Oath to Burrowbridge Dredging and Associated Activities

Volume 3: Appendices Part 6

APPENDIX 6I: HABITAT REGULATIONS ASSESSMENT

River Parrett Oath to Burrowbridge Dredging

Habitat Regulations Assessment Report

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1 PART A: INTRODUCTION AND INFORMATION ABOUT THE PLAN OR PROJECT AND AN INITIAL ASSESSMENT OF CREDIBLE RISK TO EUROPEAN SITES

1.1 A1 INTRODUCTION

This Habitat Regulations Assessment Report has been prepared by Johns Associates on behalf of the Parrett Internal Drainage Board (PIDB) to assess the potential negative impact upon European Designated Sites as a result of proposed dredging operations along a section of the River Parrett, Somerset.

The PIDB is required as the Competent Authority, to complete a Habitats Regulation Assessment to meet Regulation 63 of the Conservation of Habitats and Species Regulations 2017 for plans or proposals which have the potential to negatively impact European Sites which form part of the "Natura 2000" network. European Sites include Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites.

This assessment considers the on-site and wider potential significant ecological effects of impacts created as a result of the proposed dredging of a section of the River Parrett upon the Somerset Levels and Moors SPA and Ramsar European Sites. The section of the River Parrett to be dredged is located from Stathe to Burrowbridge.

As the Competent Authority the PIDB may only undertake the dredging project where it is able to ascertain through the HRA either:

a) that it will not have a likely significant effect on a European Site (either alone or in-combination with other plans and projects); or
b) that it will have no adverse effect on the integrity of a European Site following an Appropriate Assessment.

If such effects cannot be ruled out, the proposal cannot proceed unless the further tests provided within Regulation 64 regarding considerations of overriding public interest and Regulation 68 regarding compensation within the Habitats Regulations can be satisfied.

Consultation, hydrological and ecological data records for Somerset Levels and Moors SPA and Ramsar sites have been obtained from Natural England (NE), the Environment Agency (EA). Additional ecological data records have been obtained from the Wetland Bird Survey (WeBS) for Somerset Levels and Moors.
Ecological and hydrological surveys have been conducted at the proposed dredging site to inform the HRA.

1.2 A2 DETAILS OF THE PLAN OR PROJECT

Applicant Name: Parrett Internal Drainage Board (PIDB), via Project Manager Mark Glennerster

Location of Dredging: River Parrett, Stathe Bridge (TA7 0JN) to Burrowbridge (TA7 0RA)

Central Ordnance Survey Grid Reference: Stathe Bridge ST 3753 2909 to Burrowbridge ST 3584 3018

Location of Project: Figure A2.1 provides the location of the project

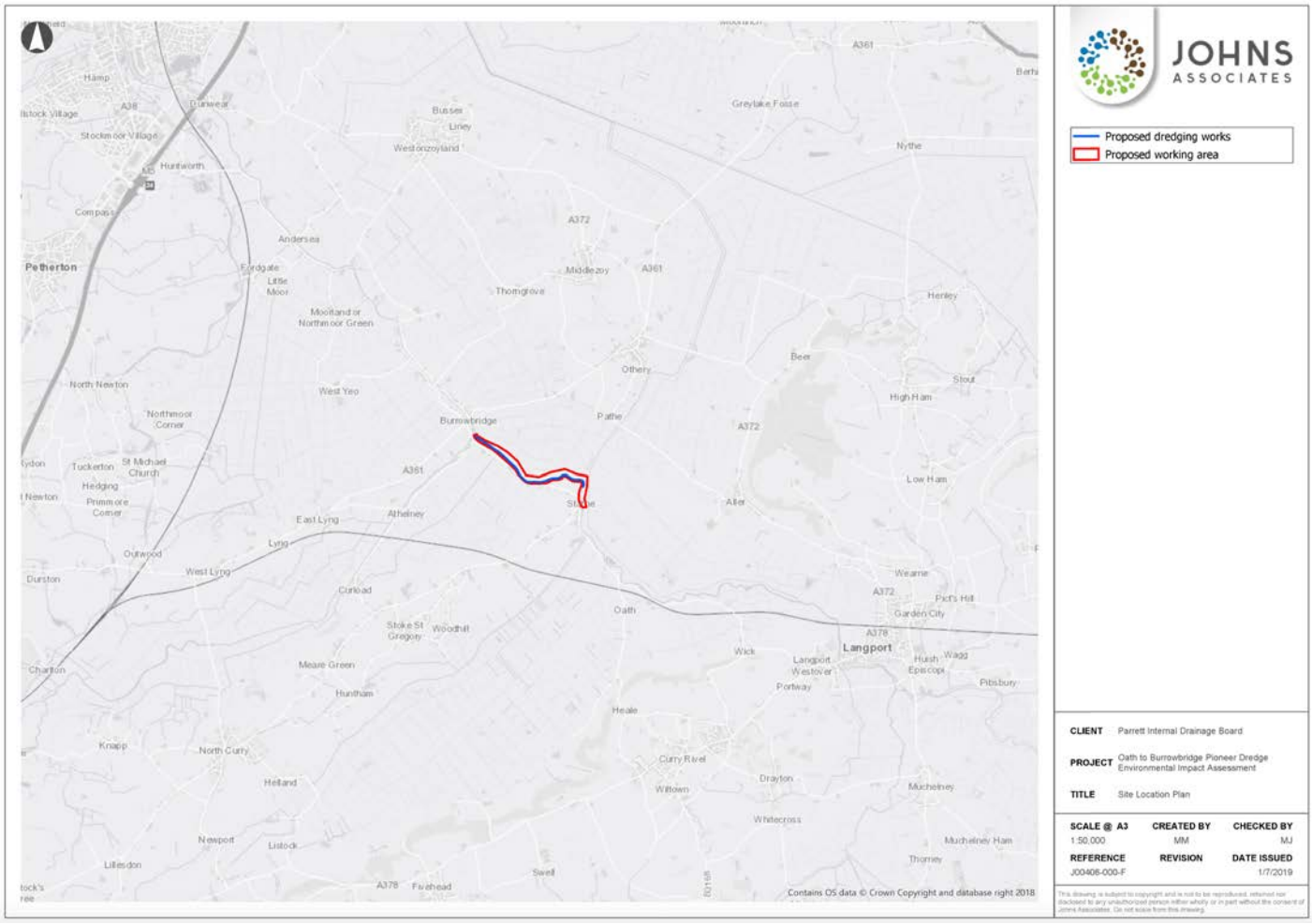

Figure A2.1 Location of Project

1.2.2 Description of the Plan or Project

The Somerset Rivers Authority (SRA) was formed in response to severe and prolonged flooding of the Somerset Levels and Moors. The SRA produced a 20-year Flood Action Plan (FAP) of which Workstream 1 includes dredging and river management. The Environment Agency (EA) dredged 8 km of the River Parrett and River Tone in 2014 following the floods to increase the conveyance capacity of the river and to reduce the likelihood and severity of future flooding to surrounding communities. The SRA carries out the ongoing

maintenance of the dredged 2014 river profiles and also identifies further dredging locations for improved flow conveyance and flood management under Workstream 1.

As a member of the Somerset Rivers Authority (SRA) the Parrett Internal Drainage Board (PIDB) propose to commence dredging operations along predominantly the northern (right) bank of the River Parrett for 2.2 km immediately downstream of Stathe Bridge (downstream of Beazleys spillway) to the confluence with the River Tone at Burrowbridge. An area of Somerset Levels and Moors SPA and Ramsar sites (Southlake Site of Scientific Interest (SSS)) is located adjacent to the northern boundary (right bank) of the majority of the length (2.09 km) of the proposed area of dredging along the River Parrett.

The works will comprise excavation to remove recent accumulations of silt on the upper banks to the design gradient of the bank, to form a two-stage channel. 22,000 m^3 of silt will be removed in total from the banks. The project aims to increase the conveyance of the channel within the dredged reach by 3-4 cumecs at low tide. A site compound will be provided adjacent to the working area and will include a welfare unit for staff, staff parking for vehicles, a storage container and fuel bowser.

All arisings from the excavation are proposed to be deposited on the landward side of the right flood bank crest (facing downstream) under conditions of D1 and U1 waste exemptions. The level of the bank crest is not to be raised above existing levels. A sample cross-section showing the proposed excavation and placement of arisings is shown as Figure A2.2.

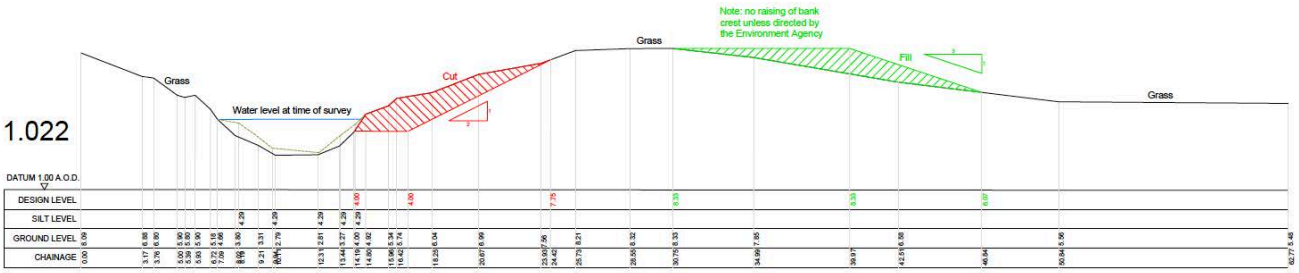

Figure A2.2 Sample of Cross Section Illustrating the Works

The works will commence in August 2019, with dredging commencing in September 2019. It is anticipated that all works will be completed in eight to ten weeks. Further activity to finalise bank profiles, vegetation restoration/management, deliver wider ecological enhancement and commence post works monitoring will occur in 2020.

The proposed project will contribute to:

- Relieve existing flood extents, durations and frequencies on several upstream moors including those on the River Sowy and Kings Sedgemoor Drain;
- Reduce the duration of flooding to the surrounding road network; and
- Reduce flooding impacts on the wider community and businesses.

In addition to these direct benefits, this scheme, (alongside the other improvement works undertaken within the FAP), will confer further benefits which are less readily quantified. Increasing the capacity of the channel

will allow greater opportunities for more flexible operation within the system when flood events are localised more in one catchment than another, or if emergency works are required. Additionally, increasing the flow passing Burrowbridge will result in increased channel velocities during low tides which will increase the natural erosion of sediment in the downstream channel, reducing the need for maintenance dredging.

Proposed Site Plan

Figure A2.3 provides the proposed extent of dredging and the proposed working area.

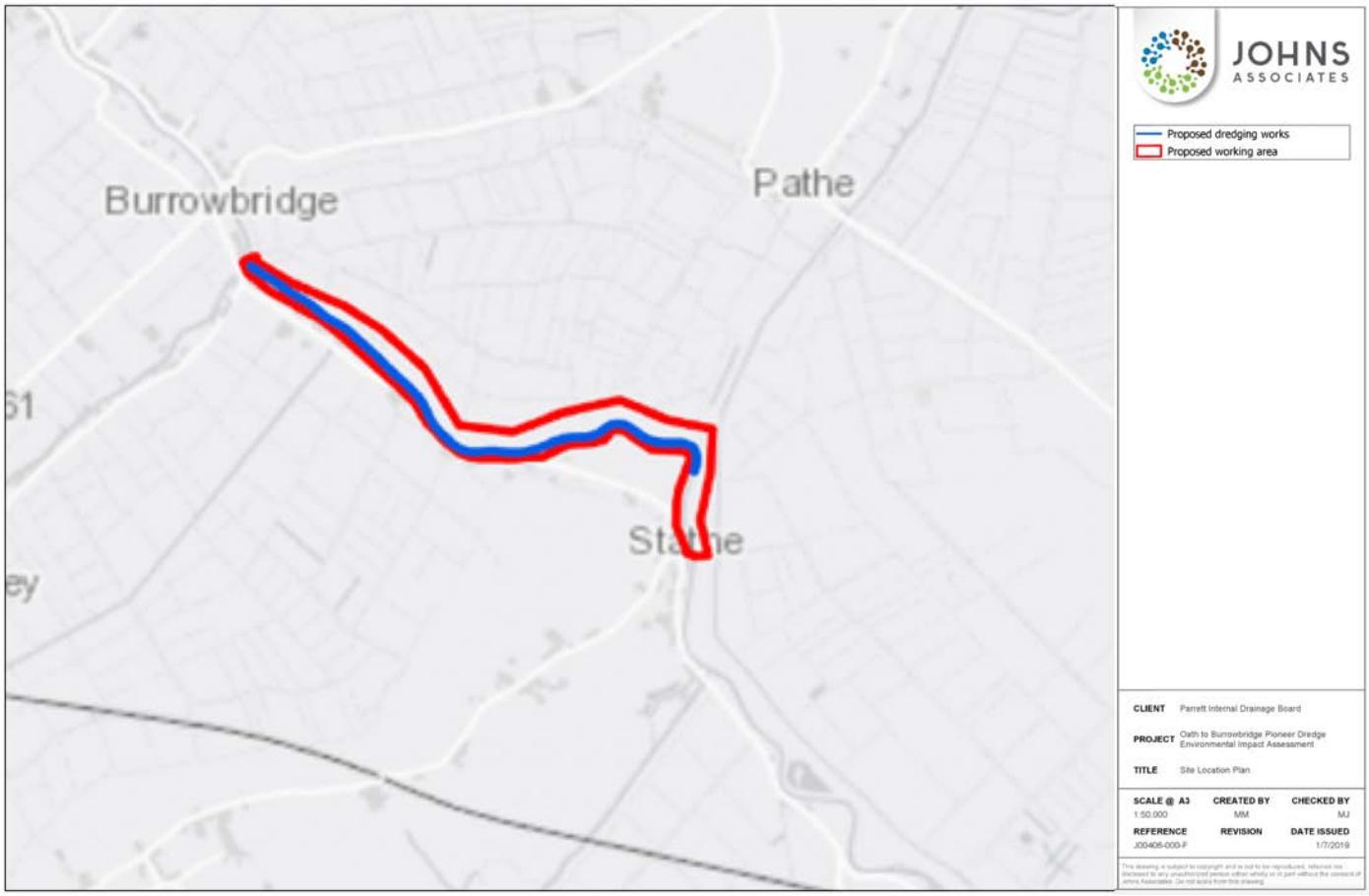

Figure A2.3 Proposed Extent of Dredging and Proposed Working Area

1.3 A3. INITIAL ASSESSMENT OF RISK TO EUROPEAN SITES

This section considers the designated European Sites which have the potential to be affected by the proposed dredging project. The location of European Sites in relation to the proposed project and the nature, type and scale of project impacts have been assessed to inform selection.

The Competent Authority has identified the following European Sites which have the potential to be affected by the proposed dredging project.

Site & Designation	Distance from Project	Size of Designated Site
Somerset Levels and Moors SPA	0 m to the North	6,395 Ha

Somerset Levels and Moors Ramsar	0 m to the North	6,388 Ha

Table A3.1 Considered European Sites

The Somerset Levels and Moors SPA and Ramsar sites have been scoped into the HRA for consideration due to the immediate proximity to the proposed development and the potential significant effect that the project may have on the integrity of the conservation status of the wider site as a result of potential changes to the hydrological functioning of the land.

Although there is an ecological link between the Somerset Levels and Moors SPA and Ramsar sites and the Severn Estuary SPA and Ramsar sites due to populations of wintering waterfowl using the Somerset Levels and Moors SPA and Ramsar sites as an alternative wintering site, inclusion of the Severn Estuary SPA and Ramsar sites have been scoped out of the HRA. It is considered that any potential significant effects upon bird species using the Somerset Levels and Moors SPA and Ramsar sites will be mitigated through the HRA and as a result any potential effects to birds which also overwinter in the Severn Estuary SPA and Ramsar sites will also be mitigated.

The Severn Estuary SAC site has been scoped out of the HRA. Recent Fish Surveys conducted in the River Parrett from May to September 2018 (Pers. Comm. Pledger, 2019)[i] have identified the presence of 13 fish species none of which are Annex II species that are a primary reason for selection of the SAC site. Additionally, it is not considered that the dredging works will result in a negative significant effect upon the Annex I habitats which are a primary reason for selection of the site which include Esturies; Mudflats and sandflats not covered by seawater at low tide; and Atlantic salt meadows *Glauco-Puccinellietalia maritimae* or on the Annex I habitats present as a qualifying feature but are not a primary reason for selection of the site (Sandbanks which are slightly covered by sea water all the time and Reef).

