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A proposed reservoir in the Fens

Associated water infrastructure – options appraisal report

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Glossary and abbreviations

Abstraction	The removal of water from any source, either permanently or temporarily.
Abstraction infrastructure	Infrastructure required to abstract water from a water source, including intake structures, pumping stations, and initial treatment.
Associated water infrastructure	The works which are required to take water from a source to a reservoir and then from a reservoir to the connection points to the existing water networks. The components of this would typically include water treatment works, transfers (pipelines, open channels or a combination of the two), abstraction infrastructure (pumping and initial treatment) and service reservoirs. Also includes the preferred discharge channel route for the water released if the reservoir needs to drawn down in an emergency situation.
Carbon costs	The calculated cost associated with the carbon emissions generated during the construction and operation of a scheme.
Component	A part of an element that does not provide the whole solution for that element on its own. Examples of components are service reservoirs, transfer routes, pumping stations or water treatment works.
Component option	An option for a partial solution to a project element, assessed in Stages B and C.
CWS	County Wildlife Site
Downstream	The transfer of water from the reservoir to public water supply network.
Downstream infrastructure	Infrastructure required to transfer water from the reservoir to the reservoir supply connection point, including the water treatment works.
EIA	Environmental Impact Assessment is an assessment process which: determines the likely environmental impact of a given action or intervention; describes the mitigation to avoid or reduce these likely impacts; and identify likely significant effects on the environment that is used to inform the decision maker before deciding whether to grant consent.
Element	The elements are the main features that combine to create a whole scheme option and comprise: upstream infrastructure; main reservoir site; downstream infrastructure; and the emergency drawdown disposal route.
Element option	An option consisting of combined components produced at the end of Stage C.
Embankment toe	The area at the base of an embankment's exposed face.
Feed corridors	Pipeline corridors in the vicinity of the Fens Reservoir used by both upstream transfer pipelines and downstream transfer pipelines allowing the transfers to start or end at the appropriate points either within the reservoir site or water treatment works site.
Fens Water Partnership	Stakeholder engagement group consisting of local stakeholders. This group informed the approach taken for Options Appraisal and contributed to the findings and outcomes of the first three Options Appraisal stages.

ha	Hectare
High-level carrier	Typically refers to a watercourse that is elevated or situated at a higher level relative to its surroundings.
Historic designated assets	A heritage asset which is formally protected by legal status. This includes, scheduled monuments, registered parks and gardens and listed buildings.
HRA	Habitats Regulations Assessment. There is a requirement under the Conservation of Habitats and Species Regulations 2017 (as amended) to determine if a plan or project may have an adverse impact on a site designated under the same (or preceding) Regulations prior to any consent or permission being determined. The process of undertaking this assessment is known as a Habitats Regulations Assessment.
Hydraulic capacity	The ability of a watercourse or channel to convey water, considering for example, volume, cross-sectional area and whether there are any obstructions.
IDB	Internal Drainage Board. A public body responsible for the management of water levels in an area. They play a fundamental part in the management of flood risk and land drainage in England.
Initial treatment	Initial treatment refers to treatment of abstracted water in proximity to the source to address concerns in respect of INNS or WFD.
INNS	Invasive Non-Native Species
Intake	A structure through which water is withdrawn from the water source, after which the water is conveyed to the associated water infrastructure.
km	Kilometre
Listed building	A building or structure designated under Chapter 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990 as being of 'special architectural or historic interest'.
LWS	Local Wildlife Site
Mineral safeguarding area	Designated areas that provide for the safeguarding of proven mineral resources which are, or may become, of economic importance from unnecessary sterilisation by non-mineral development (such as being covered by buildings).
Ml/d	Megalitres per day. One megalitre = one million litres (1,000 cubic metres).
mm	Millimetre
National Planning Policy Framework	Sets out the government's economic, environmental and social planning policies. A revised National Planning Policy Framework was published by the Department for Levelling Up, Housing & Communities in December 2023.

NPS	National Policy Statement for Water Resources Infrastructure[1]. A document produced by the government, which sets out the need and government's policies for development of nationally significant infrastructure projects for water resources in England under the Planning Act 2008 regime, and the decision-making framework for relevant development consent order applications to be considered against.
NPV	Net present value. The present-day financial value of costs for construction and operation calculated over a 100-year period.
Nature recovery network	A national network of wildlife-rich places aimed to expand, improve and connect these places across cities, towns, countryside and the coast as committed to in the government's 25 Year Environment Plan.
Open channel transfers	The transfer of water in a natural or manmade conduit that has an open top (a free surface).
Options appraisal	Process through which options are appraised to select the best performing scheme.
Pipeline corridor	An area of land within which the pipeline could be routed. Pipeline corridors vary in width depending on the stage of the assessment and the presence of known constraints.
Polygon	The indicative area or parcel of land on which a pumping station, INNS treatment works, service reservoir, or water treatment works could be developed.
Project	The Fens reservoir project being jointly promoted by Anglian Water and Cambridge Water including the reservoir, associated water infrastructure and other associated development.
Pumping station	A building that houses a pump to lift water, or push water along a pipeline. It can also mean the building and the pump(s) inside.
Ramsar sites	Wetland areas of international importance which have been designated under the criteria of the Ramsar Convention on Wetlands 1971 for containing representative, rare or unique wetland habitat types or for their importance in conserving biological diversity. The designation of UK Ramsar sites has generally been underpinned through prior notification of these areas as Sites of Special Scientific Interest.
RAPID	Regulators' Alliance for Progressing Infrastructure Development. An alliance of regulators made up of Water Services Regulation Authority (Ofwat), Environment Agency and Drinking Water Inspectorate, to help accelerate the development of new water infrastructure and design future regulatory frameworks.

[1] Defra (2023), National Policy Statement for Water Resources Infrastructure. Retrieved from: https://assets.publishing.service.gov.uk/media/6437e3a2f4d420000cd4a1a7/E02879931_National_Policy_Statement_for_Water_Resources.pdf

Raw water	Water that is untreated. In terms of the project, all water upstream of the water treatment works is considered 'raw water'. Downstream of the water treatment works it is considered 'potable water', following treatment.
rdWRMP	revised draft Water Resources Management Plan 2024
SAC	Special Areas of Conservation are European habitat sites designated under the Conservation of Habitats and Species Regulations 2017, as amended.
Scheduled monuments	Scheduled monuments are nationally important monuments that have been afforded statutory protection through their inclusion in the Schedule of monuments maintained under section 1 of the Ancient Monuments and Archaeological Areas Act 1979. The Secretary of State must be informed about any work that might affect a monument above or below ground, and Historic England gives advice to the government on each application. In assessing each application the Secretary of State will try to ensure that damage done to protected sites is kept to a minimum.
Sequential Test	A sequential, risk-based approach to development and flood risk set out in the NPS and the National Planning Policy Framework. It is undertaken to ensure that areas at little or no risk of flooding (from all sources) are developed in preference to areas at higher risk of flooding.
Service reservoir	A water storage facility that holds potable water after it has been treated in a water plant, and before it is piped to the end users. These storage areas are covered and are designed to keep the water safe from contamination.
Site selection	Process that identifies and assesses potential suitable locations for the purposes of identifying the preferred location for a project. For example, the site selection process undertaken to identify the preferred location for the Fens Reservoir.
Source	River or watercourse from which water will be sourced to fill the reservoir.
SPA	Special Protection Areas are protected areas for birds in the UK classified under the Conservation of Habitats and Species Regulations 2017 (as amended) in England and Wales (including the adjacent territorial sea).
SSSI	Sites of Special Scientific Interest
Upstream infrastructure	Infrastructure required to transfer raw water from a source towards the reservoir.
WFD	Water Framework Directive. European Directive (2000/60/EC) transposed into English and Welsh law through The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The WFD sets out requirements to prevent the deterioration of the status of water bodies and to support the achievement of the water bodies environmental objectives.
Whole scheme	The Project as a whole, combining upstream transfers, reservoir site, downstream infrastructure and emergency drawdown.
Whole scheme option	An option assessed in Stage D which combines options for all associated water infrastructure elements to give a holistic solution.

WRE	Water Resources East. One of five regional water resource groups (made up of different interested organisations, including water companies for that region) responsible for development of regional plans aligned with the National Framework for Water Resources.
WRMP	Water Resources Management Plan. Sets out a water company's intended approach towards water resource planning for meeting its duty to supply water for at least the next 25 years, to ensure the long-term balance between supply and demand is maintained; legally required to be updated every five years.
WTW	Water treatment works. A facility where raw water is treated to a standard suitable for drinking water.

Executive summary

A new storage reservoir in Cambridgeshire, referred to as the Fens Reservoir, has been identified as one of several strategic resource options required to address future deficits in public water supply for this region. Following selection of, and consultation on, the best performing reservoir location in 2022, Anglian Water and Cambridge Water have undertaken a comprehensive options appraisal process to determine the most suitable options, including placement, for upstream infrastructure, downstream infrastructure and the emergency drawdown of the reservoir – referred to as the associated water infrastructure.

This document provides a high-level overview of the options appraisal process that has been undertaken to identify the preferred options and sites for the associated water infrastructure. This includes the four stages (Stage A to D) of the options appraisal process and an overview of the key differentiators of both the least constrained options assessed at Stage C and the whole scheme options (for the associated water infrastructure) assessed at Stage D. This is to show to consultees at this early stage of the project development process the key differences that were considered as part of identifying the whole scheme options (for the associated water infrastructure) that are being taken forward at this stage. These whole scheme options are shown in the Phase two consultation – associated water infrastructure proposals brochure.

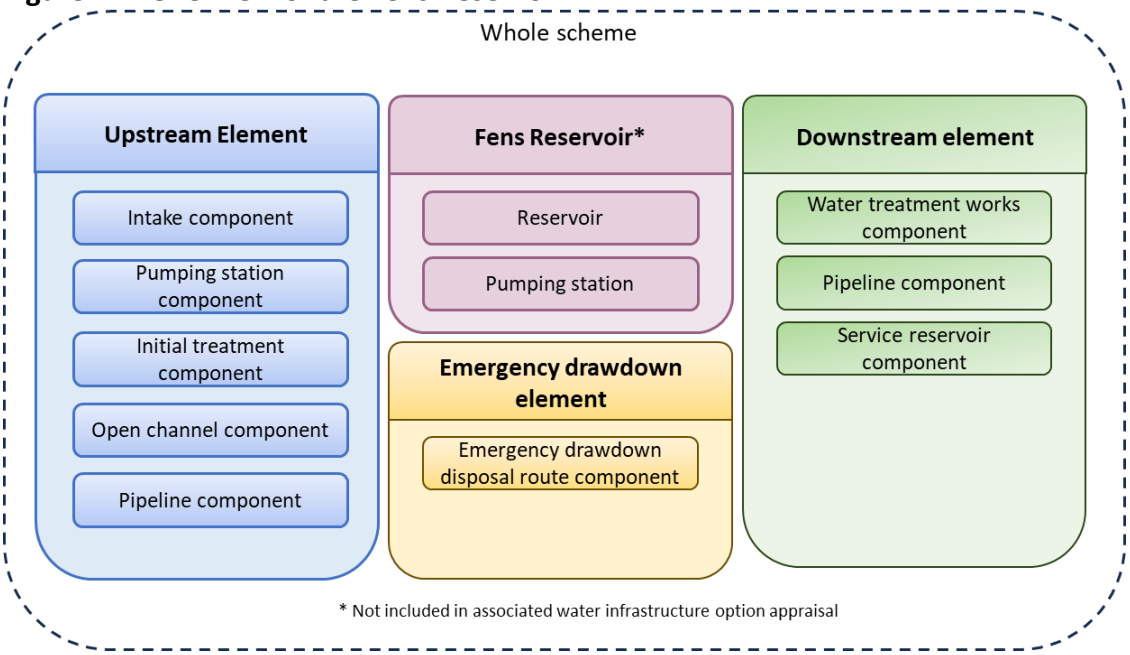
The purpose of this document is to provide consultees with information to allow them to provide a view on both the whole scheme options (for the associated water infrastructure) proposed to be taken forward, as well as the process undertaken to get to this point. This will help further development of the proposals in the next stage of development.

The approach to options appraisal

A four-stage options appraisal process (shown in Figure E.2) has identified and assessed potential options based upon a broad range of community, environmental, economic, and other technical criteria (constraints and opportunities). The process categorised each of the upstream infrastructure, downstream infrastructure and emergency drawdown disposal route into individual components, namely abstraction infrastructure, transfers, water treatment works and service reservoirs, for consideration before combining the best performing elements to create whole scheme options for the associated water infrastructure. Figure E.1 shows how the components and elements combine to create the main elements of the Project.

The site for the Fens Reservoir forms part of the whole scheme for the Project. The location of the reservoir has been identified through a separate site selection process that was shared at the earlier consultation in October 2022 and is therefore not included as part of the associated water infrastructure options appraisal reported in this document.

Figure E.1: Overview of the Fens Reservoir



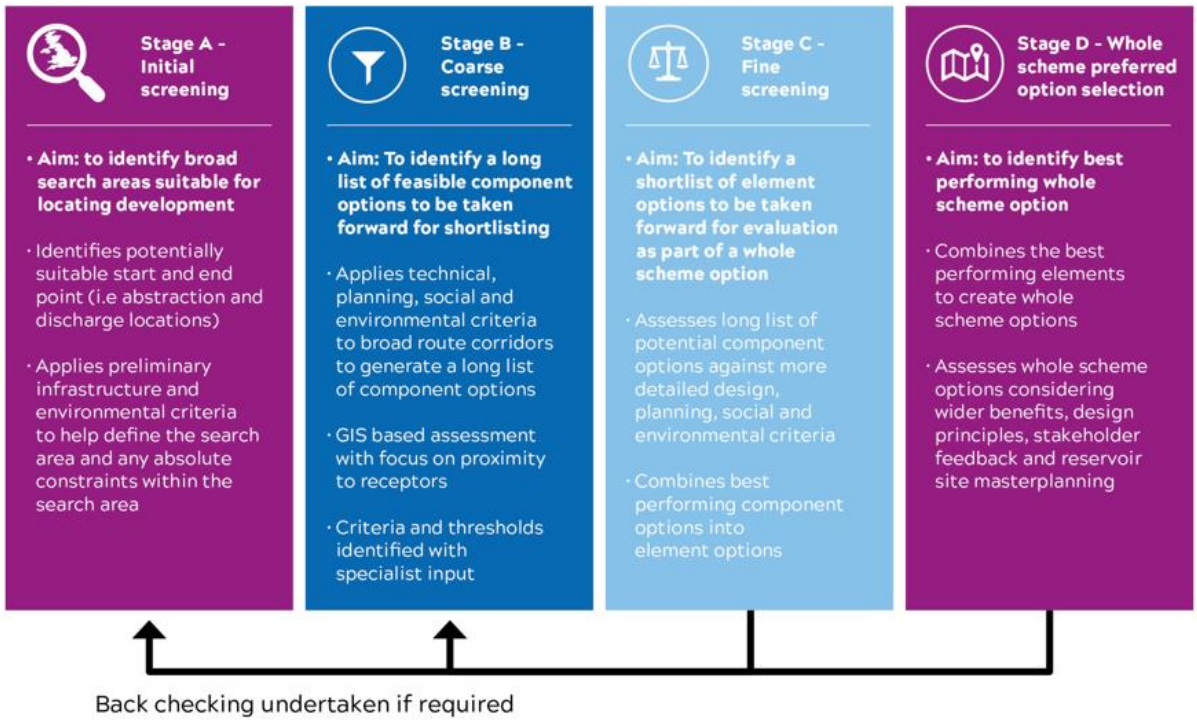
The options appraisal process and criteria used to assess options have been informed by subject matter experts across engineering, planning, environmental and land technical disciplines. Stakeholders have been engaged on the development of the options appraisal process and outcomes as they have progressed. These stakeholders were engaged through two key forums: the Fens Water Partnership and a technical working group, which included local planning authorities and statutory stakeholders.

A detailed appraisal process (Figure E.2) has been applied including the following steps:

- Stage A which comprised a high-level review against strategic constraints to identify broad search areas suitable for locating the associated water infrastructure.
- Stage B development of a long list of options for each component (as shown in Figure E.1) required for the upstream, downstream and emergency drawdown elements. The component options taken forward have been screened against engineering, environmental, planning, land use and social constraints.
- Stage C applied a more detailed appraisal against engineering, environmental, planning, land use and social criteria to understand how each component option performs and to identify any key differentiators between alternatives. Stakeholder feedback was also considered as part of this stage to inform the selection of the best performing component options. These component options were then combined to form the wider element options (e.g. upstream elements).

- Stage D combined best performing elements to create whole scheme options for associated water infrastructure which were then subject to a subject matter expert-led comparative review to identify the best performing whole scheme option(s) for the associated water infrastructure.

Figure E.2: The staged options appraisal process



Sources of supply

The origin of the water that will be stored in the reservoir is the starting point of the appraisal process. Anglian Water's rdWRMP24 identified five possible sources of supply to fill the Fens Reservoir, the Middle Level system, the River Nene, the River Great Ouse, the Counter Drain (Nene) and the Ouse Washes.

A sources of supply assessment was conducted that used the Environment Agency's Abstraction Licensing Strategies to identify a long list of sources within a 50km radius of the proposed reservoir location. Ten potential water sources were considered and tested in a staged process to identify a combination of potential preferred water sources. The sources of supply assessment identified that the preferred sources were the Middle Level system, the River Nene and its Counter Drain, the Ouse Washes and the River Great Ouse. Figure E.3 shows the preferred sources of supply for the two whole scheme options which were developed by Stage D of the appraisal.

Network connection points

The required connections of the downstream water transfers into Anglian Water's and Cambridge Water's existing supply network are considered and identified in the revised draft WRMP24 and form the end points for the associated water infrastructure. There are three required connection points:

- Bexwell near Downham Market (Anglian Water)
- Bluntisham near St Ives (Cambridge Water)
- Madingley near Cambridge (Cambridge Water)

Principles of associated water infrastructure options appraisal

Each step of the appraisal process was informed by desk-based information, professional opinion from relevant subject matter experts and stakeholder input to identify the preferred whole scheme option for the associated water infrastructure. National planning policy, in particular the NPS, has been a fundamental consideration in the appraisal process, as has the feedback from stakeholders at each of the four stages. An example of this is the preference for the use of open channels for the transfer of water, where alternative options performed similarly, as the use of these channels may unlock potential benefits to the environment and may also facilitate multi-agency opportunities. These potential benefits and opportunities could include the incorporation of habitat for wildlife, improvement of navigation routes and mitigation of flood risk.

The detailed process applied in the selection of component options of the associated water infrastructure is highlighted by two examples:

- **Upstream transfer corridors –** open channel and pipelines, as well as a combination of the two, were explored for upstream transfer options. At Stage A the area within which the transfer corridors could be placed was identified. At Stage B a list of 32 potential routings were identified and refined to 17 for more detailed assessment in Stage C. Stage C identified three preferred transfer options (connecting to three different sources) which were taken forward to Stage D.
- **Water Treatment Works and downstream transfer –** from the reservoir the downstream transfers are proposed to go north to Bexwell and south to Bluntisham and Madingley connection points. Potential locations for the water treatment works were identified in the area of overlap between the downstream transfer search areas. Areas within Flood Zone 2 and 3 were not considered as suitable locations for the water treatment works. Eleven potential locations were identified at Stage B and the two least constrained locations were progressed to Stage C. The more detailed Stage C assessments identified a single preferred location for the water treatment works that was taken forward to Stage D. From the water treatment works, the treated water would be transferred to the three connection points. No open channel transfers were considered for the downstream transfer as the water being

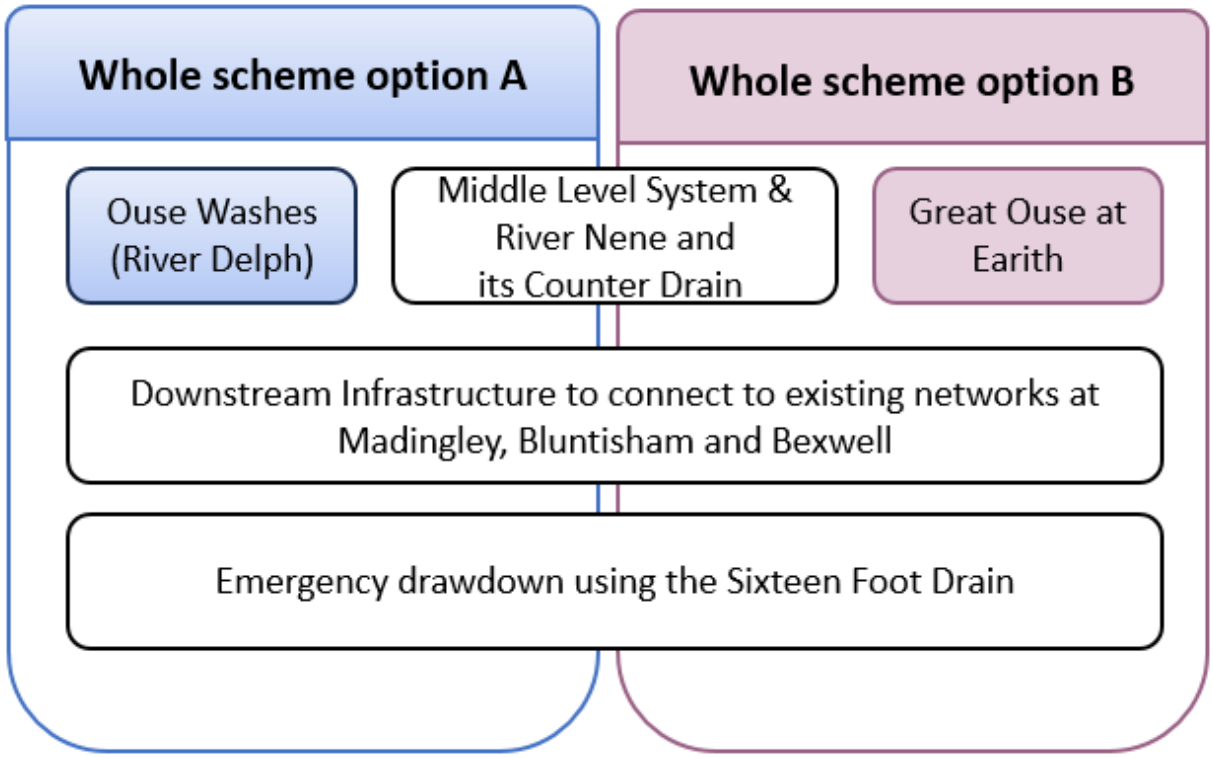
transferred is treated water. The assessment of the pipeline corridors followed the options appraisal process used on the upstream transfer options. A corridor to Bexwell to connect into the Anglian Water network and a corridor to Madingley via Bluntisham to connect into the Cambridge Water network were progressed to Stage D.

Outcome of the options appraisal process

Once each of the component and element options were considered through the staged option appraisal process (shown in Figure E.2) a comparative review of the two whole scheme options taken forward was undertaken at Stage D. These options are called whole scheme option A and whole scheme option B. The main difference between the two whole scheme options was the source of supply and the means of transferring water to the reservoir site.

Both whole scheme options would use water from the Middle Level system and the River Nene and its Counter Drain as two of the sources. For the third source of supply, whole scheme option A would use water from the Ouse Washes (River Delph) whereas whole scheme option B would use water from the Great Ouse at Earith. Figure E.3 shows the different elements of the two whole scheme options.

Figure E.3: The two whole scheme options



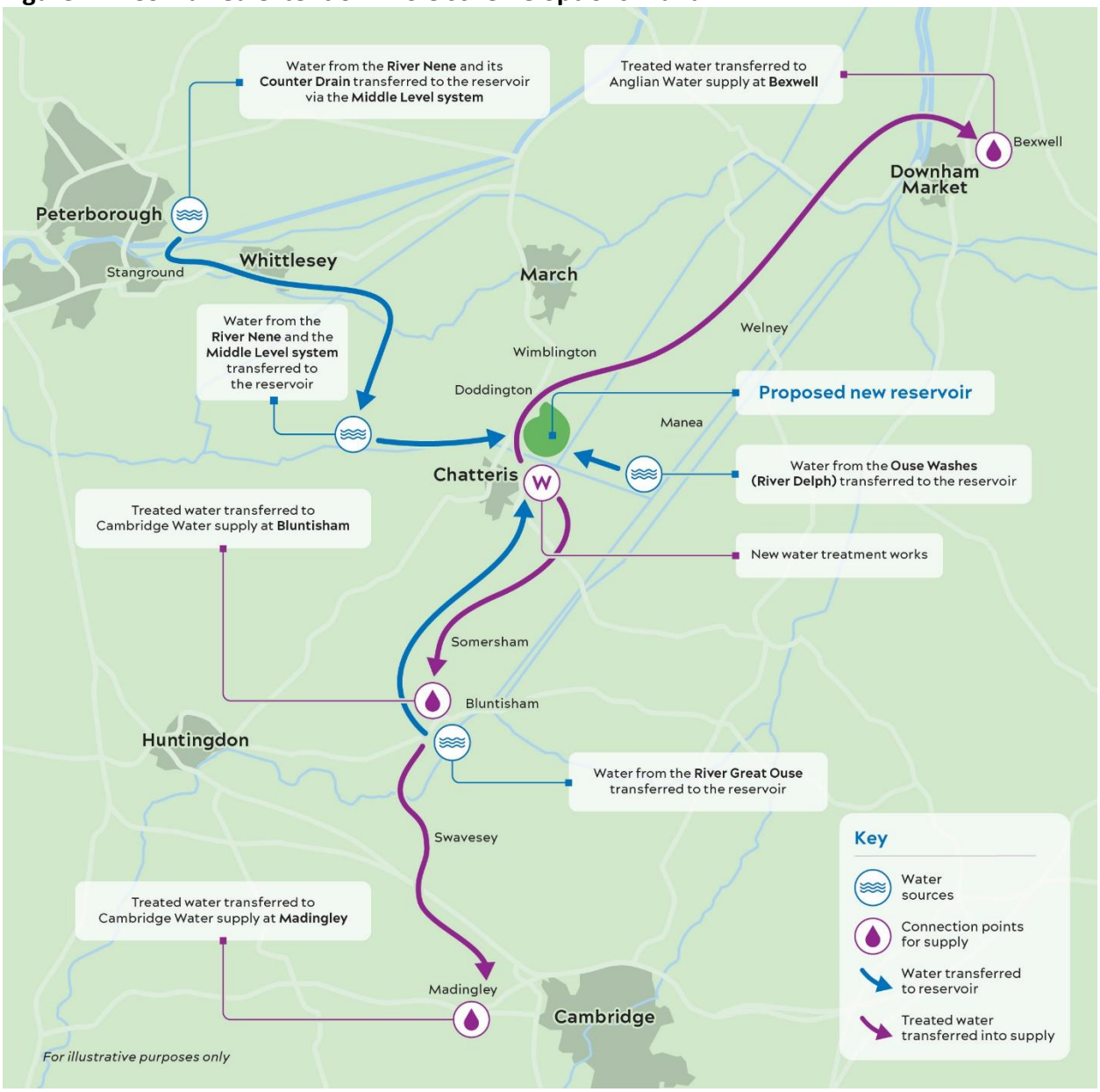
Overall whole scheme option A was considered to perform better than whole scheme option B when considered against the broad range of assessment criteria. Whole scheme option A was assessed to offer the following advantages compared to the alternative option based on the information available at this point in the process:

- It would provide a greater water yield at a lower whole life cost and carbon emissions.
- It could maximise wider system benefits associated with the use of open channels, including reinstating historic landscapes, reinstating navigational routes and improved flood storage capacity, particularly through the relining and rewetting of the Forty Foot Drain.
- It could provide benefit to the Ouse Washes designated sites by reducing flooding and helping to manage the transition from winter to summer water levels.
- It would likely result in lower level of impact on the value of designated assets heritage assets in the villages of Bluntisham and Earith.
- It would shorten the period of disturbance to land use and ownership, including functional land, along the proposed pipeline corridors during construction, as construction would only be required for the downstream pipeline.

Whole scheme option A would result in the loss of habitat within the European Designated site and associated functionally linked land owing to the need for abstraction infrastructure within the Ouse Washes European designated site. Whole scheme option A has the potential to benefit the Ouse Washes European designated site by merit of helping to achieve target water levels within the designated site, particularly in the transition from winter to summer levels. Whole scheme option B would result in a greater amount of habitat loss within the functionally linked habitat of the European designated site, but less of the site itself, and would offer much less benefit in terms of management of the water levels. Whole Scheme option A would also provide a greater water yield and have lower costs that whole scheme option B.

Taking the above into consideration, whole scheme option A is the preferred option at this stage. However, further assessment and engagement (including having regard to the responses received as part of this consultation process) will be required before it can conclusively be taken forward. At this stage, both whole scheme option A and whole scheme option B are being retained for this reason. The illustrative extent of the two options is shown in Figure E.4. Further work will be undertaken and reported to confirm whether whole scheme option A is the preferred whole scheme option to be progressed in the application for development consent under the Planning Act 2008.

Figure E.4: Combined extent of whole scheme options A and B



Supporting information

A series of documents has been published for the consultation. All of these can be viewed online at **www.fensreservoir.co.uk/documents** and are available by contacting the project team.

Supporting Information	
Document Name	**Detail**
A guide to our proposals and phase two consultation	An overview of the phase two consultation, with more information about what is being consulting on, where to find out more about the proposals and how you can have your say.
Project fact sheets	Supporting information about the approach to a range of topics and important themes.
Reservoir	
Document Name	**Detail**
Phase two consultation – main site design brochure	Information on the emerging design for the main reservoir site and the factors considered to reach this point. This provides information about the initial opportunities for the features it could include, and how it is likely to operate.
Main site design report	An explanation of the emerging design for the reservoir site, and how this was developed.
Associated Water Infrastructure	
Document Name	**Detail**
Phase two consultation – associated water infrastructure proposals	Information about the proposals for drawing available water from the sources that have been identified, transferring the water to the reservoir, treating it, and supplying it to customers. This explains the infrastructure that may be needed, and the preferred options identified at this stage.
Options appraisal report	**This report –** An overview of the options appraisal process that has been carried out to identify the preferred options and sites for the associated water infrastructure. This explains the four stages (Stage A to D) of the appraisal process, how the options that were progressed for detailed assessment compared to one another, and the different combinations assessed to identify the proposals being taken forward at this stage.

