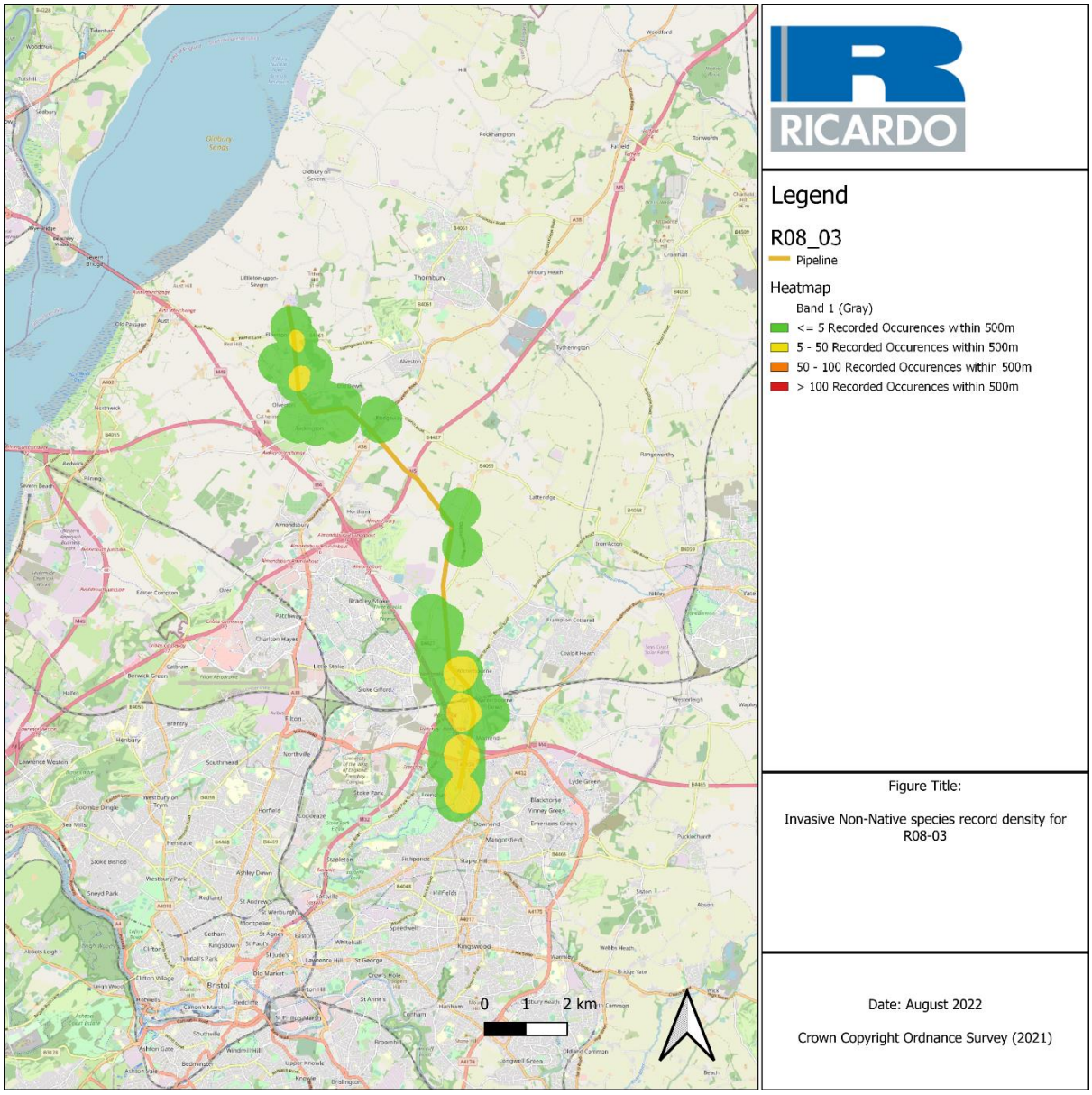

Figure 3.10 INNS Heatmap representing the available INNS occurrences data within 500m of scheme infrastructure and transfer routes for Option R08-03.

4. STAGE 2 – SAI-RAT ASSESSMENT OUTCOMES

The SAI-RAT tool assigns a risk value based on the characteristics of the transfer option. Information is inserted for each variable within the tool for each solution element/component to match the characteristics of the proposed transfer as closely as possible (as permitted by the scaling within the tool). Variables within the SAI-RAT are weighted differently based on their inherent risk to the distribution of INNS. A complete list of the variables which were inserted into the tool is provided in Appendix A1. The output scores provided by the SAI-RAT RWT risk assessment are listed in the Table 4.1 below.

Table 4.1 Risk scores produced for the WRMP24 supply options using the SAI-RAT RWT risk assessment tool.

Scheme Reference	Scheme Brief	SAI-RAT RWT Risk Score
R007	Pumped Refill of Chew Valley Reservoir	34.60
R014	Avonmouth WWTW Direct Effluent Reuse	N/A
R016	Huntspill Transfer	34.35
R024	Bring Honeyhurst source back into supply	28.08
P01-01	Increase performance of existing sources to increase DO near to licensed quality	24.70
P06	Catchment Management of the Mendip Lakes (Chew, Blagdon, and Cheddar) to manage outage risk from algal blooms	NA
P01-02	Increase performance of existing sources to increase DO near to the licensed quality	NA
P08	Increase performance of existing sources (Alderley WTW) to increase DO	NA
R08-02	New water sources within Bristol Water CAMS area for the location Middle River Avon at Bathford	32.58
R08-03	New water sources within Bristol Water CAMS area for the location Bristol Frome at Frenchay	32.20

5. ASSESSMENT SUMMARY OF THE BRISTOL WATER WRMP24

This section outlines a summary of the INNS risk assessments undertaken for the constrained list of supply options for the WRMP24.