A hydrological assessment using the EA hydraulic flood model for the lower Parrett and Tone has been conducted on behalf of the PIDB[ii] to assess the potential changes in the extent and duration of the splash level flooding of the SPA and Ramsar sites as a consequence of the proposed Oath to Burrowbridge dredging project.

The hydrological assessment has been used to inform the scope of the HRA. Table A3.1 lists the component SSSI and Functionally Linked Land areas of the SPA and Ramsar sites that will be considered in the HRA.

Area	Location of Area from Project
Southlake Moor SSSI	0 m to the North
Long Load (King's Moor and Witcombe Bottom) Functionally Liked Land	10.57 km to the South East
Aller Moor Functionally Linked Land (partially within King's Sedgemoor SSSI)	85 m to the East
Curry Moor SSSI	2.17 km to the South West
West Sedgemoor SSSI	489 m to the South

Area	Location of Area from Project
Chedzoy	5.8 km to the North West
King's Sedgemoor SSSI	1.98 km to the North East
Wet Moor SSSI	7.05 km to the South East
West Moor SSSI	6.97 km to the South East
Moorlinch SSSI	5.98 km to the North East
Huish Level Functionally Linked Land	6.23 km to the South East
South Moor (East)	6.5 km to the South East
Langport Moors (Huish Bridge)	4.27 km to the South East

Table A3.1 Considered Areas

Catcott Edington and Chilton Moors SSSI, Shapwick Heath SSSI, Tealham and Tadham Moors SSSI, Westhay Heath SSSI and Westhay Moor SSSI components of the Somerset Levels and Moors SPA and Ramsar site have been scoped out of the HRA due to the large distance from the proposed dredging project and there being no expected indicative changes in flood duration at these locations.

2 PART B: INFORMATION ABOUT THE EUROPEAN SITES WHICH COULD BE AFFECTED

2.1 B1 BRIEF DESCRIPTION OF THE EUROPEAN SITES AND THEIR QUALIFYING FEATURES

The proposed dredging project has the potential to affect the integrity of the conservation status of two European Sites; Somerset Levels and Moors SPA and Somerset Levels and Moors Ramsar Site and they are considered in more detail below.

2.1.1 Important Features and Vulnerabilities of Somerset Levels and Moors SPA (UK9010031)

The Somerset Levels and Moors SPA was designated in 1997 and is one of the largest and richest areas of traditionally managed wet grassland and fen habitats in the lowland UK. The site covers the floodplains and tributaries of the River Axe, Brue, Parrett and Tone. The majority of the site is a few metres above sea level and drains through a large network of ditches, rhynes, drains and rivers. Flooding may affect large areas in the winter depending upon rainfall and conditions. Parts of the Brue Valley include areas of former raised peatbog that have been substantially modified by agricultural intensification and peat extraction which has created areas of open water, fen and reedbed. The SPA supports important numbers of waterbirds in winter. The Natura 2000 – Standard Data Form updated in December 2015[iii] states that the site qualifies under Article 4.1 of the Birds Directive (79/409/EEC[iv]) (amended to 2009/147/EC[v]) by supporting overwinter populations of European importance of the following species listed on Annex I of the Directive:

- Bewick's Swan *Cygnus columbianus bewickii*, 191 individuals representing at least 2.7% of the wintering population in Great Britain (5-year peak mean 1991/92 - 1995/96).

- Golden Plover *Pluvialis apricaria*, 3,029 individuals representing at least 1.2% of the wintering population in Great Britain (5-year peak mean 1991/92 - 1995/96).

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting overwinter populations of European importance of the following migratory species:

- Teal *Anas crecca*, 13,307 individuals representing at least 3.3% of the wintering North-western Europe population (5-year peak mean 1991/92 - 1995/96).
- Lapwing *Vanellus vanellus* 36,316 individuals representing at least 0.5% of the European breeding population (5-year peak mean 1991/92 - 1995/96).

The JNCC SPA citation includes a further two overwinter species with populations of European importance that the site qualifies under Article 4.2 of the Directive (79/409/EEC) which are also included in the HRA:

- Shoveler *Anas clypeata*, 501 individuals representing at least 1.3% of the wintering North western/Central Europe population (5-year peak mean 1991/92 - 1995/96); and
- Wigeon *Anas penelope*, 13,661 individuals representing at least 1.1% of the wintering Western Siberia/North western/North eastern Europe population (5-year peak mean 1991/92 - 1995/96).

The area qualifies under Article 4.2 of the Directive (79/409/EEC) as a wetland of international importance by regularly supporting an assemblage at least 20,000 waterfowl:

- Over winter, the area regularly supports 73,014 individual waterfowl (5-year peak mean 1991/92 - 1995/96) including: Snipe *Gallinago gallinago*, Lapwing, Pintail *Anas acuta*, Gadwall *Anas strepera*, Shoveler, Teal, Wigeon, Golden Plover, Bewick's Swan, Whimbrel *Numenius phaeopus*.

The Natura 2000 Data Form lists the following most important negative impacts and activities with a high effect on the site:

- Modification of Cultivation Processes (inside site);
- Cultivation (inside site); and
- Human Induced Changes in Hydraulic Conditions (inside and outside site).

The Natura 2000 Data Form lists the following most important positive impacts and activities with a high effect on the site:

- Forest & Plantation Management and Use;
- Improved Access to Site;
- Modification of Cultivation Processes;
- Interpretive Centres;
- Grazing; and
- Mowing/Cutting of Grassland.

2.1.2 Important Features and Vulnerabilities of Somerset Levels and Moors Ramsar UK11064

The JNCC Information Sheet on Ramsar Wetlands (RIS) dated June 2008[vi] states that the Ramsar site consists of a series of SSSIs within the largest area of lowland wet grassland and associated wetland habitat remaining in Britain. The site is one of the most important sites in southern Britain for breeding waders. The network of rhynes and ditches support an outstanding assemblage of aquatic invertebrates, particularly beetles.

The majority of the site is dominated by open wet grassland and ditches with a range of plant communities: Species-poor grassland including the semi-improved grassland communities with perennial rye grass and naturally-occurring species-poor floodplain or inundation grassland communities (National Vegetation Classification communities (NVC) include MG13, MG6, MG7, MG10).

Species-rich fen meadows and flood pastures where agricultural improvement has been less intense with MG8 *Cynosurus cristatus-Caltha palustris* grassland with meadow thistle *Cirsium dissectum* and marsh marigold *Caltha palustris* and mire communities such as M23, M24 and M25 with more *Juncus* (rush) and *Carex* (sedge) species. Smaller areas of drier species-rich hay meadows (MG5) with common knapweed *Centaurea nigra,* green-winged orchid *Orchis morio* and quaking grass *Briza media*.

In the rivers, rhynes and ditches the floristic diversity is largely dependent upon sympathetic cleaning practices. The field ditches support the greatest floristic diversity including the species; rootless duckweed *Wolffia arrhiza,* water violet *Hottonia palustris* and frogbit *Hydrocharis morsus-ranae*. Other habitats include

withy beds, orchards and pollarded willows. The remaining habitats are largely restricted to the SSSIs within the Bure Valley where areas of former raised bog have been modified by peat extraction and agricultural improvement. Small areas of tall herb fen (S24) with marsh pea *Lathyrus palustris,* milk parsley *Peucedanum palustre* and marsh fern *Thelypteris palustris* and small remnants of raised bogs which are very degraded and support vegetation more akin to wet heath with cross-leaved heath *Erica tetralix* and purple moor-grass *Molinia caerulea*.
Open water, reed swamp and reedbed with a range of species from submerged plants to tall stands of common reed *Phragmites australis* and bulrush *Typha latifolia* are found in the flooded peat workings. Wet woodland where peat has been cut many years ago and dominated by willow *Salix* spp., birch *Betula* spp. and alder *Alnus glutinosa*.

The Ramsar Sites Criteria which apply to the designation of the Ramsar site are as follows:

- Ramsar Criterion 2: Supports 17 British Red Data Book invertebrate species;
- Ramsar Criterion 5: Assemblages of international importance, species with peak counts in winter – 97,155 waterfowl (5-year peak mean 1998/99-2002/03); and
- Ramsar Criterion 6: Species/populations occurring at levels of international importance, qualifying species/populations (as identified at designation) with peak counts in winter:
    - Bewick's swan, 112 individuals, representing an average of 1.3 % of the GB population (5-year peak mean 1998/99 – 2002/03);
    - Teal, 21,231 individuals, representing an average of 5.3 % of the GB population (5-year peak mean 1998/99 – 2002/03); and
    - Lapwing, 36,580 individuals, representing an average of 1 % of the GB population (5-year peak mean 1998/99 – 2002/03).
- Ramsar Criterion 6: Species/populations identified subsequent to designation for possible future consideration under Criterion 6 with peak counts in winter:
    - Mute swan *Cygnus olor*, 842 individuals, representing an average of 2.2 % of the GB population (5-year peak mean 1998/99 – 2002/03);
    - Wigeon, 25,759 individuals, representing an average of 1.5 % of the GB population (5-year peak mean 1998/99 – 2002/03); and
    - Shoveler, 1,094 individuals, representing an average of 2.7 % of the GB population (5-year peak mean 1998/99 – 2002/03).

Noteworthy nationally important flora species occurring on the site include: Marsh-mallow *Althaea officinalis*, tasteless water-pepper *Persicaria laxiflora*, marsh pea, milk parsley, fen pondweed *Potamogeton coloratus*, hairlike pondweed *Potamogeton trichoides*, greater water-parsnip *Sium latifollum* and rootless duckweed.
Noteworthy nationally important bird species occurring on the site with peak counts in winter include:

- Gadwall, 522 individuals, representing an average of 3% of the GB population (5-year peak mean 1998/9- 2002/3);
- Water rail *Rallus aquaticus*, Europe 36 individuals, representing an average of 8% of the GB population (5-year peak mean 1998/9- 2002/3);
- Golden plover, 3857 individuals, representing an average of 1.5% of the GB population (5-year peak mean 1998/9- 2002/3);
- Ruff *Philomachus pugnax*, 16 individuals, representing an average of 2.2% of the GB population (5-year peak mean 1998/9- 2002/3); and
- Snipe, 1633 individuals, representing an average of 1.6% of the GB population (5-year peak mean 1998/9- 2002/3).

Nationally important invertebrate species occurring on the site include: Lesser silver water beetle *Hydrochara caraboides*, flowering rush weevil *Bagous nodulosus*, orange-horned green soldier fly *Odontomyia angulata*, leaf beetle *Oulema erichsoni*, Large-mouthed valve snail ('Parrett snail') *Valvata macrostoma*, ornate brigadier true fly (species of soldier fly) *Odontomyia ornata*, large marsh grasshopper *Stethophyma grossum*, a snail-killing species of marsh fly *Pteromicra leucopeza*, sea club-rush hoverfly *Lejops vittata*, type of soldier beetle *Cantharis fusca*, Rove beetle *Paederus caligatus*, species of predatory water beetle *Hydaticus transversalis*, species of diving beetle *Dytiscus dimidiatus*, great silver water beetle *Hydrophilus piceus*, water beetle *Limnebus aluta*, species of diving beetle *Laccornis oblongus*.
No factors are reported on the Ramsar Information Sheet (RIS) that adversely affect the site's ecological character, including changes in land (including water) use and development projects. The site is stated not to be subject to adverse ecological change.

2.2 B2 EUROPEAN SITE CONSERVATION OBJECTIVES

2.2.1 Conservation Objectives of Somerset Levels and Moors SPA (UK9010031)

The Conservation Objectives[vii] for the Somerset Levels and Moors SPA are to ensure that the integrity of the site is maintained or restored to favourable condition as appropriate, subject to natural change and ensure that the site contributes to achieving the aims of the Wild Birds Directive by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of their qualifying features;
- The supporting processes on which the habitats of their qualifying features rely;

- The population of each of their qualifying features; and

- The distribution of their qualifying features within the site.

The Natural England and Natura 2000 supplementary advice on conserving and restoring site features of the SPA (NE, 2019)[viii] provides further specific targets and advice including:

- Bewick's Swan: Restore the size of non-breeding population to a level which is at or above 310 individuals, while avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

- Golden Plover: Maintain the size of the non-breeding population at a level which is at or above 3,110 individuals, while avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

- Teal: Maintain the size of the non-breeding population at a level which is at or above 7,476 individuals, while avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

- Lapwing: Maintain the size of the non-breeding population at a level which is at or above 36,565 individuals, while avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

- Assemblage of Waterfowl: Maintain the overall abundance of the non-breeding assemblage at a level above 20,000 individual wintering wetland birds. Maintain the species diversity of the bird assemblage.

The supply of water to a standard should be maintained which provides the necessary winter flood regime which includes a mixture of splash, shallow and deep flooded areas and a pattern of natural low -level flood events across the floodplain. Favourable water levels outlined within the supplementary advice must be maintained from 1 December to the end of February. Water level management on component SSSIs is implemented in line with ten Water Level Management Plans (WLMPs) approved by NE, the EA and the Parrett Internal Drainage Board (PIDB) in July 2011.

The SPA qualifying features are relatively insensitive to organic and nutrient pollution. The current water quality of the Somerset Levels and Moors is likely to be adequate to support the SPA qualifying features, however poor water quality can adversely affect the availability and suitability of feeding and roosting habitats. Typically meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC)[ix] are sufficient to support the SPA Conservation Objectives but in some cases more stringent standards may be required.

Grassland used by SPA birds should be managed by grazing or mowing and removing field-dried hay followed by aftermath grazing. By November the sward should comprise a mixture of grass tussocks and areas of shorter grass from 5 to15 cm in height. Livestock should be removed by the end of November. Fields should support a mixture of grasses and herbs with some patches of rushes and sedges to provide vegetation and seeds for ducks and swans to eat in the winter.
The landscape should remain relatively free of tall trees and scrub to provide sightlines for birds of over 200 m to reduce excessive predation in feeding areas and roost sites. In winter (1 December to 31 March) water within rhynes must have a minimum depth of 30 cm.

2.2.2 Conservation Objectives Somerset Levels and Moors Ramsar UK11064

Ramsar sites do not have conservation objectives for their features published. The habitat area of the Ramsar site overlaps with the area of the SPA and as a result the SPA objectives and the habitat requirements for many of the Qualifying Features of the SPA also apply to Qualifying Features of the Ramsar site. The conservation objective for European Sites can be applied to the features of Ramsar sites and that is: Subject to natural change, to maintain the Ramsar features and their supporting habitats in favourable condition.

The Natural England and Natura 2000 supplementary advice on conserving and restoring site features of the SPA (NE, 2019)[Xii] states that water quality poses a risk to the Ramsar Site. Diffuse water pollution caused by high phosphate levels from nutrient enrichment eg inorganic and organic agricultural fertilisers, soil loss from arable land and overflows from private septic tanks is the main source of lowered water quality through the Somerset Levels and Moors.

Diffuse water pollution is relevant to the ditch aquatic plant and invertebrate communities which suffering from the effects of hyper-eutrophication. Management measures implemented to improve water quality include PR19 (Ofwat), Catchment Sensitive Farming Programme (CSF) and the Somerset Levels and Moors Ramsar Diffuse Water Pollution from Agriculture Plan. The EA has also undertaken nutrient modelling to identify the relative importance of diffuse and point pollution and is working with the water companies to reduce point sources at sewage treatment works.

2.3 B3 CONSERVATION STATUS OF QUALIFYING FEATURES AND SITE CONDITION OF EUROPEAN SITES

The Wetlands Birds Survey (WeBS) Report (British Trust for Ornithology (BTO), 2019)[x] for the Somerset Levels and the Site Improvement Plan (SIP) for the Somerset Levels and Moors SPA[xi] has been used to inform this section.

2.3.1 Conservation Status and Site Condition Somerset Levels and Moors SPA (UK9010031)

The Qualifying Features of the Somerset Levels and Moors SPA are: A037 Bewick's swan (non-breeding); A052 Teal (non-breeding), A140 Golden Plover (non-breeding); A037 Bewick's swan (non-breeding); and waterbird assemblage. The conservation status and underlying trends of the Qualifying Features of the SPA are variable[xii] and are discussed in further detail below.

The SPA supported a peak mean of 310 Bewick's swan individuals in the period 1989/90 to 1993/94 when the SPA was notified, which have dramatically declined to 5 individuals in the period 2012/13 to 2016/17.

The current 2017/18 WeBS data for the Somerset Levels has an annual peak count of 2 individuals. This reflects national and international trends and the WeBS have issued High Alerts for an 80% population decrease over the medium term (10-years data assessed) and an 89% population decrease over the long term (up to 25 years). Unfavourable conditions on breeding grounds, staging areas and overwintering sites are all possible reasons. This species is very sensitive to disturbance.