1 Introduction

1.1 Introduction

1.1.1 This associated water infrastructure options appraisal report summarises the options process used to identify the best performing location for water infrastructure associated with the proposed Fens Reservoir. This chapter introduces the proposed Fens Reservoir and associated water infrastructure, outlines the strategic need for the reservoir, and describes the four-staged options appraisal process undertaken to identify the most suitable location and routing for associated water infrastructure required for operation of the reservoir.

1.1.2 This document provides a high-level overview of the options appraisal process that has been undertaken to identify the preferred options and sites for the associated water infrastructure. This includes the four stages (Stage A to D) of the options appraisal process and an overview of the key differentiators of both the least constrained options assessed at Stage C and the whole scheme options (for the associated water infrastructure) assessed at Stage D. This is to show to consultees at this early stage of the project development process the key differences that were considered as part of identifying the whole scheme options (for the associated water infrastructure) that are being taken forward at this stage. These whole scheme options are shown in the Associated Infrastructure Consultation Brochure.

1.1.3 The purpose of this document is to provide consultees with information to allow them to provide a view on both the whole scheme options (for the associated water infrastructure) proposed to be taken forward, as well as the process undertaken to get to this point. This will help further development of the proposals in the next stage of development.

1.1.4 A new storage reservoir in Cambridgeshire, referred to as the Fens Reservoir, has been identified as one of several strategic resource options required to address increasing deficits in future public water supply. The reservoir, promoted by Anglian Water and Cambridge Water, is being progressed through the delivery framework overseen by the Regulators' Alliance for Progressing Infrastructure Development (RAPID) and is a Nationally Significant Infrastructure Project seeking consent through the Development Consent Order regime[2].

1.1.5 A comprehensive site selection process has been undertaken to determine the preferred location for this reservoir, which is proposed approximately 2.2km north of the town of Chatteris, to the east of the A141 and the settlement of Doddington and 4.5km south of March in the Fenland District Council area as depicted in Figure 1.1 below. Further detail on the reservoir site selection process is set out in the site

[2] https://national-infrastructure-consenting.planninginspectorate.gov.uk/projects/WA010004

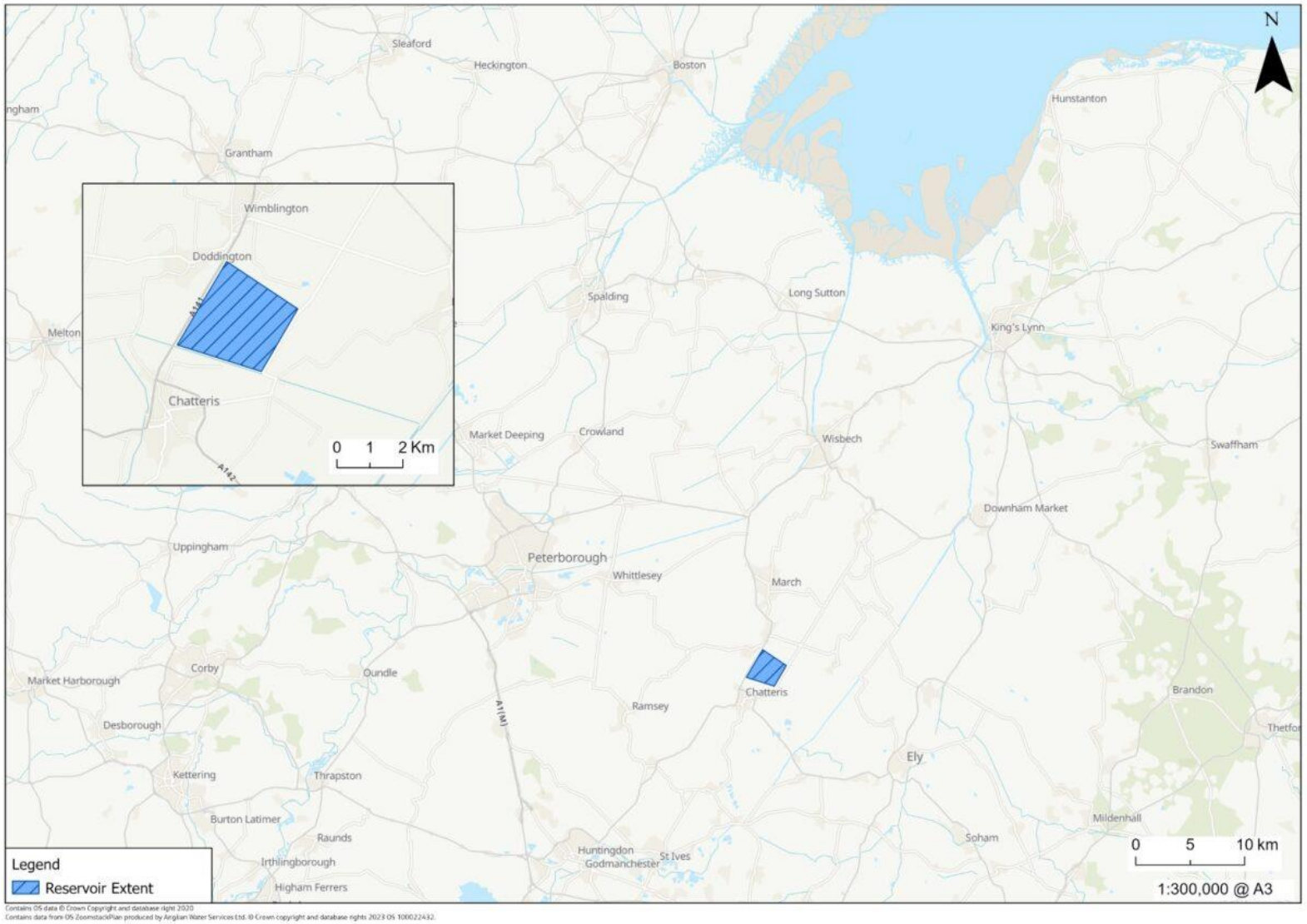
selection report for the Fens Reservoir[3], which was published as part of the phase one consultation between October and December 2022.

1.1.6 Figure E.1 shows the best performing site identified in the Fens Reservoir site selection process.

1.1.7 Following selection of the best performing reservoir location, a comprehensive options appraisal process has been undertaken to identify the preferred options, including locations and corridors, for upstream infrastructure and downstream infrastructure associated with the reservoir and disposal routes for flows from an emergency drawdown event of the reservoir, referred to as the associated water infrastructure options appraisal. Further details on this process are set out in this report including the criteria applied, how stakeholders have inputted into the process and the engineering principles used to define the land required for the associated water infrastructure. This process sought to avoid or minimise potential adverse environmental, economic or social impacts and maximise potential benefits and potential opportunities that the associated water infrastructure may enable or facilitate.

[3] Anglian Water and Cambridge Water (2022), Site Selection Report for a Reservoir in the Fens. Retrieved from: fensreservoir.co.uk/assets/images/downloads/Site-Selection-Report–Fens-Reservoir–phase-one-consultation-2022.pdf

Figure 1.1: Location plan of the Fens Reservoir site



1.2 Strategic need

1.2.1 The East of England is the driest and fastest-growing region in the country and is home to many unique and precious landscapes that rely on water. This creates particular challenges for Anglian Water and Cambridge Water. Weather is becoming more extreme and an increasing population and ambitious growth strategies place greater emphasis on the need for water supply resilience during extreme drought. Water abstraction from environmentally sensitive areas also needs to be reduced as set out in the National Framework for Water Resources[4].

1.2.2 The Water Resources East (WRE) Regional Water Resources Plan[5] and the revised draft Water Resources Management Plans 2024 (rdWRMP24)[6,7] for Anglian Water and for Cambridge Water set out a best value plan for meeting these challenges. All the plans have considered options to reduce demand for water, such as leakage reduction, and options to provide additional water. The scale of the challenge is such that it cannot be met through demand management solutions alone. The WRMPs, as well as the WRE Regional Water Resources Plan, are supported by water resources modelling that has identified the need for two new strategic raw water reservoirs in the region to address part of the supply deficit – the Fens Reservoir and Lincolnshire Reservoir.

1.2.3 Modelling and analysis undertaken to inform the above-mentioned regional and company plans has shown that the reservoirs continue to be selected as low-regret, robust options. The reservoirs need to be delivered alongside a number of other solutions and policies, including desalination and other infrastructure projects, as well as reducing leakage and demand on water supplies, which are a key part of the plans for this region. Through delivering the reservoirs first, any required desalination plants could be delivered at a later stage, providing opportunity for technological developments that may increase the efficiency of these plants and reduce their energy requirements.

1.2.4 Whilst these reservoirs are a fundamental component to the long-term water resource plans in the region, providing a safe and resilient supply of drinking water, the reservoirs and their associated water infrastructure could also provide environmental, socio-economic and recreational benefits for surrounding communities.

[4] Environment Agency (2020), Meeting Our Future Water Needs: a National Framework for Water Resources. Retrieved from: https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources

[5] WRE (2023), Regional Water Resources Plan for Eastern England. Retrieved from: https://wre.org.uk/wp-content/uploads/2023/12/WRE-Regional-Water-Resources-Plan-for-Eastern-England.pdf

[6] Anglian Water (2023), Our Water Resources Management Plan 2024, Revised Draft WRMP24, Main Document. Retrieved from: https://www.anglianwater.co.uk/siteassets/household/about-us/wrmp/revised_draft_wrmp24_main_report.pdf

[7] Cambridge Water (2023) Draft Water Resources Management Plan 2024: Retrieved from: https://www.cambridge-water.co.uk/media/3872/cam-draft-wrmp24-final-version.pdf

1.2.5 For the Fens Reservoir, regional water resources modelling has confirmed in the WRE Regional Plan 2023 that the required reservoir capacity to meet public water supply requirements should be 50 million cubic metres to provide a supply of up to 88.8 megalitres per day (Ml/d) split equally between Anglian Water and Cambridge Water.

1.3 The new storage reservoir and associated water infrastructure

1.3.1 In order to operate the Fens Reservoir to provide the resilient water supply identified, associated water infrastructure is required. This associated water infrastructure has been the focus of the options appraisal process set out in this document. The key features of the Fens Reservoir associated water infrastructure are illustrated in Figure 1.2 and comprise the following elements:

- Upstream infrastructure is required to abstract and transfer water from each identified source of water supply (see below) into the Fens Reservoir. This includes abstraction infrastructure for intakes, pumping stations and water quality treatment including measures to prevent the spread of invasive species, where required, and raw water transfers, which could be utilising existing open channel transfer, building new pipelines, or a combination of both. Upstream infrastructure requirements are described in more detail in section 3.1.
- Downstream infrastructure is required to treat and transfer water from the Fens Reservoir into the identified connection points for the existing supply network. This includes water treatment works, treated water pipelines and service reservoirs. Downstream infrastructure requirements are described in more detail in section 4.1.
- Emergency drawdown disposal route element provides a route for the safe disposal of reservoir water in the event of an emergency which threatens the integrity of the reservoir embankment. The emergency drawdown disposal route is described in more detail in section 5.1.

1.3.2 The rdWRMP24[6] identified the following five possible sources of water supply for the Fens Reservoir:

- Middle Level system
- River Nene (Stanground)
- River Great Ouse (Earith)
- Counter Drain (Nene)
- Ouse Washes (River Delph)

1.3.3 These sources of supply are the required starting points of the upstream infrastructure for abstracted water to then be transferred to the end point at the Fens Reservoir. Further detail regarding the sources of supply is provided in Chapter 2.

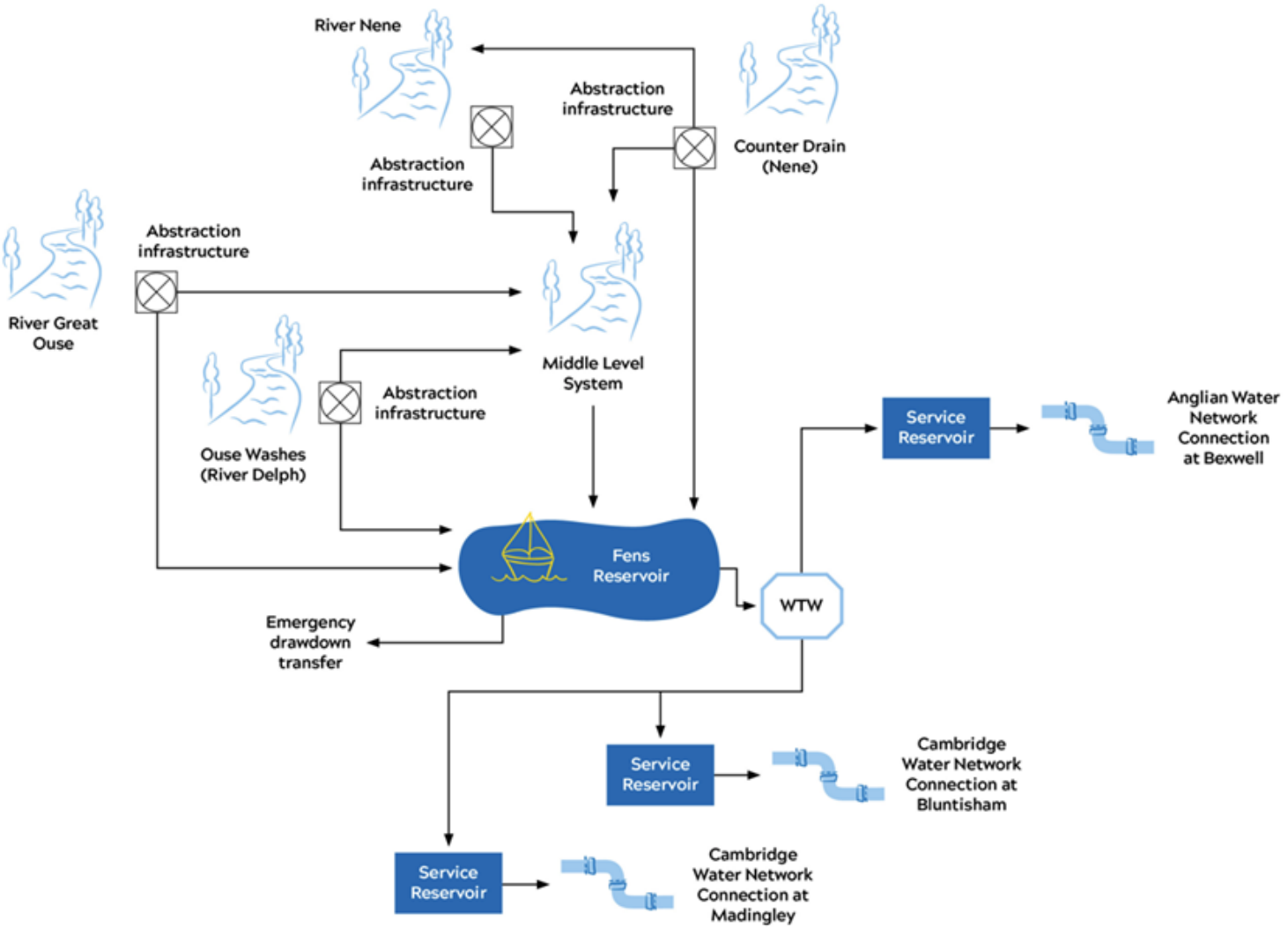
1.3.4 The Fens Reservoir (which would store the abstracted water) is then the starting point for both the downstream infrastructure and the emergency drawdown disposal route.

1.3.5 Water from the reservoir will be used to meet public water supply requirements for Anglian Water and Cambridge Water's existing supply networks. The connection points have been defined within Anglian Water and Cambridge Water's respective rdWRMPs[6,7] and are as follows:

- Bexwell, near Downham Market (Anglian Water)
- Bluntisham, near St Ives (Cambridge Water)
- Madingley, near Cambridge (Cambridge Water)

1.3.6 These connection points are the required end points of the downstream infrastructure for treated water originating from the Fens Reservoir.

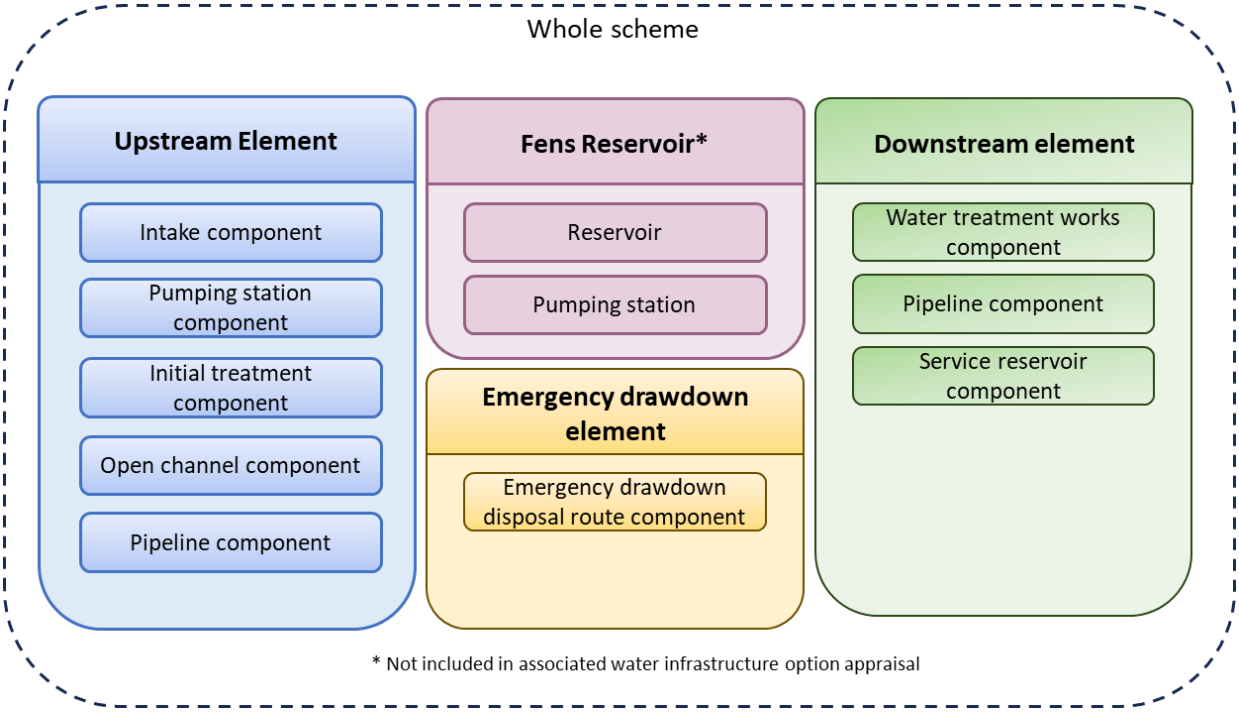
Figure 1.2: Key features of the Fens Reservoir project



1.3.7 For the purposes of the options appraisal process the above-detailed associated water infrastructure has been categorised as 'components' and 'elements'. These are depicted in Figure 1.3.

- Elements are the main features that combine to create a whole scheme and comprise: upstream infrastructure, main reservoir site, downstream infrastructure, and emergency drawdown.
- A component is a necessary part of an element that does not provide the whole solution for that element on its own. Examples of components are service reservoirs, transfer routes, pumping stations or water treatment works.

Figure 1.3: Overview of the Fens Reservoir



1.3.8 The options appraisal process for associated water infrastructure that is the subject of this document is limited to the assessment of the upstream infrastructure, downstream infrastructure and emergency drawdown disposal route elements.

1.4 The options appraisal process

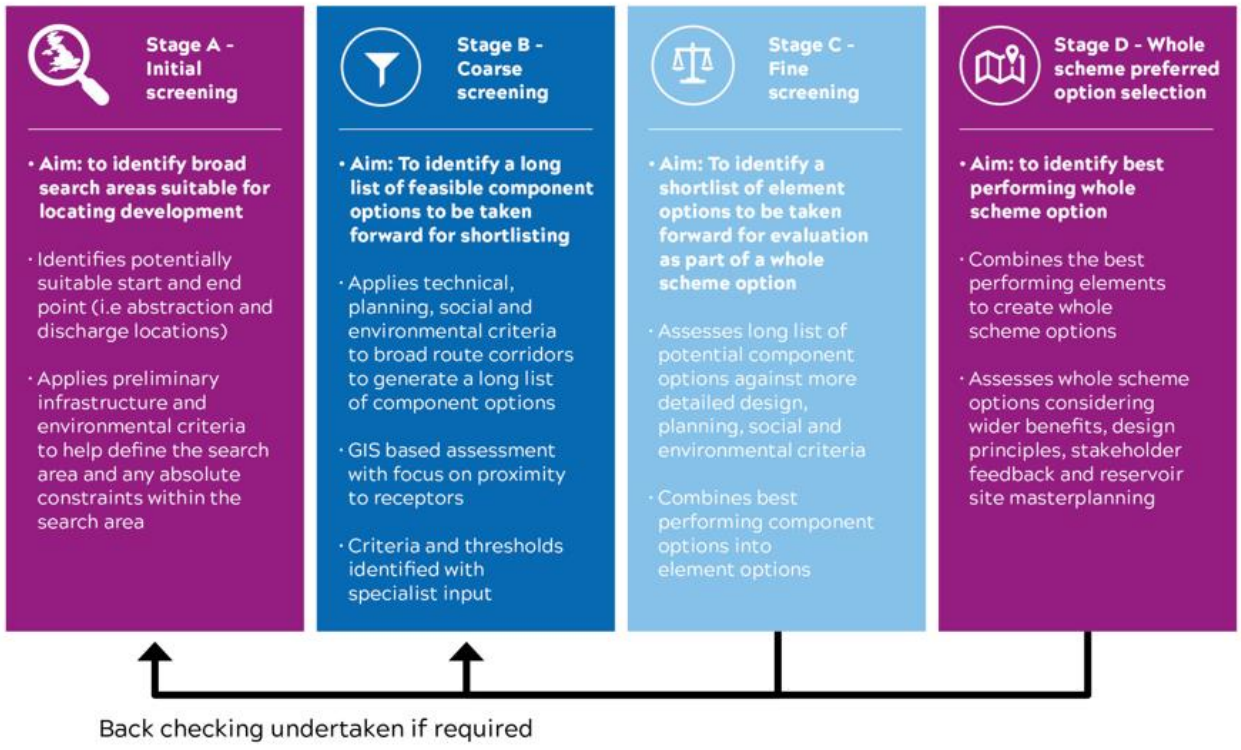
1.4.1 Anglian Water and Cambridge Water have undertaken a four-stage options appraisal process to identify and assess potential options for the associated water infrastructure based on a broad range of community, planning, economic, environmental, and other technical criteria. This included looking at both constraints and potential benefits and opportunities. The list of criteria and at what stage in the process they were considered is set out in Appendix A.

1.4.2 The criteria were selected as they would allow a robust technical, engineering and consenting appraisal to be completed against core legislative and policy requirements that would be factors in the future consenting and decision making processes. These criteria were developed using Government policy and regulations below, including the:

- National Policy Statement for Water Resources Infrastructure (April 2023);
- Infrastructure Planning (Environmental Impact Assessment) Regulations 2017;
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- The Conservation of Habitats and Species Regulations 2017 (as amended);
- National Planning Policy Framework (2023).

1.4.3 The process has been aligned with the site selection process undertaken for the reservoir. This comprehensive, staged options appraisal process is summarised in Figure 1.4.

Figure 1.4: Staged options appraisal process for the Fens Reservoir associated water infrastructure



1.4.4 A fundamental aspect of the options appraisal process has been the consideration of relevant national policy and in particular, the National Policy Statement (NPS)[1] for Water Resources Infrastructure.

1.4.5 The four stages of the options appraisal process were:

1.4.6 **Stage A – initial screening** comprised a high-level review of specific strategic constraints to identify broad search areas suitable for locating the associated water infrastructure.

1.4.7 **Stage B – coarse screening** comprised the identification of suitable locations to accommodate the upstream infrastructure component options, downstream infrastructure component options and emergency drawdown component options within the broad search areas identified at Stage A. The listed component options were screened against a range of environmental, engineering, planning, land use and social constraints. The Sequential Test for flood risk was carried out to identify suitable areas for above-ground infrastructure taking account of the component option's flood risk vulnerability. Component options that were least constrained were recommended to be taken forward to the next stage. However, some of the options progressed have potential consenting risk that needed more detailed consideration at Stage C in the context of the alternative options also being considered at that stage.

1.4.8 At **Stage C – fine screening**, the list of component options was subject to more detailed assessment against engineering, environmental, social, planning and land use criteria, to further understand potential constraints and benefits for each option and to identify any key differentiators between the options. Best performing component options were identified based on performance against these criteria and stakeholder feedback received on individual component options was also considered at this stage. The best performing component options were combined to form element options. These element options were then considered, with the best performing element options being taken forward to Stage D.

1.4.9 **Stage D – preferred whole scheme option appraisal** combined the best performing element options identified at Stage C to create whole scheme options for the associated water infrastructure[8]. A comparative review was then undertaken taking into consideration the appraisals undertaken at Stage C. This allowed the multiple strengths and weaknesses of the whole scheme options to be weighed up against one another in a subject matter expert-led comparative review to identify the best performing whole scheme option for the associated water infrastructure.

1.4.10 The identification of broad search areas (Stage A) and component options (Stage B) was undertaken using geospatial data and mapping software. Readily available datasets for Stage A and B constraints, as listed in Appendix A were considered alongside component-specific requirements and professional judgement to identify the search areas and component options.

[8] The Fens Reservoir forms part of the whole scheme, the location of the reservoir has been subject of a separate options appraisal process and is therefore not included as part of the associated water infrastructure options appraisal.

1.4.11 Further detail about each stage of the associated water infrastructure options appraisal process is provided in the following chapters.

1.5 Stakeholder engagement

1.5.1 Throughout the options appraisal process, stakeholders were invited to comment on the process and outcomes of the four stages of the process. The stakeholders that were engaged with included:

- A dedicated forum comprising the following statutory bodies, engaged with owing to the statutory function of the organisation and technical knowledge: Natural England, Historic England, Environment Agency, the Middle Level Commissioners and the relevant local planning authorities.
- Members of the pre-existing Fens Water Partnership group comprising statutory bodies and local non-statutory groups with interests and technical expertise including in local nature conservation, heritage and water resources. The FWP also played a valuable peer review role.

1.5.2 The dedicated forum and the Fens Water Partnership were engaged from early 2023 on the approach to the options appraisal process (Stage A to D), the criteria used at Stage B and Stage C, and the emerging results as the process progressed. Feedback was invited following each engagement, and this was used to inform the process. Specifically:

- In June 2023, a briefing was held with the dedicated forum and the Fens Water Partnership outlining the options appraisal approach. Details of the criteria to be used during Stages B and C of the options appraisal were circulated to the members of the dedicated forum and the Fens Water Partnership at this time.
- In August 2023 the results of Stage A were presented to the dedicated forum and the Fens Water Partnership, along with an early indication of the progress of the Stage B options identification.
- In September 2023 the results of Stage B were presented.
- In October 2023 a workshop was held with the dedicated forum and the Fens Water Partnership to capture benefits and opportunities relating to the associated water infrastructure options so that they could be considered during Stage C and D of the options appraisal.
- In January 2024 the results of Stage C were presented.
- In early May 2024 the results of Stage D were presented.

1.5.3 At the conclusion of Stage C of the options selection process, the relevant local planning authorities could be identified with respect to the emerging best performing

element options. These newly identified local planning authorities were invited to the Stage C dedicated forum to provide their feedback.

1.5.4 Feedback to each stage of the options appraisal process was requested within two weeks of the presentation of each stage to enable comments to be considered in the subsequent stage of the options appraisal process. All feedback was captured in agreed meetings records and recorded by the project team for response. This enabled the options selection process to be meaningfully influenced by the stakeholder feedback and stakeholders were made aware of the regard to their feedback in writing and through subsequent meetings.

1.5.5 This iterative engagement allowed a check and review process to be applied with stakeholder input informing the selection of the best performing associated water infrastructure options.

1.5.6 Feedback from stakeholders focused on key constraints and sensitivities that could be considered, including the identification of designated assets and sites and the need to properly assess and understand potential impacts on those designations to inform decision making. This feedback has been considered as the options appraisal process has progressed, including considering these key constraints and sensitivities at Stage B to identify least constrained options and in Stage C assessments to understand potential risks based on the information available at this early stage in the process. More detailed environmental assessments will be undertaken on the preferred whole scheme option(s) at the next stage of the development process.

1.6 Supporting information

1.6.1 A series of documents has been published for the consultation. All of these can be viewed online at **www.fensreservoir.co.uk/documents** and are available by contacting the project team.

Supporting Information	
Document Name	**Detail**
A guide to our proposals and phase two consultation	An overview of the phase two consultation, with more information about what is being consulting on, where to find out more about the proposals and how you can have your say.
Project fact sheets	Supporting information about the approach to a range of topics and important themes.
Reservoir	
Document Name	**Detail**
Phase two consultation – main site design brochure	Information on the emerging design for the main reservoir site and the factors considered to reach this point. This provides information about the initial opportunities for the features it could include, and how it is likely to operate.

Supporting Information	
Document Name	**Detail**
Main site design report	An explanation of the emerging design for the reservoir site, and how this was developed.
Associated Water Infrastructure	
Document Name	**Detail**
Phase two consultation – associated water infrastructure proposals	Information about the proposals for drawing available water from the sources that have been identified, transferring the water to the reservoir, treating it, and supplying it to customers. This explains the infrastructure that may be needed, and the preferred options identified at this stage.
Options appraisal report	**This report –** An overview of the options appraisal process that has been carried out to identify the preferred options and sites for the associated water infrastructure. This explains the four stages (Stage A to D) of the appraisal process, how the options that were progressed for detailed assessment compared to one another, and the different combinations assessed to identify the proposals being taken forward at this stage.

2 Sources of supply

2.1.1 This chapter outlines the approach and results of the process undertaken to confirm the preferred sources of supply for the Fens Reservoir.