5.1 R005: CHEDDAR 2 RESERVOIR

5.1.1 R005 Construction

The total pipeline to be constructed to facilitate the transfer of raw water from the Cheddar Springs and River Axe and onward transmission to a new Water Treatment Works (WTW) at Honeyhurst, is approximately 55km in length. In addition, six pumping stations are required to be constructed as part of the scheme. Presently, detailed construction methodologies are not available, however, it is expected that the transport of plant equipment, personnel, soils, and aggregates to and from the site will occur during the construction phase and that these activities are likely to represent INNS distribution pathways. Of the species listed in Section 3.2, Spanish Bluebell (*Hyacinthoides hispanica*), may be distributed through the transfer of bulbs or seeds. Mitigation is likely to be encompassed within standard best practice biosecurity protocols and should aim to limit the potential for INNS transfer via the pathways listed above though additional methods may be required depending upon construction methodologies and further monitoring.

5.1.2 R005 Operation

To facilitate the assessment of the operation of the R005 scheme using the SAI-RAT, it has been split into three distinct components as follows:

The abstraction of water from Cheddar Springs is perceived to be a low risk to the distribution of INNS as the abstraction source (Cheddar Springs), has a limited potential to facilitate the entrainment of INNS, due to it being spring fed and emerging close to the abstraction point. The SAI-RAT RWT tool scores the risk of the Cheddar Springs abstraction component at 37.13% based upon the variables entered into the tool, which are listed in Table A5.1 in Appendix A1 below.

The discharge of raw water abstracted from the River Axe to Cheddar 2 Reservoir has a low potential for INNS transfer as water will be treated at Axbridge WTW prior to discharge to Cheddar 2. It is assumed based on the current understanding of the treatment process at Axbridge WTW that the treatment is sufficient to remove INNS transfer risk. The SAI-RAT RWT tool scores the risk of the Axbridge Treatment Works component at 27.48% based upon the variables entered into the tool, which are listed in Table A5.1 in Appendix A1 below. Table A5.1 in the appendix below.

Onward transmission from Cheddar 2 Reservoir to a new WTW at Honeyhurst has a high potential to entrain and transport INNS from Cheddar 2 Reservoir. However, the transfer destination is likely to limit onward transmission during normal operation. The SAI-RAT RWT tool scores the risk of the abstraction and onward transmission of raw water from Cheddar 2 Reservoir to the new Honeyhurst WTW at 35.85% based upon the variables entered into the tool, which are listed in Table A5.1 in Appendix A1 below. Table A5.1 in the appendix below.

Although there are numerous differing variables within the assessment of the three components, the user can identify how these are influencing the actual risk score.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on several key aspects:

- Prevention of transfer of INNS during RWT from Cheddar Springs to Cheddar 2 Reservoir
- Prevention of transfer of INNS from the Axbridge WTW to Cheddar 2 Reservoir

- Prevention of discharge of INNS during RWT from Cheddar 2 Reservoir to the new Honeyhurst WTW.
- Prevention of transfer of INNS through operational activities such as site maintenance works, waste management and sludge disposal.

If INNS are transferred to Cheddar 2 Reservoir the waterbody will likely constitute a potential INNS propagule source which may facilitate the distribution of INNS into the surrounding habitats. To prevent the distribution of INNS to Cheddar 2 Reservoir, the raw water sources would need to be treated sufficiently to remove INNS propagules prior to transfer and discharge into the reservoir itself in line with the EA's recent position statement[4].

Operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage, information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.1.3 R005 Evidence gaps and recommendations

The SAI-RAT assessment spreadsheet does not allow the user to interpret how variables impact the risk score, therefore, confidence in the tool is based solely upon the final output scoring and the perception of its accuracy. Insight into the formulae used to calculate scores is hidden from the user, therefore, it is not clear how the risk score is calculated and it is not possible to scrutinise the results of the SAI-RAT fully. Furthermore, the risk score itself is not represented with any comparative scale, as such the output score is not useful for determining the risk of an individual component of a supply option but can be used to compare components within the same or different options.

Currently, our understanding of the INNS community within the River Axe, Cheddar Springs, along pipeline routes and at proposed infrastructure sites is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high level scheme descriptions and geospatial data which is yet to be finalised.

5.2 R007: PUMPED REFILL OF CHEW VALLEY RESERVOIR

5.2.1 R007 Construction

The scheme would require the construction of an intake on the River Avon, a new pipeline to transport the abstracted volume to Stowey WTW, and upgrades to the works. Presently, detailed construction methodologies are not available, however, it is expected that the transport of plant equipment, personnel, soils, and aggregates to and from the site will occur during the construction phase and that these activities are likely to represent INNS distribution pathways. Numerous prolific INNS are recorded within the study area (Section 3.3) with several species that have a high potential to be transported during construction activities including Japanese knotweed, Himalayan balsam and giant hogweed. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution through the distribution pathways listed above. Mitigation is likely to be encompassed within standard best practice biosecurity protocols though additional methods may be required depending upon construction methodology and further monitoring.