There has been a substantial increase in golden plover from 3,110 individuals in the period 1989/90 to 1993/94 when the SPA was notified, to 14,024 individuals in the period 2012/13 to 2016/17. The current 2017/18 WeBS data for the Somerset Levels has an annual peak count of 10,723 individuals. Flocks are highly mobile responding to prevailing weather conditions, available food resources and levels of disturbance. It is less dependent than most waders on shallow flood events to provide favourable feeding conditions.

There has been a substantial increase in Teal when the SPA was notified from 7,476 individuals in the period 1989/90 to 1993/94 to 21,918 individuals in the period 2012/13 to 2016/17. The current 2017/18 WeBS data for the Somerset Levels has an annual peak count of 7,588 individuals; slightly higher than at notification. The SPA is now the most important overwintering sit for teal in the UK. The majority (70%) of individuals are recorded on West Sedgemoor SSSI which is an RSPB reserve. The counts are made in the daytime when birds are roosting at night they may disperse to other parts of the SPA and land of functional importance outside it to feed (Chown, 2001)[xiii].

King's Sedgemoor (West) is sub-optimal for teal as a result of interrupted sightlines and disturbance. It is unknown why numbers remain very low on King's Sedgemoor East when a Raised Water Level Area is maintained over 159 ha. Teal is extremely sensitive to disturbance, and particularly vulnerable to severe cold weather. Maintenance of extensive areas of shallow water across the SPA is essential to support the population at its current level.

The SPA supported a peak mean of 36,565 lapwing individuals when the SPA was notified in the period 1989/90 to 1993/94 which has declined to 32,896 individuals in the period 2012/13 to 2016/17. The current 2017/18 WeBS data for the Somerset Levels has an annual peak count of 32,909 individuals. WeBS have issued a Medium Alert for a 31% decrease in the medium term (10-years data assessed). The majority of the overwintering population (59%) on the Somerset Levels and Moors are supported at two RSPB reserves: West Sedgemoor SSSI which is within the SPA and Greylake Reserve which is outside of the SPA. Lapwing fly from these refuges at night to land within and outside of the SPA (Chown, 2001). Flocks can be highly mobile responding to weather conditions, food resources and levels of disturbance.

The SPA supported a peak mean of an assemblage of waterfowl of 58,093 individuals when the SPA was notified in the period 1989/90 to 1993/94 comprising 41,442 waders and 16,651 wildfowl. There has been a substantial increase to 90,205 individuals in the period 2012/13 to 2016/17. In addition to population changes in the aforementioned waterfowl species, the conservation status and underlying trends of

additional species within the assemblage (gadwall, wigeon, shoveler, pintail, snipe and whimbrel) are variable and are discussed in further detail below.

The SPA supported a peak mean of 94 gadwall individuals when the SPA was notified in the period 1989/90 to 1993/94 which has increased to 618 individuals in the period 2012/13 to 2016/17. The current 2017/18 WeBS data for the Somerset Levels has a further increased annual peak count of 895 individuals. Despite this increase, there are indications of a decline in overwintering numbers on the SPA with WeBS Medium Alerts issued for a 42% population decrease over the short term (5-years data assessed) and for a 40% population decrease over the medium term (10-years data assessed).

The SPA supported a peak mean of 148 pintail individuals when the SPA was notified in the period 1989/90 to 1993/94 which has substantially increased to 922 individuals in the period 2012/13 to 2016/17. The current 2017/18 WeBS data for the Somerset Levels has an annual peak count of 218 individuals, however the 5-year average for the period 2012/13 to 2017/18 is 780 which is higher than at notification of the SPA. A highly mobile species, pintail occurs in small numbers across the floodplain.

The SPA supported a peak mean of 5,927 wigeon individuals when the SPA was notified in the period 1989/90 to 1993/94 which has substantially increased to 23,543 individuals in the period 2012/13 to 2016/17. The current 2017/18 WeBS data for the Somerset Levels has an annual peak count of 12,211 individuals. The Somerset Levels and Moors are the third most important overwintering site in the UK for wigeon. About 20% of the national population overwinter on inland sites where they feed on short swards and sometimes crops. Large areas of un-flooded but wet grassland need to be maintained to sustain this species.

The highest concentration of wigeon (42% of the total population) is recorded on West Sedgemoor. At night birds disperse to feed elsewhere in the SPA and land of functional importance outside it (Cheung, 2001). Extensive and prolonged deep-water floods are detrimental to its presence on the Somerset Levels and Moors.

The SPA supported a peak mean of 217 shoveler individuals when the SPA was notified in the period 1989/90 to 1993/94 which has increased to 1,380 individuals in the period 2012/13 to 2016/17. The current 2017/18 WeBS data for the Somerset Levels has an annual peak count of 1,129 individuals. When flooded, West Sedgemoor is particularly important with a 5-year peak of 372 individuals.

The SPA supported a peak mean of 1,768 snipe individuals when the SPA was notified in the period 1991/92 to 1995/96 which has decreased to 1,254 individuals in the period 2012/13 to 2016/17. The current 2017/18 WeBS data for the Somerset Levels has a lower annual peak count of 785 individuals and a 5-year mean average peak for the period 2012/13 to 2017/18 of 829 individuals. The Somerset Levels and Moors remains the most important overwintering site for snipe in the UK. The species is difficult to count accurately due to good camouflage and secretive behavior and the overwintering population will be higher.

The SSSI Condition Assessments of the component parts of the SPA which are scoped into consideration for assessment have been used to further inform the conservation status and site condition of the SPA. Table

B3.1 provides the Condition Assessment of the considered SSSI areas. This shows that water quality, in particular, nutrients are currently restricting recovery of certain parts of the SPA.

Area	Units	Unit Condition	Adverse Condition Reasons/Comments
Southlake Moor SSSI	044 - 046	Unfavourable – Declining (100%)	Freshwater Pollution, Discharge Pollution. High levels of Phosphate from inlet sources leading to algal dominance exceeding 10% target in major watercourses and side ditches have resulted in Unfavourable – Declining Condition. Site supports waders and wintering waterfowl which roost and feed on RWLAs in mid-winter.
Curry Moor SSSI	079 – 100, 102	Unfavourable – Declining (98.26%)	Agriculture, drainage, inappropriate water levels, water pollution, agricultural runoff, water pollution discharge. High Phosphate levels. Non-native nuttalls waterweed present in most ditches. 40 overwintering bird species recorded by Somerset Ornithological Society in Dec 2013. WeBS counts show low levels of lapwing and golden plover but increases in duck species. Lack of safe roosts due to water level management. Unfavourable invertebrate assemblage. Uneven range in succession of ditches. Steeply shelving banks in ditches.
	101	Favourable (1.74%)	Most droves appear in reasonably condition apart from in very wet conditions.
West Sedgemoor SSSI	115 - 121	Unfavourable - Declining	Freshwater Pollution, Discharge Pollution. Site checks conducted in 2016 found overall most of site appears to be in favourable condition. Site continues to support high numbers of wintering waterfowl roosting on flooded fields which are free from disturbance. High levels of Phosphate from inlet sources leading to algal dominance exceeding 10% target in major watercourses and side ditches have resulted in Unfavourable – Declining Condition. Attributes of notified infield plant communities at or above the required level.
King's Sedgemoor SSSI	087 - 107	Unfavourable - Declining	Freshwater Pollution, Discharge Pollution. Site checks conducted in 2017 found overall most of site features appear to be in favourable condition. Site

Area	Units	Unit Condition	Adverse Condition Reasons/Comments
			continues to support high numbers of wintering waterfowl, roosting and feeding on flooded fields within the RWLA which are relatively free from disturbance. High levels of Phosphate from inlet sources leading to algal dominance exceeding 10% target in major watercourses and side ditches have resulted in Unfavourable – Declining Condition.
Wet Moor SSSI	047 – 048, 052, 054, 056 – 057, 059 – 064	Unfavourable – Recovering (66.7%)	Most ditches assessed in favourable in 2009 with high species diversity in good condition. Units 054, 055, 057, 062 and 063 had poor range of ditch succession. Ditches had low water levels in Unit 053. Ditches were in unfavourable condition in Unit 054 Invertebrates in favourable condition. Wintering birds in favourable condition. Winter waterfowl numbers increased over last 20 years. Bewick's swan increasingly scarce and diving duck like pochard only seen on occasional deep flood.
	066	Unfavourable – No Change (3.09%)	Freshwater Pollution, Discharge Pollution Water quality issues (2009). Invertebrates in favourable condition.
	049 – 051, 053, 055, 058, 065	Favourable (30.22%)	Ditches assessed in favourable condition with good species diversity although early stages of succession lacking slightly. Several ditches required cleaning to reduce waterlogging. Invertebrates in favourable condition. Wintering birds in favourable condition. Winter waterfowl numbers increased over last 20 years. Bewick's swan increasingly scarce and diving duck like pochard only seen on occasional deep flood.
West Moor SSSI	042 - 051	Unfavourable - Declining	Inappropriate Cutting/Mowing, Undergrazing, Freshwater Drainage, Inappropriate Water Levels, Inappropriate Weirs, Dams and Other Structures, Freshwater Pollution, Discharge Pollution, Lack of Corrective Works, Inappropriate Weed Control, Public Access/Disturbance, Agricultural Run-off. No species rich grassland found at the site in 2012. Overwintering bird population has declined over the last

Area	Units	Unit Condition	Adverse Condition Reasons/Comments
			10 years (2012). Site conditions for birds appear to be declining. Many ditches require active management, and some have non-native species present in low numbers. Some prolonged water-logging present. Droves in Unit 051 were in relatively poor condition with deep ruts; run-off from droves may affect water quality.
Moorlinch SSSI	087 - 107	Unfavourable - Declining	Freshwater Pollution, Discharge Pollution. Most site features overall appear to be un Favourable Condition (2017). The site continuous to support relatively high numbers of waders and wintering waterfowl, roosting and feeding on flooding fields within the RWLA which are relatively free from disturbance. High levels of Phosphate from inlet sources leading to algal dominance exceeding 10% target in major watercourses and side ditches have resulted in Unfavourable – Declining Condition. There is an indication that vascular plants associated with the ditch network may have declined since the site was notified.
		Favourable	Moorlinch Condition Summary states that 2.44% is in Favourable Status however the Site Unit Condition Assessment does not list this category in the assessment.

Table B3.1 Condition Assessment of Considered SSSI Areas

2.3.2 Conservation Status and Site Condition Somerset Levels and Moors Ramsar UK11064

No factors are reported on the Ramsar Information Sheet (RIS) that adversely affect the site's ecological character, including changes in land (including water) use and development projects. The site is stated not to be subject to adverse ecological change. In the absence of specific data relating to the Somerset Levels and Moors Ramsar site, the conservation status of Qualifying Features is informed by WeBS data. Paragraphs 2.3.5 to 2.3.13 outline the current 2017/18 peak counts for teal, lapwing, wideon, shoveler and assemblages of waterfowl and Table B3.1 provides the current Site Condition Assessments for component SSSI areas of the Ramsar site.

- The site supported a peak mean assemblage of 97,155 waterfowl in the period 1998/99 to 2002/03 when the Ramsar was notified which has decreased to 90,205 individuals in the period 2012/13 to 2016/17.

- The site supported a peak mean of 112 Bewick's swan individuals in the period 1998/99 to 2002/03 when the Ramsar was notified which has substantially decreased to 4 individuals in the period 2012/13 to 2017/18.
- The site supported a peak mean of 21,231 teal individuals in the period 1998/99 to 2002/03 when the Ramsar was notified which has substantially decreased to 7,588 individuals in the period 2012/13 to 2017/18.
- The site supported a peak mean of 36,580 lapwing individuals in the period 1998/99 to 2002/03 when the Ramsar was notified which has decreased to 33,779 individuals in the period 2012/13 to 2017/18.
- The site supported a peak mean of 842 mute swan individuals in the period 1998/99 to 2002/03 when the Ramsar was notified which has increased to 1,097 individuals in the period 2012/13 to 2017/18. The current 2017/18 WeBS data for the Somerset Levels has a higher annual peak count of 1,215 individuals.
- The site supported a peak mean of 25,759 wigeon individuals in the period 1998/99 to 2002/03 when the Ramsar was notified which has decreased to 21,835 individuals in the period 2012/13 to 2017/18.
- The site supported a peak mean of 1,094 shoveler individuals in the period 1998/99 to 2002/03 when the Ramsar was notified which has increased to 1,333 individuals in the period 2012/13 to 2017/18.

A desk-based review of the habitat requirements of the 17 Ramsar invertebrates listed under Ramsar criterion 2, known to be present within local designated sites and an assessment of likely presence of these species within the proposed stretch of the River Parrett was conducted by Johns Associates in 2018[xiv].

Species Common Name	Species Latin Name	Site Condition for Species
Lesser silver water beetle	*Hydrochara caraboides*	Appears to be restricted to swamp areas and ditches associated with peat moors on the Somerset Levels. The NBN Atlas shows the distribution of *H. caraboides* is confined to the northern area of the Somerset Levels above Bridgewater.
Flowering-rush weevil	*Bagous nodulosus*	There are no local records on the NBN Atlas. A very rare weevil associated with the flowering-rush *Butomus umbellatus.*
Orange-horned green soldierfly	*Odontomyia angulata*	The orange-horned green soldierfly was historically known from the Brue valley moors from Street Heath to Edington (Vice-County [VC] 6). It was historically found in a small area of the Somerset Moors where the habitat may have been grazing marsh but could have been more similar to wet fenny heath on peat. Larvae have been recorded from the vegetated edge of pools, and they may be amphibious rather than truly aquatic as some of the pools are ephemeral. The closest record of this species on the NBN Atlas is at Westonzoyland.
Leaf beetle	Oulema erichsoni	There are no records of this species south of Bridgewater.

Large-mouthed valve snail	*Valvata macrostoma*	It could be found in the adjacent ditches, although this is unlikely unless there are historic records to suggest previous presence. The NBN Atlas shows a cluster of records near the West Sedgemoor Drain near Stoke St. Gregory.
Ornate brigadier true fly	*Odontomyia ornata*	This species is nationally scarce, being recorded in less than 40 hectares since 1990. However, the species is not showing a decline. There are unconfirmed reports of *O. ornata* from ditches near Burrowbridge so it may be pertinent to sample suitable ditches adjacent to the dredging site. WWT Consulting found *Odontomyia ornata* (precise location not given) whilst undertaking sweep surveys in vegetation in North Somerset in 2014.
Large marsh grasshopper	*Stethophyma grossum*	The large marsh grasshopper is a rare species with colonies being located in Somerset, Wiltshire, Hampshire and Surrey.
A snail-killing fly	*Pteromicra leucopeza*	Only one NBN Atlas record exists for the Somerset Levels; near Meare (unconfirmed). There are only 44 records of this species for the whole of the UK.
Sea club-rush hoverfly	*Lejops vittata*	One unconfirmed NBN Atlas record near Burrowbridge but not on the main R. Parrett channel. A very rare hoverfly of coastal levels and brackish marsh habitat where sea club-rush (*Scirpus maritimus*) is abundant. locally-occasional stands of sea club-rush were recorded during the Phase 1 Habitat Survey undertaken by Johns Associates in 2018[xv]
Soldier beetle	*Cantharis fusca*	WWT Consulting found soldier beetle individuals whilst undertaking sweep surveys in vegetation in North Somerset in 2014 (precise location not given).
Rove beetle	*Paederus caliagatus*	There are only 45 NBN Atlas records of this species for the whole of the UK, with two unconfirmed records from the Somerset Levels north of Shapwick.
Water beetle	*Hydaticus transversalis*	Fairly common across the Somerset Levels. There are confirmed NBN Atlas records in waterbodies near Burrowbridge.
Water beetle	*Dytiscus dimidiatus*	There are confirmed records of this species in water bodies near Burrowbridge on the NBN Atlas.
Great silver water beetle	*Hydrophilus piceus*	There are confirmed records of this species in water bodies near Burrowbridge on the NBN Atlas.
Water beetle	*Limnebus aluta*	Records on the NBN Atlas from the northern Somerset Levels with the majority in the vicinity of Shapwick.
Water beetle	*Laccornis oblongus*	Scattered records on the NBN Atlas are from the northern Somerset Levels with the majority in the vicinity of Shapwick.

Table B3.2 Condition Assessment of River Parrett for 17 Ramsar Invertebrate Species

PART C: SCREENING OF THE PLAN OR PROJECT FOR APPROPRIATE ASSESSMENT

To determine whether an Appropriate Assessment is required, there are two screening tests required by the assessment provisions of the Habitat Regulations which are set out below (C1 and C2) and are known as the HRA Test of Likely Significant Effects.