2.1.2 Anglian Water's rdWRMP24[6] identified five possible sources of supply to fill the Fens Reservoir, as described below:

- **Middle Level system** which would provide the primary source of water via the Sixteen Foot Drain or the Forty Foot Drain adjacent to the reservoir site, when water is available. If required, due to level constraints, water would be transferred to the Middle Level system from the other available sources to the reservoir, described below.
- **River Nene (Stanground)** which feeds the Middle Level system at Stanground via the King's Dyke throughout the year.
- **River Great Ouse (Earith)** is being assessed as a transfer option involving either a pipeline to the reservoir or a combination of pipeline and open channel transfers to the Middle Level system.
- **Counter Drain (Nene)** is expected to provide a resilient yield to supply the reservoir. The Counter Drain (Nene) currently discharges to the tidal River Nene, downstream of Dog-in-a-Doublet. Subject to ongoing assessment of water availability and quality, available water could be discharged into the fluvial Nene and transferred to the reservoir via the connection to the Middle Level system.
- **Ouse Washes (River Delph)** is located in close proximity to the reservoir and is regularly flooded with water diverted from the River Great Ouse at Earith. This potential source option involves a proposed transfer from the River Delph at or near Welches Dam, and improvements to the Forty Foot Drain to transfer water into the Middle Level system.

2.1.3 The rdWRMP24 also identified the need to continue to assess and optimise the potential abstractions from these sources.

2.1.4 Accordingly, and in response to stakeholder requests to consider additional potential sources of supply, a sources of supply assessment was conducted that used the Environment Agency's Abstraction Licensing Strategies[9] to identify a long list of sources within a 50km radius of the proposed reservoir location. The 50km radius was considered a practical limit based on professional judgement due to the complexity, cost and carbon emissions which increase significantly the further the water needs to be transferred from source to reservoir. The potential sources identified are shown in

[9] Environment Agency (2023), Abstraction licensing strategies (CAMS process). Retrieved from: https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process

Figure 2.1. In addition to the five sources of supply identified in the rdWRMP24, the following additional potential sources of supply were identified the Ely Ouse at Denver, the River Nar, the Relief Channel, the Nene Washes and Whittlesey Gravel Pits.

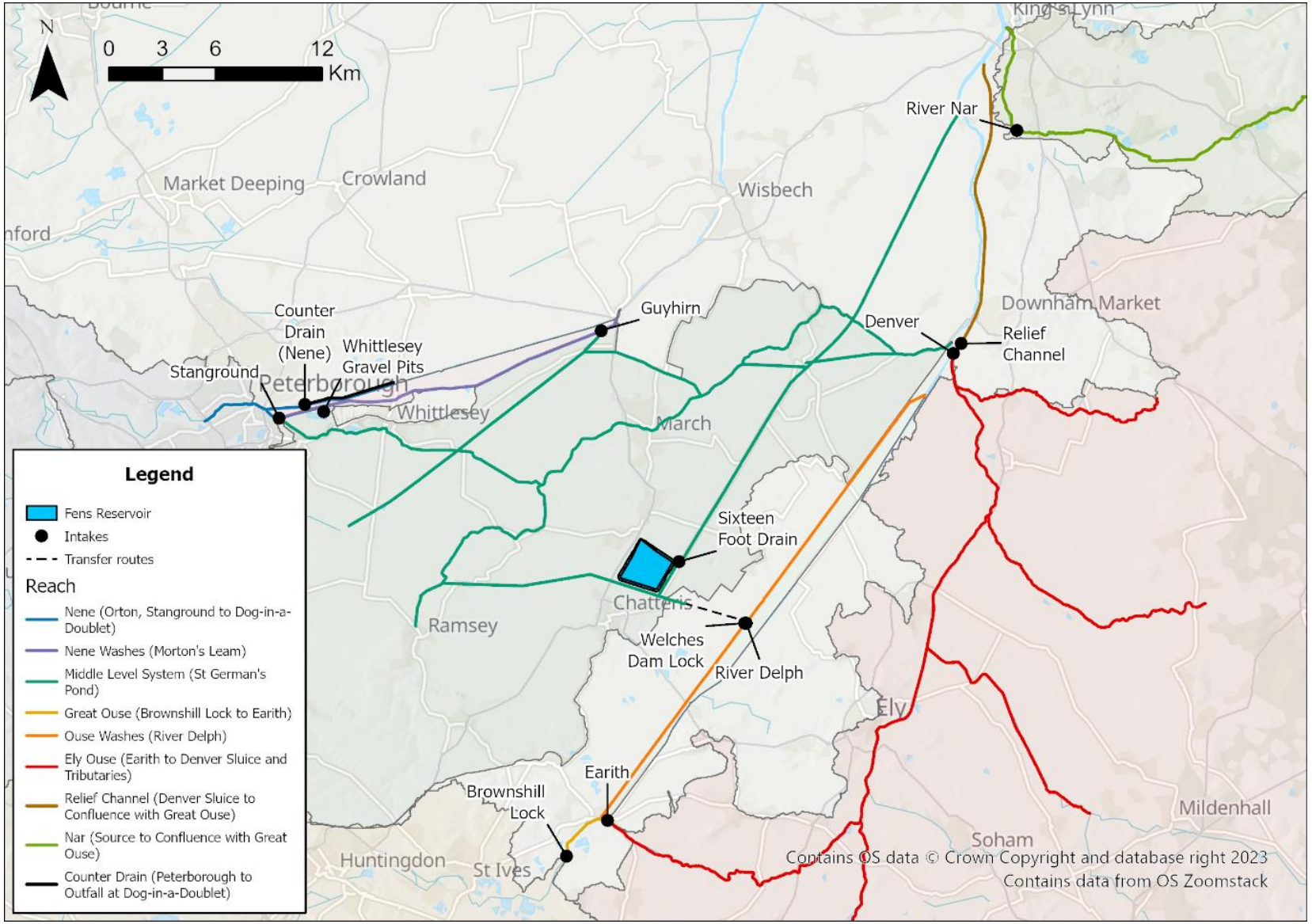
2.1.5 A staged process was followed to appraise the potential sources identified. Initially, the reservoir yield from each individual potential source was assessed, under climate change conditions with a 1 in 500-year drought[10] (in accordance with Water Resources Planning Guideline [11]). Whittlesey Gravel Pits and the Relief Channel did not provide a reliable yield for the reservoir and so did not progress.

2.1.6 Source combinations were then assessed to identify the preferred sources of supply for the Fens Reservoir.

- Inclusion of the Middle Level system as a source and the River Nene and its Counter Drain as a source in combination was found to be essential for achieving the minimum yield requirements for the reservoir set out in the rdWRMP24[6].
- When combined, several source options provided minimal additional yield and did not provide sufficient benefit to be progressed. These were the Nene at Stanground, the Nene Washes, the Ely Ouse at Denver and the Nar.
- Abstracting from the Ouse Washes (River Delph) rather than the River Great Ouse at Earith is preferred as it provides the potential to help manage flood water levels in the Ouse Washes and the potential to contribute to an improvement in the condition of the site. However, as this is subject to ongoing and more detailed investigation and assessments, the option to abstract from the River Great Ouse at Earith has been retained.

[10] Climate change assessments have mirrored those adopted in the rdWRMP24, considering the most robust level of assessment (Tier 3 in the WRPG supporting guidance).
[11] Water resources planning guideline - GOV.UK (www.gov.uk)

Figure 2.1: Fens Reservoir potential sources



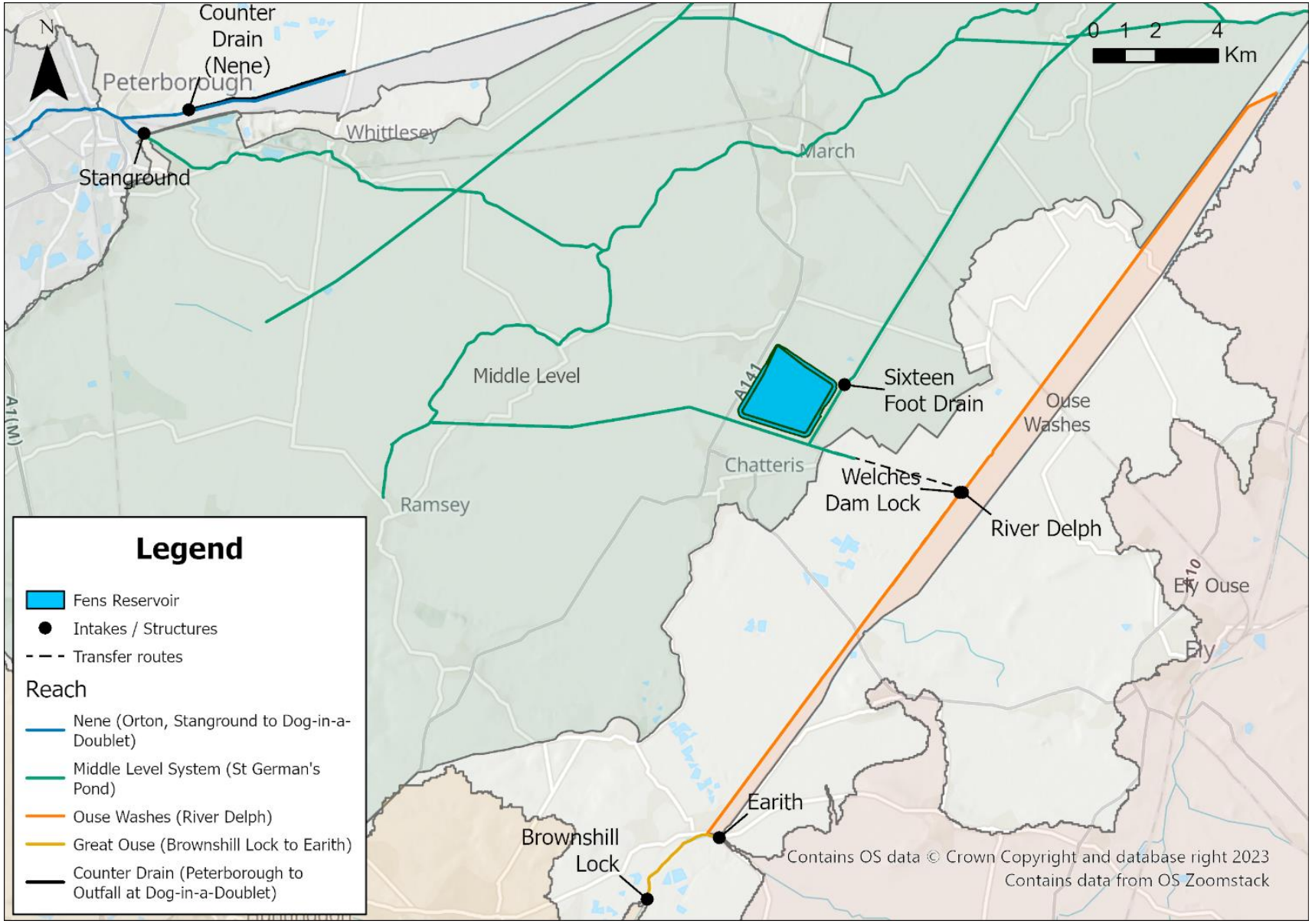
2.1.7 The sources of supply assessment considered the presence of water level management structures, such as locks and sluices, and inflows of water from tributaries to define the abstraction reach for each of the sources, as listed below and shown on Figure 2.2:

- The Great Ouse source is defined as the reach between Brownshill Lock (the tidal limit) and Earith.
- The Ouse Washes source relates to the River Delph reach between Earith and Welches Dam.
- The Middle Level system is defined as the upper drainage system of the St Germans Pond.
- The River Nene is defined as the reach between Orton Lock, Stanground Sluice and Dog-in-a-Doublet (the tidal limit).
- The Counter Drain (Nene) relates to the reach from Peterborough to the outfall at Dog-in-a-Doublet.

2.1.8 Work during the options appraisal process has identified that there is not a feasible source for abstraction from the River Nene (Stanground) alone, due to abstraction licensing constraints identified by the Environment Agency, however there are potential options for abstraction from the River Nene in conjunction with its Counter Drain source[12].

[12] Where associated water infrastructure options were developed for the River Nene source, they have been retained in this report for completeness up until the stage where it was no longer progressed as a standalone source.

Figure 2.2: Fens Reservoir preferred sources



3 Upstream infrastructure

3.1 Introduction

3.1.1 This chapter outlines the approach and results of the first three stages of the options appraisal process (initial screening, coarse screening and fine screening) for the upstream infrastructure. This included identifying the broad search areas (Stage A), defining feasible upstream component options and undertaking initial assessment (Stage B) and undertaking further component options assessments and determining the preferred component options and element options (Stage C) for progression to Stage D for identifying the best performing whole scheme option (associated water infrastructure).

3.1.2 Upstream infrastructure is required to abstract raw water from the preferred sources and transfer this water to the Fens Reservoir. The start of each transfer is therefore defined by the source, and the end of the transfers is the reservoir.

3.1.3 Upstream infrastructure elements were identified for each source of supply:

- Middle Level system to the Fens Reservoir
- River Nene and its Counter Drain to the Fens Reservoir[13]
- River Great Ouse at Earith to the Fens Reservoir
- Ouse Washes (River Delph) to the Fens Reservoir

3.1.4 There are no existing facilities for transferring water between the identified sources and the Fens Reservoir location and therefore some form of new transfer infrastructure is required.

3.1.5 The components of the upstream infrastructure elements include the following, as shown in Figure 3.1:

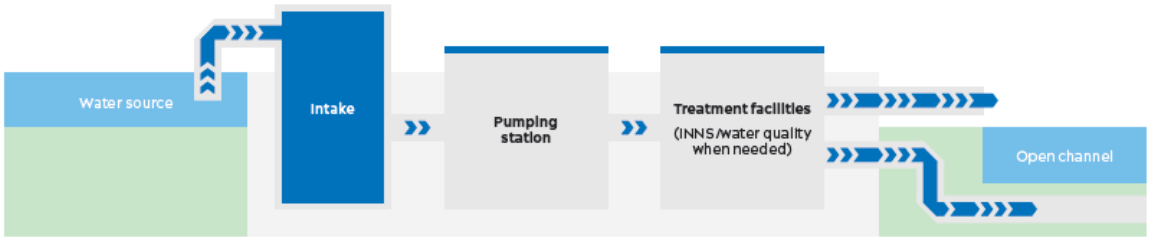
- **Abstraction infrastructure** is required to collect the water from the source watercourse, and where necessary treat it, so that it can be transferred to the reservoir. The abstraction infrastructure can be either all on the same site or split over multiple sites in relation to the same source (for example multiple sites may be required in order to locate treatment works outside of Flood Zone 3b (see paragraphs to 3.3.15). Abstraction infrastructure may include the following, depending on the particular source/circumstances:

[13] Because of the geographical proximity of these two sources of supply, the components identified for each were largely the same allowing these two to be treated as a single element from an infrastructure transfer perspective.

- River intakes - this is a structure built into the bank of the river or channel. It would include a screen to exclude any debris, such as branches or leaves, from being collected.
- Raw water pumping stations, which would lift the water either into the transfer infrastructure (see below) or to a treatment works if the river water needs treatment before being transferred.
- Treatment works may be required in some cases to remove any invasive non-native species (INNS) present (see paragraph 3.1.7) and/or to achieve the required water quality when moving water between river catchments (see paragraph 3.1.6).

- **Upstream transfer**, which would convey water from the required abstraction infrastructure to the reservoir.
  - Existing rivers and channels that flow in the direction needed for the transfers could be used as part of the transfer, a map of the major watercourses in around the Lincolnshire Reservoir is included in Appendix B.
  - New pipelines have also been considered for transferring water and could be used in combination with rivers and channels, or on their own.
  - Development of new open channel transfers covering the full distance from sources to the reservoir have been excluded from the associated water infrastructure options appraisal process due to the potential environmental impact, land requirements and likely carbon emissions and cost considerations when compared to either a full pipeline option or a combination of existing open channels and pipelines.

Figure 3.1: Indicative arrangement of upstream infrastructure



3.1.6 The Water Framework Directive (WFD) sets out requirements to prevent the deterioration of the status of water bodies (e.g. rivers, lakes and groundwater) and to support the achievement of the environmental objectives for water bodies. WFD water bodies in the UK have been allocated a specific status based on water quality and ability to support wildlife. Within the Cambridgeshire Fens the different water bodies (shown in Appendix B) have different statuses and different justification for their

respective status. Where water is transferred from one WFD water body to another, care must be taken not to reduce the water quality of the receiving WFD water body. In such cases, water quality treatment may be required before discharging the water into the receiving WFD water body. This may be required either where the receiving water body is of higher water quality than the water being introduced or where there is a water body objective to improve the quality of the receiving water.

3.1.7 The transfer of water creates a risk of either introducing INNS or encouraging the spread of INNS present in one water body or catchment to another. This can have implications for biodiversity, ecosystems and operation of the associated water infrastructure. This is generally a risk where new transfers are proposed between different water bodies and catchments, especially where these are not already connected. Conversely, where these water bodies are already connected, the proposed change to INNS risk may yet be sufficiently low, to not warrant such treatment. Further engagement and investigation would therefore be required to identify the risk of spread and associated level of INNS prevention, mitigation and/or treatment required.

3.2 Stage A – Initial screening

3.2.1 Initial screening was completed to identify broad search areas in which the abstraction infrastructure and upstream transfers could be feasibly sited for each of the identified potential sources of supply, other than the Middle Level system. These broad search areas are shown on Figure 3.2.

3.2.2 The Sixteen Foot Drain and the Forty Foot Drain are part of the Middle Level system and are immediately adjacent to the Fens Reservoir site. It has therefore been assumed that no infrastructure is required for using the Middle Level system as a source, other than the final pumping station at the reservoir, as the water will be abstracted from the Sixteen Foot Drain or the Forty Foot Drain rather than transferring it from another source in the Middle Level system that is further away. The same quantity of water would be available for abstraction from either the Sixteen Foot Drain or the Forty Foot Drain and therefore the location of the final pumping station is being identified as part of the reservoir masterplanning design process. This means that the pumping station will be integrated into the overall reservoir site design and is not considered in this options appraisal process.

3.2.3 As part of identifying broad search areas, component-specific requirements were considered. For example:

- Intakes and raw water pumping stations would need to be sited close to the source water body in order to facilitate the abstraction of water.
- Water quality and INNS treatment should preferably be located close to the source and preferably within the same source catchment so that operational

discharges from the treatment works would remain within the source catchment. This would reduce the risk of introducing invasive species or poorer quality water into a different catchment, as well as reducing the risk of INNS impacting the operability of the associated water infrastructure.

Identification of existing open channels with potential to be used for upstream transfers

3.2.4 Potential upstream existing open channel route options that could enable water transfer, or part of a transfer, have been identified by identifying main river and high-level carriers that could be used to convey water between the abstraction and discharge locations and through engagement with the Fens Reservoir Water Partnership.

3.2.5 In principle, transfers that use existing open channels are considered preferable to pipelines alone, where alternative options performed similarly, as they could unlock potential benefits to the environment, and also may facilitate multi sector opportunities. Improvements to existing open channels may improve the natural environment and provide amenity value. These potential benefits and opportunities could include the incorporation of habitat for wildlife, improvement of navigation routes and mitigation of flood risk but may require localised construction works to enable their use to transfer water.

3.2.6 Existing open channels may not be able to facilitate a transfer from the source of supply to the reservoir, as they may not pass close to both a source and the reservoir site. Short sections of new open channel or pipelines may therefore be required to complete the transfer from source to the reservoir. These sections of new open channel or pipeline as part of the longer transfer route have been considered in Stage B of the options appraisal process[14].

3.2.7 Existing open channel transfer options were identified that could convey raw water from the sources towards the Fens Reservoir in combination with either each other or with pipelines:

- River Delph
- Counter Drain (Ouse)
- Middle Level system, including the currently disused dry section of the Forty Foot Drain
- Morton's Leam

[14] The exception to this is that a search area was developed at Stage A for pipeline transfers between the River Nene and its Counter Drain and the Middle Level system. These pipelines transfers would combine with open channel transfer through the Middle Level system to convey water from the River Nene and its Counter Drain to the Fens Reservoir.

Pipeline infrastructure search areas

3.2.8 Search areas for pipelines have been identified by firstly defining the potential start and end locations for the transfer of water. At Stage A search areas were defined for between the sources and the reservoir. The abstraction reaches described in paragraph 2.1.7[15] were used as the potential start location and the reservoir was the end location.

3.2.9 The shortest and most direct pipeline route between start and end locations was identified and the search area was then defined by drawing an ellipse enclosing the start and end locations based on 1.5 times the shortest, most direct route between the start and end points. This constraint was applied to avoid excessively long pipeline corridors, taking account of environmental, carbon emissions, resource use and cost factors for both the construction and operational phases of delivery that increase with the length of any pipeline. The multiplier of 1.5 was used to define the extent of the ellipse as professional judgement suggested this would provide a practical limit, whereby pipelines extending beyond these bounds were likely to be prohibitively long.

3.2.10 An additional search area was defined for pipeline transfers between the River Nene and its Counter Drain and King's Dyke, which is part of the Middle Levels system. The Middle Levels system extends from close to the River Nene to the Fens Reservoir site. These pipeline transfers would combine with open channel transfer through the Middle Level system to convey water from the River Nene and its Counter Drain to the Fens Reservoir. The abstraction reach was as described in paragraph 2.1.7 and the end location was considered to be a discharge stretch of King's Dyke between Stanground Lock and Whittlesey Dyke. The search area was defined by the abstraction reach and discharge stretch and these were joined up with an arc on each side.

3.2.11 Pipeline corridor search areas have been identified from each of the sources and these are also shown on Figure 3.2 and are listed below:

- River Nene and its Counter Drain to Middle Level system pipeline search area.
- River Great Ouse at Earith to Fens Reservoir pipeline search area.
- Ouse Washes (River Delph) to Fens Reservoir pipeline search area.

3.2.12 The engineering, environmental, planning, and social and community constraints (see Appendix A) mapping was not applied at Stage A to the pipeline search areas as they would be below-ground assets and constraints can generally be avoided, or impacts reduced and mitigated by routing the pipeline around constraints or using trenchless construction techniques (such as trenchless crossings).

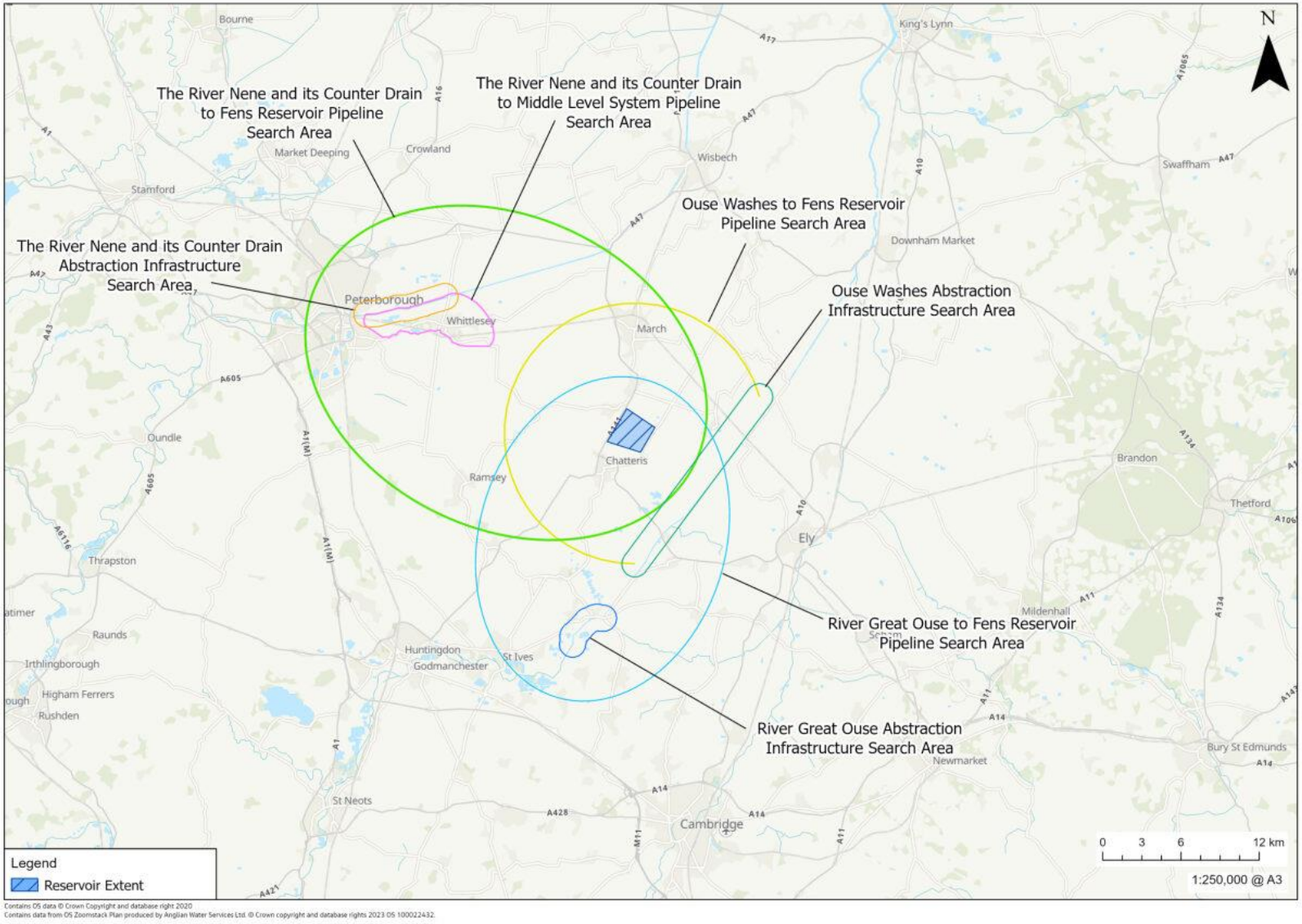
[15] The source assessment work was undertaken in parallel with associated water infrastructure options appraisal and therefore the options appraisal has adopted an abstraction reach which extends from Earith beyond Welches Dam, whereas the sources of supply assessment identified a reach between Earith and Welches Dam.

Abstraction infrastructure search areas

3.2.13 The Stage A search areas for abstraction infrastructure were defined by creating a 1km ellipse around the abstraction reach of the source river used to define the pipeline search areas (see Figure 3.2). A distance of 1km was considered a practical limit based on professional judgement due to the complexity, cost and carbon emissions which increase significantly the further the intake and pumping station are located from the source, due to the need to maintain positive pressure on the suction side of the pumps.

3.2.14 Engineering, environmental, planning, and social and community constraints detailed in Appendix A were applied to the broad search areas identified in Stage A for abstraction infrastructure to identify exclusion areas. This refers to areas within the broad search areas where existing constraints (e.g. built-up areas) would prevent the placement of abstraction infrastructure within that area.

Figure 3.2: Search areas for upstream pipelines and abstraction infrastructure



3.3 Stage B – Coarse screening

3.3.1 The purpose of Stage B was to identify component options within the search areas identified in Stage A and to screen the components against the options appraisal criteria.

3.3.2 Component options were screened against the environmental, planning, engineering, land use, social and community criteria set out in Appendix A identified as being considered at Stage B. These criteria were selected to allow key constraints to be identified for each option identified in the search areas to understand the likely feasibility of each option and potential consenting risks. This was used to inform decision making on which those options to take forward for Stage C fine screening for more detailed assessment against the Stage C criteria. The component options with the least constraints, which as a result are likely to carry the lowest risk to project delivery, were carried forward to Stage C for fine screening and a more detailed assessment against criteria.

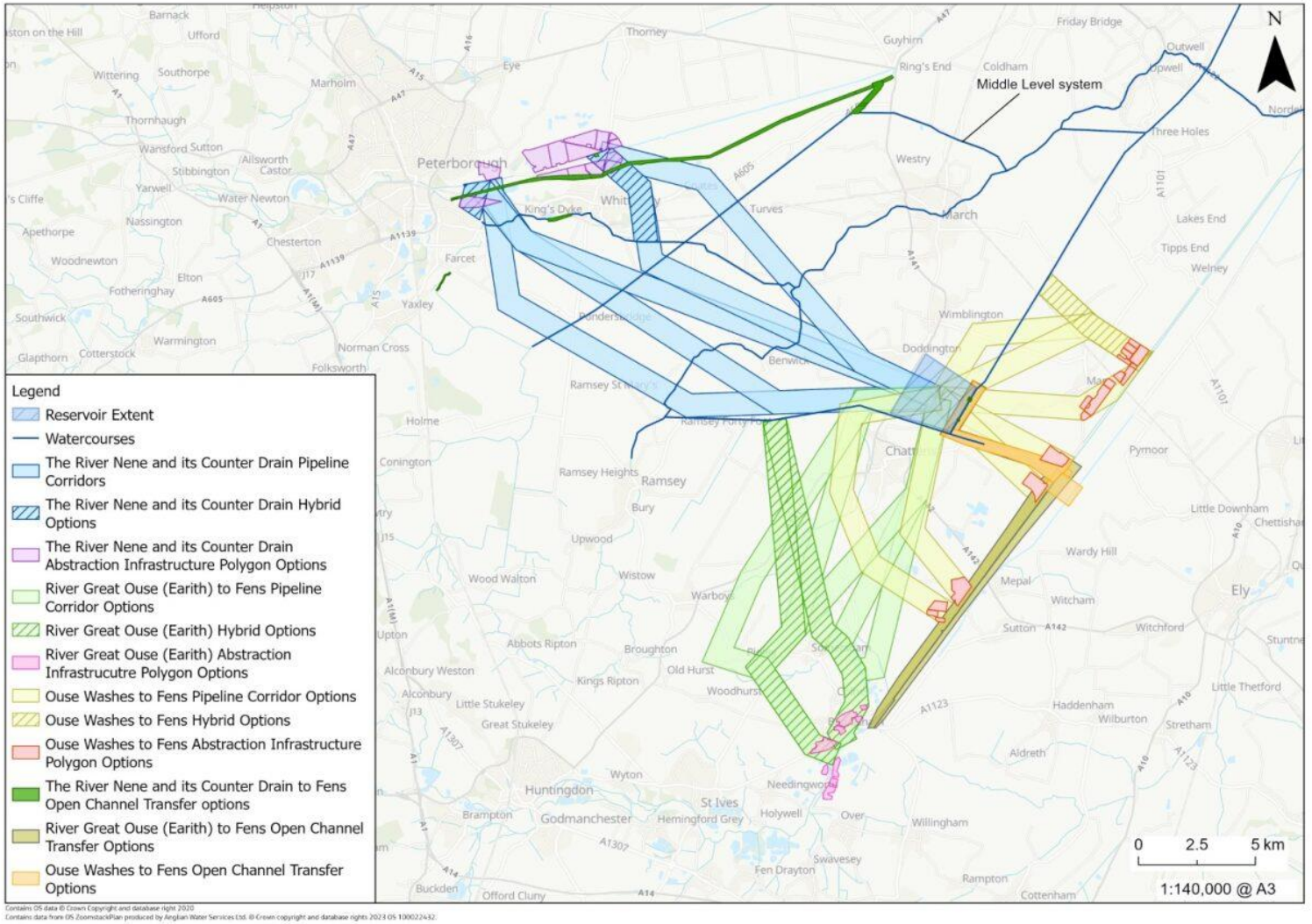
3.3.3 Within the identified search areas, potential routings for upstream water transfers and locations for the abstraction infrastructure were identified, as set out below.

