

Hornsea Project Three  
Offshore Wind Farm



## Hornsea Project Three Offshore Wind Farm

Environmental Statement:  
Volume 6, Annex 3.4 - White-clawed Crayfish Survey

PINS Document Reference: A6.6.3.4  
APFP Regulation 5(2)(a)

Date: May 2018

  
**Hornsea 3**  
Offshore Wind Farm

 **Orsted**

Environmental Impact Assessment

Environmental Statement

Volume 6

Annex 3.4 – White-clawed Crayfish Survey

**Liability**

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Report Number: A6.6.3.4

Version: Final

Date: May 2018

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[www.hornseaproject3.co.uk](http://www.hornseaproject3.co.uk)

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## Glossary

Term	Definition
Allochthonous	Not indigenous / Formed in a place other than where found
Aquatic macrophyte	Plants which are adapted for living submerged in water or at the water's surface.
Calcareous	Mostly or partly comprised of calcium carbonate.
Compounds	A collective term used to refer to secondary construction compounds along the onshore cable corridor as well as the landfall construction compound (defined in detail in volume 1, chapter 3: Project Description). Although, there is also a main construction compound, this is referred to individually due to its distant location relative to the onshore cable corridor.
Lentic	Inhabiting or situated in still fresh water.
Lotic	Inhabiting or situated in fast flowing fresh water.
Moult	To shed the exoskeleton in order to facilitate new growth.
Phase 1 Habitat Survey	A field survey technique which provides a relatively rapid system to record and map semi-natural vegetation and other wildlife habitats
Preliminary Ecological Appraisal	The first stage in any site ecological assessment. It has two main elements; an ecological desk study and an extended Phase 1 habitat survey.
Survey Area	The survey area for the white-clawed crayfish survey comprised the PEIR onshore cable corridor search area and potential alternative routes with an additional survey buffer of 50 m in accordance with best practise (as shown on Figure 1.1)

## Acronyms

Unit	Description
EIA	Environmental Impact Assessment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
PEA	Preliminary Ecological Appraisal
PEIR	Preliminary Environmental Information Report
SAC	Special Area of Conservation
SSSI	Site of Special Scientific Interest

## Units

Unit	Description
GW	gigawatt (power)
m	Metre (distance)
km	Kilometre (distance)

## 1. Introduction

### 1.1 Development background

- 1.1.1.1 Ørsted is promoting an application for a development consent order ('DCO') for the Hornsea Project Three Offshore Wind Farm (hereafter referred to as 'Hornsea Three') a proposed offshore wind farm located in the southern North Sea. This report focuses on the onshore components of Hornsea Three (as described in volume 1, chapter 3: Project Description).
- 1.1.1.2 At the time of ecological survey scoping in December 2016, a 200 m wide cable corridor search area had been identified by Ørsted. The 200 m wide search area included the locations of the proposed onshore cable corridor, HVAC booster station, HVDC converter/HVAC substation, Norwich main national grid substation and construction compounds and was the focus of the Preliminary Environmental Information Report (PEIR) published in July 2017. This search area is hereafter referred to as the 'PEIR onshore cable corridor search area'. Following this, some alternate route considerations were added. Ecological survey area boundaries were therefore based on the PEIR onshore cable corridor search area and alternate routes considered, with an appropriate survey buffer added for some survey types where necessary. The survey area applicable to this report is shown in Appendix A, Figure 1.1.
- 1.1.1.3 Subsequently, a route refinement process has been undertaken to refine the Hornsea Three onshore cable corridor to an approximately 80 m wide corridor (referred to as the 'onshore cable corridor') as well as identifying locations of construction compounds, access roads and storage areas. The location of permanent and temporary land take associated with the HVDC converter/HVAC substation and HVAC booster station has also been refined. This process is described in more detail in volume 1, chapter 4: Site Selection and Alternatives.
- 1.1.1.4 A full description of Hornsea Three is provided in volume 1, chapter 3: Project Description.

### 1.2 Ecology background

- 1.2.1.1 A Preliminary Ecological Appraisal (PEA) was undertaken in 2016 (RPS, 2016) and included a Phase 1 habitat survey of an area comprising a 500 m wide corridor (including the PEIR onshore cable corridor search area) and an ecological desk study, whereby protected species data was requested from the Norfolk Biodiversity Information Service (NBIS). The PEA results were used to inform the Preliminary Environmental Information Report (PEIR) and to determine the scope and extent of further ecological surveys required to inform the Environmental Impact Assessment (EIA) for Hornsea Three.
- 1.2.1.2 Subsequently, an additional Phase 1 habitat survey was undertaken to cover 30 areas which were either not accessible during the PEA, or became relevant to Hornsea Three due to design refinements (see volume 6, annex 3.1 of the Environmental Statement).