2.4 C1. IS THE PLAN OR PROJECT EITHER DIRECTLY CONNECTED OR NECESSARY TO THE CONSERVATION MANAGEMT OF THE EUROPEAN SITE'S QUALIFYING FEATURES?

This HRA relates to the proposed dredging of the Stathe to Burrowbridge section of the River Parrett and is therefore not directly connected with or necessary to the management of the European Site's qualifying features.

2.5 C2. LIKELIHOOD OR RISK OF SIGNIFICANT ADVERSE EFFECTS

This section details whether impacts from the project which are not directly connected with or necessary to the management of the European Sites' features, could conceivably adversely affect a European Site and would have a **likely significant effect**, either alone or in combination with other plans and projects on the Conservation Objectives of the sites outlined in Section B2.

In accordance with European case law, this HRA has considered an effect to be 'likely' if it '*cannot be excluded on the basis of objective information'* and is 'significant' if it *'undermines the conservation objectives'* (Case C127-02 *Waddenzee* para. 45 and 47*).* In accordance with Defra guidance on the approach to be taken to this decision, the Test asks whether the plan or project '*may'* have a significant effect i.e. there is a risk or a possibility of such an effect.

This assessment of risk therefore considers the precautionary principle where there is scientific doubt. The assessment excludes, at this stage, any measures proposed and outlined in the submitted details of the plan/project that are specifically intended to avoid or reduce harmful effects on a European site(s). As set out by the People over Wind and Sweetman v Coillte Teoranta ruling (April 2018), mitigation proposals cannot be taken into consideration in the HRA Test of Likely Significant Effects.

The proposed dredging project has been assessed against the European Site Conservation Objectives and against the relevant Qualifying Features. The assessment of potential effects has been informed with the best available evidence and information available.

2.6 C2.1 RISK OF SIGNIFICANT EFFECTS FROM PROJECT

Predicated impacts resulting from the proposed dredging project are considered in this section and the potential effects upon the European Sites are initially considered in isolation of the combined effects of any other enabled plans or projects.

The assessment of impacts upon the European designated sites has been conducted at two levels. First, a list of potential effects of the proposals is applied to the Qualifying Features of the two European Sites. Such effects are deemed to be potentially significant or not, based upon a consideration of the ecology of the features involved and, particularly, having regard to the list of pressures and threats for each of the key features. This first level of the assessment for Somerset Levels and Moors SPA and Somerset Levels and Moors Ramsar is presented in Table C2.1. Following this initial assessment, a more detailed Appropriate Assessment is presented for the potentially significant effects upon the integrity of the conservation status of the two European Sites.

Feature	Potential Impacts						
	Permanent	Temporary					
	Water Level Management	Noise, Disturbance & Vibration from Construction	Light Disturbance from Construction	Pollution Incidents	Fallout/Pollution from Construction Vehicle Emissions	Disruption of Movement of Fauna	Loss/Disturbance of Habitat from Construction
Somerset Levels and Moors SPA Habitat and Qualifying Bird Species	PS	PS	NS: No night-time construction works	PS	NS: Only 4-5 construction vehicles operating for 8-10 weeks	PS	PS
Somerset Levels and Moors Ramsar Habitat and Qualifying Species	PS	PS	NS: No night-time construction works	PS	NS: Only 4-5 construction vehicles operating for 8-10 weeks	PS	PS

Table C2.1 Tabulation of Potentially Significant Effects on European Designated Sites

Footnote: PS denotes potentially significant
NS denotes not significant

2.7 C3. OVERALL SCREENING DECISION FOR THE PLAN/PROJECT

On the basis of details submitted by Parrett Internal Drainage Board, the project has been considered under Regulation 24(1) or 64(1)(a) of the Habitats Regulations. It is concluded that in light of sections C1 and C2 that the dredging project is likely to (or may have) a significant effect without mitigation on the Qualifying Features of the Somerset Levels and Moors SPA and Ramsar sites and an Appropriate Assessment of the project is required.

3 PART D: APPROPRIATE ASSESSMENT AND CONCLUSIONS ON SITE INTEGRITY

3.1 D1. SCOPE OF APPROPRIATE ASSESSMENT

The following section outlines an Appropriate Assessment of the impacts of the dredging project in view of the Conservation Objectives for the European Sites. All Qualifying Features of the European Sites listed in Section B1 have the potential to be significantly affected by the dredging project and are all relevant to this Appropriate Assessment.

3.2 D2. EXISTING EVIDENCE

Data regarding the conservation status and site condition of the Qualifying Features of the designated sites outlined in section B3 of this report has been used to inform the Appropriate Assessment.
Baseline hydrological and ecological surveys have been conducted by Johns Associates and the IPDB in 2018 include:

- Oath to Burrowbridge: Ramsar Invertebrates. Johns Associates, October 2018[xiv]; and
- River Parrett (Stathe to Burrowbridge) Dredge Habitats Regulations Assessment, May 2019, Somerset Drainage Board Committee (Appendix 1).

3.3 D3. ASSESSMENT OF POTENTIAL ADVERSE EFFECTS CONSIDERING THE PLAN OR PROJECT

3.3.1 Noise Disturbance & Vibration from Construction

The overwintering period for SPA/Ramsar bird species begins on 1 October 2019. The dredging works will commence in September and will continue for 8 to 10 weeks, resulting in 4-6 weeks of dredging occurring at the start of the overwintering period for the European Sites. No night-time works will occur.

A study compiled by the Institute of Estuarine and Coastal Studies (IECS), University of Hull (2009)[xvi] found that construction noise emissions below 50 dB had a low effect and no impact on waterbirds. Piling noise 50 – 70 dB caused behavioural changes (heads up, alarm calls, changing in feeding/roosting activity). Disturbance noise above 70 dB resulted in a moderate to high effect to birds resulting in movement within the feeding zone. The study concluded that "construction noise levels should be restricted to below 70 dB (A); birds will habituate to regular noise below this level. Where possible, sudden irregular noise above 50 dB (A) should be avoided as this causes disturbance to birds".

Cutts (1999)[xvii] also concluded that noise emissions equal to or below 70dB initiated behavioural response but no flight response. The study also found that irregular piling noise (above 70dB) could produce a flight response.

A detailed measurement study was undertaken of noise levels at the Pyewipe mudflats during piling for the new Grimsby River Terminal (Postlethwaite and Stephenson, 2012)[xviii] which found slightly higher tolerance by wintering birds to levels of disturbance noise. The study found that a behavioural response (heads looking up and temporarily stopping feeding or roosting) occurred in the range of 66 – 83 dB (A) for percussive piling. Birds swam or walked away from disturbance before resuming feeding in the range of 68 – 81 dB (A) and birds took flight and landed in same feeding area or left area completely when percussive piling noise level was greater than 83 dB (A). No behavioral response occurred at percussive piling levels less than 66 dB (A).

The Defra Noise Database for Prediction of Noise on Construction and Open Sites (2005)[xix] states that the expected sound level from the long-reach tracked excavator is 78 dB (A) at source. The current ambient noise levels within Southlake SSSI adjacent to the River Parrett and noise prediction levels are not known. In a free field, a doubling of distance from a noise source reduces the sound pressure by 6 dB. In the absence of a noise assessment for the dredging works; the noise disturbance from the excavator is predicted to decrease below 70 dB at approximately 4 m from the dredging works and to below 50 dB at approximately 30 m from the works.

Assuming that wintering birds use the area within Southlake Moor SSSI up to the banks of the River Parrett, an increase in 50 – 70 dB (A) construction noise will potentially affect a 30 m width along the length of the 2.2 km of dredging which will result in a behavioral response in birds (alarm calls, heads up, change in feeding/roosting pattern) using 6.6 ha of the SPA. This area equates to 0.1% of the area of the SPA and Ramsar Sites being low to moderately affected by noise disturbance.

An increase in more than 70 dB (A) construction noise will potentially affect a 4 m width along the 2.2 km of dredging which will result in birds taking flight and leaving the feeding area within 0.88 Ha of the SPA. This area equates to 0.014% of the area of the SPA and Ramsar Sites being moderately affected by noise disturbance.

No impact techniques eg piling will be used for the dredging, it is unlikely that there will be any high levels of irregular impulsive sound due to the dredging activities; the noise disturbance will be at a constant level. Three large excavators and potentially one small excavator will be used within the dredging works and therefore the actual area being affected at any one time will be less than 2.2 km in length. It is considered likely that wintering birds will become accustomed to the noise of the excavators and will become habituated to the constant noise disturbance.

Based upon the very small area of the SPA and Ramsar sites that will be affected by the noise disturbance (0.014% moderate disturbance and 0.1% low to moderate disturbance) there is a predicted **minor adverse** significant effect upon wintering birds within Somerset Moors and Levels SPA and Ramsar site.

Construction vibration is not expected as a result of the dredging project and there is a predicted **negligible** adverse effect from construction vibration upon wintering birds using the Southlake SSSI area of the Somerset Levels and Moors SPA and Ramsar site.

3.3.2 Pollution Incidents from Construction

The Somerset Levels and Moors SPA and Ramsar Sites could be vulnerable to accidental pollution incidents such as dust and silt generation, mobilisation of contaminants and fuel spillage into surface and ground water and on the terrestrial land. Although the likelihood or frequency of such accidental pollution risks are low, a one-off event could be acute upon sensitive ecology.

There is a low potential for dust generation as a result of the dredging; the dredged material will be damp at the point of removal and will be compressed and re-graded on the banks immediately. The conditions during the Autumn and Winter months of the dredging works tend to be damp with higher rainfall which will suppress production of dust. Dust deposition is likely to be temporary and minimal causing no significant chemical changes within the water. There is a predicted **negligible** significant effect from dust generation upon Somerset Levels and Moors SPA and Ramsar sites.

Extensive sampling, chemical analysis and screening of sediment within the site of the proposed dredging was completed in 2018[xx]. Geotechnical analysis of Particle Size Distribution testing was also carried out to determine the grading of the sediment. Overall the sediment appeared to be of good chemical quality, with no exceedances of any of the screening criteria recorded in any of the samples. The sediment was classified as 'Dredging spoil not containing hazardous substances' with the European Waste Code (EWC) 170506. Based on the analyses carried out, the sediment is suitable for bankside retention, and does not pose a risk. The sediment passed the SSV and PTE screening criteria, indicating that there are no contaminants present which would be detrimental to agricultural land. There is a predicted **negligible** significant effect from mobilisation of contaminants upon Somerset Levels and Moors SPA and Ramsar sites.

Silt could be mobilised from the dredged material and nutrient-rich run-off could enter nearby ditches and rhynes within the SPA and Ramsar sites. A study on the potential dredging impacts to bankside habitat and/or disposal of dredged sediment upon the 17 species of Ramsar Invertebrate supported by Somerset Levels and Moors Ramsar site (Johns Associates, 2018)[xiv] concluded that four invertebrate species; Ornate brigadier true fly *Odontomyia ornate*, Water beetle *Hydaticus transversalis*, Water beetle *Dytiscus dimidiatus and* Great silver water beetle *Hydrophilus piceus* could be affected by sediment/run-off into ditches outside the proposed working area. The potential effect associated with mobilisation of silt upon the Somerset Levels and Moors SPA and Ramsar site is predicted to be **minor adverse.**

The Surface Water and Flood Risk (within ES Chapter 7) assessment of baseline conditions of surface water and shallow ground water within the Somerset Levels and Moors SPA and Ramsar site estimated the potential effect of a pollution incident such as oil spillage and silty runoff is predicted to be **moderate adverse**

3.3.3 Disruption of Movement of Fauna from Construction

The lower 1 – 2 m width of the marginal vegetation dominated by reed canary grass *Phalaris arundinacea* along the River Parrett will be retained to provide continuous critical habitat for invertebrate fauna. There is a predicted **negligible** significant effect from disruption of fauna from construction upon Ramsar invertebrate species.

3.3.4 Loss/Disturbance of Habitat from Construction

Material dredged from the upper banks of the River Parrett will be deposited on the landward side of the northern (right) flood bank crest resulting in a temporary loss of neutral semi-improved grassland, wet grassland and improved grassland habitat from the area of deposition within the SPA and Ramsar site which could be used by wintering birds. The location of the site compound will be within the construction area. There is a predicted **minor adverse** significant effect from loss/disturbance of habitat upon the SPA and Ramsar.

A study on the potential dredging impacts to bankside habitat and/or disposal of dredged sediment upon the 17 species of Ramsar Invertebrate supported by Somerset Levels and Moors Ramsar site (Johns Associates, 2018)[xiv] concluded that one invertebrate species; Sea club-rush hoverfly *Lejops vittata* could be affected by placement of dredged material on sea club rush *Scirpus maritimus* bankside habitat. The potential effect associated with loss of habitat upon the Somerset Levels and Moors Ramsar site is predicted to be **minor adverse**.

3.3.5 Water Level Management from Operation

A hydrological modelling study compiled by SDBC has been used to inform this HRA (Appendix 1). The EA hydraulic flood model for the lower Parrett and Tone was used to assess the potential effects of conveyance improvements. Light Detecting and Ranging (LiDAR) land level data were used to calculate the area of land which the model indicated would have at least 50 mm depth of water (splash conditions) at the peak flood level of model runs for the 2012 summer floods. The 2012 summer floods are considered to be a suitable reference event for winter floods that have an estimated probability in occurrence (ie a 1 in 3 year to a 1 in 5 year flood event).

The modeling includes the following caveats and assumptions:

- The model is calibrated to analyse large flood flows and not changes in more frequent small flood events which are the focus of the study to inform the HRA;
- The model uses reference flow events, rather than flows of known probability;
- The model does not include the ditch networks or water level management infrastructure; and
- Modelling includes the length of the River Parrett from Oath to Burrowbridge which is approximately 50% more than the actual length of proposed dredging from Sathe to Burrowbridge, therefore the actual increase in conveyance will be less.

The model has predicted changes to the level and duration of winter surface splash flooding in the following areas outlined in Table D3.1 as a result of the dredging of the River Parrett. The results of the hydrological modelling are also presented in Figures D3.1 and D3.2.

Area	Change (ha)	Change within SSSI	Change Outside SSSI	Change within RWLAs	Change outside RWLAs	Difference in Flood Duration
Southlake Moor SSSI	-1.8	-1.7	-0.1	-1.78	-0.02	No difference
Long Load (King's Moor and Witcombe Bottom) Functionally Liked Land	-69.4	0	-69.4	0	-69.4	-2 days to -7 days
Aller Moor Functionally Linked Land (partially within King's Sedgemoor SSSI)	-65.2	-6.1	-59.1	-6.24	-58.96	7 Areas: – 12 hrs to – 2 days 1 Area: No difference
Curry Moor SSSI	59	43.5	15.5	2.41	56.59	1 Area + 12 hrs to + 2 days 2 Areas: + 2 days to + 7 days
West Sedgemoor SSSI	-58.5	-57.7	-0.8	-36.42	-22.08	2 Areas: No difference 1 Area: – 2 days to – 7 days
Chedzoy	-47.2	0	-47.2	0	-47.2	– 12 hrs to – 2 days
King's Sedgemoor SSSI	-39.3	-35.9	-3.4	-1.05	-38.25	4 Areas: – 12 hrs to – 2 days 1 Area: No difference
Wet Moor SSSI	-29.7	0.3	-30	1.21	-31.09	6 Areas: – 12 hrs to – 2 days 4 Areas: – 2 days to – 7 days

Area	Change (ha)	Change within SSSI	Change Outside SSSI	Change within RWLAs	Change outside RWLAs	Difference in Flood Duration
West Moor SSSI	-22	-21.8	-0.2	-12.78	-9.22	– 2 days to – 7 days
Moorlinch SSSI	-7	-2	-5	-3.65	-3.35	– 12 hrs to – 2 days
Huish Level Functionally Linked Land	-4.9	0	-4.9	0	-4.9	– 2 days to – 7 days
South Moor	-2.2	0	-2.2	0	-2.2	1 Area – 2 days to – 7 days 1 Area: – 12 hrs to – 2 days 3 Areas: No difference
Langport Moors	-0.9	0	-0.9	0	-0.9	1 Area: – 12 hrs to – 2 days. 1 Area: No difference

Table D3.1 Analysis of Indicative Changes in Flood Extent for the Parrett Dredge

Figure D3.1 Analysis of Indicative Changes in Flood Extent for the Parrett Dredge

Figure D3.2 Analysis of Indicative Changes in Flood Duration for the Parrett Dredge

Using the 2012 summer floods as a proxy for a small winter flood, hydraulic modelling of current baseline conditions indicates a total flood area across all Parrett Moors of nearly 3,500 ha. This reduces by nearly 300 ha as a result of the Parrett dredging in the model. Across all moors there is an approximate 7% reduction in flood area. Changes in flood extent are greatest (70%) outside the areas of SSSI (200 ha) and 80% is outside of Raised Water Level Areas (RWLAs) (230 ha). It must be noted that the reductions will in fact be smaller for the proposed dredging project, which is approximately 50% of the modelled scheme.