Upstream water transfers – pipeline and open channel transfers

3.3.4 Options for open channel transfer, pipeline transfer and combinations of both (hybrid options) were identified for upstream transfers of raw water from source water bodies to the reservoir. At Stage B the pipeline transfers were assumed to end in the centre of the reservoir, as the reservoir emerging design and illustrative master plan were still under development. Open channel transfers to the reservoir were assumed to end adjacent to the reservoir. These endpoints were revised at Stage C.

3.3.5 The upstream options considered at Stage B are presented at Figure 3.3.

Figure 3.3: Overview of all upstream options considered at Stage B



3.3.6 The hydraulic capacity of existing open channels identified at Stage A (see paragraphs 3.2.4 to 3.2.7) was assessed to understand their suitability for transfer of raw water to the reservoir. Those channels with sufficient hydraulic capacity were then screened against the Stage B criteria to identify the least constrained options.

3.3.7 Where an open channel does not extend all the way from source to reservoir, or levels do not facilitate the transfer by gravity, supplementary components were identified to enable the transfer from source to reservoir. These supplementary components included new open channel sections and pipeline transfers.

3.3.8 As a starting point, pipeline corridor options were identified with the aim of minimising the overall length of the route, as far as this is practicable, in order to minimise the likely impacts from carbon emissions and costs for the infrastructure, as well as minimising the extent of land that would be required or impacted. A 1km wide pipeline corridor was developed for each route to provide sufficient flexibility to refine the corridor route during the Stage C fine screening. The corridors avoided constrained land where practicable. Generally, the preferred construction method for a pipeline is installing it using an open cut trench. However, for some sections of the pipeline route there will be critical crossings that will not be generally suited to open cut excavation and so a different construction method is required using trenchless construction techniques. For the purpose of this assessment, trenchless techniques have been assumed to be used to cross physical constraints where open cut would be unlikely to be approved, these were:

- A-Roads
- Motorways
- Railways
- High pressure gas pipelines
- Buried High Voltage electrical lines
- Main Rivers
- Strategic Anglian Water pipelines

3.3.9 At Stage B the pipeline corridors were 1km wide and were not narrowed to avoid known constraints. A 1km corridor is much wider than will actually be required for construction and operation of the pipeline and therefore there is flexibility to align the route within the corridor to avoid constraints at the stage in the process where the pipeline route is identified within the preferred corridor. If constraints cannot reasonably be avoided, measures such as trenchless construction, could be adopted to mitigate impacts on particularly sensitive constraints. Further scheme development and assessments are required to identify potential impacts and risks to inform the construction methodology for any pipeline routes.

3.3.10 This process identified 32 potential transfer routings:

- **River Nene and its Counter Drain to Fens Reservoir**: Five pipelines, three open channel transfers and two hybrid options (a combination of pipelines and open channel transfers).
- **River Great Ouse at Earith to Fens Reservoir:** Six pipelines, two open channel transfers and three hybrid options.
- **Ouse Washes (River Delph) to Fens Reservoir:** Eight pipelines, two open channel transfers and one hybrid option.

Abstraction infrastructure

3.3.11 Polygons for abstraction infrastructure were delineated close to the source water bodies, using geospatial data and mapping software, to avoid the most sensitive environmental, heritage, developed land use and infrastructure constraints. The minimum area of land required for a polygon was assessed based on being able to accommodate at least the pumping station footprint and the temporary space (based on early, indicative work) needed during construction (2.7ha). Where INNS treatment and/or water quality treatment may be required, the land area requirements were assessed to be 8.5ha. Any required treatment would either be located within the same polygon as the pumping station, if the polygon is large enough, or in a separate polygon.

3.3.12 Land adjacent to the source water body may often be in the floodplain and vulnerable to flooding due to the nature of being close to a water body. The flood vulnerability classification of the abstraction infrastructure was therefore assessed to understand suitability for it being located within flood zones, in accordance with the Flood Sequential Test[16]. Flood Risk vulnerability classifications[17] are essential infrastructure, highly vulnerable, more vulnerable, less vulnerable and water compatible.

- Water compatible infrastructure is compatible with all Flood Zones including the Functional Floodplain, also known as Flood Zone 3b.
- Less vulnerable infrastructure is compatible with Flood Zones 1, 2 and 3a but is not permitted within the Functional Floodplain/Flood Zone 3b.
- More vulnerable infrastructure compatible with Flood Zones 1 and 2 but requires an Exception Test to be permitted within Flood Zone 3a and is not permitted within Flood Zone 3b.

[16] https://www.gov.uk/guidance/flood-risk-and-coastal-change#the-sequential-approach-to-the-location-of-development
[17] Flood risk and coastal change - GOV.UK (www.gov.uk)

- Highly vulnerable infrastructure compatible with Flood Zone 1 but requires an Exception Test to be permitted within Flood Zone 2 and is not permitted within Flood Zones 3a and 3b.
- Essential infrastructure is compatible with Flood Zones 1 and 2 but requires an Exception Test to be permitted with Zone 3a or 3b.

3.3.13 The intakes and raw water pumping stations were assessed to be 'water-compatible'[18] and therefore suitable for location in Flood Zone 3b. However, the water quality and INNS treatment facilities were assessed to be 'less vulnerable' to flood risk and therefore recommended to be located outside the functional floodplain/Flood Zone 3b.

3.3.14 Where feasible, the abstraction infrastructure polygons have been sized to incorporate both the pumping station and any potential water quality and/or INNS mitigation/treatment, if required. Where the pumping stations' polygons were identified in the Flood Zone 3b, separate polygons were identified outside of the Flood Zone 3b for potential water quality and/or INNS mitigation/treatment works.

3.3.15 This process identified 46 potential locations for abstraction infrastructure. These comprised 17 for the River Nene and its Counter Drain, nine for the River Great Ouse at Earith and 20 for the Ouse Washes (River Delph).

Stage B screening

3.3.16 At Stage B the component options identified above were assessed against engineering, environmental, planning, land use and social criteria, as listed in Appendix A. These criteria were selected to identify the most significant constraints, taking account of the requirements of the NPS and other relevant legislation and policy requirements. The assessments were carried out using geospatial data and mapping software. Desktop datasets for Stage B criteria were considered alongside component-specific requirements and professional judgement of the subject matter experts to identify and assess component options.

3.3.17 The Stage B options were considered against the Stage B criteria to identify potential constraints that may affect the feasibility of the component or introduce consenting risk compared to the alternative options available. Preference was given to options with less constrained land on the basis that those options were likely to carry the overall lowest risk to consenting and project delivery. These options were taken forward to Stage C fine screening for more detailed assessment against the Stage C criteria.

3.3.18 Different criteria have differing level of protection given to them under the NPS and so this has been considered as part of the Stage B screening process. For example, an

[18] Annex 3

internationally designated habitat site is considered more sensitive and afforded a higher level of protection than a site with a local or regional wildlife designation under the NPS. Judging the subtle differences and weighing the balance of respective constraints was undertaken in workshops attended by multidisciplinary subject matter experts.

3.3.19 In some cases it was not feasible to locate infrastructure away from sensitive receptors due to the geographical extent of some constraints and some of the water sources being designated biodiversity sites (including Ramsar sites, Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Sites of Special Scientific Interest (SSSI)). As a result, in these circumstances options identified at Stage B may extend into these areas that would otherwise be avoided, with the potential for any direct and indirect effects on constraints and designations being considered further in the more detailed assessments at the later stages of the options appraisal process.

3.3.20 The least constrained component options from an environmental perspective were generally the options that avoid or minimise impacts on internationally or nationally designated habitats sites, although this hasn't been possible in all cases, and that avoid or minimise the potential for impacts on designated heritage assets, such as scheduled monuments. The preferred pipeline corridor options from an engineering perspective were generally the shortest routes, making them preferable in comparison to longer corridors due to the lower associated production of carbon emissions and the cost of construction and maintenance, reduced disturbance to existing land use, and routes with the fewest crossings, making them less technically complex than other options.

3.3.21 Polygons for above-ground infrastructure, including pumping stations, water treatment works and INNS treatment, were identified to avoid the most sensitive constraints. Where the search areas included land with sensitive constraints, such as environmental and planning policy designations like common land or Green Belt, these were not excluded from the polygon at Stage B as there could be an overriding case for locating infrastructure within the designated land areas when considered against the alternative options and subject to compliance with any relevant legislative or policy tests. Where polygons performed well against Stage B criteria generally, but are within or close to a designated site or asset, these were carried forward to Stage C for further consideration against any alternative options to understand if any alternative options would avoid or reduce the impact on the designation.

3.3.22 Seventeen upstream water transfers and nine abstraction infrastructure polygons were presented to the Project stakeholders and recommended for progression to Stage C:

- **River Nene and its Counter Drain to Fens Reservoir:** Three open channel transfers, one hybrid option and two abstraction infrastructure polygons.
- **River Great Ouse at Earith to Fens Reservoir:** Three pipelines, two open channel transfers, two hybrid options and one abstraction infrastructure polygon.

- **Ouse Washes (River Delph) to Fens Reservoir:** Three pipelines, two open channel transfers, one hybrid option and six abstraction infrastructure polygons.

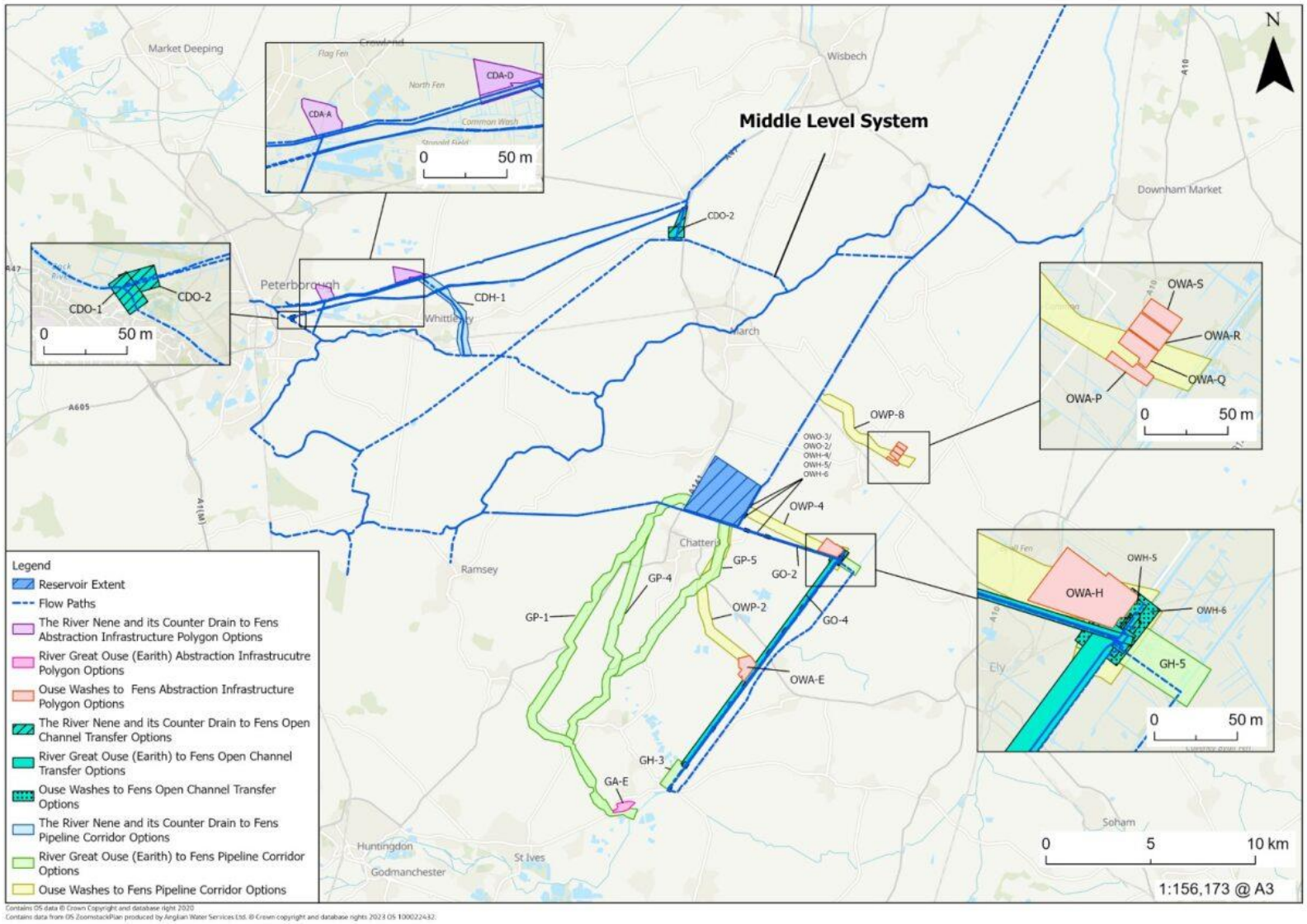
3.4 Stage C – Fine screening

3.4.1 Fine screening incorporated four steps to support and inform decision-making on the options (from Stage B) for progression to Stage D – preferred whole scheme option appraisal for the associated water infrastructure elements. These were the following:

- Refinement of component options taking into account the Stage B appraisals.
- The Stage C technical appraisals (the appraisal criteria can be found in Appendix A) to assess the component options against more detailed criteria and stakeholder engagement on individual components.
- Combination of the best performing component options into elements, and review of the combinations to ensure that when considered as part of an element, the best performing component options remained the best performing component options.
- Where more than one element option was created from the best performing component options, these were compared against each other to identify the best performing element options for progression to Stage D.

3.4.2 The upstream options considered at Stage C are presented at Figure 3.4.

Figure 3.4: Overview of all upstream options considered at Stage C



Nene sources

3.4.3 During Stages A and B, associated water infrastructure options were considered for both the River Nene and its Counter Drain. Further work in parallel to the options appraisal process as part of the sources of supply assessment (refer to Chapter 2), showed that including the River Nene as a standalone source would not significantly increase the amount of water transferred to the reservoir, but it would increase the cost and carbon emissions due to the need to upgrade infrastructure. Subsequently, the River Nene source was removed as a standalone source of water for Fens Reservoir. During Stage C, pipeline transfers were considered from the Counter Drain (Nene) and also open channel transfers from the River Nene in conjunction with its Counter Drain.

3.4.4 As a result, the transfer options for Nene sources were reviewed and updated to account for the River Nene not being adequate as a standalone source of water and therefore the reduced capacity needed for the transfer. The Nene sources assessed at Stage C included two open channel transfer options, one hybrid option and two abstraction infrastructure polygons. The abstraction infrastructure polygons were in the same locations for both hybrid and open channel options.

Design refinement

3.4.5 Design refinement primarily involved amendment of pipeline corridors and above-ground infrastructure polygons to minimise encroachment on key constraints and maximise distance from sensitive receptors. Design refinement was based on the outcomes of the consideration of the criteria considered at Stage A and Stage B (as set out in Appendix A) which identified constraints, so that opportunities to refine the design could be identified to avoid these constraints, where reasonably practicable at this early stage in the process.

3.4.6 The polygons for abstraction infrastructure identified at Stage B were not reduced in size to more closely match the expected land requirements, keeping the full polygons at this stage gives greater flexibility for siting of the infrastructure within the polygon to avoid, reduce or mitigate any potential impacts. The preferred siting of the infrastructure within the polygons will be identified at a later stage of the Project. One of the polygons located at the River Great Ouse was refined to avoid areas within flood zones and areas with the greatest abstraction height difference.

3.4.7 At this stage, pipeline corridor options were reduced from 1km to 500m. A corridor width of 500m is still many times wider than the actual width of the pipeline route that would be required for construction; however, it allows for flexibility for the detailed routing of the pipeline at a later stage within the wider area of land being considered in the corridor. At some places, the width of the corridor was narrowed to less than 500m or its alignment was altered at specific points along the route in order to avoid

or minimise potential impacts on particular environmental sensitivities and engineering constraints.

3.4.8 Open channel transfer options were refined using hydraulic models and calculations to determine constraints and their extents. Analysis of the route and the hydraulic results informed the development of the components and the infrastructure or improvements required to provide the transfer.

3.4.9 Initial hydraulic assessments of existing structures along the open channels were undertaken in order to assess whether or not the structures are a constraint to the capacity of the channel. Where constraints to the capacity of the channel were identified, options were considered to overcome the constraint, such as bypasses or channel widening.

Ouse Washes hybrid transfers

3.4.10 At Stage B both open channel and pipeline options had been considered for abstracting from the Ouse Washes in the vicinity of Welches Dam Pumping Station. Two new hybrid options from Welches Dam were introduced at Stage C which combined the Stage B options. These options involve pumping water from the abstraction infrastructure via a piped connection to the Forty Foot Drain. Once in the Forty Foot Drain, the flows would be transferred to Fens Reservoir via open channel transfer.

Stage C Technical appraisals

3.4.11 Desk-based technical appraisals were undertaken by subject matter experts to assess each component option against the more detailed Stage C criteria to identify potential risks to the feasibility of each option and consenting risks to inform the identification of the preferred elements to be taken forward into the Stage D. The Stage C technical appraisal considered the criteria set out as being used in Stage C in Appendix A and covers a wide range of technical and engineering, environmental, planning and land criteria.

3.4.12 Decision making throughout Stage C was based on understanding how each of the options performed against the Stage C engineering, environmental, land use and planning criteria set out in Appendix A and through the lens of the NPS consenting tests for water resources infrastructure, and then the comparison of the alternative options against each other to identify the best performing options.

3.4.13 Some criteria are informed by specific policy or legislative consenting tests that must be considered at the decision-making stage. Examples of these include the Conservation of Habitats and Species Regulations 2017 as amended (known as the Habitats Regulations) and Green Belt land (protected through Chapter 13 of the

National Planning Policy Framework[19]). The development of the Stage C fine screening appraisal process considers the options against these consenting tests to inform decision making on what tests need to be met for an option to progress.

3.4.14 The Green Belt was also identified as an important planning constraint that must be considered when selecting suitable sites for the service reservoirs. However, it was considered that the Green Belt should not be used as a primary constraint in site selection for the following reasons:

- In the case of the Madingley connection point, the existing service reservoir is within the Cambridge Green Belt where there is little if any opportunity for avoidance by locating within the Cambridge urban area or in more distant rural areas.
- As the Green Belt designation is a non-statutory planning policy designation, development within it may be acceptable if the proposed works are not inappropriate or very special circumstances exist.

3.4.15 A collaborative workshop was held with the dedicated forum and the Fens Water Partnership to capture potential benefits and opportunities for each of the associated water infrastructure options under consideration. The outcomes of this workshop were considered as part of the Stage C assessments.

3.4.16 The following sections present the outcomes of the assessments for the upstream infrastructure options, focussing on aspects that are key differentiators between options or where there are potential consenting risks.

River Nene and its Counter Drain to Fens Reservoir

Upstream water transfers

3.4.17 The components brought forward from Stage B to Stage C are summarised in Table 3-1. The location of each of the components are shown in Figure 3.4.

Table 3-1: Upstream component options for the River Nene and its Counter Drain to Fens Reservoir

Transfer component	Associated Abstraction Infrastructure Polygons
The River Nene and its Counter Drain to Fens Reservoir	
Open channel transfer CDO-1	Polygon CDA-A, Polygon CDA-D
Open channel transfer CDO-2	Polygon CDA-A, Polygon CDA-D
Hybrid transfer option CDH-1	Polygon CDA-D

[19] Department for Levelling Up, Housing & Communities (2023), National Planning Policy Framework. https://assets.publishing.service.gov.uk/media/65a11af7e8f5ec000f1f8c46/NPPF_December_2023.pdf

3.4.18 Two open channel transfer options and one hybrid transfer option were assessed at Stage C:

- Open channel transfer via Stanground Lock, where water already transfers from the River Nene to the Middle Level system via Stanground Lock (CDO-1)
- Open channel transfer via Morton's Leam, requiring construction of a new open channel approximately 1.53km in length between the River Nene and Middle Level system (CDO-2).
- Hybrid transfer option which is a combination of pipelines and open channel transfer (CDH-1). This option would include abstraction from the Counter Drain (Nene), treatment and a transfer via pipeline to the Middle Level system.

3.4.19 All three of these options have been considered against the Stage C criteria, set out in Appendix A. A summary of how each of them perform against the criteria and each other is set out in the following paragraphs.

3.4.20 The construction works required for the Morton's Leam option (CDO-2) are more extensive than is required for Stanground Lock option (CDO-1), making it less preferred from an engineering perspective.

3.4.21 The Morton's Leam option (CDO-2) and the hybrid transfer option are likely to result in changes to the hydrology of Morton's Leam which forms the SAC component of the Nene Washes European designated site. Morton's Leam and the Nene Washes SAC are not within the footprint of the Stanground Lock option. All three options are within the Nene Washes SPA and Ramsar. Construction of the Morton's Leam option (CDO-2) would also lead to temporary and permanent habitat loss of the Nene Washes. The impact of this on the European designated site would need to be assessed as part of a Habitats Regulations Assessment (HRA) and there is a risk that it would result in an adverse effect on integrity of the site that could only be consented if a derogation could be secured. The Environment Agency and Natural England have provided feedback regarding concerns in relation to likely effects on the European designated site associated with this option.

3.4.22 One hybrid transfer option (a combination of pipelines and open channel transfers), CDH-1, was identified in Stage B for progression to Stage C. The hybrid option would include abstraction of water from the Counter Drain (Nene), initial treatment (if required) and new pipeline to transfer water into the Middle Level system. The pipeline corridor leaves the Counter Drain (Nene) in a south-easterly direction, until it crosses the A605 to the west of Coates and then heads in a southerly direction, crossing a railway line to the north-east of Springwater Business Park, before reaching the King's Dyke east of Whittlesey. The remaining transfer to the Fens Reservoir would then be open channel transfer through the Middle Level system.

3.4.23 The hybrid transfer option CDH-1 would be the most expensive option due to the likely requirement for three trenchless crossings. This option would also involve construction within the Nene Washes European designated site, as well as within the associated Goose and Swan Functionally Linked Land. It may also cause changes to the sediment regime in the tidal River Nene which may impact the ability of the tidal River Nene to discharge the Nene Washes. In addition, the pipeline corridor intersects a residential area within Whittlesey which includes a number of sensitive residential receptors; and archaeological remains of regional importance are likely to be impacted through construction of this option.

3.4.24 The open channel option via Stanground Lock (CDO-1) was therefore the only Counter Drain (Nene) to Fens Reservoir transfer option progressed to Stage D for the following reasons:

- This option would require less construction work than would be required for the hybrid option and open channel via Morton's Leam, making it less expensive than the other options.
- The open channel option via Stanground Lock avoids the heritage constraints associated with the hybrid option; and the additional HRA risks to the SAC associated with open channel via Morton's Leam.

Abstraction infrastructure

3.4.25 Two abstraction infrastructure polygons for the Counter Drain (Nene) were identified in Stage B for progression to Stage C (CDA-A to the east of Anglian Water's Flag Fen Water Recycling Centre to the east of Peterborough, and CDA-D is further east, downstream, close to Dog-in-a-Doublet), these are shown in Figure 3.4. The CDA-D footprint is shared between the two open channel and one hybrid transfer option (CDH-1). CDA-D extends into the Nene Washes SSSI designated site, but for the CDH-1 hybrid transfer option the polygon would be reduced from the southern boundary so that it stops approximately 90m from the Nene Washes SSSI. However, the hybrid transfer was not progressed to Stage D. Only the larger CDA-D is presented below.

3.4.26 Both CDA-A and CDA-D intersect the Nene Washes SSSI. Overall habitat loss within the SSSI is not considered significant due to the small footprint of works within the much larger SSSI (0.2% and 0.8% of the SSSI respectively). Both options would also result in the permanent loss of up to 2.5ha of the Nene Washes Ramsar/SPA designated site. Further design, assessment and engagement with stakeholders is required to understand the ecological impact of land loss on habitats and qualifying features, and if measures can be adopted to avoid, reduce or mitigate any significant effects.

3.4.27 CDA-A is immediately to the south of the Flag Fen Scheduled Monument and therefore carries heritage risks, in particular impacts on the setting of the scheduled monument and the potential risk of any dewatering damaging buried remains. Both of these risks would need to be further assessed and measures taken to avoid, reduce or mitigate

potential impacts. The other polygon (CDA-D) is located where there is an existing pumping station that may be suitable for modification. Three scheduled monuments are between 100m and 300m north of this polygon. Construction in both polygons could result in substantial harm on the value of scheduled monuments. There is potential to reduce the level of harm through design of the infrastructure to avoid the scheduled monuments and by minimising any excavation work close to them. Further engagement with the relevant regulators is required to understand the preferred location for discharge water from the Counter Drain (Nene) into the River Nene as this is a key factor in deciding the preferred location. Both polygons have therefore been taken forward to Stage D.

River Great Ouse at Earith to Fens Reservoir

Upstream water transfers

3.4.28 The components brought forward from Stage B to Stage C are summarised in Table 3-2. The location of each of the components are shown in Figure 3.4.

Table 3-2: Upstream component options for River Great Ouse at Earith to Fens Reservoir-

Transfer component	Associated Abstraction Infrastructure Polygons
River Great Ouse at Earith to Fens Reservoir	
Pipeline Corridor GP-1	Polygon GA-E
Pipeline Corridor GP-4	Polygon GA-E
Pipeline Corridor GP-5	Polygon GA-E
Open channel transfer GO-2	N/A
Open channel transfer GO-4	N/A
Hybrid option GH-3	N/A
Hybrid option GH-5	N/A

3.4.29 Three pipelines (GP-1, GP-4, and GP-5), two open channel transfers (GO-2, GO-4) and two hybrid options (GH-3 and GH-5) were identified in Stage B for progression to Stage C.

3.4.30 Pipeline Corridor GP-1 leaves the River Great Ouse near Earith in a westerly direction, before crossing the A1123 and Wadsby's Folly to the south-west of Bluntisham and then travelling in a north-westerly direction. Once the corridor reaches the B1086, it takes a more westerly direction until it passes Pidley then moves in a north-easterly direction, crossing the A141, and continuing in this direction until it crosses the Forty Foot Drain. Once it crosses the Forty Foot Drain, it takes a more easterly direction, crossing the A141 before reaching the Fens Reservoir.

3.4.31 Pipeline Corridor GP-4 follows the alignment of Pipeline Corridor GP-1 until just after it crosses the B1086 where it takes a northerly direction and crosses the B1089 in between Pidley and Somersham. The corridor then travels in a north-easterly direction to the north-west of Somersham, before taking a more northerly direction and

rejoining the same corridor as Pipeline Corridor GP-1 to the west of Chatteris, just after crossing the A141, until it reaches the Fens Reservoir.

3.4.32 Pipeline Corridor GP-5 matches the alignment of Pipeline Corridor GP-4 until it passes Somersham where Pipeline Corridor GP-4 heads to the north-west and Pipeline Corridor GP-5 takes a north-easterly direction up to Chatteris. The corridor then crosses the A142 to the east of Chatteris, before heading in a more northerly direction until it reaches the Fens Reservoir.

3.4.33 The three pipeline transfers all abstract from the River Great Ouse at the same point near Earith. The abstraction location on the River Great Ouse is within the RSPB Ouse Fen Nature Reserve. This is common across all of the pipeline options from the River Great Ouse.

3.4.34 The upstream pipeline corridors from the River Great Ouse at Earith overlap with downstream corridors from the Fens Reservoir to Madingley, providing an opportunity to use a common corridor for both upstream and downstream pipelines, which in turn potentially minimises the overall environmental impacts and would likely reduce construction costs of the Project, by constructing these sections together in one location.

3.4.35 The main differentiator between the corridors from an engineering perspective is length and number of trenchless crossings. Corridor GP-1 is the longest corridor and Corridor GP-5 the shortest with least number of trenchless crossings required. Corridor GP-5 also has the most overlap with a downstream pipeline corridor to Madingley.

3.4.36 Corridor GP-1 and GP-4 avoid the Goose and Swan Functionally Linked Land Impact Risk Zone. Corridor GP-5 passes through the Functionally Linked Land to the east of Chatteris as it approaches the reservoir site. The Functionally Linked Land envelope close to the Fens Reservoir site is demarcated for winter birds, particularly swans which spend a proportion of their time outside the SPA, feeding on crops. There would be no permanent habitat loss within the Functionally Linked Land associated with the pipeline, however a very small amount would be required if chambers associated with valves and similar equipment are needed. The impacts on the Functionally Linked Land are therefore expected to be temporary and limited to the construction period. Anglian Water and Cambridge Water anticipate that the impacts could be avoided, reduced or mitigated through the timing of the construction of the works and other measures, but further assessment and engagement with the relevant regulator is required.

3.4.37 There are no significant heritage risk differences between the three pipeline options.

3.4.38 All pipeline corridor options have some interaction with County Wildlife Sites and historic and permitted landfill sites. However, the corridor widths identified provides sufficient flexibility to adjust the pipeline alignment to avoid any historic or permitted landfill sites. Neither of these issues are considered significant constraints. The

environmental issues on Corridor GP-4 are similar to Corridor GP-1, except that is has more interaction with the County Wildlife Sites and there are more historic landfills close to the corridor. Other than the potential temporary impact on the Functionally Linked Land, Corridor GP-5 has similar environmental issues to Corridor GP-1.

3.4.39 From considering the performance of each pipeline corridor against the Stage C criteria, Corridor GP-5 is the preferred option pipeline as it is shorter and is therefore lower cost and has less impact on carbon emissions. Anglian Water and Cambridge Water anticipate that the impacts could be avoided, reduced or mitigated where the route passes through the Functionally Linked Land through the timing of the construction of the works and other measures, but further assessment and engagement with the relevant regulator is required.