1.2.1.3 Records of white-clawed crayfish were returned as part of the desk study and suitable aquatic habitat was identified within the Phase 1 survey area, including within the PEIR onshore cable corridor search area (but not during the second Phase 1 habitat survey of additional areas, see volume 6, annex 3.1). Based on these findings further survey for white-clawed crayfish was recommended.

1.2.1.4 Based on this recommendation, Thomson Ecology Ltd was commissioned in November 2016 to undertake surveys for white-clawed crayfish within a project-specific survey area (defined in section 2.1), as shown in Appendix A, Figure 1.1.

1.2.1.5 Of relevance to this report, it is noted that, Weybourne/Spring Beck (WC1A2 and WC1A3 in Appendix A, Figure 2.1 and 2.2) was the site of the release of 77 white-clawed crayfish translocated from a River Wensum crayfish rescue in September 2016, just upstream of the Station Rd Bridge in Weybourne at TG1121842880 (personal communication between Martin Pugh and Helen Beardsley at Environment Agency).

### 1.3 Legislative background

- 1.3.1.1 Both within and outside designated sites, white-clawed crayfish are partly protected under the Wildlife and Countryside Act 1981 (WCA), which makes it an offence to capture this species without a licence and also prohibits trade in this species. White-clawed crayfish are included under Annexes II and V of the European Union Directive Habitats Directive. The Habitats Directive has been transposed into UK law by the Conservation of Habitats and Species (Amendment) Regulations 2012. This legislation requires that areas are designated as Special Areas of Conservation (SACs) to protect white-clawed crayfish populations.
- 1.3.1.2 The white-clawed crayfish has been adopted as a Species of Principal Importance for the Conservation of Biodiversity in England, under Section 41 of the Natural Environment and Rural Communities Act 2006 (NERC). This places a duty on all government departments to have regard for the conservation of these species and on the Secretary of State to further, or promote others to further the conservation of these species. Furthermore, the National Planning Policy Framework states that local planning authorities should promote the protection and recovery of priority species populations linked to national and local targets, which presumably means those listed under the Section 41 of the NERC Act, the former UK Biodiversity Action Plan and on Local or Regional priorities species lists.

### 1.4 The brief and objectives

- 1.4.1.1 The brief of the survey was to:
- Undertake a habitat suitability assessment based on locations identified as being potentially suitable within the PEA;
  - Carry out presence or likely absence surveys for white-clawed crayfish on suitable habitat for crayfish that has the potential to be impacted by Hornsea Three; and

- Provide a survey report to include methods and results of white-clawed crayfish surveys, including digital mapping.

1.4.1.2 The objective of the survey was to identify the presence of white-clawed crayfish populations within the survey area, and more specifically within the onshore cable corridor, to enable an assessment of the potential impacts of Hornsea Three on this species within volume 3, chapter 3: Ecology and Nature Conservation of the Environmental Statement.

## 2. Methodology

### 2.1 Survey area

2.1.1.1 A survey area was defined comprising the PEIR onshore cable corridor search area and potential alternative routes, with an additional survey buffer of 50 m, as shown in Appendix A, Figure 1.1. The location of survey sites within the survey area were identified based on the findings of the PEA (RPS, 2016) and included waterbodies comprising rivers, streams, ditches and ponds. Each survey site was given a unique identification code. Where land access was granted, these locations were visited to determine if the habitat present was suitable to support white-clawed crayfish. Where suitable habitat was present, a presence or likely absence survey for white-clawed crayfish was undertaken. Further details on the survey methodology are detailed below.

2.1.1.2 The survey sites for white-clawed crayfish and location of water bodies surveyed is shown in Appendix A, Figure 2.1 to 2.13.

2.1.1.3 The main construction compound to the east of the Hornsea Three onshore cable corridor is outside of the survey area for this study and comprises existing hard standing with negligible ecological importance. Therefore, a detailed survey of baseline conditions was not required.