Langport Moors, West Sedgemoor, Aller Moor, King's Sedgemoor and Chedzoy experience the greatest change in flood extent and have a predicted minimum 10% reduction in flooding. Reductions in flood duration are relatively small: typically, a 12-hour to a 2-day reduction in flooding due to increased flood flow conveyance of the River Parrett.

RWLAs considerably contribute to achieving and sustaining wetland condition of the SPA and maintain the required conditions during December to February. It is possible to compare RWLA to the effect of dredging in terms of area and duration: ha/days (the length time flooded multiplied by area). Assuming 50% the area within RWLAs achieves the required winter conditions, RWLAs contribute 167,300 ha/days, which compares with a reduction of 1500 ha/days for a typical winter flood as a consequence of the proposed Parrett Dredge. This represents a 1% reduction in SPA winter flood conditions due to dredging, when compared to the combined contribution of RWLAs. The potential effect associated with water level management upon the Somerset Levels and Moors SPA and Ramsar site is predicted to be **minor adverse**.

3.3.6 Summary of Potentially Adverse Effects Considering the Project (Alone)

The proposed dredging has the following potential adverse effects upon the integrity of the conservation status of the Somerset Levels and Moors SPA and Ramsar European Sites:

- Temporary In-Direct Minor Adverse Effect from Noise: Potential flight response in wintering birds predicted in 0.014% area of the European Sites.

- Temporary In-Direct Moderate Adverse Effect from Pollution Incidents from Construction: Potential siltation/oil spill and contamination of ditches within the European Sites;

- Temporary Direct Minor Adverse Effect from Loss/Disturbance of Habitats from Construction: Removal of grassland and potential sea club rush habitat from European Sites; and

- Permanent In-Direct Minor Adverse Effect from Water Level Management from Operation: Predicted 1% reduction in SPA/Ramsar site winter flood conditions in European Sites.

3.4 D4. ASSESSMENT OF POTENTIAL ADVERSE EFFECTS CONSIDERING THE PLAN OR PROJECT IN-COMBINATION WITH OTHER ENABLED PLANS AND PROJECTS

There is a requirement for the dredging project to be assessed in-combination with other enabled projects to assess the cumulative effects that could potentially arise from the combination of different aspects of the projects. A Water Framework Directive Assessment[xxi] and consultation with the Environment Agency and

Natural England has been completed and has identified one project; the Sowy Flood Relief Channel Project as requiring to be considered in-combination for the purposes of this Appropriate Assessment.

The construction period of the Sowy project will not overlap and as a result there will be no increased combined effects as a result of noise, pollution incidents and loss/disturbance of habitats. There are potential in-combination effects as a result of water level management and this is assessed further in detail below.

3.4.1 In-Combination Water Level Management from Operation

The hydrological modelling study compiled by SDBC has been used to assess the combined effects of the proposed dredging within the River Parrett with the proposed Sowy Flood Relief Channel Project on the surface water conditions within the SPA and Ramsar sites and on Functionally Linked Land. The model has assessed a larger scheme area for the Sowy than the area which will in fact be dredged. The model has predicted changes to the level and duration of winter surface splash flooding in the following areas outlined in Table D4.1. The results of the hydrological modelling are also presented in Figures D4.1 and D4.2.

Area	Change (ha)	Change within SSSI	Change Outside SSSI	Change within RWLAs	Change outside RWLAs	Difference in Flood Duration
Southlake Moor SSSI	-3.8	0	-3.8	0	0.0	No difference
Long Load (King's Moor and Witcombe Bottom) Functionally Liked Land	-84.1	0	-84.1	0	-84.1	-2 days to -7 days
Aller Moor Functionally Linked Land (partially within King's Sedgemoor SSSI)	-205.4	-33.7	-171.7	-15.61	-189.79	6 Areas: -2 days to -7 days 1 Area: –12 hrs to –2 days 1 Area: No difference
Curry Moor SSSI	11.8	8.5	3.3	0.8	11	No difference
West Sedgemoor SSSI	-88.9	-87.7	-1.2	-54.49	-34.41	2 Areas: No difference 1 Area: – 2 days to –7 days
Chedzoy	21.7	0	21.7	0	21.7	No difference

Area	Change (ha)	Change within SSSI	Change Outside SSSI	Change within RWLAs	Change outside RWLAs	Difference in Flood Duration
King's Sedgemoor SSSI	47.3	45.4	1.9	-1.1	48.4	3 Areas: – 2 days to – 7 days 2 Areas: No difference
Wet Moor SSSI	-63.4	-1.3	-62.1	0.94	-64.48	Areas: – 2 days to – 7 days
West Moor SSSI	-26.1	-25.8	-0.3	-15.26	-10.84	– 2 days to – 7 days
Moorlinch SSSI	7.4	-0.5	7.9	-0.84	8.24	No difference
Huish Level Functionally Linked Land	-21.7	0	-21.7	0	-21.7	– 2 days to – 7 days
South Moor	-3.9	0	-3.9	0	-3.9	1 Area: – 2 days to – 7 days 2 Areas: – 12 hrs to – 2 days 2 Areas: No difference
Langport Moors	-5.8	0	-5.8	0	-5.8	1 Area: – 12 hrs to – 2 days. 1 Area: – 2 days to – 7 days

Table D4.1 Analysis of Indicative Changes in Flood Extent for the Parrett Dredge and Sowy Combined

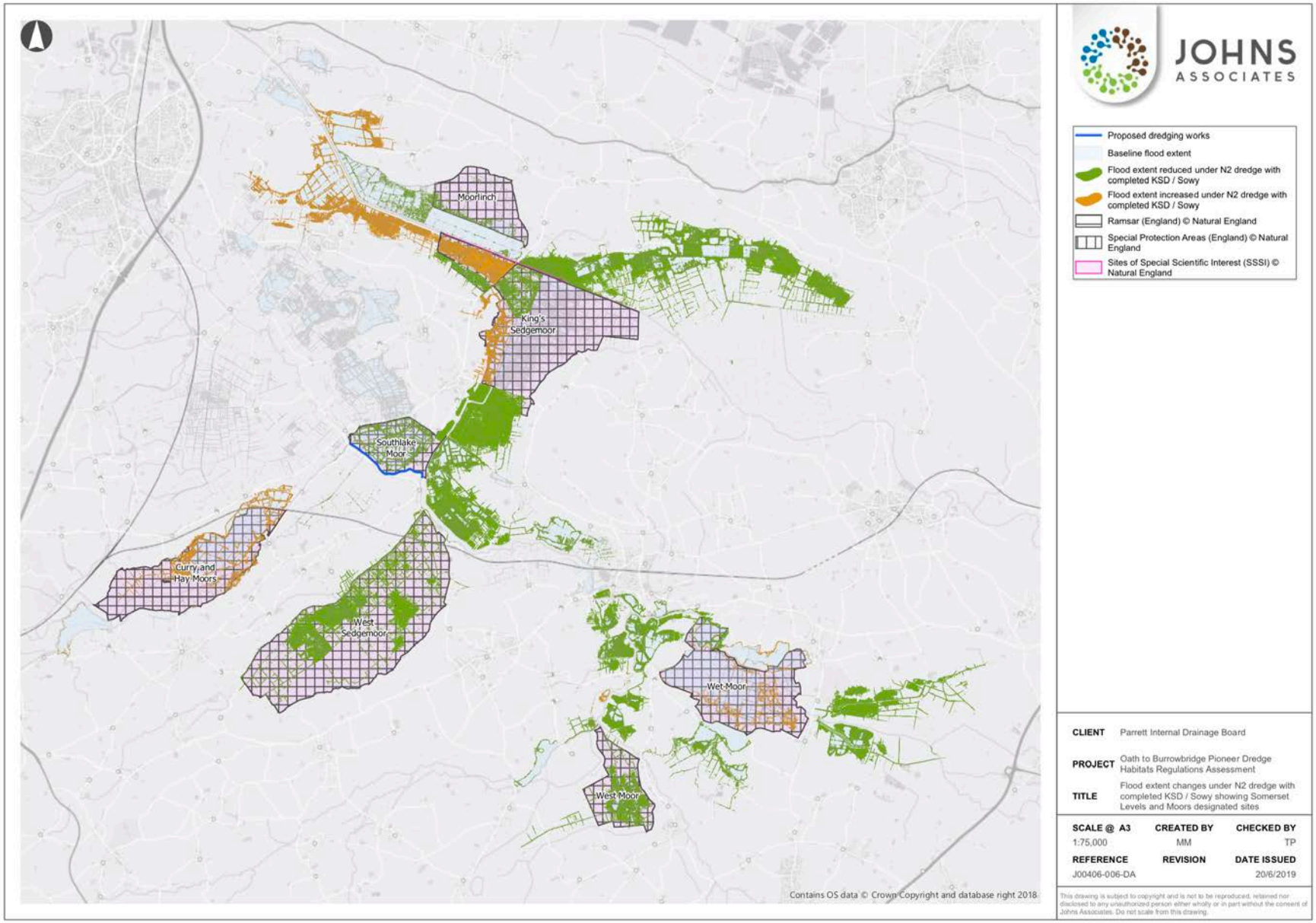

Figure D4.1 Analysis of Indicative Changes in Flood Extent for the Parrett Dredge and Sowy Combined

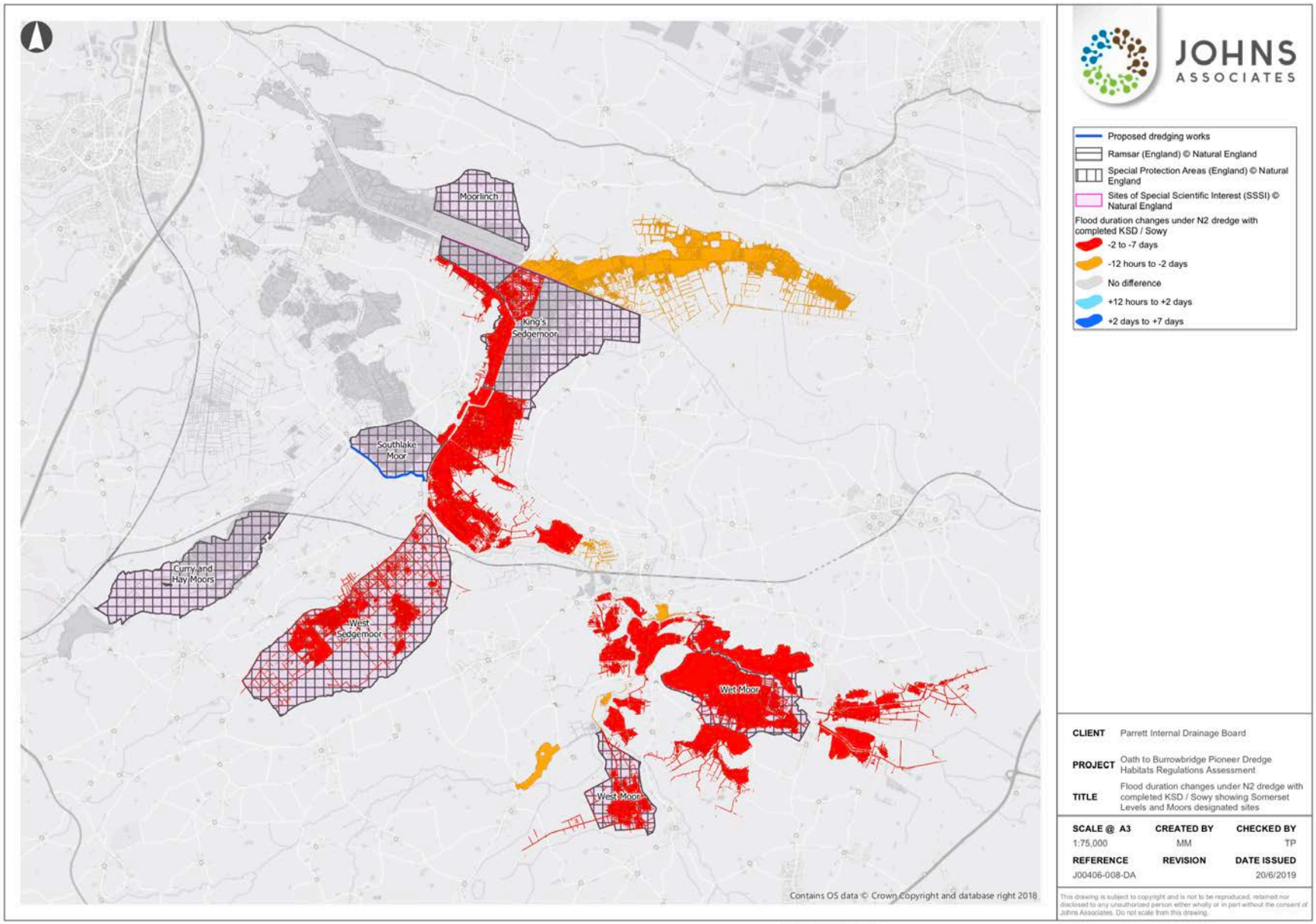

Figure D4.2 Analysis of Indicative Changes in Flood Duration for the Parrett Dredge and Sowy Combined

Hydraulic modelling of the combined effects of the Parrett Dredge and Sowy indicate a combined reduction in flood area of 15%, compared to 7% for dredging alone. Again, the greatest changes occur for Langport Moors, West Sedgemoor and Aller Moor. However, there is a slight reduction in the decrease in flood extent for Moors downstream of Beer Wall.

The actual changes flood extent and duration, delivered by both the Dredge and the Sowy, are likely to be less than indicated in the modelling, simply because the increases in flood flow conveyance will be approximately 50% less than the scheme designs modelled in this analysis.

The potential effect associated with water level management as a result of the Parrett dredging with the Sowy Dredging upon the Somerset Levels and Moors SPA and Ramsar site is predicted to be **minor adverse**.

3.5 D5. MITIGATION OF ADVERSE EFFECTS

This section discusses mitigation (using avoidance where possible) to minimise adverse effects on the European Sites and other features considered in this report. Mitigation will require the involvement of relevant authorities and agreement of specific measures to achieve the protection of the European protected species and habitats that may potentially be affected by the proposed dredging project.

There are likely significant effects arising from the proposed dredging project and cumulative effects of the Sowy project. Mitigation is discussed below, taking each of the points in turn.

3.5.1 Noise Disturbance & Vibration from Construction

Construction noise mitigation measures will be outlined in a site-specific CEMP. General principles for control will include: The maximum sound levels of all plant used on the remediation site will comply with EC directive 2001/14/EC; best practical means will be employed to limit noise levels; site vehicles will not be over-revved, or left with engines idling; and auxiliary equipment will be shut down when not in use and sited with due consideration.

On a site-specific basis, an Ecological Clerk of Works (ECoW) will conduct a daily assessment of migratory wintering birds present within South Lake adjacent to the site works and will monitor the behavioural response of the birds to the dredging works. Should birds not become habituated to the effect of constriction noise, the ECoW will direct the location of digging where feasible to avoid the effects of noise upon the birds using the site at that time. Following mitigation there is predicted to be a negligible residual significant effect.

3.5.2 Pollution Incidents from Construction

With operation management and control of deliveries the risk of pollution incidents during construction to the Somerset Levels and Moors SPA and Ramsar sites is small, however the area is highly sensitive. Mitigation includes: Bank re-instatement, appropriate bunding for temporary fuel or chemical storage; use of less toxic alternatives; provision of emergency spill kits; examination of unusual solid materials or liquids, and following best practice approach in accordance with specifications with the Construction Environmental Management Plan (CEMP).

3.5.3 Loss/Disturbance of Habitat from Construction

The new bank created from the deposition of the dredged material will be re-seeded using a mix appropriate to the hydrological conditions, soil type and local area. The bank will be fenced off temporality over a 12-month period to prevent poaching and trampling by cattle while the vegetation re-establishes.

Following re-instatement of the grassland habitat there is predicted to be a **negligible residual significant** effect.

3.5.4 Water Level Management from Operation

Mitigation measures for changes to water level extent and duration have been informed and agreed through consultation with the EA, NE, RSPB and PIDB. Table D5.1 provides a summary of the agreed mitigation, approved by the PIDB, SDBC, NE and EA at a minuted meeting on 28th June 2019. Following implementation of the mitigation measures there is predicted to be a **negligible residual significant** effect.