3.4.40 Open channel options GO-2 and GO-4 would both transfer water from the River Great Ouse into the River Delph via a new lock that would be required as part of the project. Open channel option GO-4 would construct a new lock near Welches Dam to connect the River Delph and the Counter Drain (Ouse). These options combine with the Ouse Washes open channel options to ultimately transfer water to the Fens Reservoir. Water would be abstracted from the River Delph into the Counter Drain (Ouse) using one of the Ouse Washes options. With both open channel options GO-2 and GO-4, water would then enter the Forty Foot Drain through a refurbished Welches Dam Lock with the Forty Foot Drain between this refurbished lock and Horseway Lock being rehabilitated to allow open channel transfer to the reservoir site.

3.4.41 Hybrid option GH-3 would transfer water from the River Great Ouse to the Counter Drain (Ouse) by pipeline. The pipeline leaves the River Great Ouse at Earith in a north-easterly direction, passing Earith until it reaches the Counter Drain (Ouse). The water would then pass from the Counter Drain (Ouse) into the Forty Foot Drain that would have the locks and channel refurbished, as described above for open channel option GO-4. Hybrid option GH-5 would abstract from the Hundred Foot Drain (also known as the New Bedford River) to the east of the Ouse Washes and transfer water via a tunnel under the Ouse Washes to the Forty Foot Drain. As with the other hybrid option, water would be directed to the reservoir via a refurbished Forty Foot Drain.

3.4.42 Open channel options GO-2 and GO-4 and hybrid option GH-3 all utilise the Counter Drain (Ouse) and therefore carry a similar HRA and WFD risk of potentially impacting on the Ouse Washes SAC. The open channel options also both utilise the River Delph and these impacts are similar to the impacts of options which abstract from the Ouse Washes but do not bring the associated benefits. There is a risk of adverse effects along the Great Ouse transitional water body associated with all three options. GO-2 and GO-4 have potential to cause minor, localised effects along the River Delph (including the Hundred Foot Washes), GH-3 carries a risk of adverse impacts along the Counter Drain (Ouse) (Sutton and Mepal Internal Drainage Board including Cranbrook Drain) and has the potential to cause minor localised effects along the Ouse (Roxton to Earith), and GO-4 has a high risk of significant adverse impacts along the Counter Drain

(Ouse) (Sutton and Mepal Internal Drainage Board including Cranbrook Drain). Abstraction from the Ouse Washes is therefore preferred over an open channel transfer from Earith on the basis that the HRA and WFD risks are similar.

3.4.43 The open channel options GO-2 and GO-4 and hybrid option GH-3 from Earith have therefore not been progressed on the basis of:

- impacts on the Ouse Washes SAC; and
- if the HRA and WFD risks associated with the Ouse Washes SPA and Ramsar can be mitigated then a direct abstraction from the Ouse Washes (River Delph) would be preferred due to a higher water yield and potential opportunities to manage the water levels, for conservation purposes, in the designated site.

3.4.44 Hybrid option GH-5 was developed to avoid potential impacts to the Counter Drain (Ouse) and River Delph. Whilst this option would avoid these potential impacts, it would require the construction of abstraction infrastructure within the Ouse Washes SPA and Ramsar, resulting in impacts to the Ouse Washes.

3.4.45 The abstraction point for hybrid option GH-5 on the Hundred Foot Drain (also known as the New Bedford River) was not identified in the sources assessment as a potential source location. The impact of this abstraction on river levels is uncertain, as the river is level controlled but there is no water level information available from this location. Water quality, including turbidity and salinity, is also uncertain at this location as no records are available. Further work would be needed to model and investigate these points. In addition, hybrid option GH-5 would require construction within the Ouse Washes SPA, which the pipeline-only options could avoid. Hybrid option GH-5 is also less preferred from a cost and carbon emissions perspective, due to implications associated with the complex engineering works required of the option. No additional benefits could be realised with this option, such as co-locating pipeline routes, as can be done with some of the pipeline-only options. Pipeline-only options were therefore considered less impactful on the environment compared to the hybrid options, and based on these factors, this option has not been progressed.

3.4.46 **Pipeline Corridor GP-5 was therefore progressed to Stage D as the preferred River Great Ouse to Fens Reservoir transfer option.**

Abstraction infrastructure

3.4.47 A single abstraction infrastructure polygon was identified in Stage B for progression to Stage C, which is Polygon GA-E. The polygon is located immediately south of Bluntisham and the A1123, north of the RSPB Ouse Fen Nature Reserve and has a very low risk of flooding from surface water (less than 0.1% AEP).

3.4.48 The Bluntisham Conservation Area lies to the north of Polygon GA-E and there are potential construction and operational impacts on the value of Bluntisham Conservation Area, Grade II* Bluntisham House and the Grade I listed Parish Church of

St Mary, highlighted by Historic England, through changes to setting. Initial consideration from subject matter experts is that these risks would be mitigable through siting of works within Polygon GA-E, good design and control measures during construction; however, further assessment and engagement would be required to confirm this. A public right of way also runs through Polygon GA-E north to south in the western part of the site and would require diversion.

Ouse Washes (River Delph) to the Fens Reservoir

Upstream water transfers

3.4.49 The components brought forward from Stage B to Stage C are summarised in Table 3-3. The location of each of the components are shown in Figure 3.4.

Table 3-3: Upstream component options for Ouse Washes (River Delph) to the Fens Reservoir

Transfer component	Associated Abstraction Infrastructure Polygons
Ouse Washes (River Delph) to Fens Reservoir	
Pipeline Corridor OWP-2	Polygon OWA-E
Pipeline Corridor OWP-4	Polygon OWA-H
Pipeline Corridor OWP-8	Polygon OWA-P, OWA-Q, OWA-R, OWA-S
Open channel transfer OWO-2	n/a
Open channel transfer OWO-3	n/a
Hybrid transfer OWH-4	Polygon OWA-H
Hybrid transfer OWH-5	Polygon OWA-H
Hybrid transfer OWH-6	Polygon OWA-H

3.4.50 Three pipeline transfer options were identified in Stage B for progression to Stage C (OWP-2, OWP-4, and OWP-8).

3.4.51 OWP-2 leaves the Ouse Washes north of Sutton Gault in a north-westerly direction, turning slightly more north to the west of Block Fen, before crossing the A142 to the east of Chatteris. Once the corridor crosses this A road, it takes a north-easterly direction around Chatteris before crossing the B1093 and travelling north until it reaches Fens Reservoir.

3.4.52 OWP-4 leaves the Ouse Washes near Welches Dam in a north-westerly direction, crossing the Sixteen Foot Bank to the north-east of Chatteris, before reaching Fens Reservoir.

3.4.53 OWP-8 leaves the Ouse Washes north-east of Manea in a north-westerly direction, crossing the B1093 north of Manea before travelling in a northerly direction until it reaches The Chase. The corridor then takes a north-westerly direction until it reaches the Sixteen Foot Drain.

3.4.54 None of the three pipeline corridors (OWP-2, OWP-4, and OWP-8) were recommended for progression to Stage D because of concerns related to potential impacts on the

historic environment. Historic England raised concerns regarding two of the corridors which have a high risk of discovering remains associated with scheduled monuments on Honey Hill, which could be of equivalent value. The third pipeline transfer corridor is located further from designated heritage assets, but a large number of archaeological features and a number of prehistoric find spots are recorded within this corridor. Furthermore, peat deposits are mapped within this corridor which have a high potential to preserve palaeoenvironmental and archaeological remains. In order to avoid the potential heritage impacts associated with the pipeline corridors, reduce the risk of substantial harm, and having regard to the potential benefits associated with the open channel transfers in this context, none of the pipeline options were progressed to Stage D.

3.4.55 Two open channel transfer options (OWO-2, and OWO-3) were identified in Stage B for progression to Stage C. Both options involve discharging water from the River Delph into the Counter Drain (Ouse). Discharging water into the Counter Drain (Ouse) has a risk of permanent deterioration of WFD status for the Counter Drain (Ouse) and may also impact one of the qualifying features of the Ouse Washes SAC (spined loach).

3.4.56 Three hybrid transfers were considered at Stage C (OWH-4, OWH-5 and OWH-6). All three options would involve transferring water from the Ouse Washes to the Middle Level system via the Forty Foot Drain. OWH-4 and OWH-5 would both require significant construction works to place a shaft within the Middle Barrier Bank. Space for construction within this area is constrained, and there is a risk that sinking a shaft may affect the structure of the bank.

3.4.57 OWH-6 provides a modified version of OWH-4 and OWH-5 which would not require construction works within the Middle Barrier Bank. This option would abstract water from the Ouse Washes in the vicinity of Welches Dam and transfer it across the Counter Drain (Ouse) to a pumping station and treatment site, if initial treatment is indeed required. The water would then be discharged into the Forty Foot Drain near Welches Dam Lock. The section of the Forty Foot Drain between Welches Dam Lock and Horseway Lock would be upgraded to allow open channel transfer to the reservoir site.

3.4.58 **The hybrid option OWH-6 was the only Ouse Washes to Fens Reservoir transfer option progressed to Stage D for the following reasons**:

- Realise the potential benefits associated with rewetting the Forty Foot Drain, including the creation of new areas of water habitat, opportunities for Biodiversity Net Gain (BNG), and to reactively take water from the Ouse Washes system in the spring as noted by the RSPB. Rewetting the Forty Foot Drain also provides an opportunity to renovate and enhance Horseway Lock and reinstate historic navigation through the Forty Foot Drain and Welches Lock.
- Avoid the potential heritage impacts associated with the pipeline corridors.

- Avoid construction works within the Middle Barrier Bank and the associated risks to the structure of the bank.
- Avoid the potential risks to the Counter Drain (Ouse) and resulting additional HRA/WFD consenting risks associated with the open channel options by transferring water from the Ouse Washes to the Middle Level system via the Forty Foot Drain rather than the Counter Drain (Ouse), thereby avoiding the risk of permanent deterioration of WFD status for the Counter Drain (Ouse) and potential impacts to one of the qualifying features of the Ouse Washes SAC.

Abstraction infrastructure

3.4.59 Six abstraction infrastructure polygons (OWA-E, -H, -P, -Q, -R and -S) were identified in Stage B for progression to Stage C and are shown in Figure 3.4.

3.4.60 Five of these polygons were associated with the pipeline transfer corridors. Given none of these pipeline options were progressed to Stage D, the five corresponding polygons were also not progressed to Stage D. The remaining polygon (OWA-H) may be used by either the pipeline options or the hybrid transfer options.

3.4.61 The preferred abstraction point for the Ouse Washes is within the area of the existing Welches Dam Pumping Station, to the west of Pymoor and north-west of Ely. Alternative options for the intake and crossing of the Counter Drain (Ouse) were assessed, however further engagement with key stakeholders, including Environment Agency, Natural England and RSPB, is required to identify the preferred configuration.

3.4.62 The space in the vicinity of Welches Dam Pumping Station is constrained and there would be insufficient space to co-locate any required water treatment with the intake. **The remaining polygon (OWA-H) was therefore progressed to Stage D to site an INNS treatment plant and/or water quality treatment plant, if required.**

3.5 Element identification

3.5.1 Figure 3.5 shows the component options identified and considered at Stages B and C for the upstream infrastructure during the option appraisal process.

3.5.2 The component options remaining at the end of the Stage C option appraisal process were then combined into element options, joining the preferred transfer component option(s) with the preferred abstraction infrastructure component option(s) progressed to Stage D. The element options for the upstream infrastructure components progressed to Stage D are shown in Table 3-4.

Figure 3.5: Summary of the Fens upstream infrastructure option appraisal process-

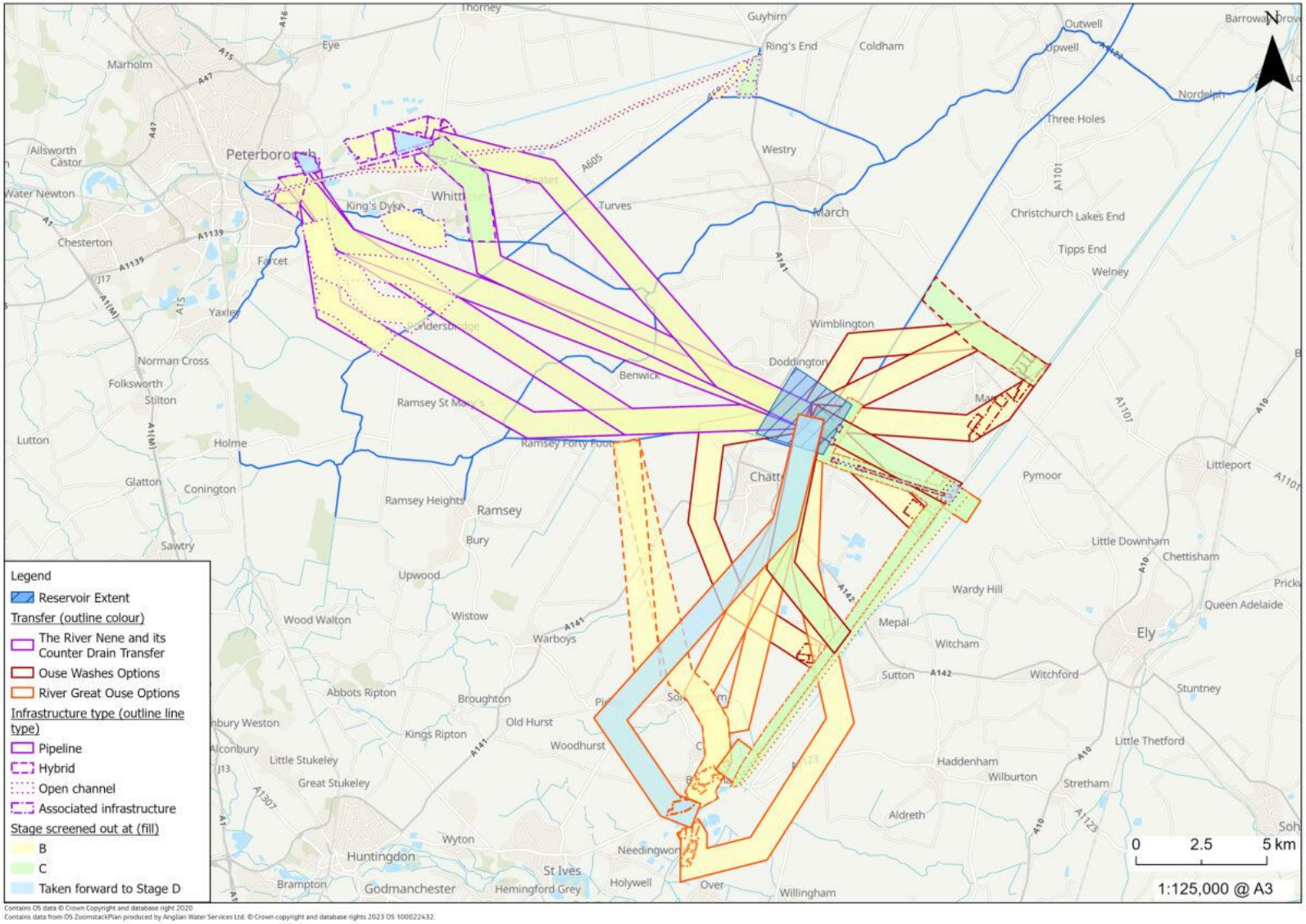


Table 3-4: Upstream elements progressed to Stage D

Element name	Transfer component	Abstraction infrastructure component
River Great Ouse at Earith to Fens Reservoir	Pipeline Corridor GP-5	Polygon GA-E at Earith
Ouse Washes (River Delph) to Fens Reservoir	Hybrid option from Welches Dam (OWH-6)	Abstraction at Welches Dam and treatment (if required) at Polygon OWA-H
River Nene and its Counter Drain to Middle Level system	Open Channel transfer via Stanground Lock (CDO-1)	Either Polygon CDA-A near Flag Fen and Polygon CDA-D near Dog-in-a-Doublet

4 Downstream infrastructure

4.1 Introduction

4.1.1 This chapter outlines the approach and results of the first three stages of the option appraisal process (Stage A initial screening, Stage B coarse screening and Stage C fine screening) for the downstream infrastructure. This included identifying the broad search areas (Stage A), defining feasible downstream components (Stage B) and determining the preferred components (Stage C) for progression to Stage D for identifying the best performing whole scheme option.

4.1.2 Downstream infrastructure is required to treat and transfer water from the Fens Reservoir to the existing supply network. The start of each transfer is the reservoir and the end of the transfers is within the vicinity of the identified connection point to the existing supply network.

4.1.3 Downstream infrastructure elements were identified to supply water to each of the connection points:

- Fens Reservoir to Bexwell to the east of Downham Market (Anglian Water)
- Fens Reservoir to Madingley near Cambridge via Bluntisham east of St Ives (Cambridge Water)

4.1.4 There are no existing facilities for transferring water between the Fens Reservoir location and the connection points and therefore new transfer infrastructure is required.

4.1.5 The components of the downstream transfer elements include the following:

- **Water treatment works**, required to treat the water to drinking water standards so that it is safe to drink.
- **Downstream transfer**, pipelines which would convey water from the water treatment works to the service reservoirs. Open channels are not suitable for downstream transfers of treated water because of the need to avoid contamination of the water which is treated to drinking water standard.
- **Service reservoirs** to store treated water at the connection points. Service reservoirs provide storage to manage daily fluctuations in water demand. They also allow supply to be maintained to the network in the event of an upstream interruption to the water treatment works or pipeline transfer. Locating the service reservoir close to the network it supplies is preferred as this reduces the likelihood of supply failure due to issues upstream of the service reservoir.

4.2 Stage A – Initial screening

4.2.1 Initial screening was completed to identify broad search areas in which the water treatment works, downstream transfers and service reservoirs for each of the confirmed connection points could be feasibly sited. These broad search areas are shown on Figure 4.1.

Downstream transfer

4.2.2 The search areas for downstream pipelines have been defined in the same way as has been described for upstream pipelines (Section 3.2).

Water treatment works

4.2.3 The search area for the downstream potable water treatment works was defined by the common search area between the three pipeline search areas. Figure 4.1 the water treatment works search area as a grey area where the three pipeline search areas overlap.

Service reservoirs

4.2.4 New service reservoirs are required at the three connection points (Bexwell, Bluntisham and Madingley), which are close to existing service reservoirs. The new and existing service reservoirs need to be close as they will be required to work together hydraulically so that the water levels move up and down in conjunction with each other, thereby maintaining current pressure and flow direction in the existing network[20]. To achieve this, the new and existing service reservoirs would need to be at a similar elevation and to connect to the existing network in a similar location.

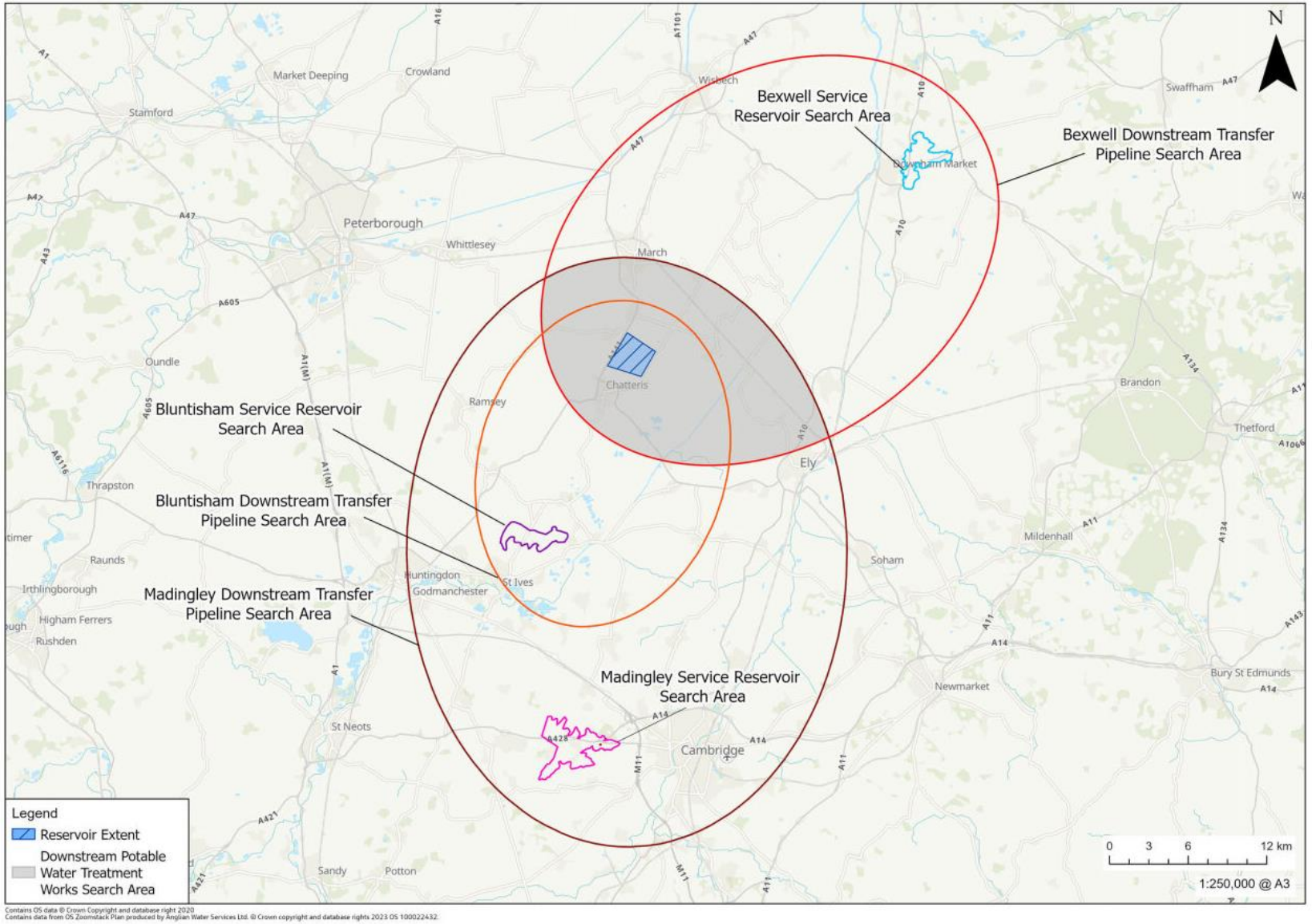
4.2.5 The search area for the new service reservoirs has therefore been focused within the location of the existing service reservoirs. Topographical contour lines were used to determine the ground level at the existing service reservoirs. Ideally the proposed and existing reservoirs would have the same top water level; however, a limit on the difference in ground elevation of 8m was selected in order to develop a search area that was large enough to contain multiple feasible sites once further constraints have been excluded. The search area selected would achieve a similar elevation at existing and new service reservoirs.

4.2.6 The engineering, environmental, planning, and social and community constraints mapping were applied to the broad search areas identified in Stage A (see Appendix A for details of the criteria applied) for the water treatment works and service reservoirs to identify exclusion areas. This refers to areas within the broad search areas where existing constraints (e.g. built-up areas) would prevent the placement of above-ground infrastructure within that area.

[20] Changes in pressure and flow direction in the network can cause increased leakage and water quality issues.

4.2.7 The engineering, environmental, planning, and social and community constraints mapping was not applied at Stage A to the pipeline search areas as they are below-ground assets and constraints can be avoided, or impacts mitigated by routing the pipeline around constraints or using trenchless construction techniques (such as trenchless crossings).

Figure 4.1: Search areas for downstream pipelines, water treatment works and service reservoirs



4.3 Stage B – Coarse screening

4.3.1 The purpose of Stage B was to identify component options within the search areas identified in Stage A and to assess the component options against the Stage B options appraisal criteria.

4.3.2 Component options were screened against the environmental, planning, engineering, land use, social and community criteria set out in Appendix A identified as being considered at Stage B. These criteria were selected to allow key constraints to be identified for each option identified in the search areas to understand the likely feasibility of each option and potential consenting risks. This was used to inform decision making on which those options to take forward for Stage C fine screening for more detailed assessment against the Stage C criteria. The component options with the least constraints, which as a result are likely to carry the lowest risk to project delivery, were carried forward to Stage C for fine screening and a more detailed assessment against criteria.

4.3.3 Within the broad search areas, potential routings for the downstream pipelines and locations for the water treatment works and service reservoirs were identified.

4.3.4 The downstream options considered at Stage B are presented at Figure 4.2, while the water treatment works considered at Stage B are presented at Figure 4.3.

Figure 4.2: Overview of all downstream options considered at Stage B

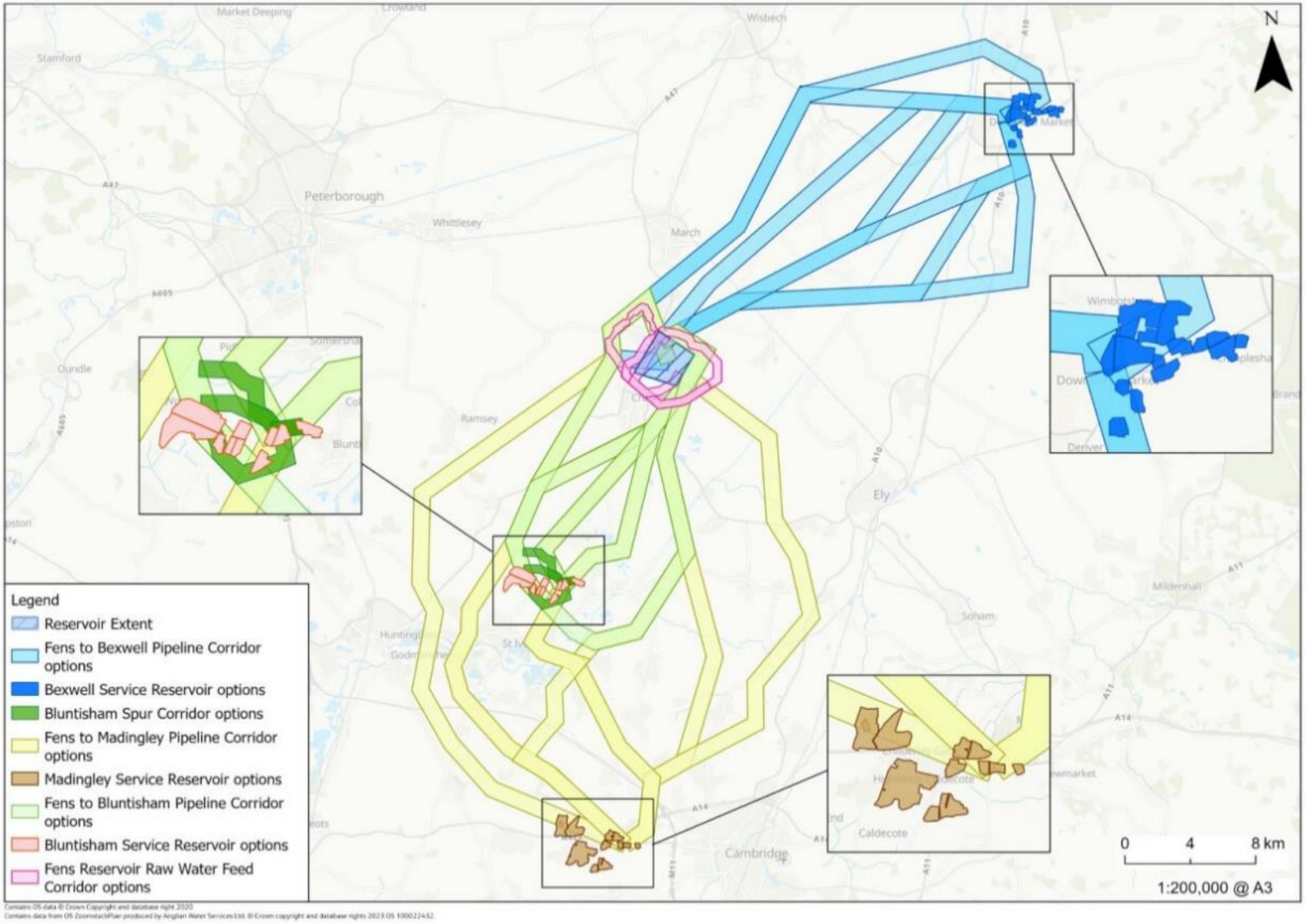
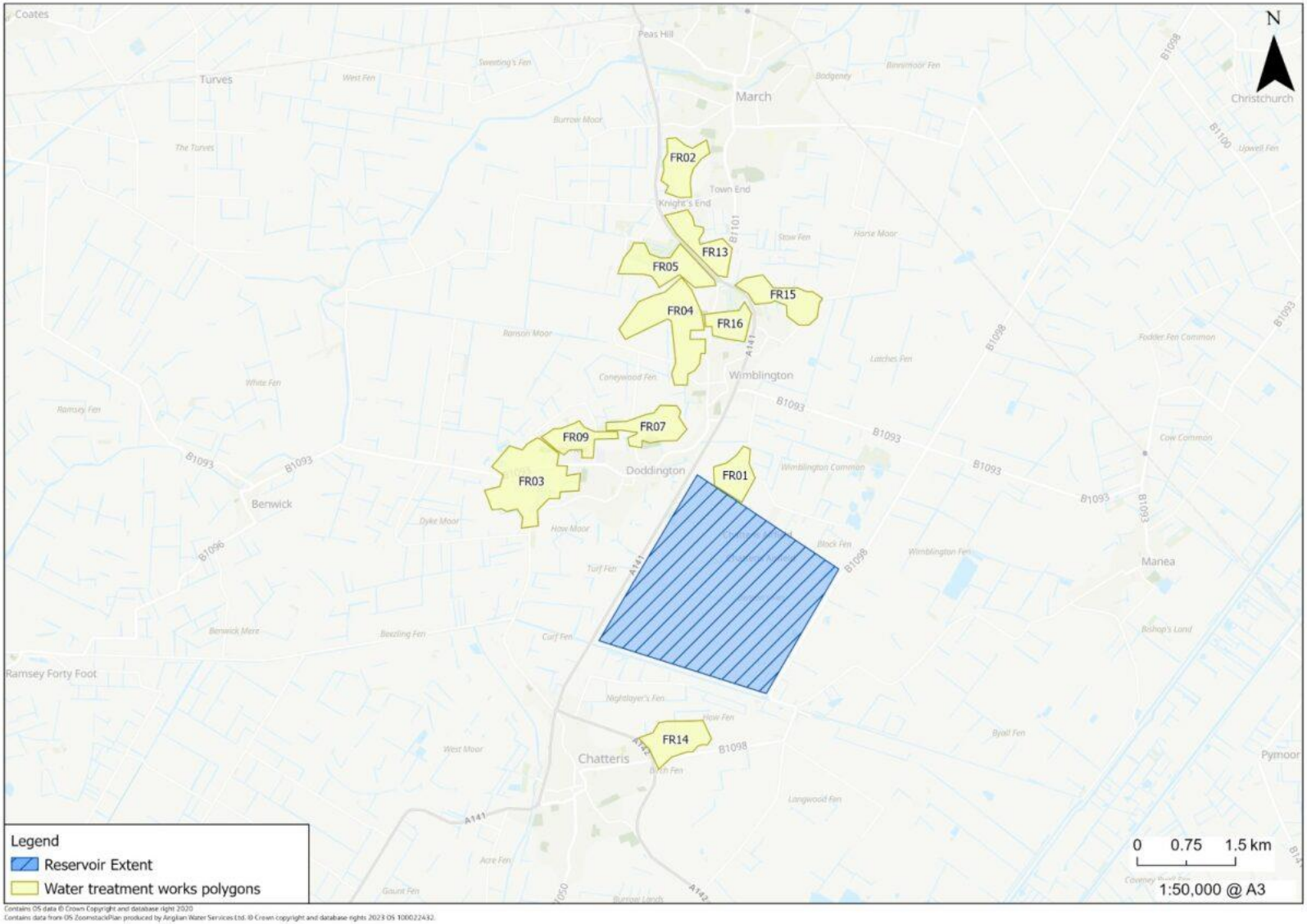


Figure 4.3: Overview of water treatment works options considered at Stage B



Downstream pipelines

4.3.5 Pipeline corridors have been defined between the reservoir (as the water treatment works location was unknown at this stage) to each identified service reservoir polygon in the same way as has been described for upstream pipelines.