### 2.2 Survey method

2.2.1.1 Surveys were undertaken in accordance with best practice (Peay, 2003).

#### 2.2.2 Habitat suitability assessment

2.2.2.1 Crayfish tend to occur mainly in areas with relatively hard water underlain by calcareous rocks although they can be found in a wide variety of freshwater lentic and lotic aquatic environments, from large, deep reservoirs to small, permanent shallow streams. They are principally found in areas of good water quality, although they can withstand a limited concentration of organic pollution. However, they are susceptible to discharge of farm effluent and their refuges are also susceptible to silt pollution.

2.2.2.2 Of the 31 survey sites identified as having the potential to support white-clawed crayfish based on the findings of the PEA (RPS, 2016), 14 were accessible to survey (see section 2.4). Each of the accessible survey sites was visited and a habitat suitability assessment undertaken for a 500 m stretch of the waterbody (250 m either side of the survey area centreline).

2.2.2.3 Characteristics indicating habitat suitability for white-clawed crayfish were recorded at each survey site visited. Habitat characteristics recorded included:

- Water quality – crayfish prefer clean, well oxygenated water;
- Invertebrates – A high abundance of invertebrates provides food for crayfish;

- Water pH – crayfish are most frequently found in well buffered, base-rich rivers and streams and are usually absent from acid waters (<pH6.0);
  - Permanence – watercourses should be permanent and present throughout the year;
  - Flow rate – crayfish prefer watercourses exhibiting relatively stable hydrological conditions, ensuring that refuges are not subject to excessive scouring or instability;
  - Shelter – refuges in the form of cobbles or rubble, scattered boulders or logs, submerged vegetation and submerged, exposed tree roots are often used;
  - Profile – crayfish may construct burrows for shelter, for this reason they may favour vertical, undercut banks, with overhanging vegetation; and
  - Aquatic vegetation - the presence of a variety of submerged vegetation provides shelter from predation and high flow events, and is a partial food source for crayfish.
- 2.2.2.4 Habitat suitability was categorised into low, moderate and high suitability based on the above characteristics as shown below:
- Unsuitable – (Includes dry waterbodies, stagnant water, little or no refugia, poor aquatic diversity and dense vegetation);
  - Low suitability – (Limited refugia, shallow channels, silty patches, narrow channels);
  - Moderate suitability – (Burrowing opportunities, abundant refugia available); and
  - High suitability – (Abundant refugia, evidence of burrows and burrowing opportunities, deep in areas, large range of invertebrates, wide channels and presence of submerged vegetation).
- 2.2.2.5 A presence / likely absence survey for white-clawed crayfish was undertaken at all survey sites which were found to have suitable habitat to support the species.
- 2.2.3 Presence / likely absence survey - refuge search**
- 2.2.3.1 At each survey site identified as having suitable habitat to support white-clawed crayfish, a 100 m section of the waterbody (i.e. 50 m either side of the survey area centreline), was assessed for suitability to survey; considering access from the banks, flow, channel depth and potential hazards. Within this 100 m section, five accessible patches favourable to crayfish were identified for refugia search.
- 2.2.3.2 Typically, white-clawed crayfish occupy cryptic habitats in crevices under submerged rocks, among submerged tree roots, aquatic macrophytes, submerged burrows, leaf packs or other man made litter, during the daytime. Suitable refugia including submerged rocks, logs and vegetation were searched.
- 2.2.3.3 At each of the five patches, ten potential refugia were searched. These were:
- Large enough to provide ample shelter to various size classes of crayfish;
  - Relatively stable, fully submerged and resistant to high flows;
  - Located near flow that is slow enough for crayfish activity requirements, but with sufficient velocity to provide sufficiently oxygenated waters; and
  - Free of gross siltation; providing refuge space within or underneath the refugia to allow crayfish to shelter.
- 2.2.3.4 The refugia within each patch were manually searched, and banks examined for the presence of crayfish burrows. Records were made of the type of potential refugia present, their location within the channel and the presence/absence of crayfish. Additional information recorded included life stage, and whether adults had signs of disease or if females were carrying eggs or juveniles.
- 2.2.3.5 Where ten potential refugia could not be found, alternative methods were used which included netting (using a net to encourage any potential crayfish to leave submerged vegetation) and burrow searching.
- 2.2.3.6 The main threats to white-clawed crayfish populations in the UK are competition from the introduced American signal crayfish (*Pacifastacus leniusculus*) and crayfish plague (*Aphanomyces astaci*), which is carried by some populations of the signal crayfish and causes mass mortality of white-clawed crayfish. Therefore, the presence of non-native species of crayfish were also recorded during the survey (including signal crayfish) and any individuals recorded were removed and disposed of safely. Sampling equipment was sanitised following any detection of non-native crayfish to prevent spread of crayfish plague between waterbodies.
- 2.2.3.7 The presence/absence of bullhead (*Cottus gobio*) was also recorded, this is another species of conservation concern which utilises very similar refuges to crayfish and requires good water quality. When they are present, conditions are usually also suitable for crayfish.
- 2.2.3.8 At each survey patch a GPS reading and photograph was taken, and details of the environmental conditions at the time of survey recorded. The channel width, flow rate, underlying substrate, siltation, depth and channel features were recorded.
- 2.3 Surveyors**
- 2.3.1.1 The crayfish survey was undertaken by Felicity Andruszko BSc (Hons) MSc GradCIEEM and Martin Pugh BSc (Hons) MCIEEM.
- 2.4 Limitations**
- 2.4.1.1 As noted in section 2.1, the survey area for this study was based on the PEIR onshore cable corridor search area and some alternative route options as shown in Appendix A, Figure 1.1. Since then, further design refinements have occurred (e.g. refinement of the onshore cable corridor route as well as identification of main and other compounds, access roads and storage areas) which fall outside of the survey area described in this report (an area of 38.56 ha, comprising 7.25% of the onshore cable corridor and associated infrastructure, falls outside of the white-clawed crayfish survey area). When these design refinements were finalised, the survey season had finished and it was not possible to survey these newly identified areas for white-clawed crayfish.