Area	Description	Type	Responsible Body	When	Comments
Aller Moor	Remedial Work at Beer Wall	Structures	EA	Autumn 2019	Not part of Sowy scheme mitigation but as completion of Beer Wall project.
	WLMP change – winter penning levels for Aller Moor	Operational protocols WLMP – at least 300mm of water in ditches at winter pen	EA/IDB	Winter 2020/21	Use EA structures Church Drove, Oxleaze Drove and IDB structure Stathe Drove to pen winter level. Operate IDB weirs Lucas Rhyne, Black Withies and Leazeway to hold water in winter. Maintain a 30 cm ditch water level.
	Operation of Langacre and Beer Wall	Operational Protocols	EA	Completion of beer wall 2019/20	Operate to effect 'no change' in winter months. ('no change' baseline - before the culverts were put under the road).
	Monitoring & WLMP update	Monitoring & WLMP update	IDB	2020 – 2022	Ecological and Monitoring plan.
King Sedgemoor (Non SSSI) Butleigh and Walton Moor, 18 ft rhyne	Telemetry to be installed at Nythe structure	Telemetry	IDB	Autumn 2019	Telemetry installed at Greylake.
	Monitor using telemetry at greylake and nythe structure	Monitoring	IDB	2020 – 2022	If effect seen then investigate operate Greylake sluice differently (environmental trigger). Or alternative option: purchase a piece of land and create new RWLA.
	Consider Operation of Greylake sluice Consider Nythe structure or other alternative.	Operating Protocols (Monitoring & Mitigation)	IDB	2022	If required and feasible, as informed by monitoring.

Area	Description	Type	Responsible Body	When	Comments
West Sedgemoor (SSSI)	Monitoring compliance of existing WLMPS	Operating Protocols (Monitoring & Mitigation)	EA	2020/21	Monitoring to trigger operational protocol of pumping stations.
Long Load (King's Moor and Witcombe Bottom)	Monitoring	Overwintering bird survey and existing data review	IDB	2019/20	
Long Load (King's Moor and Witcombe Bottom)	Operation of Long Load pumping station and syphon	Environmental Trigger points	2 year approach to affect.		Only if effect seen through monitoring? Operate to effect 'no change' in winter months. Retention of ecologically beneficial water.
Wet Moor (non SSSI)		Monitor		Effect after two years	Water levels, telemetry, levels and duration
Wet Moor (non SSSI)	Operate North barrier bank and sluice. Operate HEPs for the West	Environmental Trigger Points			Operate to effect 'no change' in winter months. Retention of ecologically beneficial water. Only if effect seen through monitoring?
West Moor (SSSI)	Replace RWLA structures	Structure	EA to install, IDB to operate	2020/21	Replace 4 stock structures, modification of 2 tilting weirs) approx. £100k Alternative Option: Possibility to extend the RWLA, re resilient wet grassland project.
West Moor (SSSI)	WLMP	WLMP review			

Area	Description	Type	Responsible Body	When	Comments
Huish Level	Assess potential WLM options.	Study	IDB/EA	2021	
Moorlinch RWLA	Refurbish the existing RWLA, Consider minor extension to the east	Construction/Appraisal	EA – Construction IDB – Future operation	2021 -2023	
King Sedgemoor SSSI	Monitor site conditions	Monitoring	IDB / EA	2020 ONWARDS	
Curry Moor SSSI	Monitor site conditions	Monitoring	IDB /EA	Continuation of existing	Monitoring already in place for Curry moor,

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Table D5.1 Water Level Management Mitigation Measures

3.6 D6. CONCLUSIONS ON SITE INTEGRITY

The Appropriate Assessment conducted under Regulation 24 or 63 of the Habitats Regulations 2017 to ascertain whether there will be an adverse effect upon the integrity of European Sites has concluded that with the mitigation measures outlined within this HRA report implemented that there will be a **negligible adverse effect** upon the integrity of the conservation status of the Somerset Levels and Moors SPA and Ramsar Sites as a result of the proposed dredging of the River Parrett either alone or in combination of the River Sowy dredging project.

[i] Technical note: 2018 pre-dredge River Parrett fish surveys. Pledger, AG (2019). Email by Andrew Pledger, Geography and Environment, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK.

[ii] . River Parrett (Stathe to Burrowbridge) Dredge Habitats Regulations Assessment, May 2019, Somerset Drainage Board Committee

[iii] JNCC, 13/06/08. Natura 2000 – Standard Data Form UK9010031 Somerset Levels and Moors

[iv] European Council Directive 79/409/EEC on the Conservation of Wild Birds

[v] European Council Directive 2009/147/EC on the Conservation of Wild Birds

[vi] JNCC, 13/06/08. Information Sheet on Ramsar Wetlands (RIS) UK11064 Somerset Levels and Moors

[vii] European Site Conservation Objectives for Somerset Levels and Moors SPA Site Code UK9010031, 21 February 2019 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

[viii] Improvement Programme for England's Natura 2000 Sites (IPENS) Planning for the Future. Site Improvement Plan Somerset Levels and Moors UK9010031. Version 1 04/11/2014

[ix] Water Framework Directive (WFD 2000/60/EC

[x] Frost, T.M., Austin, G.E., Calbrade, N.A., Mellan, H.J., Hearn, R.D., Robinson, A.E., Stroud, D.A., Wotton, S.R. and Balmer, D.E. 2019. Waterbirds in the UK 2017/18: The Wetland Bird Survey. BTO/RSPB/JNCC. Thetford.

[xi] Improvement Programme for England's Natura 2000 Sites (IPENS) Planning for the Future. Site Improvement Plan Somerset Levels and Moors UK9010031. Version 1 04/11/2014

[xii] European Site Condition Objectives: Supplementary advice on conserving and restoring site features, Somerset Levels and Moors SPA Site Code: UK9010031. Natural England, 4 February 2019.

[xiii] Chown, D. 2001. Nocturnal use of the Somerset Levels and Moors floodplain by overwintering waterfowl: 2000/2001, A report to the English Nature Somerset Team.

[xiv] River Parrett Oath to Burrowbridge: Ramsar Invertebrates, Johns Associates, October 2018.
[xv] Phase 1 Johns Associates, 2018

[xvi] IECS (2009), Institute of Estuarine and Coastal Studies, University of Hull. Report *Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance* to Humber INCA

[xvii] Cutts, N.D. (1999) Avifaunal Disturbance Assessment, Flood Defence Work, Saltend. Report to the Environment Agency.

[xviii] Grimsby River Terminal (Postlethwaite and Stephenson, 2012. Xodus Group

[xix] Update of Noise Database for Prediction of Noise on Construction and Open Sites, Defra, 2005

[xx] Reference sediment analysis report, 2018

[xxi] WFA In-combination document

APPENDIX 1

River Parrett (Stathe to Burrowbridge) Dredge Habitats Regulations Assessment

May 2019, Philip Brewin, SDBC Ecologist

Aims:

- Assess potential changes in surface water conditions on SPA Moors in the Parrett and Tone Moors, during the winter months (Dec-Feb), as a consequence of the proposed Parrett Dredge between Stathe to Burrowbridge.
- Assess combined effects of the proposed Parrett Dredge and Sowy Flood Relief Channel Project on surface water conditions on the Moors in winter.

Objectives:

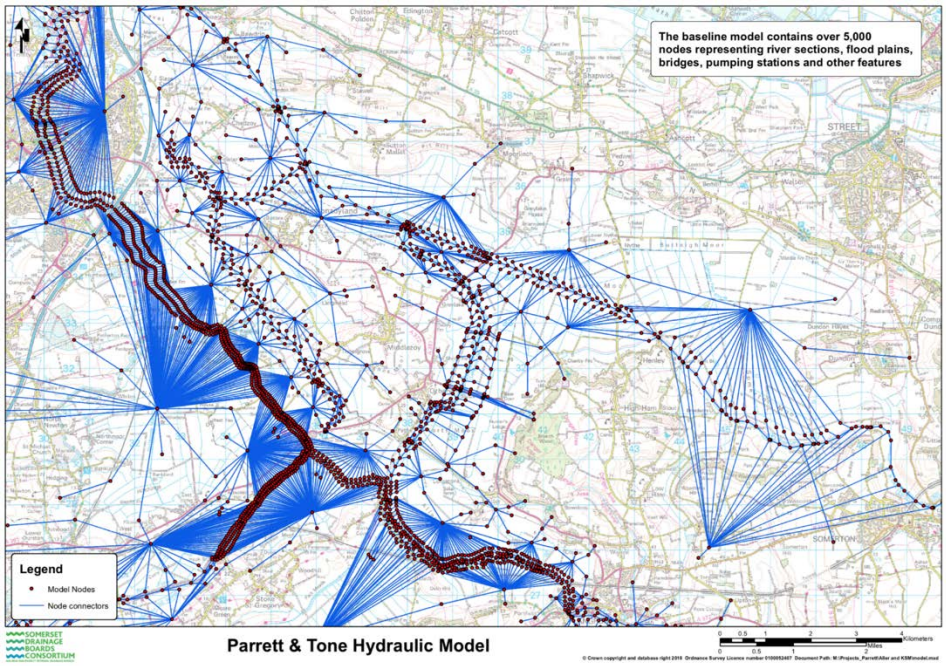
- Identify areas where changes in winter surface water conditions are likely occur as a consequence of increased flood flow conveyance in the Parrett and the Sowy.
- Assess the potential magnitude of these changes, in terms of flood extent and duration, for small winter floods that contribute to achieving the required SPA conditions.
- Determine the significance of these changes in relation to the Favourable Conservation Status of the Levels and Moors SPA.
- Identify infrastructure improvements and changes in operational protocols required to mitigate any significant effects.
- Formally agree the mitigation requirements and implement changes in the respective Water Level Management Plans.

Modelling:

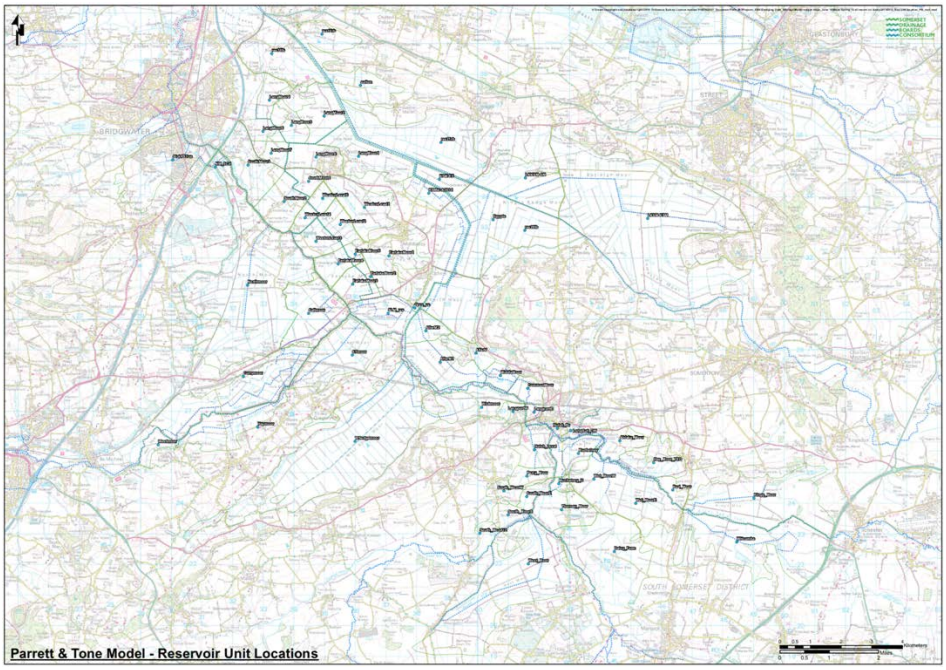
- The EA hydraulic flood model for the lower Parrett and Tone was used to assess the potential effects of conveyance improvements in the Parrett Dredge (Stathe to Burrowbridge) and the combined effects of the Parrett Dredge with the Sowy Project.
- Model runs of the 2012 summer floods were used to produce flood hydrographs for each area, for the following scenarios:
    1. Current baseline conditions (including 2014 Parrett and Tone Dredge etc)
    2. Stathe to Burrowbridge Dredge (current baseline + Dredge 7m^3s)
    3. Stathe to Burrowbridge Dredge and the Sowy (current baseline + Dredge 7m^3s + Sowy 7m^3s)
- The 2012 summer floods are the smallest flood flows for which the model is calibrated.
- The 2012 summer floods are considered a suitable proxy (reference event) for winter floods that have an estimated probability of occurrence, in any one year, of between 20-30% (i.e. a 1 in 3 year to 1 in 5 year winter flood event).
- Flood hydrographs for each scenario were compared to identify indicative changes in both flood extent and flood duration for each area, taking into account designations and RWLAs.

Important Caveats and Assumptions:

- The model's primary purpose is the analysis large flood flows and the model works well for flood flows that are within the calibrated range of the model. The HRA assessment focuses on changes that occur during more frequent small flood events.
- The model uses reference flow events, rather than flows of known probability.
- The model does not include the ditch networks or all water level management infrastructure, which affects interpretation of model output for some areas.
- The Dredge and Sowy designs assessed in the model are 'full' schemes (approx. increase flood flow conveyance of 7m^3s for both). The current proposed designs for both projects are smaller and therefore the actually increase in conveyance will be less (approx. 3-4m^3s).

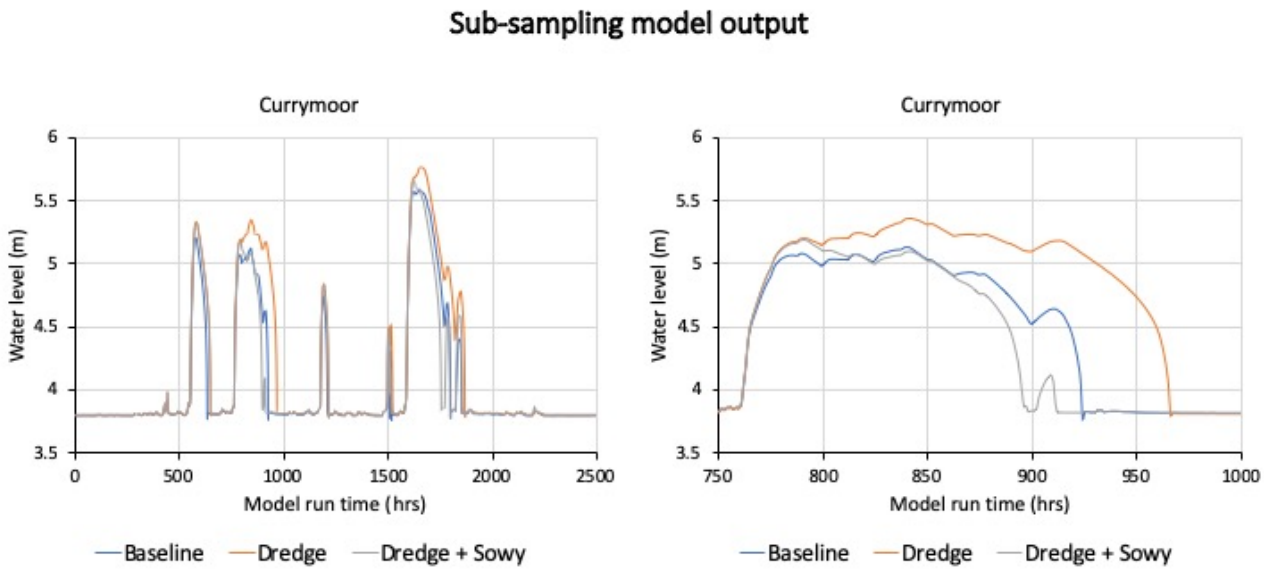


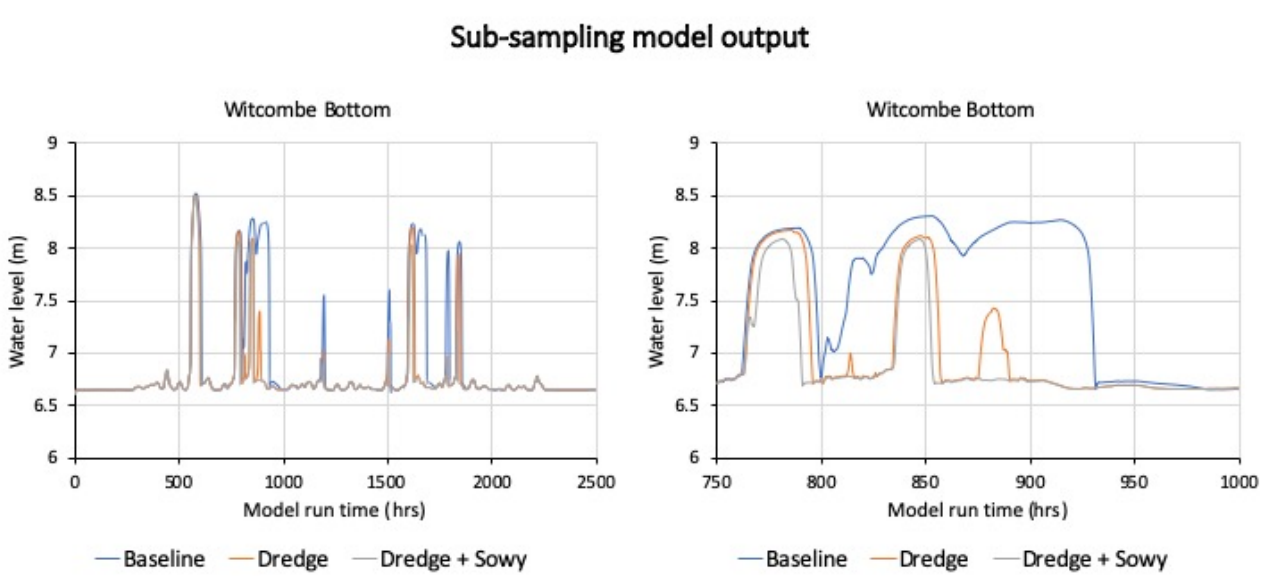
Parrett & Tone Hydraulic Model



Methods:

- The 2012 summer floods are represented in a 100-day model run, consisting of multiple flood peaks. After analysis of the full model run, the model output was subsampled to assist interpretation of the results in relation to a single flood flow event. Interpretation of the subsampled model run is presented here.
- Local knowledge was used to assist in interpretation of model outputs, especially in areas where the model was less able to indicate likely changes in flood extent or duration.