4.3.6 Seventeen potential corridors were identified:

- Fens Reservoir to Bexwell: Seven pipeline corridors.
- Fens Reservoir to Madingley via Bluntisham: Ten pipeline corridors.

Water treatment works

4.3.7 Water treatment works polygons were required to have a minimum land area of 18.4ha to allow space for both the treatment works and the temporary space needed during construction.

4.3.8 Flood mapping was used to identify suitable areas located outside the Flood Zones 2 and 3 in accordance with the Sequential Test[21], and so this flood mapping was used as an additional constraint during the development of polygons.

4.3.9 Eleven potential locations for the water treatment works were identified.

Service reservoirs

4.3.10 The area of land required for each service reservoir was assessed based on being able to accommodate both the footprint size of the service reservoir, and the temporary space (based on an early preliminary assessment) needed during construction. This assessment then informed the minimum land area for the polygons identified at Stage B, which were:

- Bexwell – 8ha
- Madingley – 5.3ha
- Bluntisham – 5.3ha

4.3.11 Twenty-four potential locations for service reservoirs were identified, comprising three for Bexwell, eleven for Madingley and ten for Bluntisham.

Stage B screening

4.3.12 Stage B screening was undertaken for the downstream infrastructure as described for the upstream infrastructure in paragraphs 3.3.16 to 3.3.21.

[21] https://www.gov.uk/guidance/flood-risk-and-coastal-change#the-sequential-approach-to-the-location-of-development

4.3.13 Following the identification of least constrained components, a review was undertaken to identify any geographic 'gaps' between components that would be required to be combined into elements, e.g. water treatment works and downstream pipeline corridors. Where gaps were identified, additional components were identified and assessed to link the components together. These included the following:

- In order to transfer water from Fens Reservoir to the new Bluntisham service reservoir, pipeline corridors were created. However, at Stage B an alternative that could improve efficiency and minimise impacts was identified. By introducing a spur from the pipeline between Fens Reservoir and Madingley service reservoir, leading to the new Bluntisham service reservoir, the development of a whole new pipeline corridor for just the reservoir to Bluntisham transfer could be avoided.
- As design of all the different transfers evolved, having numerous pipelines coming in and out of the Fens Reservoir would be impractical, unfeasible and cause avoidable cost, carbon emissions and environmental implications. A need emerged for consolidation of both upstream and downstream corridors to reduce the overall impacts. To address this, four corridors were identified around the Fens Reservoir that could be used for routing both upstream and downstream transfer pipelines, these corridors were referred to as feed corridors. The four feed corridor options were considered against the Stage B criteria set out in Appendix A. The two least constrained feed corridor options were progressed to Stage C.

4.3.14 The Stage B options were considered against the Stage B criteria set out in Appendix A to identify potential constraints that may affect the feasibility of the component or introduce consenting risk compared to the alternative options available. Preference was given to options with less constrained land on the basis that those options were likely to carry the overall lowest risk to consenting and project delivery. Further detail on this part of the process can be found in paragraph 3.3.16 to 3.3.21 These options were taken forward to Stage C fine screening for more detailed assessment against the Stage C criteria:

- Two pipeline corridors from Fens Reservoir to Bexwell.
- Three pipeline corridors from Fens Reservoir to Madingley, with a spur corridor to Bluntisham. A further two pipeline corridors were identified from Fens Reservoir to Bluntisham.
- Two water treatment works polygons, including two potential feed corridors linking the Fens Reservoir to the two potential water treatment works polygons.
- Two service reservoir polygons at Bexwell, five at Madingley and three at Bluntisham.

4.4 Stage C – Fine screening

4.4.1 Fine screening incorporated four steps to support and inform decision-making on the options (from Stage B) for progression to Stage D – preferred whole scheme option appraisal for the associated water infrastructure elements. These were the following:

- Refinement of components taking into account the Stage B appraisals.
- The Stage C technical appraisals (the appraisal criteria can be found in Appendix A) to assess options against more detailed criteria and stakeholder engagement on individual components.
- Combination of the best performing components into elements and technical appraisal of the combinations to ensure that when considered as part of an element, the best performing components remained the best performing components.
- Where more than one element option was created from the best performing component options, these were compared against each other to identify the best performing element options for progression to Stage D. In some cases it was not possible to distinguish between component options, in which case element options with alternatives for the same component were progressed for engagement with stakeholders and subsequently into Stage D for consideration as part of the whole scheme option.

4.4.2 The downstream options considered at Stage C are presented at Figure 4.4, while the options for the water treatment works are presented at Figure 4.5.

Figure 4.4: Overview of all downstream options considered at Stage C

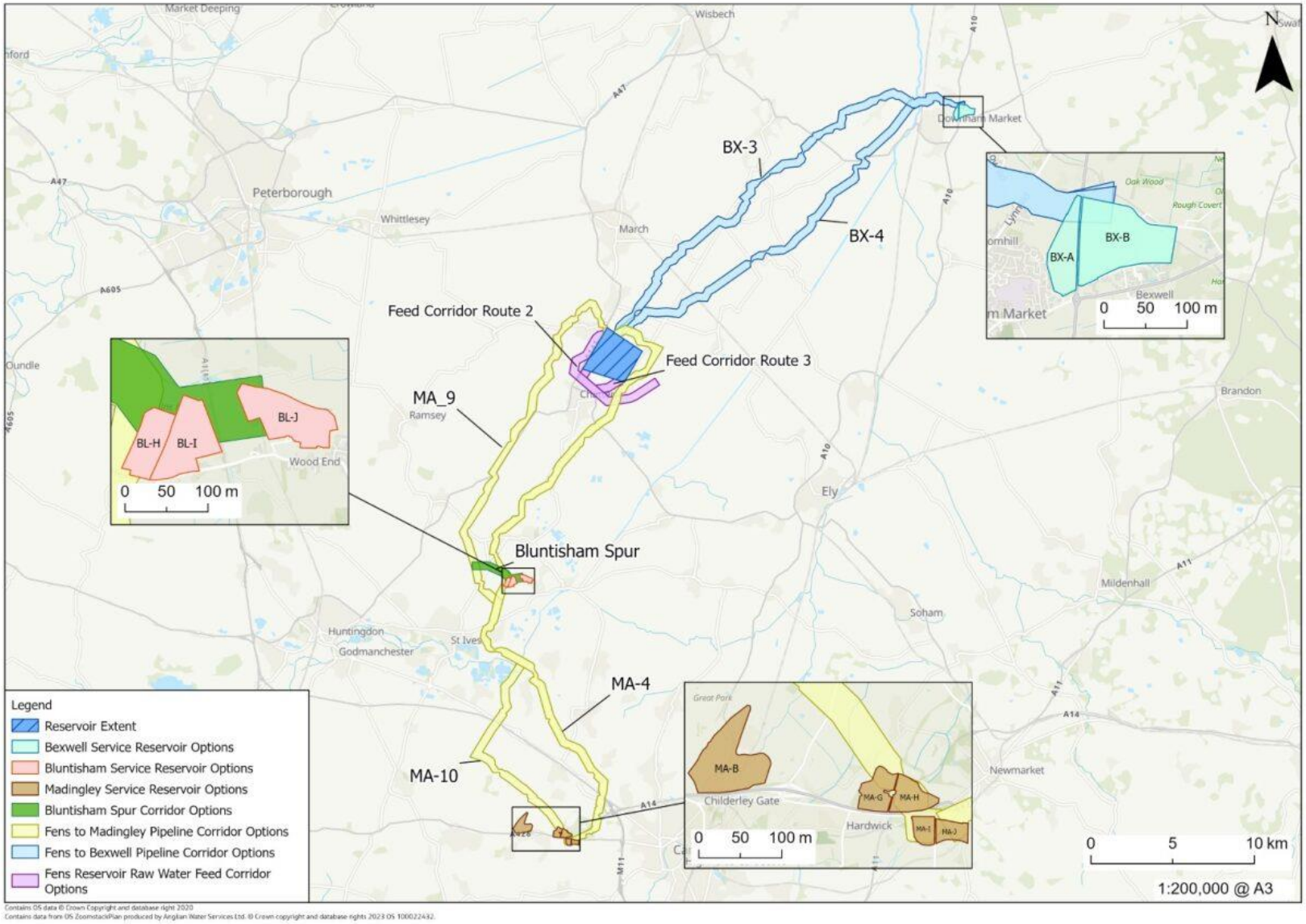
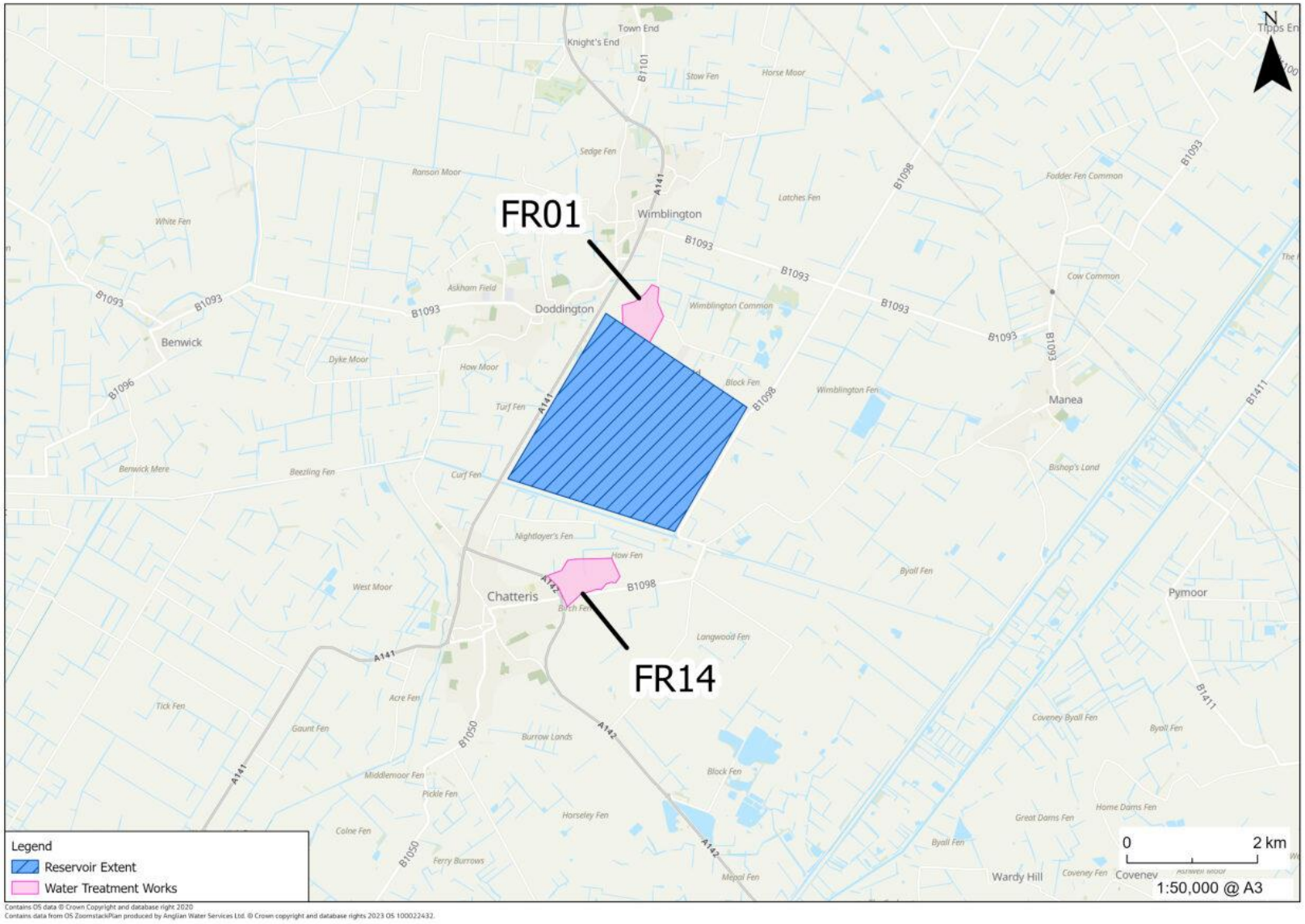


Figure 4.5: Stage C water treatment works options



Design refinement

4.4.3 Design refinement primarily involved amendment of pipeline corridors and above-ground infrastructure polygons to minimise encroachment on key constraints and maximise distance from sensitive receptors. Design refinement was based on the outcomes of the consideration of the criteria considered at Stage A and Stage B (as set out in Appendix A) which identified constraints, so that opportunities to refine the design could be identified to avoid these constraints, where reasonably practicable at this early stage in the process.

4.4.4 The polygons identified at Stage B for water treatment works and service reservoirs were not reduced in size to more closely match the expected land requirements, keeping the full polygons at this stage gives greater flexibility for siting of the infrastructure within the polygon to avoid, reduce or mitigate any potential impacts. The preferred siting of the infrastructure within the polygons will identified at a later stage of the Project.

4.4.5 Service reservoir and water treatment works polygons were generally carried forward to Stage C without refinement. Minor alteration was made to the water treatment works Polygon FR01 directly north of the reservoir. The polygon boundary was extended south to align with the northern extent of the reservoir (i.e. the embankment toe) to form a contiguous site with the reservoir. This resulted in an approximately 18% expansion of the polygon area (which was backchecked to ensure that the Stage B conclusions remained valid).

4.4.6 At this stage, pipeline corridor options were reduced from 1km to 500m. A corridor width of 500m is still many times wider than the actual corridor width that would be required for construction; however, it allows for flexibility for the detailed routing of the pipeline at a later stage within the wider area of land being considered in the corridor. At some places, the width of the corridor was narrowed to less than 500m or its alignment was altered at specific points along the route in order to avoid or minimise potential impacts on particular environmental sensitivities and engineering constraints.

4.4.7 The best performing Fens Reservoir to Bluntisham and Fens Reservoir to Madingley pipeline corridors at Stage B followed a similar route for the distance between the Fens Reservoir and Bluntisham. At Stage C a combined corridor to Bluntisham was therefore adopted. The Fens Reservoir to Madingley pipeline components were assessed at Stage C but no separate assessment was carried out for Fens Reservoir to Bluntisham pipeline components, as they use the same pipeline corridor. From Stage C onwards, the element was renamed as Fens Reservoir to Madingley, via Bluntisham.

Technical appraisals

4.4.8 Technical appraisals followed the same approach taken for upstream infrastructure, described in paragraphs 3.4.11 to 3.4.13.

4.4.9 The following sections present the outcomes of the assessments for the downstream infrastructure options, focussing on aspects that are key differentiators between options or where there are potential consenting risks.

Fens Reservoir to Bexwell

Transfers

4.4.10 Component options assessed at Stage B and C are shown in Figure 4.4.

4.4.11 The components brought forward from Stage B to Stage C are summarised in Table 4-1.

Table 4-1: Downstream component options for Fens Reservoir to Bexwell transfers progressed to Stage C

Transfer component	Associated Water Treatment Works Polygons	Associated Service Reservoir Polygons
Pipeline Corridor BX-3	Polygon FR01, Polygon FR14	Polygon BX-A, Polygon BX-B
Pipeline Corridor BX-4		

4.4.12 Two potential pipeline corridors were identified in Stage B for progression to Stage C, Corridors BX-3 and BX-4.

4.4.13 Corridor BX-3 leaves the reservoir in a north-easterly direction, crossing the Sixteen Foot Bank to the north of Christchurch Village, and the A1101 to the south of Threeholes. The corridor then continues in a north-westerly direction passing the A1122. Once the corridor passes the north of Barroway Drove Village, it takes an easterly direction between Downham Market and Wimbotsham and crosses the A10 before reaching the service reservoir location to the north of Bexwell.

4.4.14 Corridor BX-4 also leaves the reservoir in a north-easterly direction but takes a sharp turn east when parallel to Wimblington, and crosses the Sixteen Foot Bank before turning north-east and crossing the A1101 to the south of Christchurch Village. It continues in parallel with Corridor BX-3, crossing the A1122 as it passes the east of Nordelph, until it reaches Corridor BX-3 at the point it takes an easterly turn. From here, it shares the same path as Corridor BX-3 to the service reservoir at Bexwell.

4.4.15 Both corridors follow a broadly similar alignment, with Corridor BX-3 being the more westerly option and Corridor BX-4 further the east and closer to the Ouse Washes. There is little difference in the topography of the two routes and therefore hydraulic considerations are similar. Corridor BX-3 has slightly better ground conditions, whereas Corridor BX-4 has two fewer trenchless crossings compared to Corridor BX-3. Corridor BX-4 has a lower cost and carbon emissions than Corridor BX-3.

4.4.16 Both routes pass through the Goose and Swan Functionally Linked Land, although. Corridor BX-4 has a greater length within the Functionally Linked Land. A Stage 2 Appropriate Assessment for both routes is likely to be required. Anglian Water and Cambridge Water anticipate that the impacts could be avoided, reduced or mitigated through the timing of the construction of the works and other measures, but further assessment and engagement with the relevant regulator is required.

4.4.17 Both routes also cross mineral safeguarding areas and partially overlap with an area north of Downham Market that is allocated for local housing.

4.4.18 Corridor BX-3 passes approximately 2m north of a bowl barrow and Romano-British enclosure scheduled monument. There is a potential for remains associated with these to be found within the corridor and as such, Corridor BX-3 may result in substantial harm on the value of this asset. Corridor BX-3 therefore presents a higher risk from a historic environment perspective than Corridor BX-4.

4.4.19 Minor environment issues have been identified on both routes and each route has aspects where it performs better than the other.

4.4.20 When considered against the Stage C criteria, Corridor BX-4 is preferred as no scheduled monuments were identified within or in close proximity to it. The risk of substantial harm on a heritage asset is therefore considered lower. Corridor BX-4 also has lower costs and carbon emissions associated with it.

Service reservoir

4.4.21 Two polygons for the Bexwell service reservoir have been assessed at Fine Screening: Polygon BX-A and Polygon BX-B which are either side of the A10 at Bexwell. At this stage, no major potential environmental constraints have been identified for either polygon.

4.4.22 The existing service reservoir closer to Polygon BX-A. Locating the new service reservoir close to the existing one is preferable from an operational perspective, as the new and existing service reservoirs will be required to work together hydraulically and would need to connect to the existing network in a similar location. Anglian Water has recently constructed a pipeline to the existing Bexwell service reservoir that travels through Polygon BX-A as part of a separate infrastructure project. However, as a large portion of Polygon BX-A has been bought by a third party and is being developed for housing, Polygon BX-A is unfeasible as there is not enough space remaining in the polygon to site a new service reservoir.

4.4.23 An existing planning consent, in the southern part of Polygon BX-B to the north of the Bexwell Business Park, is in place and is acknowledged in the emerging local plan. However, there is adequate space in the remainder of Polygon BX-B to accommodate the construction and operation of the new service reservoir. Constructing the new service reservoir in Polygon BX-B would require additional crossings of the A10. Whilst

this is likely to result in higher cost and impacts associated with carbon emissions, Polygon BX-B is located further away from residential and commercial areas than Polygon BX-A and the existing adjacent development is directly adjacent to Bexwell Business Park which is predominantly industrial/commercial, meaning it is less likely to affect local residents during construction.

4.4.24 **Polygon BX-B was the overall preferred option** although it is further from the existing service reservoir and requires crossing of the A10 it was progressed to Stage D.

Fens Reservoir to Madingley, via Bluntisham

4.4.25 Component options assessed at Stage B and C are shown in Figure 4.4.

4.4.26 The components brought forward from Stage B to Stage C are summarised in Table 4-2.

Table 4-2: Downstream component options for Fens Reservoir to Madingley transfers progressed to Stage C

Transfer component	Associated Water Treatment Works Polygons	Associated Service Reservoir Polygons
Pipeline Corridor MA-4	Polygon FR01, Polygon FR14	Polygon MA-B, MA-G, MA-H, MA-I, MA-J
Pipeline Corridor MA-9		
Pipeline Corridor MA-10		
Bluntisham Spur		Polygon BL-H, Polygon BL-I, Polygon BL-J

Transfers

4.4.27 Three potential pipeline corridors were identified in Stage B for progression to Stage C: Corridors MA-4, MA-9 and MA-10.

4.4.28 Corridor MA-4 leaves via the north of the reservoir and loops around following the northern and eastern side of the reservoir. It then heads in a south-westerly direction crossing the A142 as it passes to the east and south of Chatteris, until it reaches a point in between the east of Pidley and the west of Somersham. From here, Corridor MA-4 travels in a southerly direction, passing to the east of St Ives Golf Club, crossing the A1123 to the north of Needingworth and follows the west of Needingworth until it reaches the north of Hollywell village. The corridor then takes a south-easterly direction crossing the River Great Ouse, before passing east of Swavesey and south of Over, and then north of Bar Hill and south of Longstanton and Oakington. It then turns in a southerly direction, crossing the A14 and the A428 and passing the east of Madingley. The corridor ends at the service reservoir location to the south of Madingley.

4.4.29 Corridor MA-9 leaves the reservoir in a northerly direction, crossing the A141 and passing Doddington before taking a turn in a south-westerly direction. It crosses the Forty Foot Bank and continues running adjacent and parallel to the A141 until near Warboys where the route diverts towards the west of Pidley. From here, the corridor continues in a south-easterly direction until it passes the north of St Ives Golf Club where it then follows the same alignment as Corridor MA-4 to the service reservoir location to the south of Madingley.

4.4.30 From the reservoir, Corridor MA-10 follows the same alignment as Corridor MA-4 until the corridor reaches the west of Over. Corridor MA-10 then takes a south-westerly direction passing between Fen Drayton and Swavesey and crossing the A1307 and A14. When the corridor reaches the point in between Elsworth and Boxworth, it turns south-easterly towards the Madingley service reservoir location.

4.4.31 Corridor MA-10 was the preferred option from a cost and carbon emissions perspective for the following reasons:

- Corridor MA-4 and Corridor MA-9 require more trenchless crossings (of roads and water bodies) than Corridor MA-10.
- Corridor MA-4 passes through more unfavourable ground (largely Flood Zone 2 and peaty soils) than the other two options.
- Corridor MA-10 has the potential to share a combined corridor with the majority of the upstream transfer route (River Great Ouse) Pipeline Corridor GP-5 meaning there would be less overall disruption during construction as one construction area would be needed in the area for this part of the route that is shared between upstream and downstream transfers. This benefit can only be achieved if as part of the upstream transfer options appraisal process the River Great Ouse source and upstream Pipeline Corridor GP-5 option are taken forward to Stage D.

4.4.32 Corridor MA-4 and Corridor MA-10 share the same alignment between the Fens Reservoir and Bluntisham which crosses the Goose and Swan Functionally Linked Land associated with the Ouse Washes designated site. There would be no permanent habitat loss within the Functionally Linked Land associated with pipelines, other than the potential for a very small amount for any chambers associated with valves and similar equipment. Apart from the possible small areas of habitat loss, the impacts on the Functionally Linked Land are expected to be temporary and limited to the construction period. These impacts are limited in scale and design refinement will seek to avoid or reduce the impacts. Where this is not possible mitigation such as controlling the timing of the construction of the works would be applied.

4.4.33 The pipeline corridor options have different risks of encountering heritage assets. Based on stakeholder feedback from Historic England, Corridor MA-4 presents the highest risk from a historic environment perspective. The risks associated with Corridor

MA-10, from a historic environment perspective, were considered to be similar to those of Corridor MA-4.

4.4.34 Corridor MA-4 did not perform as well as Corridor MA-9 and Corridor MA-10 overall when assessed against the Stage C engineering and environmental options appraisal criteria.

4.4.35 Corridor MA-9 and Corridor MA-10 both have the potential for various impacts of differing significance. Although Corridor MA-10 crosses the Goose and Swan Functionally Linked Land and there may be the need for some small permanent elements, there are significant engineering benefits associated with Corridor MA-10. Overall, **Corridor MA-10 was considered the preferred option and was progressed to Stage D**. Corridor MA-9 was not progressed to Stage D.

4.4.36 One option for the spur from the Fens Reservoir to Madingley pipeline to the west to connect into Bluntisham, was identified in Stage B for progression to Stage C, which is referred to as the Bluntisham Spur.

4.4.37 Assessment against the selection criteria demonstrated that there are no major engineering constraints associated with the Bluntisham Spur.

4.4.38 From an environmental perspective, the main impact of the Bluntisham Spur route is likely to be the impact on the Heath Fruit Farm County Wildlife Site (CWS) which is also an Orchard Priority Habitat. Further assessment and engagement on this part of the Bluntisham Spur route is required to identify whether there are opportunities to avoid or reduce the impact on the CWS and Orchard Priority Habitat.

4.4.39 **The Bluntisham Spur was progressed to Stage D**.

Bluntisham Service reservoir

4.4.40 Three polygons for the Bluntisham service reservoir were identified in Stage B for progression to Stage C, Polygons BL-H, BL-I and BL-J (see Figure 4.4). Following the Stage C options assessment process, no major engineering or environmental concerns have been identified at this stage, for any of these polygons.

4.4.41 The new service reservoir will need to supply water into the existing service reservoir and/or the existing water towers, to the north-east of Bluntisham. A booster pumping station associated with the new service reservoir may be required, to facilitate this connection. Space to site a potential booster pumping station was accounted for within the new service reservoir polygons.

4.4.42 Polygon BL-H is furthest from the existing service reservoir whereas Polygon BL-J is the closest. The construction requirements will be similar for all three polygons and therefore cost and carbon emissions are assumed not to be a differentiator.

4.4.43 There is a County Wildlife Site located to the north-west of Bluntisham, north of 'The Heath' road. Polygons BL-H and BL-I are located to the west of the County Wildlife Site

and the existing service reservoir is located to the east of it. In order to connect to the existing water tower and existing service reservoir the County Wildlife Site will have to be crossed by pipeline, either after the new service reservoir (for Polygon BL-H or BL-I) or before it (for Polygon BL-J). As the County Wildlife Site will be crossed for all options it has not been considered a differentiator.

4.4.44 Polygon BL-J is closest to residential properties and therefore has a higher risk of potential air quality and noise impacts during construction. There are four Listed Buildings to the north of Wood End which is closer to Polygon BL-J; however, there is sufficient space within the polygon to avoid or reduce changes to the setting of the heritage assets through the subsequent stages of design.

4.4.45 **Polygon BL-J is the preferred option for the Bluntisham service reservoir** as it is the closest to the existing service reservoir and potential impacts on local residents or heritage assets could likely be avoided, reduced or mitigated.

Madingley Service reservoir

4.4.46 Five polygons have been assessed at Stage C: Polygons MA-B, MA-G, MA-H, MA-I and MA-J.

4.4.47 All the polygons, except Polygon MA-B, are within the Cambridge Green Belt, as is the existing Cambridge Water service reservoir that is part of the network at Madingley.

4.4.48 Polygon MA-J is closest to the existing service reservoir. The land for Polygon MA-J is owned by Cambridge Water and there is sufficient space for the new service reservoir. There are no major environmental constraints identified at this stage for this polygon and it is the preferred option from an environmental perspective.

4.4.49 **Polygon MA-J has been identified as the best performing service reservoir option**. If the necessary works are inappropriate (in National Policy Statement and National Planning Policy Framework policy terms), very special circumstances in relation to the new service reservoir within the Green Belt at Madingley will have to be demonstrated as part of the development of this service reservoir.

Water treatment works

4.4.50 A single water treatment works is proposed to treat water before it is transferred, to supply both Cambridge Water and Anglian Water. A single, larger water treatment works would be lower capital and operational cost than two smaller water treatment works and would therefore offer better value for money to customers. Two potential land polygons for the water treatment works locations have been assessed against the Stage C Fine Screening criteria. These are the following:

- FR01 to the north of the Fens Reservoir site, abutting the northern extent of proposed reservoir site. Polygon is located east of Doddington in near to the Isle of Ely Way.

- FR14 to the south of the Fens Reservoir site. Polygon is located just north of Chatteris near to the A142.

4.4.51 The identified polygons are larger than the area required for the permanent water treatment works site and have sufficient space to accommodate the additional space requirements during the construction period (as identified based on a preliminary assessment). Preferred locations for the water treatment works within the overall polygons have not been determined at this stage and will be further assessed and refined as the design develops. This flexibility in siting of the water treatment works within the larger polygon area allows further assessments to be undertaken to inform design work that allows its siting in a location that avoids or minimises potential impacts wherever practicable.

4.4.52 The treatment process will be the same for both locations for the water treatment works and therefore is not a factor in differentiating between the polygons.

4.4.53 The capital cost and carbon emissions estimates at this early stage are similar for both sites. The difference is less than 1% which is within the margin of error at this early stage of the project development.

4.4.54 The assessment of power availability has concluded that there is insufficient grid capacity to provide the power needed for the water treatment works in this area, which applies to both of the polygons being considered. Further engagement with the Distribution Network Operators is needed to obtain an estimate of the cost of power upgrades, but from the early technical work the upgrade for FR01 will also include local cabling and substation upgrades, which would likely result in additional costs when compared to FR14, which currently has more available capacity than the FR01 site.