[4] Environment Agency (2022). Managing the risk of spread of Invasive Non-Native Species through raw water transfers. April 2022.

5.2.2 R007 Operation

The abstraction and transfer of raw water from the River Avon to a treatment works prior to transmission to Chew Valley Reservoir poses an INNS transfer risk. The abstraction of water from the River Avon is perceived to have a high potential for INNS transfer, due to watershed area of the Avon and location of the abstraction point, being downstream of Bath. The transfer will also cross operational catchments increasing the risk of INNS transportation between catchments. However, the destination of transfer will limit the onward transmission and establishment of INNS during normal operation.

The assessment completed using the SAI-RAT of the transfer from the River Avon to the WTW prior to transfer to Chew Valley Reservoir produced a score of 34.6%. The variables entered into the tool are listed in Table A5.1 in Appendix A1. How the variables impact the overall risk scoring is not clear as the formulae and inherent risk scoring for the SAI-RAT tool are not visible to the user. It has been assumed for the purpose of this assessment that the treatment of water prior to discharge to Chew Valley Reservoir will be sufficient to remove all INNS propagules, therefore, onward transmission to Chew Valley Reservoir has not been assessed.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on several key aspects:

- Prevention of transfer of INNS during RWT from the River Avon to the WTW.
- Prevention of transfer of INNS through operational activities such as site maintenance works and waste management.

If water is discharged during transfer and prior to treatment, there is a potential for INNS to be transferred between operational catchments. To mitigate this, the raw water source would need to be treated sufficiently to remove INNS propagules prior to transfer to the WTW in line with the EA's recent position statement.

Operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming, for example, that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.2.3 R007 Evidence gaps and recommendations

The SAI-RAT assessment spreadsheet does not allow the user to interpret how variables impact the risk score, therefore confidence in the tool is based solely upon the final output scoring and the perception of its accuracy. Insight into the formulae used to calculate scores is hidden from the user therefore it is not clear how the risk score is calculated and therefore it is not possible to scrutinise the results of the SAI-RAT fully. Furthermore, the risk score itself is not represented with any comparative scale, as such the output score is not useful for determining the risk of an individual component of an SRO but can be used to compare components within the same or different schemes.

Currently, our understanding of the INNS community within the river Avon, along pipeline routes and at infrastructure sites is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high-level scheme descriptions and geospatial data which is yet to be finalised.

5.3 R014: AVONMOUTH WWTW DIRECT EFFLUENT REUSE

5.3.1 R014 Construction

The scheme would require the construction of a new pipeline and possible upgrade of existing pipelines to transport treated effluent between Avonmouth WwTW and Littleton WTW. Presently, detailed construction methodologies are not available, however it is expected that the transport of plant equipment, personnel, soils and aggregates to and from the site will occur during construction and that these activities are likely to represent INNS distribution pathways. Numerous prolific INNS are recorded within the study area (Section 3.4) with several species that have a high potential to be transported during construction activities including Japanese knotweed, Himalayan balsam and giant hogweed. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution via construction related pathways. Mitigation is likely to be encompassed within standard best practice biosecurity protocols though additional methods may be required depending upon construction methodology and further monitoring.

5.3.2 R014 Operation

During normal operation, the scheme does not constitute a raw water transfer. Water would be treated at Avonmouth WwTW to a high standard (Reverse Osmosis) effectively eliminating INNS transfer risk before being transferred to Littleton WTW via a pipeline.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on prevention of the transfer of INNS through operational activities such as site maintenance works and waste management.

Operations at the treatment works may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.3.3 R014 Evidence gaps and recommendations

Currently, our understanding of the INNS community along pipeline routes and at infrastructure sites is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high-level scheme descriptions and geospatial data which is yet to be finalised.

5.4 R016: HUNTSPILL TRANSFER

5.4.1 R016 Construction

The scheme would require the construction of >19km of pipeline and possible upgrades to Axbridge Water Treatment Works. Presently, detailed construction methodologies are not yet available, however it is expected that the transport of plant equipment, personnel, soils and aggregates to and from the site will occur during construction and that these activities are likely to represent INNS distribution pathways. INNS are recorded within the study area (Section 3.5) with several species that have a high potential to be transported during construction activities including Himalayan balsam and Spanish bluebell. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution via construction related pathways. Mitigation is likely to be encompassed within standard best practice biosecurity protocols though additional methods may be required depending upon construction methodology and further monitoring.

5.4.2 R016 Operation

The abstraction and transfer of raw water from the Huntspill River to a treatment works prior to transmission to Cheddar Reservoir poses an INNS transfer risk. The abstraction of water from the Huntspill River is perceived to have a high potential for INNS transfer due to the location of the abstraction point being within a lowland area. However, the destination of transfer will likely limit the onward transmission and establishment of INNS during normal operation due to the treatment proposed (sand filtration).

The assessment completed using the SAI-RAT of the transfer from the Huntspill River to the WTW prior to discharge to Cheddar Reservoir scores 34.35%. The variables entered into the tool are listed in Table A5.1 in Appendix A1. How these variables impact the overall risk scoring is not clear as the formulae and inherent risk scoring for the SAI-RAT tool are not visible to the user. It has been assumed for the purpose of this assessment that the treatment of water prior to discharge to Cheddar Reservoir will be sufficient to remove all INNS propagules, therefore onward transmission to Cheddar Reservoir has not been assessed.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on several key aspects:

- Prevention of transfer of INNS during RWT from the Huntspill River to the WTW.
- Prevention of transfer of INNS through operational activities such as site maintenance works and waste management.