- 2.4.1.2 Landowner permission was required to undertake field surveys within the survey area identified. The status of landowner permission to access survey areas was reviewed on a weekly basis during the survey season. However, a total of 17 waterbodies identified for HSA survey could not be visited due to a lack of landowner access permission, these included locations on the River Wensum and River Tud (ten of these sites are located within the onshore cable corridor as described in volume 1, chapter 3: Project Description). Table 2.1 lists the waterbodies that could not be accessed and the location of these waterbodies is shown in Appendix A, Figure 2.1 to 2.13 (relative to both the survey area and the onshore cable corridor).
- 2.4.1.3 Although it was not possible to survey the areas listed above, they were covered in the desk study and Phase 1 habitat survey within the PEA (RPS, 2016) which enables the likelihood of white-clawed crayfish presence to be assessed.
- 2.4.1.4 Field drains are likely to be less suitable for supporting white-clawed crayfish than rivers and streams. However a number of field drains associated with the River Glaven catchment (WC1B1, WC1B4, WC1B5, WC1B6 and WC1B7) are all in close proximity to waterbodies where white-clawed crayfish have been recorded in the desk study and may support this species. The pond (WC1B3) in the same area could also support white-clawed crayfish, however, is outside of the onshore cable corridor. The field drain (WC1C3) of the River Bure catchment is unlikely to support white-clawed crayfish as they were not recorded at the site surveyed on the River Bure. This also applies to the field drain (WC1E1) close to Trout Stream. The PEA (RPS, 2016) acknowledges that signal crayfish are present on the River Wensum (WC1E5) which reduces the likelihood of white-clawed crayfish being present. Consequently it is also unlikely that white-clawed crayfish are present in field drains (WC1E3, WC1E4, WC1E6) associated with the River Wensum. The desk study returned no records for white-clawed crayfish on the River Tud (WC1E7) and impacts on this and other rivers will be avoided by horizontal directional drilling. As white-clawed crayfish were recorded to be present on the River Yare, it is possible they could be present in field drains (WC1G1, WC1G2, WC1G3, WC1G4) associated with this river.
- 2.4.1.5 Based on the above, it is considered that sufficient ecological information is available to inform the impact assessment on white-clawed crayfish reported in volume 3, chapter 3: Ecology and Nature Conservation.
- 2.4.1.6 The areas where survey could not be completed, that will be directly impacted Hornsea Three (impacts on Main rivers and the majority of ordinary watercourses will be avoided by horizontal directional drilling), will be checked during pre-construction surveys enabling amendment of mitigation or the application of further mitigation, to that specified in volume 3, chapter 3: Ecology and Nature Conservation.
- 2.4.1.7 Table 2.1 contains all the waterbodies within the survey area that could not be accessed.

Table 2.1: List of waterbodies within survey area where access was a survey limitation.