4.4.55 FR01 is approximately 500m east of the Scheduled Monument, moated bishops' palace at Manor Farm, meaning that this option represented a higher risk from changes to setting impacting on its value. Both options have potential for unidentified archaeological remains and was therefore not a differentiating factor. As Polygon FR14 was unlikely to result in changes to the setting of designated heritage assets, it is preferred in heritage terms.

4.4.56 Polygon FR01 is within a Mineral Safeguarding Area, but FR14 is not.

4.4.57 FR14 is on the edge of the town of Chatteris, to the north-east of the A142. It is adjacent to the Goose and Swan Functionally Linked Land associated with the Ouse Washes SPA and Ramsar site. Although there would be no direct loss of Functionally Linked Land, there is a potential for disturbance to both geese and swans using the Functionally Linked Land, during construction and operation beyond that experienced as a result of traffic and the town of Chatteris. Anglian Water and Cambridge Water anticipate that the impacts could be avoided, reduced or mitigated. Further assessment and engagement with the relevant regulator will be required to demonstrate this.

4.4.58 FR14 is closer to more residential properties and other sensitive receptors than FR01, with two receptors within the site polygon and 22 other residential receptors and two other receptors within 75m. The closest property to FR01 is a residential property approximately 180m to the west. For either polygon the exact location of the WTW would be refined within the selected polygon to avoid, reduce or mitigate impacts, in this location siting is likely to avoid the properties within the polygon. This increases the risk of air quality and noise during construction and longer-term noise during operation. However, the majority of the nearby receptors are on the opposite side of the A141 and their noise environment is likely to be currently dominated by the road. Selecting this option will require that baseline noise data is collected and an assessment of the changes in noise levels assessed. Good design and construction planning will help associated noise risks to be avoided, reduced or mitigated, including identifying where the water treatment works is best sited within the overall larger polygon.

4.4.59 Polygon FR01 is close to the settlement edge of Wimblington and Doddington and the landscape is currently less open and expansive than for FR14 and so was preferable from a landscape perspective. However, Polygon FR14 sits within an area of proposed allocation in the draft Local Plan for employment opportunities and is therefore preferred from a land use perspective. The construction of a water treatment works is considered to be compatible with this allocation, although it has the potential to impact the wider use of the whole proposed allocation.

4.4.60 The environmental assessments undertaken at this stage determined that FR01 would result in a greater loss in total area of best and most versatile agricultural land and peat when compared to FR14.

4.4.61 Access to FR14 was considered to be less disruptive to local road users and more suitable due to available access to polygon FR14 from the A142 and B1098.

4.4.62 **Considering the above comparative assessment, FR14 has been preferred over FR01 as:**

- FR14 is less likely to result in changes to the setting of designated heritage assets.
- FR14 likely needs less significant power network upgrades.
- Polygon FR01 is within a Mineral Safeguarding Area.
- FR01 would result in a greater loss in total area of best and most versatile agricultural land and peat.
- Access to FR14 was considered to be less disruptive to local road users and more suitable due to available access to polygon FR14 from the A142 and B1098.

4.4.63 There is potential for impacts on the Functionally Linked Land in close proximity to the polygon FR14; however, Anglian Water and Cambridge Water anticipate that the

impacts could be avoided, reduced or mitigated through the timing of the construction of the works and other measures, but further assessment and engagement with the relevant regulator is required.

Feed corridors

4.4.64 Two feed corridor options were identified in Stage B for progression to Stage C, Corridors 2 and 3.

4.4.65 Both corridors pass to the south and west of the reservoir site, providing a corridor for both upstream and downstream pipelines to and from the reservoir and water treatment work polygons. The key difference between the corridors is that Corridor 2 is along the western side of the A141, whereas Corridor 3 stays on the eastern side and goes though the western edge of the Fens Reservoir site.

4.4.66 Due to the locations of Corridor 2 and Corridor 3 in relation to the Goose and Swan Functionally Linked Land associated with the Ouse Washes designated site, further assessment and engagement around both options with relevant stakeholders are required to identify design solutions that minimise impacts to the Ouse Washes and associated habitat loss.

4.4.67 From a heritage perspective, the potential impacts on the historic environment associated with Corridor 3 are less significant when compared to Corridor 2. Corridor 2 is located approximately 15m east of the moated bishops' palace at Manor Farm (Scheduled Monument), and in accordance with the NPS[1], may result in substantial harm on the value of the scheduled monument and possible remains that extend outside of the Scheduled Monument. In comparison Corridor 3 is located approximately 170m east of moated bishops' palace at Manor Farm. The presence of the A141 means that it is unlikely that there will be significant alteration to the value of the moated bishops' palace at Manor Farm associated with the heritage assets setting, and in accordance with the NPS, Corridor 3 is likely to result in less than substantial harm on the value of the Scheduled Monument.

4.4.68 Based on the potential number of crossings and overall corridor length, Corridor 3 will likely have a lower carbon emissions cost for all upstream and downstream pipe combinations than Corridor 2. It was also considered that as over half of Corridor 3 is within the Fens Reservoir site, more impacts associated with Corridor 3 will be contained within the reservoir site footprint, thereby reducing the zone of impact associated with this option.

4.4.69 Both Corridor 2 and Corridor 3 were carried forward to Stage C as, at the time of the Stage B assessment, the emerging design for the reservoir site was not sufficiently developed to confirm whether or not there would be sufficient space within the reservoir site for Corridor 3, specifically whether land take and permanent access needed for maintenance would be feasible. It was confirmed at Stage C that Corridor 3 can align with the emerging design for the reservoir site. As a result **Corridor 3 was**

progressed to Stage D because Corridor 3 performed better overall against the environmental and engineering criteria. Corridor 2 was not progressed to Stage D.

4.5 Element identification

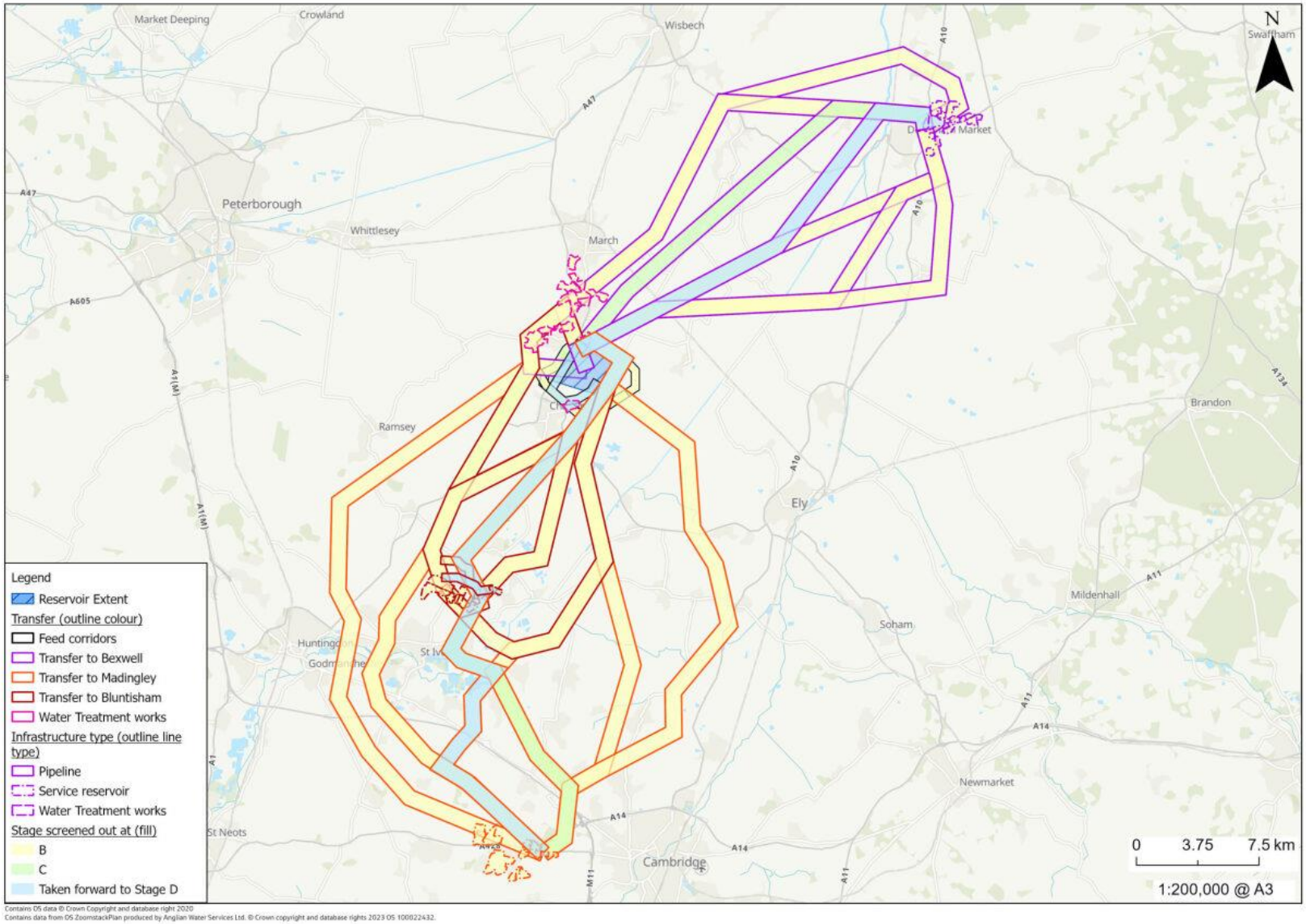
4.5.1 Figure 4.6 shows the components identified and considered at Stages B and C for the downstream infrastructure during the options appraisal process.

4.5.2 The components remaining at the end of the Stage C options appraisal process were then combined into elements, joining the preferred transfer component with the preferred service reservoir infrastructure component progressed to Stage D. The element options for the downstream infrastructure components progressed to Stage D are shown in Table 4-3.

Table 4-3: Downstream elements progressed to Stage D

Element name	Water treatment works	Transfer component	Feed corridor	Service reservoir
Fens Reservoir to Madingley	Polygon FR14	Corridor MA-10 and Bluntisham Spur Corridor	Corridor 3	Madingley Polygon MA-J Bluntisham Polygon BL-J
Fens Reservoir to Bexwell		Corridor BX-4	Corridor 3	Bexwell Polygon BX-B

Figure 4.6: Summary of the Fens downstream infrastructure option appraisal process



5 Emergency drawdown disposal route

5.1 Introduction

5.1.1 This chapter outlines the approach and results of the options appraisal process for the disposal routes for flows from an emergency drawdown event. This included identifying the broad search areas (Stage A) and defining the preferred discharge flow route at Stage B. No further refinement of the emergency flow route was required at Stage C.

5.1.2 The purpose of the disposal route for flows from the reservoir in an emergency drawdown event is to allow the water level in the reservoir to be lowered in a controlled way. By identifying disposal routes for flows in the event of an emergency the risk of a catastrophic flood arising from the very unlikely circumstances of infrastructure failure is reduced. Such an emergency situation is very unlikely to occur over the lifetime of the reservoir, but as part of designing the reservoir the ability to draw it down must be included within the design, and consent secured for the safe disposal of water should it be required.

5.1.3 The options appraisal process has identified the preferred discharge channel route for flows in an emergency drawdown event. Managed watercourses that flow from the reservoir site towards the sea (which is a permanent disposal receptor) are preferred for disposal of drawdown flows.

5.1.4 Due to the circumstances in which any emergency drawdown event would occur, any expected significant adverse environmental effects that might arise from the highly unlikely operation of the emergency drawdown are proposed to be assessed, alongside the risks associated with catastrophic infrastructure failure, under the Major Accidents and Disasters assessment under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, which will, where appropriate, identify measures envisaged to prevent or mitigate any identified significant adverse environmental effects and provide details of the preparedness for and proposed response(s).

5.1.5 If following the relevant work being undertaken in association with the Major Accidents and Disasters assessment, including any outcomes of on-going engagement with technical stakeholders, further consideration is needed to investigate any potential additional interventions associated with emergency drawdown, this process and its outcomes will be reported at a later date.

5.2 Stage A – Initial screening

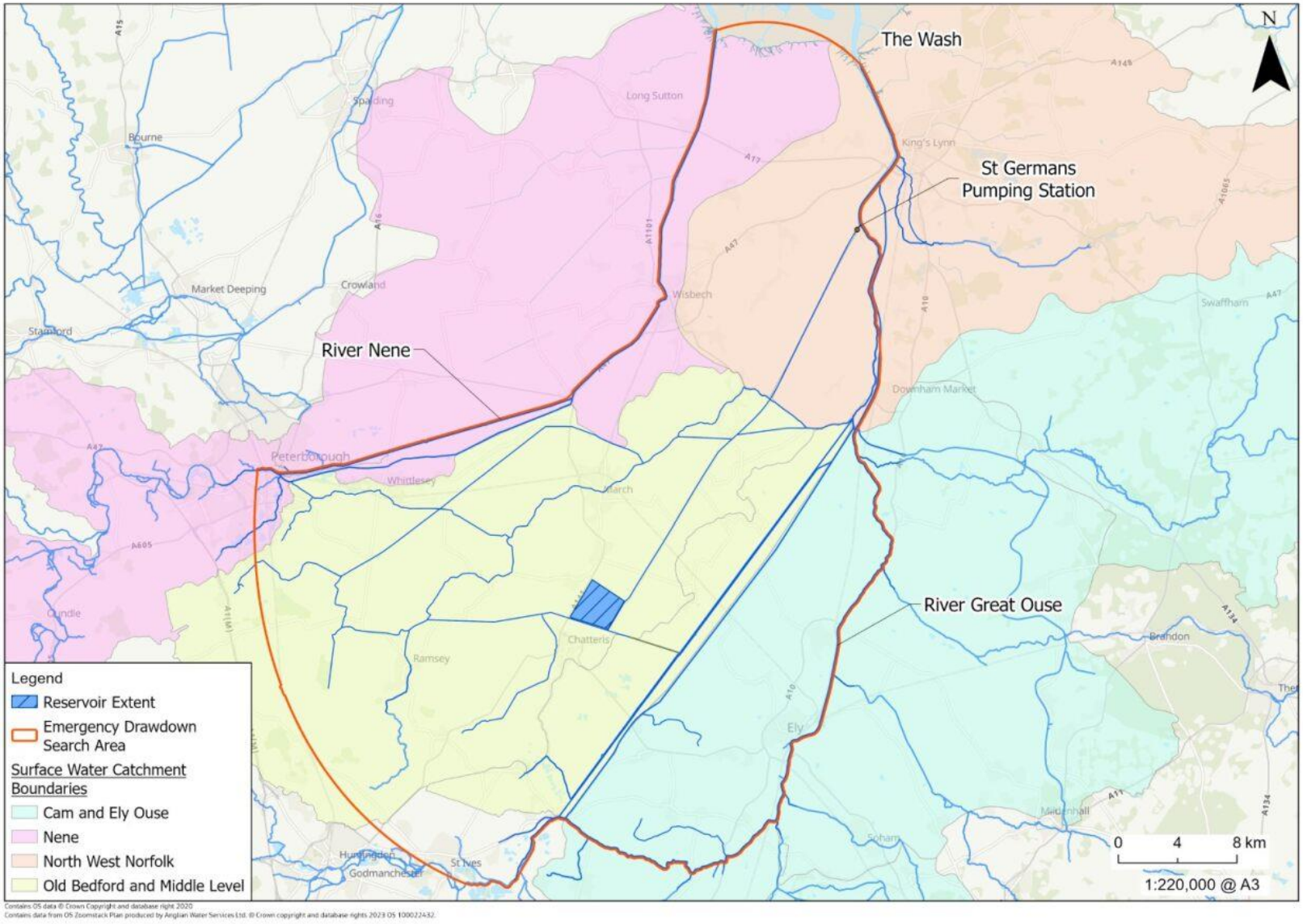
5.2.1 The initial screening for identifying the search area for emergency drawdown disposal routes comprised the following steps:

- Identification of the existing managed watercourses with connection to the proposed reservoir location.
- Identification of the existing flow direction of these watercourses.
- Identification of a potential ultimate disposal location.
- Definition of a suitable search area based on watercourse catchments and the existing flow direction.

5.2.2 The local catchment of the Fens Reservoir is the Old Bedford and Middle Level Management Catchment which discharges into the River Great Ouse and ultimately the sea at The Wash, as does the Cam and Ely Ouse Management Catchment which is to the south and east of the Fens Reservoir. The Nene Management Catchment to the north of the reservoir also discharges to the sea at The Wash. The Wash is situated on the east coast of England, at Boston.

5.2.3 The existing water systems surrounding the proposed location of the Fens Reservoir drain to the north-east, and eventually out to The Wash. The ultimate disposal location for emergency drawdown is therefore considered to be The Wash (the sea) The Stage A emergency drawdown disposal route search area is bounded by the River Nene to the north and by the River Great Ouse to the east and south. To the south-west the search area has been bounded by an arc formed between the River Nene and the River Great Ouse. The emergency drawdown disposal route search area is shown in Figure 5.1.

Figure 5.1: Search area for emergency drawdown flow route



5.3 Stage B – Coarse screening

5.3.1 The ultimate destination of any water released during an emergency drawdown event is The Wash (the sea). Stakeholder engagement with the Environment Agency and the Middle Level Commission Internal Drainage Board has been undertaken as part of Stage B to identify all potential options for routing the emergency drawdown flow from the reservoir to The Wash.

5.3.2 Operation of the emergency drawdown in an emergency situation may change the freshwater inputs into The Wash for the duration that the flow route is utilised. The operational impacts of this on The Wash SPA, Ramsar, SSSI and The Wash & North Norfolk Coast SAC are uncertain at this stage, with modelling and further environmental assessment required as the project progresses. This is common across all of the emergency drawdown disposal route options and therefore is not a differentiator in the selection of the preferred disposal route for water released during an emergency drawdown.

Main flow route

5.3.3 The hydraulic capacity of existing channels within the search area defined at Stage A was estimated using channel dimensions, or hydraulic models (where available). Hydraulic modelling assumed that any existing pumping stations that form part of the flow route can operate at their full design capacity at any point during a tidal cycle.

5.3.4 Potential flow routes to The Wash were identified using the Counter Drain (Ouse), Ouse Washes, Nene Washes and Middle Level system. An alternative option of constructing a deep tunnel from the Fens Reservoir to The Wash was also considered to create a new flow path to The Wash.

5.3.5 The deep tunnel option from the Fens Reservoir to The Wash would require construction activities within The Wash (Ramsar, SPA, Ramsar, SSSI) which would have direct construction impacts on the European and nationally designated sites, in addition to the potential operational impacts common to all options.

5.3.6 The potential flow routes utilising the Counter Drain (Ouse), Ouse Washes and Nene Washes would have potential operational impacts on other European and nationally designated sites when the flow routes are utilised in an emergency situation, in addition to the potential operational impact on The Wash.

5.3.7 Options via the Counter Drain (Ouse) would all result in large volumes of additional flow through the Counter Drain (Ouse) during operation of the emergency drawdown. The Counter Drain (Ouse) is within the Ouse Washes (Ramsar, SAC, SPA, and SSSI and these options therefore present a potential risk to the qualifying features of the European designated sites, including to the spined loach (one of the qualifying features of the SAC) and their habitat.

5.3.8 The options utilising the Ouse Washes (Ramsar, SAC, SPA, SSSI) and Nene Washes (Ramsar, SAC, SPA, SSSI) would have a direct impact on these European and nationally designated sites.

5.3.9 The options utilising the Counter Drain (Ouse), Ouse Washes, Nene Washes and the deep tunnel to The Wash would have direct impacts on European and national designated sites in addition to the operational impact on The Wash associated with all options for the emergency drawdown, that would likely be unacceptable under the Habitats Regulations. These options are therefore least preferred options.

5.3.10 Discharge to St Germans Pond in the Middle Level system (with an outfall into either Sixteen Foot Drain or Forty Foot Drain) with discharge via St Germans pumping station was identified as the preferred flow route as it does not have any additional direct impacts on the internationally designated sites. The option makes use of existing infrastructure, including St Germans pumping station which has a capacity greater than the maximum flows that would be released from the reservoir in the very unlikely scenario of an emergency drawdown event.

5.4 Stage C – Fine screening

5.4.1 No further assessment of the preferred flow route, discharge to St Germans Pond in the Middle Level system (with an outfall into either Sixteen Foot Drain or Forty Foot Drain) with discharge via St Germans pumping station was required for the disposal path in the event of an emergency drawdown at Stage C and the preferred disposal route identified at Stage B was carried forward to Stage D.

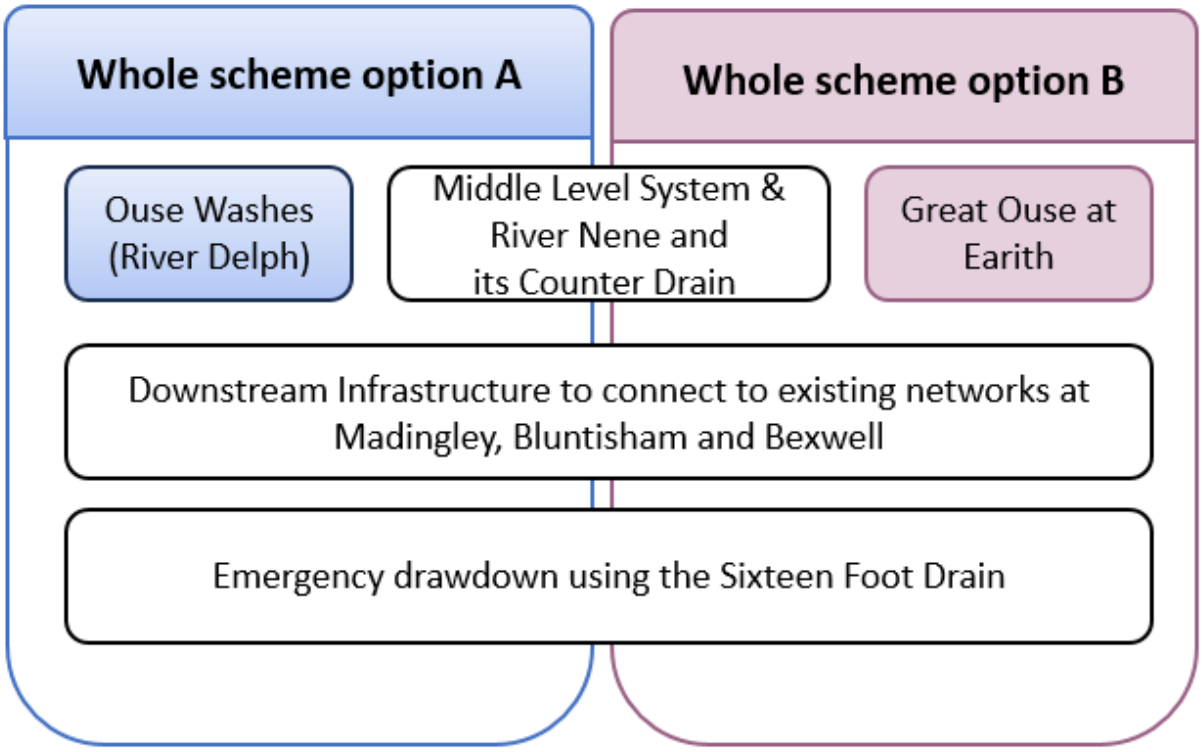
6 Stage D – Preferred whole scheme options appraisal

6.1 Introduction

6.1.1 The final stage of the options appraisal process involved a comparative review of the whole scheme options based on desk-based technical appraisals, consideration of wider benefits and stakeholder input to establish the preferred location and routing of associated water infrastructure (upstream infrastructure, downstream infrastructure and emergency drawdown disposal route) for the Fens Reservoir. This chapter summarises the approach and outcome of Stage D – whole scheme preferred option appraisal.

6.1.2 The preferred components identified through Stage C were combined to form two whole scheme options at Stage D. As shown in Figure 6.1, the key difference between the two whole scheme options was associated with the source of supply and related upstream infrastructure. The downstream infrastructure and emergency drawdown disposal route were the same for both whole scheme options. The whole scheme options are depicted in Appendix C.

Figure 6.1: Whole scheme options



6.1.3 Both whole scheme options use water from the Middle Level system and the River Nene and its Counter Drain as two of the sources. For the third source of supply, whole scheme option A (WSO-A) abstracts from the Ouse Washes (River Delph) and whole scheme option B (WSO-B) abstracts from the Great Ouse at Earith.

6.1.4 The best-performing reservoir location has been identified through an earlier, separate option appraisal process. Stage D therefore focussed on the associated water infrastructure elements of the whole scheme options.

6.2 Whole scheme option A

Upstream infrastructure

Table 6-1: Upstream elements included in WSO-A

Element name	Transfer component	Abstraction infrastructure component
Ouse Washes (River Delph) to Fens Reservoir	Hybrid option from Welches Dam (OWH-6)	Abstraction at Welches Dam and treatment (if required) at Polygon OWA-H
The River Nene and its Counter Drain to Middle Level system	Open Channel transfer via Stanground Lock (CDO-1)	Either Polygon CDA-A near Flag Fen or Polygon CDA-D near Dog-in-a-Doublet

6.2.1 WSO-A would take water from the Ouse Washes and the River Nene and its Counter Drain using a combination of pipelines and existing open channels to convey the water to the Fens Reservoir, where it can be abstracted from the Middle Level system along the Forty Foot Drain or Sixteen Foot Drain.

6.2.2 Water would be abstracted from the Ouse Washes (River Delph) within the area of Welches Dam Pumping Station. From here, water would be conveyed by pipeline to the Forty Foot Drain directly north of Welches Dam Lock.

6.2.3 This would require relining and rewetting of the Forty Foot Drain towards Horseway Lock. It is not proposed to reinstate Welches Dam Lock, thereby avoiding potential water quality and INNS concerns that may arise because of reconnecting the Middle Level system with the Counter Drain (Ouse). The Forty Foot Drain would therefore remain separated from the Counter Drain (Ouse).

6.2.4 Water quality treatment and measures for INNS treatment/prevention, if required, would be placed on the western side of the Counter Drain (Ouse) in an area adjacent to and north of the Forty Foot Drain.

6.2.5 Water would also be transferred from the River Nene and its Counter Drain to the Middle Level system. This would entail a new pumping station situated to the north of the Counter Drain (Nene) to transfer flows from the Counter Drain (Nene) to the River Nene.

6.2.6 Two parcels of land remain under consideration for placement of a pumping station, water quality treatment and INNS treatment/prevention, if required, for abstraction of water from the Counter Drain (Nene). These are: a parcel of land directly adjacent to Anglian Water's existing Flag Fen Wastewater Treatment Works; and an area of land directly north-west of Dog-in-a-Doublet Lock.

6.2.7 From the River Nene, water would flow into the Middle Level system via Stanground Lock. This would require modifications to the lock, with the development of a 2m-wide bypass culvert proposed. Water quality and INNS treatment/prevention is not anticipated between the River Nene and Middle Level system as there is an existing connection between the two catchments. Further assessment and engagement with relevant regulators is required on the proposed connection.

Downstream infrastructure

Table 6-2: Downstream elements included in WSO-A

Element name	Water treatment works	Transfer component	Feed corridor	Service reservoir
Fens Reservoir to Madingley	Polygon FR14	Corridor MA-10 and Bluntisham Spur Corridor	Corridor 3	Madingley Polygon MA-J Bluntisham Polygon BL-J
Fens Reservoir to Bexwell		Corridor BX-4	Corridor 3	Bexwell Polygon BX-B

6.2.8 From the reservoir, water will be treated and conveyed to the existing supply network at the three points identified in Anglian Water and Cambridge Waters' respective rdWRMPs 2024[6,7] at Madingley, Bluntisham and Bexwell.

6.2.9 The water treatment works is proposed south of the reservoir, just north-east of Chatteris. The circa 45ha land parcel is bordered by the A142 on its western edge and New Road (B1098) to the south.

6.2.10 From the water treatment works, treated water would be conveyed by pressurised pipeline to service reservoirs. These reservoirs would store the treated water near to the existing supply network, releasing water into the existing network.

6.2.11 The downstream pipeline corridor towards Madingley and Bluntisham runs initially in a south-west direction from the water treatment works towards Somersham. From here it continues south, with a spur connection to the service reservoir at Bluntisham. The route continues south, followed by routing around the east of Fen Drayton Lakes near to Swavesey. It continues in a general south-west direction towards Elsworth, before turning south-east to Madingley, where the preferred area for the service reservoir is located to the east of Hardwick village. The route is 43.3km of pipeline and would be installed by open cut installation techniques except where it crosses the constraints, such as A roads, detailed in Paragraph 3.3.8.

6.2.12 The preferred area of land identified for siting of a new service reservoir at Madingley is located east of Hardwick, immediately south of the A428 and St Neots Road. It is bordered to the west by Long Road. As this is within the Green Belt, if the necessary works are inappropriate (in National Policy Statement and National Planning Policy Framework policy terms), very special circumstances would need to be demonstrated. If it is not possible to demonstrate very special circumstances then further consideration would be required to identify a suitable location for the Madingley service reservoir.

6.2.13 The area of land identified for siting of a new service reservoir at Bluntisham is located directly north-west of the village, north of Wood End Road.

6.2.14 The new reservoir at Bluntisham would require a spur from the downstream transfer to Madingley. This spur would start north of Wheatsheaf Road and west of Pidley Sheep Lane. The circa 3.5km pipeline would cross the B1040 north of existing dwellings, routing in an east-southeasterly direction towards the new service reservoir.

6.2.15 The downstream pipeline towards Bexwell runs north-east from the water treatment works at Chatteris. It would convey water to the new service reservoir located to the north of Bexwell Business Park, which is located to the east of Downham Market. The route will be a 28.9km pipeline. It would likely be installed by open cut trenching techniques, but where the route crosses other critical infrastructure, trenchless techniques have been assumed to be used to cross physical constraints such as A roads and main rivers, where open cut would be unlikely to be approved.

6.2.16 The area of land identified for siting of a new service reservoir at Bexwell is located directly north of the village. It is bordered by the A10 to the west and New Road to the north.

Emergency drawdown disposal route

6.2.17 Discharge to St Germans Pond in the Middle Level system (with an outfall into either Sixteen Foot Drain or Forty Foot Drain) with discharge via St Germans pumping station was identified as the preferred flow route.