If water is discharged during transfer and prior to treatment, there is a potential that INNS could be transferred to new habitats or increase the propagule pressure in areas where specific INNS are already present. To mitigate this, the raw water source would need to be treated sufficiently to remove INNS propagules prior to transfer to the WTW in line with the EA's recent position statement.

Operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.4.3 R016 Evidence gaps and recommendations

The SAI-RAT assessment spreadsheet does not allow the user to interpret how variables impact the risk score, therefore confidence in the tool is based solely upon the final output scoring and the perception of its accuracy. Insight into the formulae used to calculate scores is hidden from the user therefore it is not clear how the risk score is calculated and therefore it is not possible to scrutinise the results of the SAI-RAT fully. Furthermore, the risk score itself is not represented with any comparative scale, as such the output score is not useful for determining the risk of an individual component of an SRO but can be used to compare components within the same or different schemes.

Currently, our understanding of the INNS community within the Huntspill river, along pipeline routes and at infrastructure sites is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high-level scheme descriptions and geospatial data which is yet to be finalised.

5.5 R024: HONEYHURST

5.5.1 R024 Construction

The scheme would require the construction of a new pumping station at the Honeyhurst Well site and the construction of a new 4.2km pipeline. At present detailed construction methodologies are not yet available, however it is expected that the transport of plant equipment, personnel, soils and aggregates to and from the site will occur during construction and that these activities are likely to represent INNS distribution pathways. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution via construction related pathways. Mitigation is likely to be encompassed within standard best practice biosecurity protocols though additional methods may be required depending upon construction methodology and further monitoring.

5.5.2 R024 Operation

The abstraction and transfer of raw water from Honeyhurst Well to Cheddar WTW poses an INNS transfer risk. The abstraction of water from the Honeyhurst Well is perceived to have a low potential for INNS transfer due to the abstraction point being fed by a well. Additionally, the destination of transfer will limit the onward transmission and establishment of INNS during normal operation.

The assessment completed using the SAI-RAT of the transfer from Honeyhurst Well to Cheddar WTW scores 28.08%. The variables entered into the tool are listed in Table A5.1 in Appendix A1. How these variables impact the overall risk scoring is not clear as the formulae and inherent risk scoring for the SAI-RAT tool are not visible to the user.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on several key aspects:

- Prevention of transfer of INNS during RWT from the Honeyhurst Well to Cheddar WTW.
- Prevention of transfer of INNS through operational activities such as site maintenance works and waste management.

If water is discharged during transfer and prior to treatment, there is a potential that INNS could be transferred to new habitats or increase the propagule pressure in areas where specific INNS are already present. To mitigate this, the raw water source would need to be treated sufficiently to remove INNS propagules or kept covered to avoid INNS occurrence prior to transfer to the WTW in line with the EA's recent position statement.

Operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.5.3 R016 Evidence gaps and recommendations

The SAI-RAT assessment spreadsheet does not allow the user to interpret how variables impact the risk score, therefore confidence in the tool is based solely upon the final output scoring and the perception of its accuracy. Insight into the formulae used to calculate scores is hidden from the user therefore it is not clear how the risk score is calculated and therefore it is not possible to scrutinise the results of the SAI-RAT fully. Furthermore, the risk score itself is not represented with any comparative scale, as such the output score is not useful for determining the risk of an individual component of an SRO but can be used to compare components within the same or different schemes.

Currently, our understanding of the INNS community along pipeline routes and at infrastructure sites is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high-level scheme descriptions and geospatial data which is yet to be finalised.

5.6 P01-01: CHARTERHOUSE

5.6.1 P01-01 Construction

The scheme would require upgrades to treatment facilities at an existing infrastructure site. At present detailed construction methodologies are not available, however it is expected that the transport of equipment and personnel to and from the site will occur during construction and that these activities are likely to represent INNS distribution pathways. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution via construction related pathways. Mitigation is likely to be encompassed within standard best practice biosecurity protocols though additional methods may be required depending upon construction methodology.

5.6.2 P01-01 Operation

The abstraction and transfer of raw water from Charterhouse Springs to a Charterhouse WTW poses an INNS transfer risk. The abstraction of water from the Charterhouse Springs is perceived to have a very-low potential for INNS transfer due to the source being fed by a groundwater spring and the transfer of raw water occurring over a very short distance. Additionally, the destination of transfer will limit the onward transmission and establishment of INNS during normal operation.

The assessment completed using the SAI-RAT of the transfer from charterhouse springs to Charterhouse WTW scores 22.70%. The variables entered into the tool are listed in Table A1.1 in Appendix A1. How these variables impact the overall risk scoring is not clear as the formulae and inherent risk scoring for the SAI-RAT tool are not visible to the user.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on several key aspects:

- Prevention of transfer of INNS during RWT from the Charterhouse Springs to Charterhouse WTW.
- Prevention of transfer of INNS through operational activities such as site maintenance works and waste management.

If water is discharged during transfer and prior to treatment, there is negligible potential that INNS could be transferred to new habitats or increase the propagule pressure due to the abstraction source type. Additionally, treatment prior to onward transmission would prevent onward transmission away from the treatment works.

Operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.6.3 P01-01 Evidence gaps and recommendations

The SAI-RAT assessment spreadsheet does not allow the user to interpret how variables impact the risk score, therefore confidence in the tool is based solely upon the final output scoring and the perception of its accuracy. Insight into the formulae used to calculate scores is hidden from the user therefore it is not clear how the risk score is calculated and therefore it is not possible to scrutinise the results of the SAI-RAT fully. Furthermore, the risk score itself is not represented with any comparative scale, as such the output score is not useful for determining the risk of an individual component of an SRO but can be used to compare components within the same or different schemes.

Currently, our understanding of the INNS community along pipeline routes and at infrastructure sites is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high-level scheme descriptions and geospatial data which is yet to be finalised.

5.7 P01-02: FORUM

5.7.1 P01-02 Construction

The scheme would require upgrades to treatment facilities at an existing site. At present detailed construction methodologies are not available, however it is expected that the transport of plant equipment, aggregates, soils and personnel to and from the site will occur during construction and that these activities are likely to represent INNS distribution pathways. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution via construction related pathways. Mitigation is likely to be encompassed within standard best practice biosecurity protocols though additional methods may be required depending upon construction methodology.

5.7.2 P01-02 Operation

During normal operation the scheme does not constitute a raw water transfer. Raw water stored within a storage reservoir will be treated on site prior to onward transmission to supply.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on prevention of the transfer of INNS through operational activities such as site maintenance works and waste management.

Operations at the treatment works may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.7.3 P01-02 Evidence gaps and recommendations

Currently, our understanding of the INNS community within proximity to Forum service reservoir and treatment works is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring to inform should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high-level scheme descriptions and geospatial data which is yet to be finalised.

5.8 P08: ALDERLEY

5.8.1 P08 Construction

The scheme would require upgrades to treatment facilities at an existing site. At present detailed construction methodologies are not available, however it is expected that the transport of plant equipment and personnel to and from the site will occur during construction and that these activities are likely to represent INNS distribution pathways. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution via construction related pathways. Mitigation is likely to be encompassed within standard best practice biosecurity protocols though additional methods may be required depending upon construction methodology.

5.8.2 P08 Operation

During normal operation the scheme does not constitute a raw water transfer, raw water will be abstracted and treated within the treatment works footprint.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on the prevention of the transfer of INNS through operational activities such as site maintenance works and waste management.

Operations at the treatment works may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.8.3 P08 Evidence gaps and recommendations

Currently, our understanding of the INNS community in proximity to Alderley WTW works is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring to inform mitigation requirements at the site should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high-level scheme descriptions and geospatial data which are yet to be finalised.

5.9 R08-02: BATHFORD

5.9.1 R08-02 Construction

The scheme would require the construction of a new treatment works capable of treating 1.4 Ml/d, and approximately 16,680m of new pipelines. At present detailed construction methodologies are not available, however it is expected that the transport of plant equipment, personnel, soils and aggregates to and from the site will occur during construction and that these activities are likely to represent INNS distribution pathways. Numerous prolific INNS are recorded within the study area (Section 3.9) with several species that have a high potential to be transported during construction activities including Japanese knotweed, Himalayan balsam and giant hogweed. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution through the distribution pathways listed above. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution via construction related pathways. Mitigation is likely to be encompassed within standard best practice biosecurity protocols though additional methods may be required depending upon construction methodology and further monitoring.

5.9.2 R08-02 Operation

During normal operation, the scheme does not constitute a raw water transfer. Water abstracted from the Middle Avon will be treated at a bankside water treatment works before onward transmission to a service reservoir, therefore, eliminating INNS transfer risk.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on prevention of the transfer of INNS through operational activities such as site maintenance works and waste management.

Operations at the treatment works may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.9.3 R08-02 Evidence gaps and recommendations

Currently, our understanding of the INNS community within proximity to the proposed Bathford WTW and infrastructure construction areas is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring to inform mitigation requirements should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high-level scheme descriptions and geospatial data which are yet to be finalised.

5.10 R08-03: FROME AT FRENCHAY

5.10.1 R08-03 Construction

The scheme would require the construction of two pumping stations and approximately 13km of pipeline. At present detailed construction methodologies are not available, however it is expected that the transport of plant equipment, personnel, soils and aggregates to and from the site will occur during construction and that these activities are likely to represent INNS distribution pathways. Numerous prolific INNS are recorded within the study area (Section 3.93.9) with several species that have a high potential to be transported during construction activities including Japanese knotweed, Himalayan balsam and giant hogweed. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution through the distribution pathways listed above. Mitigation during construction activities is likely to be required to target INNS and prevent their distribution via construction related pathways. Mitigation is likely to be encompassed within standard best practice biosecurity protocols though additional methods may be required depending upon construction methodology and further monitoring.

5.10.2 R08-03 Operation

The abstraction and transfer of raw water from the River Frome and transmission to Littleton WTW poses an INNS transfer risk. The abstraction of water from the River Frome is perceived to have a high potential for INNS transfer, due to watershed area of the Frome and location of the abstraction point, being within, and flowing from, relatively urbanised areas. The transfer will also cross operational catchments increasing the risk that new INNS may be transported between catchments. However, the destination of transfer will limit the onward transmission and establishment of INNS during normal operation.