Waterbody Number	Access Restriction	Figure Number (Appendix A)
WC1B1	No landowner agreement for access	2.3
WC1B3		2.3
WC1B4		2.3
WC1B5		2.3
WC1B6		2.3
WC1B7		2.3
WC1C3		2.5
WC1E1		2.7
WC1E3		2.8
WC1E4		2.8
WC1E5		2.8
WC1E6		2.8
WC1E7		2.9
WC1G1		2.13
WC1G2		2.13
WC1G3		2.13
WC1G4		2.13



### 3. Results

- 3.1.1.1 Table 3.1 provides a summary of the results for all 31 sites identified within the survey area as having the potential to support white-clawed crayfish based on the PEA (RPS, 2016), noting that access was not possible to 17 of these sites (see section 2.4 above). The full results are provided in Appendix B. These included rivers (Bure, Wensum, Tud and Yare), streams (Spring Beck, Reepham Beck and Trout Stream), field drains and ponds. The location of the survey sites is shown in Appendix A, Figure 2.1 to 2.13, whilst photographs of sites where crayfish were recorded are provided in Figure 3.1.
- 3.1.1.2 Although 17 sites had no access to survey (including the River Wensum and River Tud), both the HSA and presence/likely absence survey was undertaken at 14 sites. White-clawed crayfish were recorded at one site on the River Yare, whilst the signal crayfish, an invasive North American species, was recorded at two sites (River Bure and Reepham Beck).
- 3.1.1.3 Of the 14 sites surveyed, seven were found to be unsuitable to support white-clawed crayfish. Of the seven suitable sites surveyed, one site (WC1F3 – River Yare) was assessed to be of high suitability, four sites (WC1A3 – Weybourne/Spring Beck; WC1C1 – River Bure; WC1D1 – Reepham Beck; and WC1E2 – Trout Stream) were assessed to be of moderate suitability and two sites (WC1F5 – field drain in River Yare catchment and WC1F6 – field drain in River Yare catchment) were assessed to be of low suitability.
- 3.1.1.4 The native white-clawed crayfish was recorded at one site (WC1F3 – River Yare, Appendix A, Figure 2.10). At this site, three healthy white-clawed crayfish were caught and identified, with a further three individuals sighted but not captured. This indicates a healthy population of white-clawed crayfish along this section of the River Yare and it is, therefore, unlikely that signal crayfish have yet colonised this section of the river. The habitat at this location is of high suitability with ample refugia including vertical clay banks, dense marginal reed sweet-grass and large stones around the bridge. Suspected crayfish burrows were observed downstream of Bawburgh bridge (Appendix A, Figure 2.10).
- 3.1.1.5 The invasive signal crayfish was recorded at two of the sites surveyed (WC1C1 – River Bure and WC1D1 – Reepham Beck). The habitat at these sites was found to be suitable to support white-clawed crayfish with clay banks for burrowing on the River Bure and submerged tree roots providing refugia for juveniles at both sites. However, the presence of a signal crayfish population at these sites indicates the native white-clawed crayfish is unlikely to be present. The native species was not recorded during the survey at these sites.
- 3.1.1.6 No white-clawed or signal crayfish were recorded at site WC1E2 – Trout Stream. However, this site had suitable habitat with an abundance of refugia (cobbles, roots and vertical banks).
- 3.1.1.7 Of the seven sites that could not be accessed, according to the desk study (RPS, 2016) pond WC1B1 although has no records itself, does have records of white-clawed crayfish within a pond about 200-300 m connected to these waterbody. The waterbody which contains WC1B4, WC1B5, WC1B6 and WC1B7 does have records of white-clawed crayfish nearby which may become connected with heavy rainfall and so there is a possibility of white-clawed crayfish in these areas. WC1C3 has records of signal crayfish both up and downstream of the survey area and so is unlikely to harbour white-clawed crayfish. WC1E1 is a subsidiary of Trout Stream and WC1E2 which was assessed as moderate suitability to support white-clawed crayfish and so may have potential. WC1E5 is found on the River Wensum which has records of signal crayfish upstream, and in addition WC1E3, WC1E4 and WC1E6 are located close to this river and so it is likely these may also have records of signal crayfish. All other waterbodies (WC1E7, WC1G1, WC1G2, WC1G3, WC1G4) has no presence records of either species.
- 3.1.1.8 Weybourne/Spring Beck (WC1A3) was the site of a white-clawed crayfish introduction, where 77 white-clawed crayfish were released from a River Wensum crayfish rescue in September 2016 (personal communication between Martin Pugh and Helen Beardsley at Environment Agency). However, no white-clawed crayfish were recorded during the presence and likely absence survey at this survey site and the habitat suitability was considered only moderate as the channel is small and shallow, with limited refugia.