Analysis of indicative changes in flood extent and duration:

Flood Extent

- Peak flood levels for each area were compared between model scenarios to calculate changes in flood extent.
- LiDAR land level data were used to calculate the area of land, which the model indicated would have at least 50mm depth of water (splash conditions) at the peak flood level.

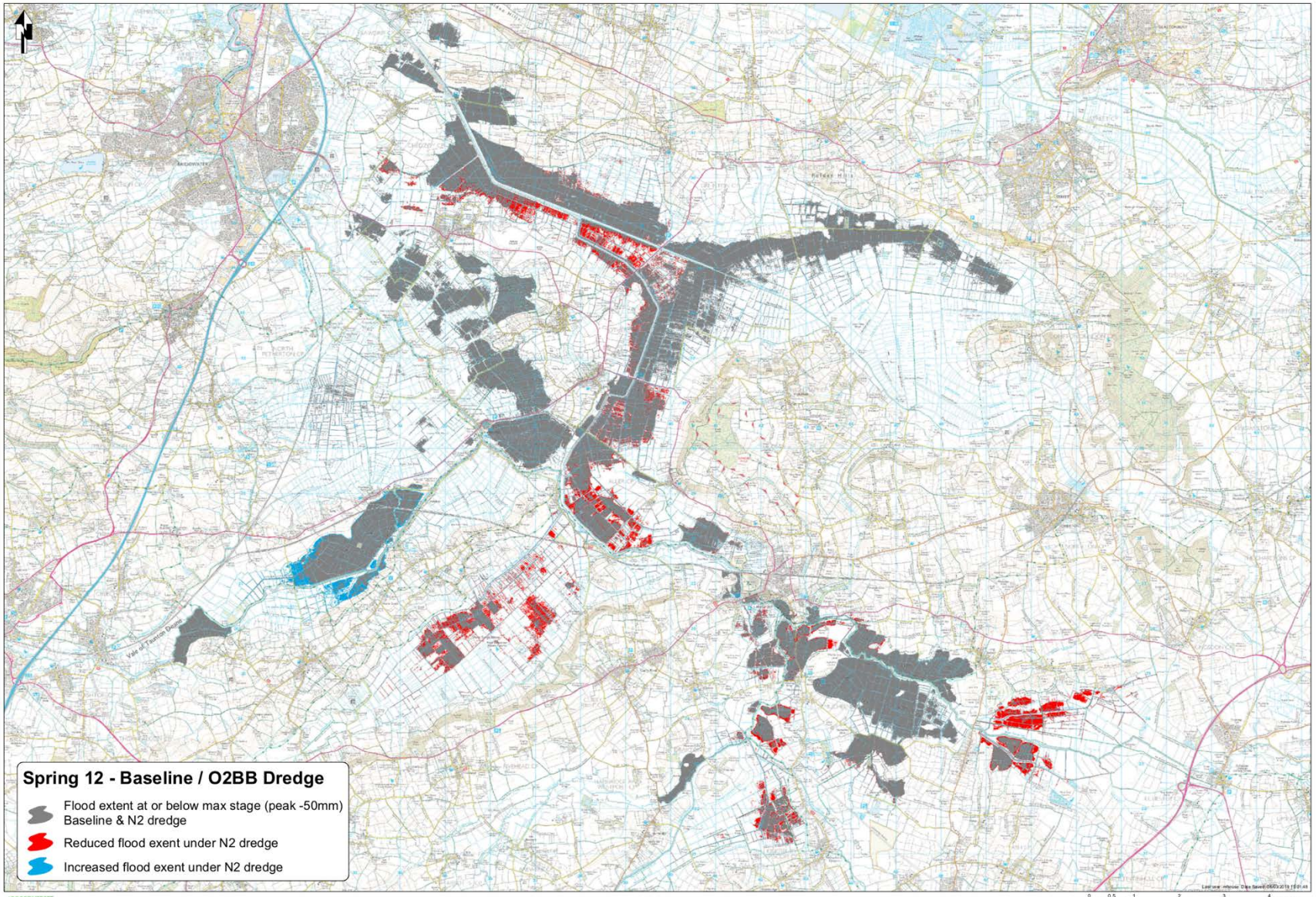
Flood Duration

- LiDAR land level data and local knowledge were used to determine the minimum flood threshold (land level) for each area.
- The cumulative length of time above these flood thresholds were compared between model scenarios to calculate the flood duration for each area.
- In areas where it was not possible to reliably calculate flood durations, local knowledge was used to infer the indicative changes in flood durations.

Indicative changes in flood extent and duration for the Parrett Dredge:

- Analysis of peak flood levels for the baseline model run indicates a combined maximum flood extent of 3,500ha across all Parrett and Tone Moors.
- The modelled flood extent decreases by 300ha for the Parrett Dredge scenario (+7m^3s Parrett).
- Changes in flood extent are greatest outside SSSIs (200ha) and outside RWLAs (230ha).
- Modelling suggests the Parrett Dredge could potentially reduce flood extent for winter floods by approximately 10% (300ha) for the full (+7m^3s) scheme. This reduction will be smaller for the proposed project, which is approximately 50% of the modelled scheme.

Analysis of indicative changes in flood extent for the Parrett Dredge

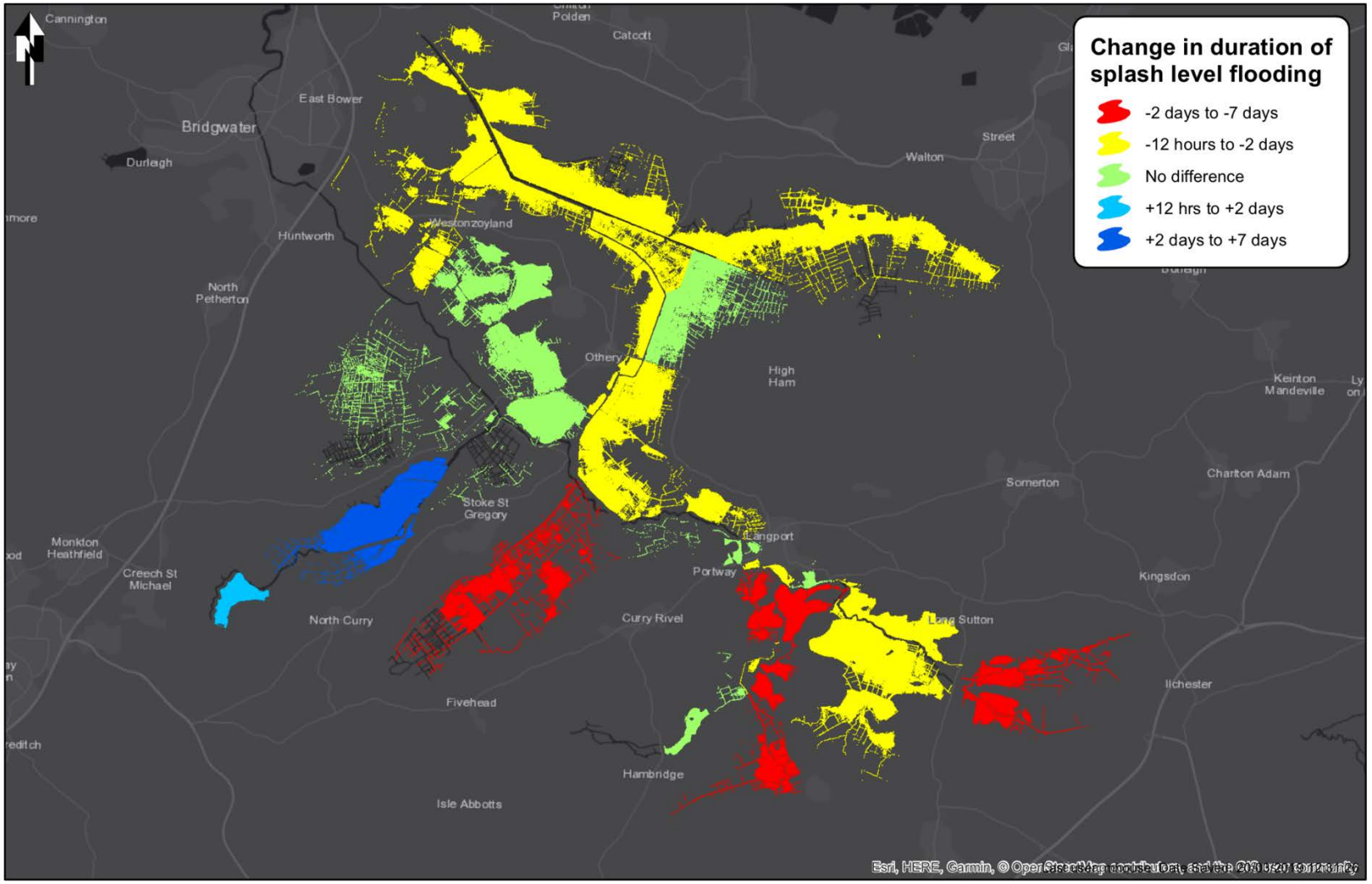


Flood Extent: 50mm below peak level between model time steps 750 to 1,000 hours

Analysis of indicative changes in flood extent for the Parrett Dredge

Name	Baseline (ha)	Dredge (ha)	Change (ha)	Change within SSSIs (ha)	Change outside SSSIs (ha)	Change within RWLAs (ha)	Change outside RWLAs (ha)	% Change outside RWLAs
Long Load	118.7	49.3	-69.4	0	-69.4	0	-69.4	-58.5
Wet Moor	839.9	811.6	-29.7	0.3	-30	1.21	-31.09	-3.7
West Moor	49.4	27.4	-22	-21.8	-0.2	-12.78	-9.22	-18.7
South Moor	39.4	37.2	-2.2	0	-2.2	0	-2.2	-5.6
Huish Level	37.6	32.7	-4.9	0	-4.9	0	-4.9	-13.0
Langport Moors	22.3	21.4	-0.9	0	-0.9	0	-0.9	-4.0
West Sedgemoor	122.2	63.7	-58.5	-57.7	-0.8	-36.42	-22.08	-18.1
Stanmoor	1.1	1.1	0	0	0	0	0	0.0
Currymoor	269.2	328.2	59	43.5	15.5	2.41	56.59	21.0
Northmoor	17.3	17.3	0	0	0	0	0	0.0
Aller Moor	339.6	274.4	-65.2	-6.1	-59.1	-6.24	-58.96	-17.4
KSM SSSI	250.2	210.9	-39.3	-35.9	-3.4	-1.05	-38.25	-15.3
KSM	330.2	330.2	0	0	0	0	0	0.0
Moorlinch	329	322	-7	-2	-5	-3.65	-3.35	-1.0
Southlake	126	124.2	-1.8	-1.7	-0.1	-1.78	-0.02	0.0
Earlake	132.4	132.4	0	0	0	0	0	0.0
Langmead & Weston	158.2	158.2	0	0	0	0	0	0.0
Chedzoy	232.1	184.9	-47.2	0	-47.2	0	-47.2	-20.3
Bradney	38.1	38.1	0	0	0	0	0	0.0
Bawdrip	25.2	25.2	0	0	0	0	0	0.0
	Baseline (ha)	**O2BB (ha)**	**Change (ha)**	**Change within SSSIs (ha)**	**Change outside SSSIs (ha)**	**Change within RWLAs (ha)**	**Change outside RWLAs (ha)**	**% Change outside RWLAs**
Total	**3478.1**	**3190.4**	**-289**	**-81**	**-208**	**-58**	**-231**	**-6.6**

Analysis of indicative changes in flood duration for the Parrett Dredge



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Baseline - O2BB (Spring 12)

0 1 2 4 6 8 10 Kilometers

0 0.5 1 2 3 4 5 Miles

 Document Path: M:\Projects_SRA\Dredging Oath_BBridge\PB Feb 19\Baseline O2BB duration comparison.mxd