The assessment completed using the SAI-RAT of the transfer from the River Frome to the WTW scores 32.20%. The variables entered into the tool are listed in Table A5.1 in Appendix A1. How these variables impact the overall risk scoring is not clear as the formulae and inherent risk scoring for the SAI-RAT tool are not visible to the user.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on several key aspects:

- Prevention of transfer of INNS during RWT from the River Frome to the WTW.
- Prevention of transfer of INNS through operational activities such as site maintenance works and waste management.

During normal operation the INNS transfer risk is very low as the transfer destination is a water treatment works. However, if water is discharged at washout points prior to treatment, there is a potential for INNS transfer between operational catchments. The level of risk that washout points present in terms of INNS transfer risk will need to be assessed individually.

Operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to

attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific WTW site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

5.10.3 R08-03 Evidence gaps and recommendations

The SAI-RAT assessment spreadsheet does not allow the user to interpret how variables impact the risk score, therefore confidence in the tool is based solely upon the final output scoring and the perception of its accuracy. Insight into the formulae used to calculate scores is hidden from the user therefore it is not clear how the risk score is calculated and therefore it is not possible to scrutinise the results of the SAI-RAT fully. Furthermore, the risk score itself is not represented with any comparative scale, as such the output score is not useful for determining the risk of an individual component of a scheme but can be used to compare variants of the same or different schemes.

Currently, our understanding of the INNS community within proximity to the abstraction location and scheme infrastructure is limited by the availability of occurrence records within NBN Atlas. In most instances, these records are not captured as part of targeted INNS monitoring but are instead the product of site observations during various ecological surveys or citizen science programmes. Therefore, monitoring to inform mitigation should be considered if the scheme is carried forward.

Our understanding of the construction methodologies and operational specifications is limited at this stage. Therefore, the above assessment is based upon high-level scheme descriptions and geospatial data which are yet to be finalised.

5.11 SUMMARY RISK RATING

A summary RAG rating of the INNS transfer risk relating to both construction and operational activities was calculated to provide input into the Strategic Environmental Assessment (SEA) of the WRMP24. RAG ratings are based upon the current understanding of the scheme design and the above assessment. Construction risk scoring was calculated based on the assumption that construction mitigation would be implemented in line with standard best practice. Summary scores and descriptions are provided in Table 5.1 and Table 5.2 below.

Table 5.1 Summary post mitigation construction risk scores for the Bristol Water WRMP24 constrained supply options.

Scheme	Construction Risk Description	Score
R005	The scheme requires the construction of >50km of pipeline and six pumping stations, therefore there is a risk of INNS transfer resulting from the movement of biological materials within soils and aggregates and via machinery and personnel during construction. Standard mitigation encompassed within construction best practices, such as those discussed within the INNS assessment report is likely to reduce the INNS transfer considerably although there remains a moderate risk given the scale of infrastructure required for the scheme.	**Moderate**
R007	The scheme requires the construction of an intake structure on the River Avon and a pipeline of >15km as well as updates and expansion of existing treatment works. Therefore there is a risk of INNS transfer resulting from the movement of biological materials within soils and aggregates and via machinery and personnel during construction. Standard mitigation encompassed within construction best practices such as those discussed within the INNS assessment report is likely to reduce the INNS transfer risk considerably though there remains a moderate risk given the scale of infrastructure required for the scheme.	**Moderate**
R014	The scheme requires the construction of a pipeline of ~15km, therefore there is risk of INNS transfer resulting from the movement of biological materials within soils and aggregates and via machinery and personnel during construction. Standard mitigation encompassed within construction best practices such as those discussed within the INNS assessment report is likely to reduce the INNS transfer risk considerably though there remains a moderate risk given the scale of infrastructure required for the scheme.	**Minor**
R016	The scheme requires the construction of a pipeline of ~19km as well as updates and expansion of existing treatment works, therefore there is risk of INNS transfer resulting from the movement of biological materials within soils and aggregates and via machinery and personnel during construction. Standard mitigation encompassed within construction best practices such as those discussed within the INNS assessment report is likely to reduce the INNS transfer risk considerably though there remains a moderate risk given the scale of infrastructure required for the scheme.	**Moderate**

Scheme	Construction Risk Description	Score
R024	The scheme requires the construction of a pipeline of 4km pipeline and pumping station, therefore there is a risk of INNS transfer resulting from the movement of biological materials within soils and aggregates and via machinery and personnel during construction. Standard mitigation encompassed within construction best practices such as those discussed within the INNS assessment report is likely to reduce the INNS transfer risk considerably though there remains a minor risk given the scale of infrastructure required for the scheme.	**Minor**
P01-01	The scheme requires updates to an existing treatment facility, as such there is of INNS transfer resulting from the movement of machinery and personnel during construction. Standard mitigation encompassed within construction best practices such as those discussed within the INNS assessment report is likely to reduce the INNS transfer risk considerably though there remains a negligible risk given the scale of infrastructure required for the scheme.	**Negligible**
P01-02	The scheme requires updates to an existing treatment facility, as such there is of INNS transfer resulting from the movement of machinery and personnel during construction. Standard mitigation encompassed within construction best practices such as those discussed within the INNS assessment report is likely to reduce the INNS transfer risk considerably though there remains a negligible risk given the scale of infrastructure required for the scheme.	**Negligible**
P08	The scheme requires updates to an existing treatment facility, as such there is of INNS transfer resulting from the movement of machinery and personnel during construction. Standard mitigation encompassed within construction best practices such as those discussed within the INNS assessment report is likely to reduce the INNS transfer risk considerably though there remains a negligible risk given the scale of infrastructure required for the scheme.	**Negligible**
R08-02	The scheme requires the construction of >16km of pipeline and a new treatment facility, therefore there is a risk of INNS transfer resulting from the movement of biological materials within soils and aggregates and via machinery and personnel during construction. Standard mitigation encompassed within construction best practices such as those discussed within the INNS assessment report is likely to reduce the INNS transfer considerably though there remains a moderate risk given the scale of infrastructure required for the scheme.	**Moderate**
R08-03	The scheme requires the construction of an abstraction point, pumping station, >13km of pipeline and a new treatment facility, therefore there is a risk of INNS transfer resulting from the movement of biological materials within soils and aggregates and via machinery and personnel during construction. Standard mitigation encompassed within construction best practices such as those discussed within the INNS assessment report is likely to reduce the INNS transfer considerably though there remains a moderate risk given the scale of infrastructure required for the scheme.	**Moderate**