Table 3.1: White-clawed crayfish survey results summary.

Waterbody ID	Figure No. Photo No. -where relevant (Appendix A)	Waterbody Description	White-clawed crayfish presence or likely absence	White-clawed crayfish habitat suitability
WC1A1	Figure 2.1	Former gravel pit	Likely absent	Unsuitable
WC1A2	Figure 2.1	Reed bed off Weybourne/Spring Beck	Likely absent	Unsuitable
WC1A3	Figure 2.2 Photograph 1	Weybourne/Spring Beck	Likely absent	Moderate suitability
WC1B1	Figure 2.3	Field drain (River Glaven catchment)	No Access	No Access
WC1B2	Figure 2.3	Field drain (River Glaven catchment)	Likely absent	Unsuitable
WC1B3	Figure 2.3	Pond	No Access	No Access
WC1B4	Figure 2.3	Field drain (River Glaven catchment)	No Access	No Access
WC1B5	Figure 2.3	Field drain (River Glaven catchment)	No Access	No Access
WC1B6	Figure 2.3	Field drain (River Glaven catchment)	No Access	No Access
WC1B7	Figure 2.3	Field drain (River Glaven catchment)	No Access	No Access
WC1C1	Figure 2.4 Photograph 2 and 3	River Bure	Likely absent (signal crayfish present)	High suitability
WC1C2	Figure 2.4	Oxbow type pond off River Bure	Likely absent	Unsuitable
WC1C3	Figure 2.5	Field drain (River Bure catchment)	No Access	No Access
WC1D1	Figure 2.6	Reephams Beck (Booton Common)	Likely absent (signal crayfish present)	High suitability
WC1E1	Figure 2.7	Drain by Trout Stream	No Access	No Access
WC1E2	Figure 2.7 Photograph 4	Trout Stream	Likely absent	High suitability
WC1E3	Figure 2.8	Drain near River Wensum	No Access	No Access
WC1E4	Figure 2.8	Drain near River Wensum	No Access	No Access
WC1E5	Figure 2.8	River Wensum	No Access	No Access
WC1E6	Figure 2.8	Drain near River Wensum	No Access	No Access
WC1E7	Figure 2.9	River Tud	No Access	No Access
WC1F1	Figure 2.10	Drain near River Yare	Likely absent	Unsuitable
WC1F2	Figure 2.10	Drain near River Yare	Likely absent	Unsuitable

Waterbody ID	Figure No. Photo No. -where relevant (Appendix A)	Waterbody Description	White-clawed crayfish presence or likely absence	White-clawed crayfish habitat suitability
WC1F3	Figure 2.10 Photograph 5 and 6	River Yare	Present	High suitability
WC1F4	Figure 2.11	Field Drain (River Yare catchment)	Likely absent	Unsuitable
WC1F5	Figure 2.11	Field Drain (River Yare catchment)	Likely absent	Low suitability
WC1F6	Figure 2.12	Field Drain (River Yare catchment)	Likely absent	Low suitability
WC1G1	Figure 2.13	Field Drain (River Yare catchment)	No Access	No Access
WC1G2	Figure 2.13	Field Drain (River Yare catchment)	No Access	No Access
WC1G3	Figure 2.13	Field Drain (River Yare catchment)	No Access	No Access
WC1G4	Figure 2.13	Field Drain (River Yare catchment)	No Access	No Access

## 4. Conclusion

- 4.1.1.1 Within the survey area, seven waterbodies were assessed as having suitable habitat for the white-clawed crayfish (WC1F3 – River Yare; WC1A3 – Weybourne/Spring Beck; WC1C1 – River Bure; WC1D1 – Reepham Beck; and WC1E2 – Trout Stream; WC1F5 – field drain in River Yare catchment and WC1F6). However, presence of white-clawed crayfish was only recorded at one survey site located on the River Yare (WC1F3) which is within the onshore cable corridor.
- 4.1.1.2 The invasive signal crayfish species was recorded at two survey sites located on the River Bure (WC1C1) and Reepham Beck (WC1D1), indicating that the native white-clawed crayfish was unlikely to be present. The native species was not recorded during the survey at these sites.
- 4.1.1.3 Results of the survey have been used to inform the final location and design of onshore components of Hornsea Three (see volume 1, chapter 4: Site Selection and Alternatives) and to enable the assessment of the impacts on ecology and nature conservation, reported in volume 3, chapter 3: Ecology and Nature Conservation.