6.3 Whole scheme option B

Upstream infrastructure

Table 6-3: Upstream elements included in WSO-B

Element name	Transfer component	Abstraction infrastructure component
River Great Ouse at Earith to Fens Reservoir	Pipeline Corridor GP-5	Polygon GA-E at Earith
The River Nene and its Counter Drain to Middle Level system	Open Channel transfer via Stanground Lock (CDO-1)	Either Polygon CDA-A near Flag Fen or Polygon CDA-D near Dog-in-a-Doublet

6.3.1 WSO-B would take water from the Great Ouse at Earith and the River Nene and its Counter Drain. Water from the Great Ouse at Earith would be piped directly to the reservoir or the Middle Level system. Water from the River Nene and its Counter Drain source would use a combination of pipelines and existing open channels to convey the water to the Fens Reservoir, where it will be abstracted from the Middle Level system along the Forty Foot Drain.

6.3.2 Water would be conveyed directly to the Fens Reservoir from the Great Ouse at Earith using a 1,500mm diameter pipeline of approximately 19.3km in length. It would be installed via open cut installation techniques except where it crosses the constraints, such as A roads, detailed in Paragraph 3.3.8.

6.3.3 The proposed pipeline corridor follows a route from south of Bluntisham within the RSPB Hanson Ouse Fen Nature Reserve north-west towards Pidley. Following crossing of the B1040 it realigns northwards between Pidley and Somersham, before heading north-east, skirting Somersham towards Chatteris. It passes south-east of Chatteris until it crosses the A142 whereafter it heads north towards the Fens Reservoir with Chatteris to the east of its alignment.

6.3.4 Water would also be abstracted and transferred from the River Nene and its Counter Drain to the Fens Reservoir as described above (paragraphs 6.2.5 to 6.2.7) for WSO-A.

Downstream infrastructure

6.3.5 The downstream infrastructure for WSO-B is the same as described above for WSO-A (refer to paragraphs 6.2.8 to 6.2.16).

Emergency drawdown disposal route

6.3.6 The emergency drawdown disposal route for WSO-B is the same as described above for WSO-A (refer to paragraph 6.2.17).

6.4 Comparison of whole scheme options

6.4.1 The similarities between the two whole scheme options, as detailed above, means that both options performed similarly against many of the selection criteria including criteria from planning, community and environmental criteria. Both options performed well against these criteria and are not considered to be a risk to project delivery based on the information currently available at this stage. This was achieved by careful consideration of the various constraints to help refine and select the best performing components to make up the whole scheme options. Where key differentiators were identified between the criteria this is discussed further in the following section.

6.4.2 WSO-A performed better than WSO-B in respect of yield and whole life costs, which are particularly important for deliverability of the project and value for customers' money. Hydrological modelling undertaken to date showed that abstraction from the

Ouse Washes (River Delph) would yield more water than the Great Ouse at Earith. An increased yield is better value for money for customers and may put back the date when additional sources of water are required in the future.

6.4.3 Based on the cost and carbon emissions estimation work carried out to date at this early stage of the project development, WSO-B has a higher whole life cost of approximately 6% more than WSO-A. This is mainly related to the cost of construction with the provision of an upstream transfer pipeline from the River Great Ouse source to the Fens Reservoir being more costly than rewetting the Forty Foot Drain and using the existing open channel system as part of the Ouse Washes (River Delph) source. From an operational perspective, the use of the upstream transfer pipeline for WSO-B is expected to have a higher operating cost.

6.4.4 WSO-A is also preferred in respect to carbon emissions based on the early assessment work carried out so far, with a net present value for carbon emissions of £50m compared to £58.8m. The 17% difference results from the provision of a pipeline from the River Great Ouse to the Fens Reservoir rather than using the existing open channel system. While cost and carbon emissions are likely to change because of design development, the level of differentiation (6% and 17% respectively) is such that WSO-A would likely remain the preferred option. Further cost and carbon emissions analysis and assessment will be progressed as the Project develops and there is a greater level of information available.

6.4.5 There are many sites across the East of England, particularly within the Cambridgeshire Fens, that are designated for nature conservation locally, nationally and internationally. The Habitats Regulations was therefore a key consideration in the option appraisal process, with due care taken to avoid or minimise impacts on European designated sites and their associated functionally linked land. The confirmed sources of supply identified, the delivery points into the existing supply network and the disposal route for an emergency drawdown event meant that full avoidance of European designated sites and their associated functionally linked land is not possible. Some encroachment of these sites and their associated functionally linked land will be required to deliver the Project in this area. The risk of potential impacts on these designations from the two whole scheme preferred options could likely include:

- The Ouse Washes SPA, SAC and Ramsar as a result of abstraction from the Ouse Washes (River Delph) for WSO-A and the supply of water to a new service reservoir at Bexwell (both options).
- The Wash SPA and Ramsar, and The Wash and North Norfolk Coast SAC as a result of abstraction from the River Nene and its Counter Drain and transfer to the Middle Level system for both options; abstraction from the Ouse Washes (River Delph) for WSO-A.

- The Nene SPA, SAC and Ramsar as a result of abstraction from the River Nene and its Counter Drain and transfer to the Middle Level system for both options.
- Potential impacts on Goose and Swan Functionally Linked Land for both options due to the location of the reservoir, routing of downstream infrastructure and requirement for emergency drawdown all being within functional land. Abstraction from the Ouse Washes (River Delph) would encroach upon Goose and Swan Functionally Linked Land for WSO-A, while the upstream transfer pipeline from the Great Ouse at Earith (WSO-B) would also cross Goose and Swan Functionally Linked Land.

6.4.6 Whole scheme option A would result in the loss of habitat loss within the European Designated site and associated functionally linked land owing to the need for abstraction infrastructure within the Ouse Washes European designated site. Whole scheme option A has the potential to benefit the Ouse Washes European designated site by merit of helping to achieve target water levels within the designated site, particularly in the transition from winter to summer levels. Whole scheme option B would result in a greater amount of habitat loss within the functionally linked habitat of the European designated site, but less of the site itself, and would offer much less benefit in terms of management of the water levels. Further assessment and engagement with the relevant regulator is required on design solutions that minimise infrastructure within the Ouse Washes and associated habitat loss. While the intake and pumping station would likely be located along the Middle Level Barrier Bank near the existing Welches Dam Pumping Station on the edge of or within the Ouse Washes, initial treatment (i.e. water quality treatment and INNS treatment, if required) would be placed west of the Counter Drain (Ouse) outside of the Ouse Washes but within Goose and Swan Functionally Linked Land. This reduces potential impact on the Ouse Washes SPA, while ensuring initial treatment is kept as close as possible to the source.

6.4.7 Considering the above points, both whole scheme options are anticipated to require a Stage 2 Appropriate Assessment to assess the likely significant effects of the proposed upstream infrastructure, downstream infrastructure and emergency drawdown on the integrity of the designated sites and their conservation objectives, and to consider ways to avoid or reduce (mitigate) any potential for an adverse effect on the integrity of the site, including its qualifying features.

6.4.8 Abstraction from the Great Ouse at Earith avoids the need for abstraction infrastructure in the Ouse Washes SPA and SAC. However, it does not offer the same high yield or benefit of abstraction from the Ouse Washes (River Delph). Abstraction from the Ouse Washes (River Delph) also has the potential to provide benefit for the Ouse Washes SPA and SAC (notwithstanding the physical infrastructure required), particularly in the transition from winter to summer water levels.

6.4.9 Although abstraction from the River Great Ouse at Earith avoids placement of abstraction infrastructure in a European designated site as with WSO-A, an intake and

pipeline would still be required within the RSPB Ouse Fen Nature Reserve. The pumping station and treatment works (if required) would therefore be located north of the RSPB reserve with the potential to alter the setting of both Bluntisham and Earith Conservation Areas, including the Grade I Parish Church of St Mary, Grade II Bluntisham and Earith War Memorial and Grade II* Bluntisham House within the Bluntisham Conservation Area. In terms of impact on historic environment and high value landscape, WSO-B is therefore less preferred than WSO-A as it is likely to affect a greater number of visual receptors with direct views from Bluntisham Conversation Area, compared to abstraction from the Ouse Washes (River Delph).

6.4.10 Relining and rewetting of the Forty Foot Drain from the disused Welches Dam Lock to Horseway Lock has the potential for renovation and enhancement of Horseway Lock and will provide the opportunity to reinstate a historic navigation route through the Forty Foot Drain and towards Welches Dam. Abstraction from the Ouse Washes (River Delph) and transfer of the water into the Forty Foot Drain just north of Welches Dam Lock therefore provides potential benefit related to the reinstatement of historic landscape features, further informing the preference for WSO-A compared to WSO-B from a historic environment and landscape perspective. In particular, this allows for potential enhancement of existing open channel systems and improved opportunities for achievement of biodiversity net gain compared to the use of an upstream pipeline.

6.4.11 The presence of the Forty Foot Drain was identified as one of the key opportunities for potential benefits in the selection of the reservoir site. As detailed in the site selection report for the reservoir, the presence of the Forty Foot Drain and adjacent Nature Recovery Network would provide opportunities to increase ecological connectivity of varied habitat types at a landscape level, while providing opportunities to reinstate the Forty Foot Drain and reduce flood risk. WSO-A would allow the benefits identified in the selection of the reservoir site to be explored further, whereas WSO-B would not unlock these potential wider system benefits.

6.4.12 The wider system benefits are considered to outweigh the construction-related benefit associated with using the same pipeline corridor for both the upstream transfer and downstream transfer between Bluntisham and the Fens Reservoir. While using the same corridor for both the upstream and downstream transfers would reduce the overall disturbance to existing land use and ownership compared to a different routing for each, it would potentially mean that those parcels of land, including functionally linked land, are disturbed by construction-associated activities for a longer period of time. This would depend on the construction methodology and programme for both pipeline corridors. Therefore, even though WSO-A is anticipated to cause additional disruption to land use and ownership in the vicinity of Welches Dam Pumping Station and the length of the Forty Foot Drain to be relined and rewetted, this level of disruption is considered less than the prolonged disruption associated within a circa 20km pipeline.

6.4.13 From a WFD perspective, both whole scheme options would require water quality treatment for the transfer of water from the Counter Drain (Nene) to the River Nene. WSO-B was preferred to WSO-A due to the avoidance of potential water quality concerns associated with transferring water for the River Delph to the Middle Level system by piping water directly from the Great Ouse at Earith to the Fens Reservoir or Middle Level system. For WSO-A, water quality of the River Delph is understood to be lower than the Middle Level system with higher levels of phosphate and ammonia. Transferring River Delph water to the Middle Level system could lead to a water body scale deterioration, and water quality treatment is likely to be required. In the event that water is abstracted from the River Delph via a siphon and tunnel, this would hold further WFD concerns associated with the below-ground shaft, tunnel and pipeline construction and maintenance within the Ouse Washes designated area. Further investigation and engagement with relevant stakeholders will be undertaken to confirm requirements.

6.4.14 Both whole scheme options received some positive feedback from stakeholders in the Fens Water Partnership, particularly in respect of the potential for wider system benefits associated with the use of open channels, the reinstatement of the Forty Foot Drain and improved water level (flood) management from abstracting from the River Ouse. Stakeholders also raised some concerns that are being considered as part of the ongoing development of the Project and consultation and engagement with stakeholders. These included concerns around historic environment (particularly in the vicinity of Flag Fen water recycling centre) and impact on European designated sites, including crossing of Goose and Swan Functionally Linked Land.

Preferred Whole Scheme Selection

6.4.15 Overall WSO-A was considered to perform better than WSO-B when considered against the broad range of selection criteria. In particular, WSO-A offers the following advantages:

- It would provide a greater yield, which would require less other investment to meet the required need and is therefore better value for money, at a lower whole life cost and carbon emissions.
- It could maximise wider system benefits associated with the use of open channels, including potentially reinstating historic landscapes, reinstating navigational routes and improved flood storage capacity, particularly through the relining and rewetting of the Forty Foot Drain.
- It could provide benefit to the Ouse Washes SAC and SPA by reducing flooding and helping to achieve the transition from winter to summer water levels and then managing summer water levels.

- It would result in lower impact to high-value historic designated assets in the villages of Bluntisham and Earith and would present an opportunity to enhance the historic landscape through the renovation of Horseway Lock.
- It would shorten the period of disturbance to land use and ownership, including Functionally Linked Land, along the proposed pipeline corridors during construction, as construction would only be required for the downstream pipeline.

6.4.16 Taking the above into consideration, WSO-A is the preferred option, but as outlined above further assessment and engagement is required as understanding of the Project develops and having regard to feedback from consultees. Therefore, at the present time, both WSO-A and WSO-B are being progressed, with further work being undertaken to confirm whether WSO-A is the preferred whole scheme option and taken forward as the sole option for consenting through the Development Consent Order.

7 Option appraisal – next steps

7.1.1 The four-stage options appraisal process has considered the technical feasibility of sites and options for the associated water infrastructure for the Fens Reservoir. Through the consideration of the options appraisal criteria across the four stages, Anglian Water and Cambridge Water identified a preferred whole scheme option.

7.1.2 The preferred whole scheme option, WSO-A, presents opportunities to maximise the wider system benefits of open channel transfers through abstraction and transfer of water from the Middle Level system, the River Nene and its Counter Drain and Ouse Washes (River Delph). It would allow the reinstatement of the Forty Foot Drain between Welches Dam Lock and Horseway Lock, thereby contributing to biodiversity enhancement and opening up opportunities for navigation. It would also bring management benefits to the Ouse Washes SAC and SPA by reducing flooding and helping management water levels, thereby contributing to the conservation management of this European designated site.

7.1.3 Both whole scheme options may result in impacts on European designated sites or the associated Functionally Linked Land. Both options would therefore be subject to an HRA. Further investigation on WSO-A, specifically abstraction from the Ouse Washes (River Delph) is required to understand the likelihood of significant effects, and feasible options to avoid or reduce (mitigate) any potential for an adverse effect on the integrity of the site, including its qualifying features. In conjunction with the requirements of the source (e.g. in relation to yield) from an operational perspective, this will help to inform the final selection of a preferred whole scheme option. Anglian Water and Cambridge Water will engage with the relevant regulators as part of its ongoing assessment process.

7.1.4 Heritage risks have been identified during the options appraisal and, where practicable, will be avoided or minimised through design development. These potential impacts, along with other potential environmental impacts associated with the preferred whole scheme option, will be assessed further through the Environmental Impact Assessment (EIA) process. The EIA will assess potential impacts during both construction and operation, temporary and permanent, to identify whether there are any likely significant effects on the environment and to identify methods of avoiding, minimising or mitigating effects that would reduce the impact to a level where significant effects would not occur. This process will involve engagement with relevant stakeholders, including local planning authorities and statutory environmental bodies such as the Environment Agency, Natural England and Historic England.

7.1.5 There remains various factors for some of the components that form the whole scheme options that require further investigation and consideration given the early stage of scheme development. Further assessment of the component options and

engagement with key stakeholders is required to develop the preferred component options. Components with optionality include the following:

- Location of any required treatment for water abstracted from the Counter Drain (Nene) and location of discharge of water into the River Nene, required for WSO-A and WSO-B.
- Arrangement of the abstraction from Ouse Washes at Welches Dam and arrangement for crossing the Counter Drain (Ouse), required for WSO-A only.
- There is a policy test to meet around the demonstration of very special circumstances in relation to the new service reservoir within the green belt at Madingley.

7.1.6 Further engagement with regulators to determine whether any additional works are required to enable the safe discharge of water from the reservoir in an emergency.

Appendix A – Option Appraisal Criteria

A.1 The criteria applied during the option appraisal process have been grouped into five categories that represent key themes for assessing options for the Project. Table A-1 lists the criteria that were considered during the different stages of the option appraisal process explained in Chapters 1 to 6 to inform the best performing components and preferred whole scheme option. When considering attributes in the assessment the presence or proximity of that attribute have been considered, for example the presence of national trails or the proximity of residents or dwellings.

A.2 The criteria were selected as they would allow a robust technical, engineering and consenting appraisal to be completed against core legislative and policy requirements that would be factors in the future consenting and decision-making processes. These criteria were developed using the Government policy and regulations below, including:

- National Policy Statement for Water Resources Infrastructure (April 2023).
- Environmental Impact Assessment Regulations 2017.
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.
- The Conservation of Habitats and Species Regulations 2017 (as amended).
- National Planning Policy Framework (2023).

Table A-1: Attributes considered against the respective criteria during option appraisal

Category	Criterion	Attributes considered	Stage applied		
			A	B	C
Social and community	Built-up areas	Identification of large areas of existing developments (excluding brownfield sites)	✓	✓	
	Population and human health	Identification of national trails		✓	✓
		Identification of open access land		✓	✓
		Identification of national cycle routes		✓	✓
		Assessment of population health sensitivity			✓
		Assessment of the number of population health exposure risk			✓
	Socio-economics and community	Identification of residents/dwellings			✓
		Identification of business owners/businesses			✓
		Identification of tenants/landowners			✓
		Identification of community infrastructure such as education or healthcare facilities			✓

Category	Criterion	Attributes considered	Stage applied		
			A	B	C
	Access and amenity	Identification of public rights of way, cycleways, footpaths			✓
		Identification of bridleways			✓
		Identification of open space used for play and amenity (formal and informal)			✓
		Identification of recreational facilities (sports clubs and indoor/outdoor pitches and sites)			✓
		Identification of public transport			✓
	Equalities	Identification of places of worship			✓
		Identification of social infrastructure catering for needs of a specified protected characteristic group			✓
Engineering	Carbon[22]	Assessment of capital carbon		✓	✓
		Assessment of operational carbon		✓	✓
		Assessment of whole life carbon			✓
	Cost[23]	Assessment of capital cost		✓	✓
		Assessment of operational cost		✓	✓
		Assessment of whole life costs			✓
	Major Infrastructure	Proximity to A roads suitable for heavy goods vehicle traffic		✓	✓
		Proximity to airfields	✓	✓	
		Identification of utilities			✓
		Assessment of the number of rail crossings		✓	
		Assessment of the number of A road crossings		✓	
		Assessment of the number of main river crossings		✓	
		Assessment of the number of strategic gas/electric/pipelines crossings		✓	
	Technical	Assessment of trenchless crossings and associated ground condition risks			✓
		Assessment of site topography			✓

[22] At Stage B proxies for cost and carbon were considered e.g. length of pipeline and pumping head based on topography

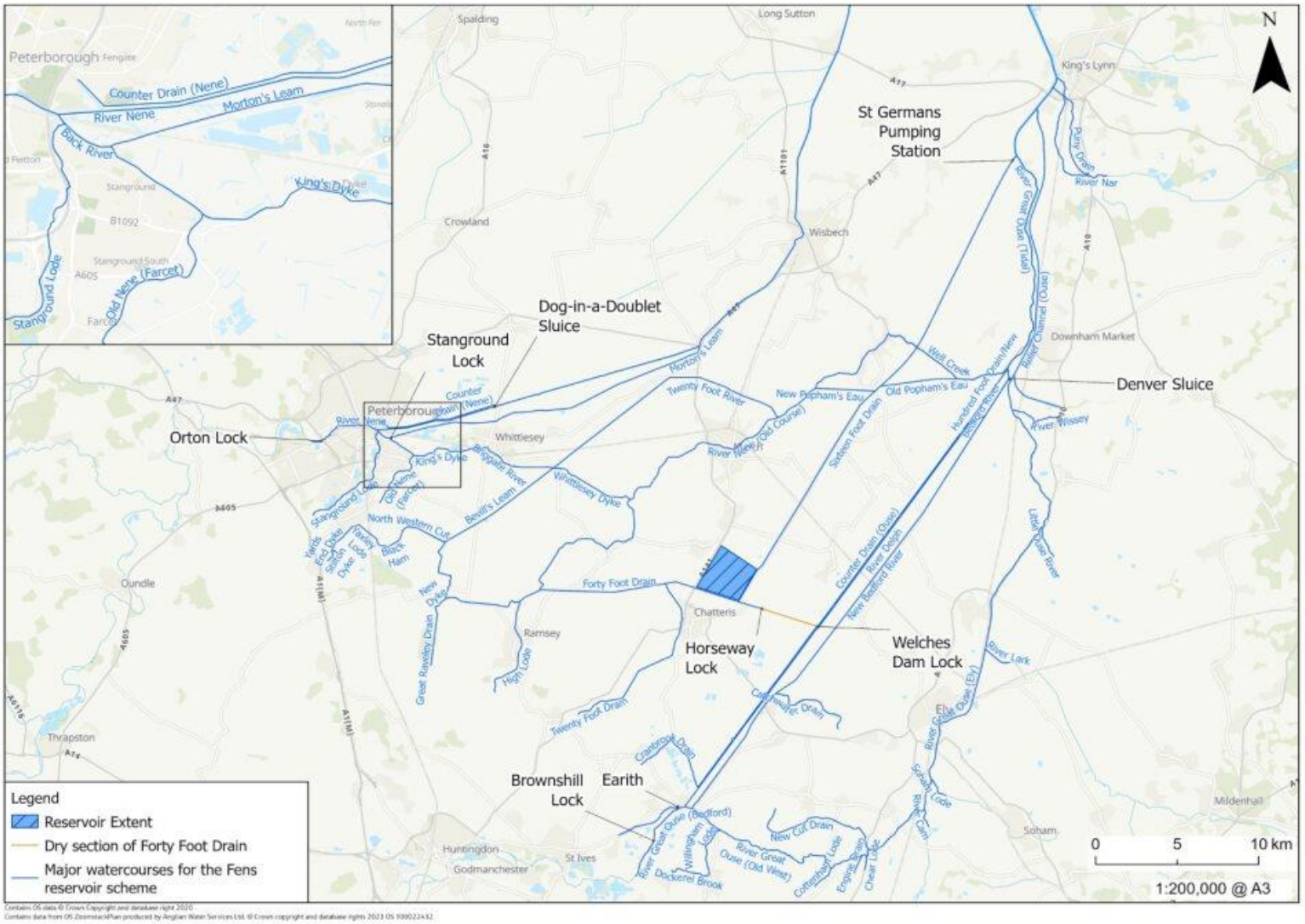
[23] Costs excluded consideration of land purchase, construction/operation of water quality treatment works and INNS treatment/prevention, and cost of power upgrades. These were not considered differentiators for the purposes of the option appraisal process as further investigation and engagement would be needed to confirm requirements and associated costs regardless of the whole scheme solution taken forward.

Category	Criterion	Attributes considered	Stage applied		
			A	B	C
		Assessment of ground condition risk			✓
		Assessment of number of pumping stations			✓
		Assessment of suitability of terrain for pipelines			✓
		Assessment of operational complexity (scheme operation and maintenance)			✓
		Assessment of power availability			✓
		Assessment of the potential for future expansion		✓	
		Assessment of cut and fill			✓
		Assessment of general uncertainty			✓
		Alignment between open channel transfers and emergency drawdown disposal route options			✓
		Assessment of impact on navigation			✓
Environment	Air quality	Identification of Air Quality Management Areas		✓	✓
		Identification of sensitive human receptors			✓
	Historic environment	Identification of Scheduled monuments	✓	✓	✓
		Identification of World Heritage Sites	✓	✓	✓
		Identification of Registered Parks and Gardens	✓	✓	✓
		Identification of Registered Battlefields	✓	✓	✓
		Identification of Listed buildings	✓	✓	✓
		Identification of Conservation Areas		✓	✓
		Identification of locally listed buildings (non-designated assets)			✓
		Identification of archaeological assets (non-designated assets)			✓
	Landscape character	Identification of Areas of Outstanding Natural Beauty	✓	✓	✓
		Identification of National Parks	✓	✓	✓
		Identification of local landscape designations			✓
		Identification of open greenspaces		✓	✓
	Biodiversity	Identification of National Nature Reserves	✓	✓	✓
		Identification of Ramsar sites (including listed or proposed Ramsar sites)	✓	✓	✓

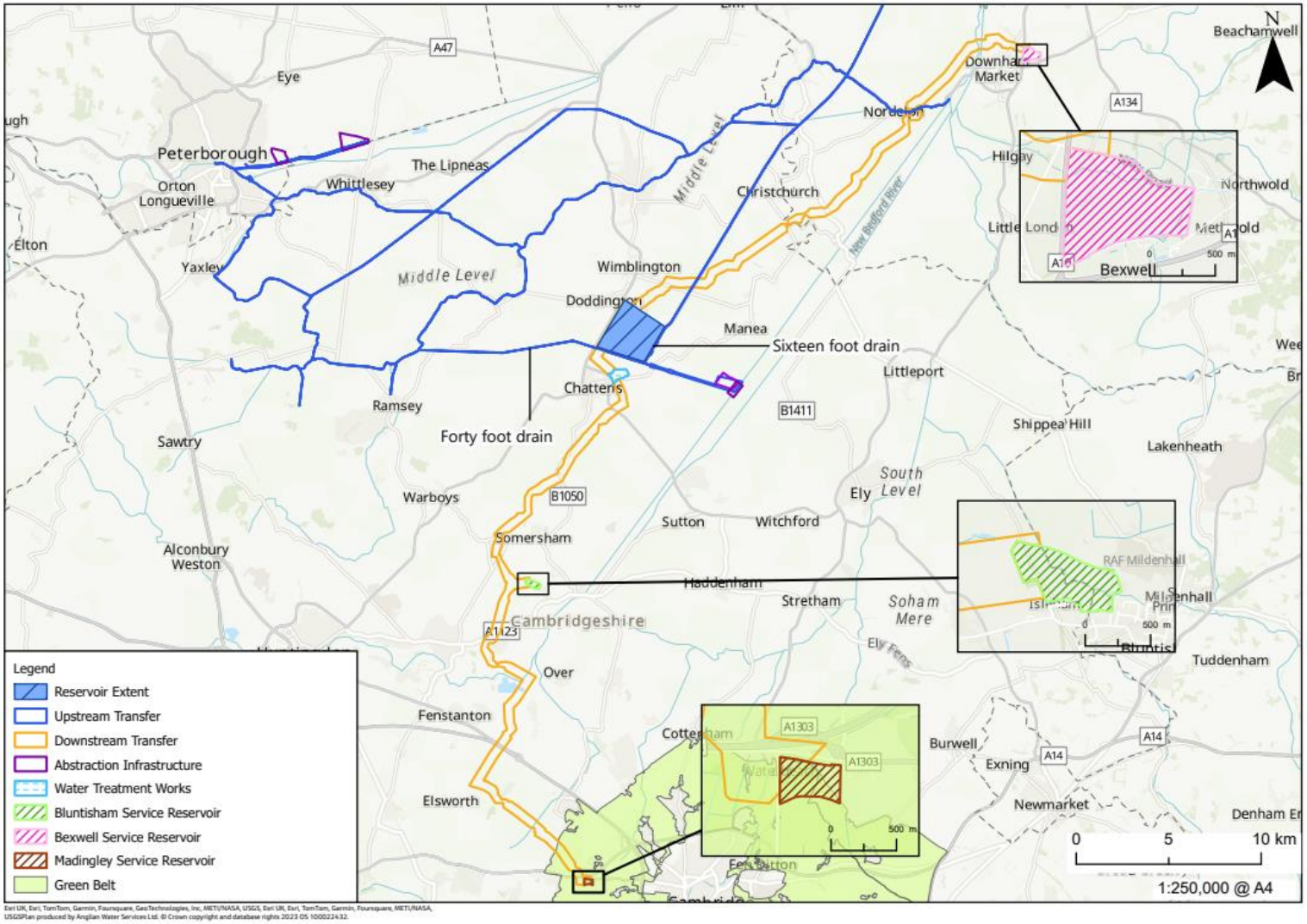
Category	Criterion	Attributes considered	Stage applied		
			A	B	C
		Identification of SAC (including possible SAC)	✓	✓	✓
		Identification of SPA (including potential SPA)	✓	✓	✓
		Identification of Sites of Special Scientific Interest	✓	✓	✓
		Identification of Goose and Swan Functional Land		✓	
		Identification of Ancient woodland	✓	✓	✓
		Identification of ancient/veteran trees			✓
		Identification of Local Wildlife Site (LWS) / County Wildlife Site (CWS)		✓	✓
		Identification of Local Nature Reserves		✓	✓
		HRA screening			✓
		Identification of priority habitats		✓	✓
		Identification of nature reserves (where not SSSI, LWS/CWS or LNR)			✓
		Assessment of Biodiversity Net Gain			✓
	Noise	Identification of noise-sensitive receptors (construction and operational)			✓
	Water environment	Identification of flood risk zones (fluvial flooding, flooding surface water, flooding in Internal Drainage Board areas, flooding from existing reservoirs, and flooding from groundwater)		✓	✓
		Identification of defended fluvial flood areas			✓
		Identification of areas at risk of flooding from existing reservoirs			✓
		Identification of areas at risk from ground water flooding			✓
		WFD Level 1 screening assessment for surface water and groundwater bodies (and review of high-level 2 classes)			✓
		Identification of main rivers	✓	✓	✓
		Identification of watercourses and water bodies	✓		
		Identification of Source Protection Zones		✓	✓
		Identification of Local Geological Sites		✓	✓

Category	Criterion	Attributes considered	Stage applied		
			A	B	C
	Geology and soils	Identification of Best and Most Versatile land and Agricultural Land Classification		✓	✓
		Identification of peat soils			✓
		Identification of Contaminated land		✓	✓
		Assessment of geomorphology of river abstraction and discharge sites		✓	✓
	Materials and waste	Identification of historic and authorised landfill		✓	✓
	Land designation	Identification of Mineral Safeguarding Zones		✓	✓
	Traffic and transport	Assessment of road network			✓
Planning and land use	Development conflicts, land use and planning	Identification of Mineral safeguarding sites		✓	✓
		Presence of other Nationally Significant Infrastructure Projects		✓	✓
		Identification of designated common land		✓	✓
		Identification of committed development including those under construction		✓	✓
		Identification of Green Belt		✓	✓
		Identification of Mineral safeguarding zones			✓
		Identification of Special Category Land/Protected Undertakers			✓
Potential for benefits and opportunities	Water environment	Identification of fluvial flooding opportunities			✓
		Identification of surface water flooding opportunities			✓
		Identification of defended breach flooding risks			✓
		Identification of WFD opportunities			✓
		Identification of flood risk management			✓
	Noise	Identification of noise improvement opportunities			✓
	Opportunities	Identification of navigation opportunities			✓
		Identification of agricultural opportunities			✓
		Identification of wetland habitat creation opportunities			✓

Appendix B – Major Watercourses



Appendix C.1 – Whole Scheme Option A



Appendix C.2 – Whole scheme option B