Table 5.2 Summary post mitigation operational risk scores for the Bristol Water WRMP24 constrained supply options.

Scheme	Operation Risk Description	Score
R005	The abstraction and transfer of raw water from the Cheddar Springs to Cheddar 2 Reservoir and the onward transfer of raw water from the Cheddar 2 Reservoir to Honeyhurst WTW pose an INNS transfer risk. Additionally, operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may also present a risk. Based on the current scheme design and understanding of mitigation in place there is a moderate risk of INNS transfer during the operation of the scheme.	**Moderate**
R007	The abstraction and transfer of raw water from the River Avon to Stowey WTW pose a potential INNS transfer risk, however, INNS are not likely to be transported during onward transmission from the treatment works to Chew Valley Reservoir. Additionally, operations at the various sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming, for example, that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. Based on the current scheme design and understanding of mitigation in place there is a minor risk of INNS transfer during the operation of the scheme.	**Minor**
R014	This option would take treated effluent from Wessex Water's Avonmouth Wastewater Treatment Works for further treatment at Littleton WTW (blended with canal water), and then put it directly into supply. Therefore, during normal operation, there is no risk of INNS transfer. Operations at the treatment works may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. Based on the current scheme design and understanding of mitigation in place there is a negligible risk of INNS transfer during the operation of the scheme.	**Negligible**
R016	The abstraction and transfer of raw water from the Huntspill River to a treatment works pose a potential INNS transfer risk; however, INNS are not likely to be transported during onward transmission to Cheddar Reservoir. Additionally, Operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. Based on the current scheme design and understanding of mitigation in place there is a minor risk of INNS transfer during the operation of the scheme.	**Minor**
R024	The abstraction of water from the Honeyhurst Well is perceived to have a low potential for INNS transfer due to the abstraction being fed by a covered well. Additionally, the destination of transfer will limit the onward transmission and establishment of INNS during normal operation. Operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. Based on the current scheme design and understanding of mitigation in place there is a negligible risk of INNS transfer during the operation of the scheme.	**Negligible**

Scheme	Operation Risk Description	Score
P01-01	The abstraction of water from the Charterhouse Springs is perceived to have a very-low potential for INNS transfer due to the source being fed by a groundwater spring and the transfer of raw water occurring over a very short distance. Additionally, operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. Based on the current scheme design and understanding of mitigation in place there is a negligible risk of INNS transfer during the operation of the scheme.	**Negligible**
P01-02	During normal operation the scheme does not constitute a raw water transfer. Potable water stored within a storage reservoir will be treated on-site prior to onward transmission to supply. Additionally, operations at the treatment works may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. Based on the current scheme design and understanding of mitigation in place there is a negligible risk of INNS transfer during the operation of the scheme.	**Negligible**
P08	During normal operation the scheme does not constitute a raw water transfer, raw water will be abstracted and treated within the treatment works footprint. Additionally, operations at the treatment works may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. Based on the current scheme design and understanding of mitigation in place there is a negligible risk of INNS transfer during the operation of the scheme.	**Negligible**
R08-02	During normal operation, the scheme does not constitute a raw water transfer. Water abstracted from the Middle Avon will be treated at a bankside water treatment works before onward transmission to a service reservoir, therefore, eliminating INNS transfer risk. Additionally, operations at the treatment works may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. Based on the current scheme design and understanding of mitigation in place there is a negligible risk of INNS transfer during the operation of the scheme.	**Negligible**
R08-03	The abstraction of water from the River Frome is perceived to have a high potential for INNS transfer, however, the destination of transfer will limit the onward transmission and establishment of INNS during normal operation. Additionally, operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. Based on the current scheme design and understanding of mitigation in place there is a minor risk of INNS transfer during the operation of the scheme.	**Minor**

APPENDICES

A1 SAI-RAT input variables

Table A5.1: SAI-RAT RWT risk assessment inputs used to assess the Bristol Water WRMP24 constrained options