Analysis of indicative changes in flood duration for the Parrett Dredge

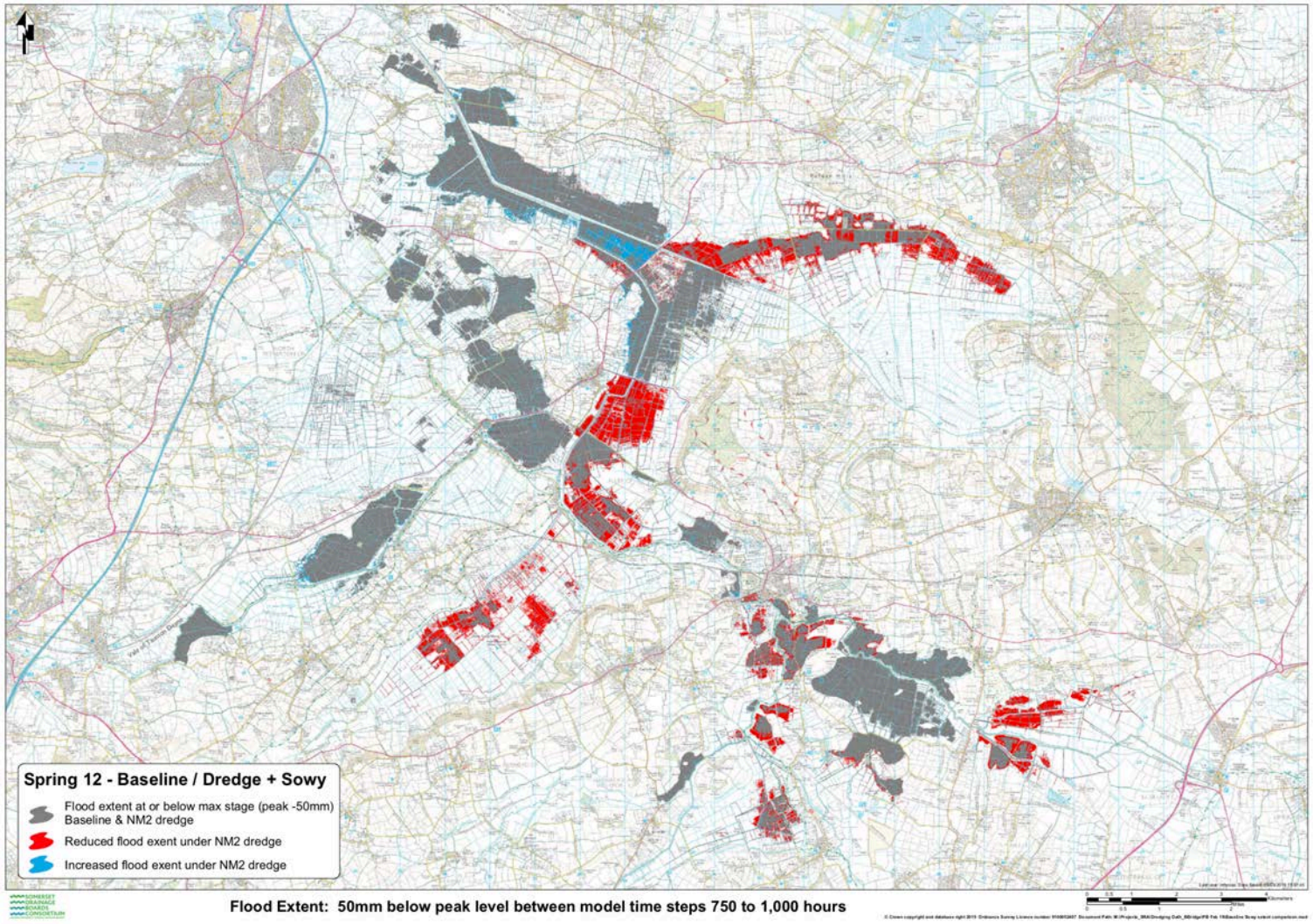
Unit name	Area	Difference in flood duration	Unit name	Area	Difference in flood duration
Witcombe Bottom	Long Load	1	Sowy Pathe	Aller Moor	2
Kings Moor	Long Load	1	Aller Beer Wall	Aller Moor	2
Rod Moor (Wetmoor)	Wet Moor	2	KSM Beer Wall	KSM SSSI	2
Hay Moor (Wetmoor)	Wet Moor	2	KSM RWLA	KSM SSSI	2
Ablake (Wetmoor)	Wet Moor	2	Bimpits KSM	KSM SSSI	2
Wet Moor	Wet Moor	2	Middlezoy Moor	KSM SSSI	2
Wet Moor W	Wet Moor	2	KSM SSSI High Ham	KSM SSSI	3
Town Tree Farm	Wet Moor	2	KSM 18ft Rhyne	KSM	2
Thorney Moor	Wet Moor	1	KSM Butleigh Drove	KSM	2
Muchelney	Wet Moor	1	Moorlinch	Moorlinch	2
Muchelney S	Wet Moor	1	West Moor Moorlinch	Moorlinch	2
West Moor	West Moor	1	Southlake	Southlake	3
South Moor E	South Moor	2	Earlake SE	Earlake	3
South Moor	South Moor	3	Earlake SW	Earlake	3
South Moor S	South Moor	3	Earlake NW	Earlake	3
South Moor W	South Moor	3	Earlake NE	Earlake	3
Perry Moor	South Moor	1	Nether Moor Earlake	Earlake	3
Huish Level	Huish Level	1	Langmead	Langmead & Weston Level	3
Huish Bridge	Langport Moors	2	Weston Level SE	Langmead & Weston Level	3
Long Sutton Catchwater	Langport Moors	3	Weston Level SW	Langmead & Weston Level	3
Wick Moor E	West Sedgemoor	3	Weston Level NW	Langmead & Weston Level	3
Wick Moor	West Sedgemoor	3	Weston Level NE	Langmead & Weston Level	3
West Sedgemoor	West Sedgemoor	1	Sedgemoor Drove Chedzoy	Chedzoy	2
Stanmoor	Stanmoor	3	Chedzoy	Chedzoy	2
Currymoor	Currymoor	5	Chedzoy NE	Chedzoy	2
Hay Moor	Currymoor	5	Chedzoy N	Chedzoy	2
West Moor (Curry Moor)	Currymoor	3	Chedzoy NW	Chedzoy	2
Northmoor	Northmoor	3	Chedzoy SW	Chedzoy	2
Saltmoor	Northmoor	3	Chedzoy SE	Chedzoy	2
Common Moor South	Aller Moor	3	South Moor SE	Chedzoy	2
Common Moor Aller	Aller Moor	2	South Moor SW	Chedzoy	2
Middlemoor Aller	Aller Moor	2	South Moor NW	Chedzoy	2
Aller Drove (Aller)	Aller Moor	2	Bradney	Chedzoy	2
Church Drove Aller	Aller Moor	2	Bawdrip	Chedzoy	2
Aller village	Aller Moor	2			

Key	
1	-2 days to -7 days
2	-12 hrs to 2 days
3	No difference
4	+12 hrs to +2 days
5	+2 days to +7 days

Indicative changes in flood extent and duration for the Parrett Dredge and Sowy combined

- Analysis of peak flood levels for the baseline model run indicates a combined maximum flood extent of 3,500ha across all Parrett and Tone Moors.
- Flood extent reduces by 600ha in the combined Dredge and Sowy scenario (+7m^3s Parrett, +7 m^3s Sowy).
- Changes in flood extent are greatest outside SSSIs (500ha) and outside RWLAs (510ha).
- Modelling suggests that the Parrett Dredge, combined with the Sowy, could potentially reduce flood extent for winter floods by approximately 20% (600ha) for the full (+7m^3s) schemes. This reduction will be smaller for the proposed projects, which are both approximately 50% of the modelled schemes.

Analysis of indicative changes in flood extent for the Parrett Dredge and Sowy combined

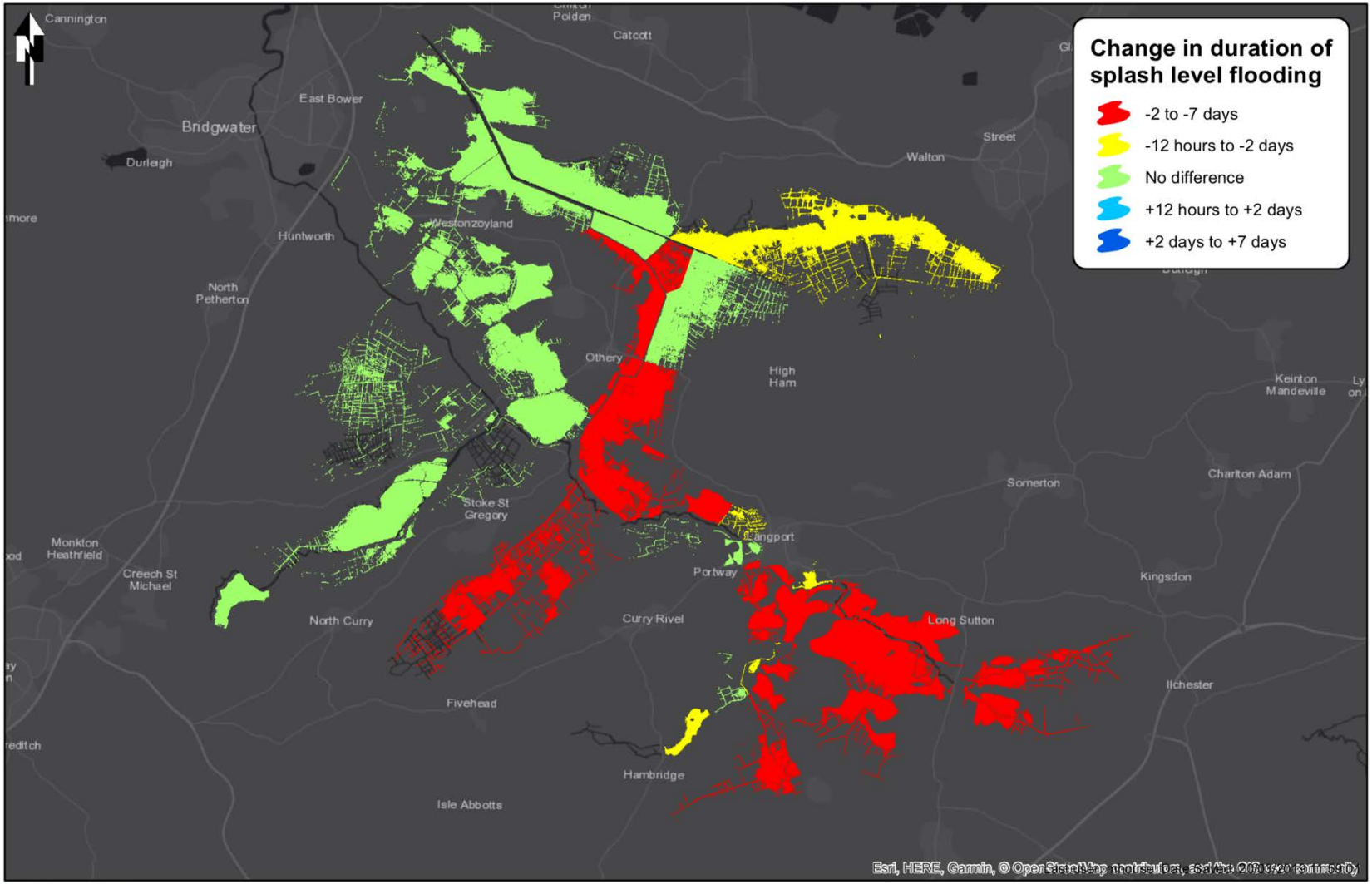


Flood Extent: 50mm below peak level between model time steps 750 to 1,000 hours

Analysis of indicative changes in flood extent for the Parrett Dredge and Sowy combined

Name	Baseline (ha)	Dredge + Sowy (ha)	Change (ha)	Change within SSSIs (ha)	Change outside SSSIs (ha)	Change within RWLAs (ha)	Change outside RWLAs (ha)	% Change outside RWLAs
Long Load	118.7	34.6	-84.1	0	-84.1	0	-84.1	-70.9
Wet Moor	839.9	777.6	-63.4	-1.3	-62.1	0.94	-64.48	-7.7
West Moor	49.4	23.3	-26.1	-25.8	-0.3	-15.26	-10.84	-21.9
South Moor	39.4	35.5	-3.9	0	-3.9	0	-3.9	-9.9
Huish Level	37.6	15.9	-21.7	0	-21.7	0	-21.7	-57.7
Langport Moors	22.3	16.5	-5.8	0	-5.8	0	-5.8	-26.0
West Sedgemoor	122.2	33.3	-88.9	-87.7	-1.2	-54.49	-34.41	-28.2
Stanmoor	1.1	1.1	0	0	0	0	0	0.0
Currymoor	269.2	281	11.8	8.5	3.3	0.8	11	4.1
Northmoor	17.3	17.3	0	0	0	0	0	0.0
Aller Moor	339.6	134.2	-205.4	-33.7	-171.7	-15.61	-189.79	-55.9
KSM SSSI	250.2	297.5	47.3	45.4	1.9	-1.1	48.4	19.3
KSM	330.2	141.4	-188.8	0	-188.8	-5.81	-182.99	-55.4
Moorlinch	329	336.4	7.4	-0.5	7.9	-0.84	8.24	2.5
Southlake	126	122.2	-3.8	-3.8	0	-3.8	0	0.0
Earlake	132.4	132.4	0	0	0	0	0	0.0
Langmead & Weston	158.2	158.2	0	0	0	0	0	0.0
Chedzoy	232.1	253.8	21.7	0	21.7	0	21.7	9.3
Bradney	38.1	38.1	0	0	0	0	0	0.0
Bawdrip	25.2	25.2	0	0	0	0	0	0.0
	Baseline (ha)	**O2BB Sowy (ha)**	**Change (ha)**	**Change within SSSIs (ha)**	**Change outside SSSIs (ha)**	**Change within RWLAs (ha)**	**Change outside RWLAs (ha)**	**% Change outside RWLAs**
Total	**3478.1**	**2875.5**	**-604**	**-99**	**-505**	**-95**	**-509**	**-14.6**

Analysis of indicative changes in flood duration for the Parrett Dredge and Sowy combined



SOMERSET DRAINAGE BOARDS CONSORTIUM

Baseline - O2BB + Sowy (Spring 12)

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Analysis of indicative changes in flood duration for the Parrett Dredge and Sowy combined

Unit name	Area	Difference in flood duration	Unit name	Area	Difference in flood duration
Witcombe Bottom	Long Load	1	Sowy Pathe	Aller Moor	1
Kings Moor	Long Load	1	Aller Beer Wall	Aller Moor	1
Rod Moor (Wetmoor)	Wet Moor	1	KSM Beer Wall	KSM SSSI	1
Hay Moor (Wetmoor)	Wet Moor	1	KSM RWLA	KSM SSSI	1
Ablake (Wetmoor)	Wet Moor	1	Bimpits KSM	KSM SSSI	1
Wet Moor	Wet Moor	1	Middlezoy Moor	KSM SSSI	3
Wet Moor W	Wet Moor	1	KSM SSSI High Ham	KSM SSSI	3
Town Tree Farm	Wet Moor	1	KSM 18ft Rhyne	KSM	2
Thorney Moor	Wet Moor	1	KSM Butleigh Drove	KSM	2
Muchelney	Wet Moor	1	Moorlinch	Moorlinch	3
Muchelney S	Wet Moor	1	West Moor Moorlinch	Moorlinch	3
West Moor	West Moor	1	Southlake	Southlake	3
South Moor E	South Moor	2	Earlake SE	Earlake	3
South Moor	South Moor	3	Earlake SW	Earlake	3
South Moor S	South Moor	2	Earlake NW	Earlake	3
South Moor W	South Moor	3	Earlake NE	Earlake	3
Perry Moor	South Moor	1	Nether Moor Earlake	Earlake	3
Huish Level	Huish Level	1	Langmead	Langmead & Weston Level	3
Huish Bridge	Langport Moors	1	Weston Level SE	Langmead & Weston Level	3
Long Sutton Catchwater	Langport Moors	2	Weston Level SW	Langmead & Weston Level	3
Wick Moor E	West Sedgemoor	3	Weston Level NW	Langmead & Weston Level	3
Wick Moor	West Sedgemoor	3	Weston Level NE	Langmead & Weston Level	3
West Sedgemoor	West Sedgemoor	1	Sedgemoor Drove Chedzoy	Chedzoy	3
Stanmoor	Stanmoor	3	Chedzoy	Chedzoy	3
Currymoor	Currymoor	3	Chedzoy NE	Chedzoy	3
Hay Moor	Currymoor	3	Chedzoy N	Chedzoy	3
West Moor (Curry Moor)	Currymoor	3	Chedzoy NW	Chedzoy	3
Northmoor	Northmoor	3	Chedzoy SW	Chedzoy	3
Saltmoor	Northmoor	3	Chedzoy SE	Chedzoy	3
Common Moor South	Aller Moor	3	South Moor SE	Chedzoy	3
Common Moor Aller	Aller Moor	2	South Moor SW	Chedzoy	3
Middlemoor Aller	Aller Moor	1	South Moor NW	Chedzoy	3
Aller Drove (Aller)	Aller Moor	1	Bradney	Chedzoy	3
Church Drove Aller	Aller Moor	1	Bawdrip	Chedzoy	3
Aller village	Aller Moor	1			

Key	
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Summary of potential changes in surface water conditions on SPA Moors in the Parrett and Tone Moors, during the winter months (Dec-Feb), as a consequence of the proposed Parrett Dredge between Stathe to Burrowbridge

- Using the 2012 summer floods as a proxy for a small winter flood, hydraulic modelling of current baseline conditions indicates a total flood area across all Parrett Moors of nearly 3,500ha. This reduces by nearly 300ha, with the inclusion of Parrett Dredge ($7m^3s$) in the model. Across all moors, this is approximately a 7% reduction in flood area.

- The areas that experience the greatest change in flood extent include Langport Moors, West Sedgemoor, Aller Moor, King's Sedgemoor and Chedzoy. All of these areas have at least a 10% reduction in flooding.

- 70% (200ha) of this change in flood extent occurs outside of SSSI. This is because SSSIs are generally the lowest lying land. Changes in flood extent are greatest on the relatively higher ground, which tends to be outside SSSIs.

- 80% (230ha) of this change in flood extent occurs outside of RLWAs. As with SSSIs, this because RWLAs are usually located on the lowest lying land. Changes in flood extent are greatest on relatively higher ground, which tends to be outside RWLAs.

- Reductions in flood duration are relatively small: typically, a 12-hour to 2-day reduction in flooding, due to increased flood flow conveyance in the Parrett.

- The contribution of RWLAs to achieving and sustaining wetland condition for the SPA is considerable. These wetland schemes maintain the required conditions during the months of Dec, Jan and Feb. It is possible to compare RWLA to the effect of dredging in terms of area and duration: ha/days (the length time flooded multiplied by area). Assuming 50% the area within RWLAs achieves the required winter conditions, RWLAs contribute 167,300 ha/days, which compares with a reduction of 1500 ha/days for a typical winter flood as a consequence of the proposed Parrett Dredge. This represents a 1% reduction in SPA conditions due to dredging, when compared to the combined contribution of RWLAs.

- Hydraulic modelling of the combined effects of the Parrett Dredge and Sowy indicate a combined reduction in flood area of 15%, compared to 7% for dredging alone. Again, the greatest changes occur for Langport Moors, West Sedgemoor and Aller Moor. However, there is a slight reduction in the decrease in flood extent for Moors downstream of Beer Wall.

- The actual changes flood extent and duration, delivered by both the Dredge and the Sowy, are likely to be less than indicated in the modelling, simply because the increases in flood flow conveyance will be approximately 50% less than the scheme designs modelled in this analysis.