## 5. References

HM Government (2006) Natural Environment and Rural Communities Act.

HM Government (1981) Wildlife and Countryside Act.

National Planning Policy Framework (NPPF) (2012).

Peay, S. (2003) Guidance on Habitat for White-clawed Crayfish. Environment Agency R& D Technical Report W1-067/TR.

RPS (2016) Hornsea Three Preliminary Ecological Appraisal.

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## Appendix A Figures

### A.1 White-clawed crayfish survey area



 White-clawed Crayfish Survey Area

It is drawn to the readers attention that the survey area depicted in this figure is not representative of the final project boundary. The relationship between the final project boundary and the survey area, as well as any implications for the baseline information as it relates to the EIA is discussed in the limitations section of this annex (see Section 2).

Reference System : OSGB36 Scale@A3:1:250,000  
 Projection : BNG Vertical reference: Newlyn



REV	REMARK	DATE
01	Initial Issue	09/11/2017

Hornsea Project Three  
 Figure 1.1:  
 White-clawed Crayfish Survey Area

Doc no: FDEW112/24060/1  
 Created by: NS  
 Checked by: AS  
 Approved by: NS



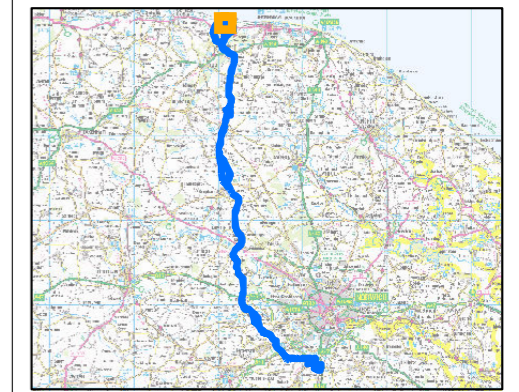
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## A.2 White-clawed crayfish survey results



- White-clawed Crayfish Habitat Suitability Assessment Category**
- Unsuitable
  - White-clawed Crayfish Survey Area
  - Landfall Construction Compound
  - Storage Area
  - Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



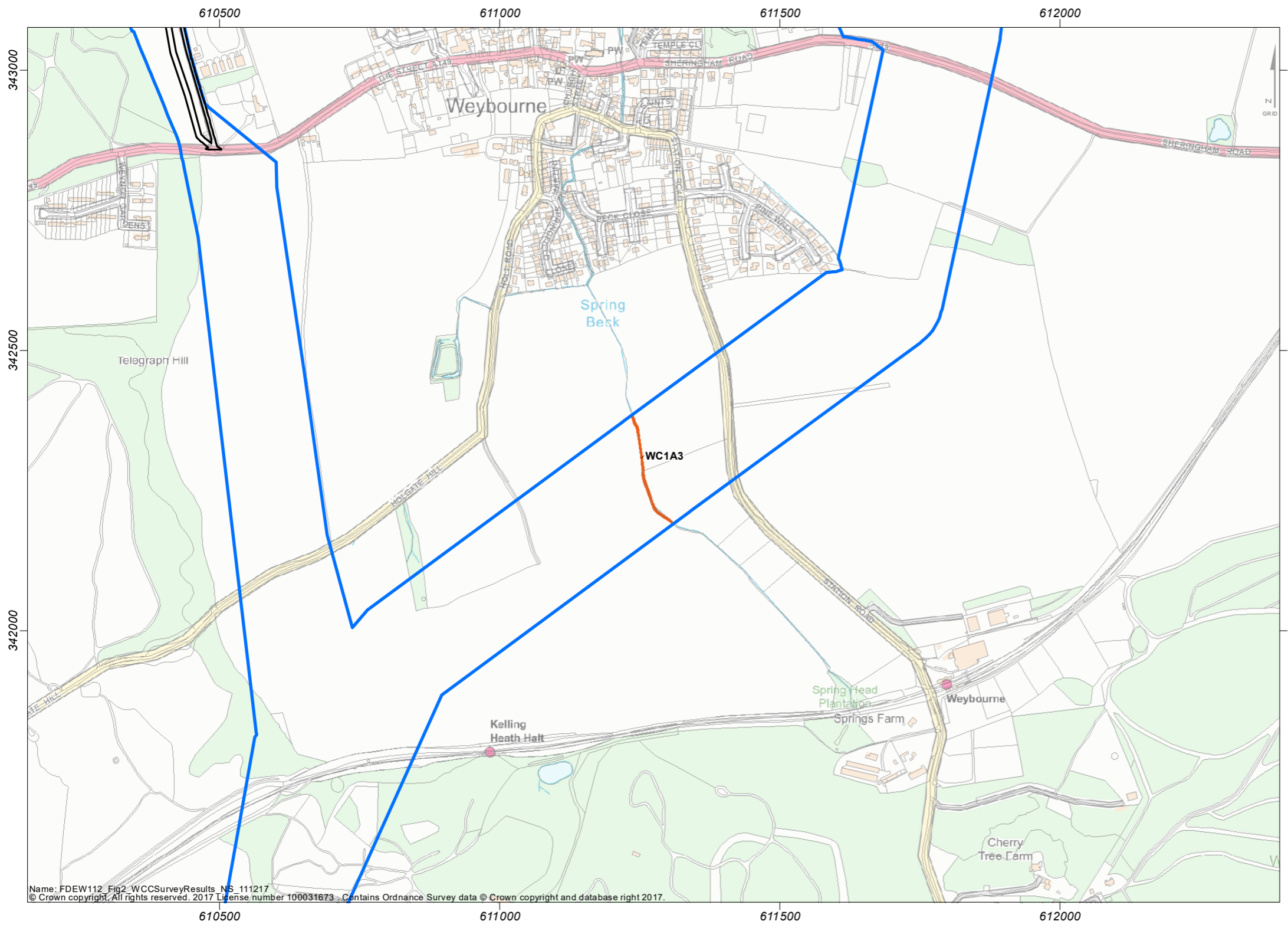
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 Projection : BNG  
 Scale@A3:1:7,964  
 Vertical reference: Newlyn