RWT Name	R005 (Reach 1 - Cheddar Springs to Cheddar 2)	R005 (Reach 2 – Axbridge WTW to Cheddar 2)	R005 (Reach 3 - Cheddar 2 to Honeyhurst WTW)	R007	R016	R024	P01-01	R08-02	R08-03
Source Name	Cheddar Springs	Axbridge Treatment works	Cheddar 2	River Avon	Huntspill River	Honeyhurst Well	Upper and Lowe Springs	River Avon	River Frome
Source Management Catchment	Somerset South and West	Somerset South and West	Somerset South and West	Avon Bristol and Somerset North Streams	Somerset South and West	Somerset South and West	Somerset South and West	Avon Bristol and Somerset North Streams	Avon Bristol and Somerset North Streams
Source Operational Catchment	Brue and Axe	Brue and Axe	Brue and Axe	Avon Bristol Urban	Brue and Axe	Brue and Axe	Brue and Axe	Avon Bristol Urban	Avon Bristol Urban
Source Waterbody ID	GB109052021540			GB109053027371	GB108052021210			GB109053027372	GB109053027840
Source Type	Spring, natural springs	Water Treatment works	Online waterbody	River	River	Spring, natural springs	Spring, natural springs	River	River
Number of RWT inputs into source	None	1	1	Unknown	Unknown	None	None	Unknown	Unknown
Pathway Type	Pipeline	Pipeline	Pipeline	Pipeline	Pipeline	Pipeline	Pipeline	Pipeline	Pipeline
Receptor Name	Cheddar 2	Cheddar 2	WTW	WTW	WTW	WTW	WTW	WTW	WTW

RWT Name	R005 (Reach 1 - Cheddar Springs to Cheddar 2)	R005 (Reach 2 – Axbridge WTW to Cheddar 2)	R005 (Reach 3 - Cheddar 2 to Honeyhurst WTW)	R007	R016	R024	P01-01	R08-02	R08-03
Receptor Management Catchment	Somerset South and West	Somerset South and West	Somerset South and West	Avon Bristol and Somerset North Streams	Somerset South and West	Somerset South and West	Somerset South and West	Avon Bristol and Somerset North Streams	Avon Bristol and Somerset North Streams
Receptor Operational Catchment	Brue and Axe	Brue and Axe	Brue and Axe	Avon Bristol Rural	Brue and Axe	Brue and Axe	Brue and Axe	Avon Bristol Rural	Severn Lower Vale
Receptor Waterbody ID									
Receptor Type	Online waterbody	Online waterbody	Water treatment works	Water treatment works	Water treatment works	Water treatment works	Water treatment works	Water treatment works	Water treatment works
Isolated receptor catchment	No	No	No	No	No	No	No	No	No
Volume of water	6-50 Ml/d	6-50 Ml/d	6-50 Ml/d	6-50 Ml/d	6-50 Ml/d	0-5 Ml/d	0-5 Ml/d	0-5 Ml/d	0-5 Ml/d
Frequency of operation	Year round - continuous, variable flow	Occasional i.e. infrequent, regulatory compliance	Year round - continuous, variable flow	Occasional i.e. infrequent, regulatory compliance	Occasional i.e. infrequent, regulatory compliance	Occasional i.e. infrequent, regulatory compliance	Year round - continuous, variable flow	Occasional i.e. infrequent, regulatory compliance	Occasional i.e. infrequent, regulatory compliance
Transfer distance (Km)	1.1-5	1.1-5	5.1-10	15.1-20	15.1-20	1.1-5	<1	10.1-15	10.1-15

RWT Name	R005 (Reach 1 - Cheddar Springs to Cheddar 2)	R005 (Reach 2 – Axbridge WTW to Cheddar 2)	R005 (Reach 3 - Cheddar 2 to Honeyhurst WTW)	R007	R016	R024	P01-01	R08-02	R08-03
Washout/maintenance points outside of catchments	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	None	Unknown	Unknown
Source Navigable	No	No	No	Yes	No	No	No	No	No
Pathway Navigable	No	No	No	No	No	No	No	No	No
Angling at Source	Unknown	No	Unknown	Members and day ticket holders, local matches	Members and day ticket holders, local matches	No	No	Members and day ticket holders, local matches	Members and day ticket holders, no matches
Angling on Pathway	No	No	No	No	No	No	No	No	No
Water sports at Source	Casual use by individuals/clubs	No	Unknown	Local events	Casual use by individuals/clubs	No	No	Casual use by individuals/clubs	Casual use by individuals/clubs
Water sports on Pathway	No	No	No	No	No	No	No	No	No
Presence of high priority INNS_Source	Known to be present	Not recorded	Not recorded	Known to be present	Known to be present	Known to be present	Not surveyed - unknown	Known to be present	Known to be present
Presence of high priority INNS_Pathway	Known to be present	Known to be present	Known to be present	Known to be present	Known to be present	Known to be present	Known to be present	Known to be present	Known to be present

RWT Name	R005 (Reach 1 - Cheddar Springs to Cheddar 2)	R005 (Reach 2 – Axbridge WTW to Cheddar 2)	R005 (Reach 3 - Cheddar 2 to Honeyhurst WTW)	R007	R016	R024	P01-01	R08-02	R08-03
Highest order site designation_Receptor	None	None	None	None	National	None	None	None	None
Presence of priority habitat _Pathway	Known to be present	Known to be present	Known to be present	Known to be present	Known to be present	Known to be present	Not known to be present	Known to be present	Known to be present
Presence of priority habitat_Receptor	Known to be present	Known to be present	Known to be present	Not known to be present	Known to be present	Not known to be present	Not known to be present	Known to be present	Known to be present
Other existing connections between source and receptor	None	None	None	None	None	None	None	None	None
Risk Score (%)	**37.13**	**27.48**	**35.85**	**34.60**	**34.35**	**22.08**	**22.70**	**32.58**	**32.20**

T: +44 (0) 1235 753000

E: enquiry@ricardo.com

W: ee.ricardo.com