0 210 Metres

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01	Initial Issue	09/11/2017

**Hornsea Project Three**  
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 White-clawed Crayfish Survey Results.

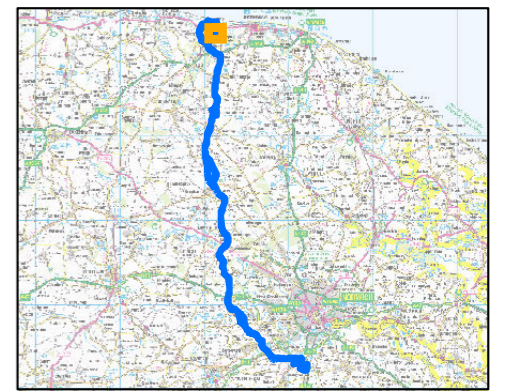




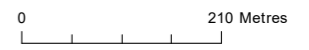
**White-clawed Crayfish Habitat Suitability Assessment Category**

- Moderate Suitability
- White-clawed Crayfish Survey Area
- Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



Reference System : OSGB36  
 Projection : BNG  
 Scale@A3:1:7,964  
 Vertical reference: Newlyn



REV	REMARK	DATE
01	Initial Issue	09/11/2017

Hornsea Project Three  
 Figure: 2.2  
 White-clawed Crayfish Survey Results.

Doc no: FDEW112/24908/1  
 Created by: NS  
 Checked by: AS  
 Approved by: NS



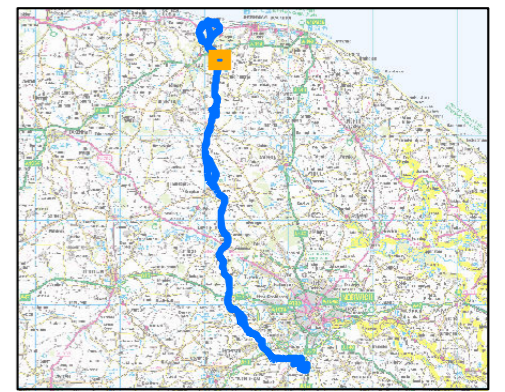
Name: FDEW112\_Fig2\_WCCSurveyResults\_NS\_111217  
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**White-clawed Crayfish Habitat Suitability Assessment Category**

- Unsuitable
- Waterbody not Accessible for Survey
- White-clawed Crayfish Survey Area
- Storage Area
- Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



Reference System : OSGB36      Scale@A3:1:7,964  
 Projection : BNG                      Vertical reference: Newlyn



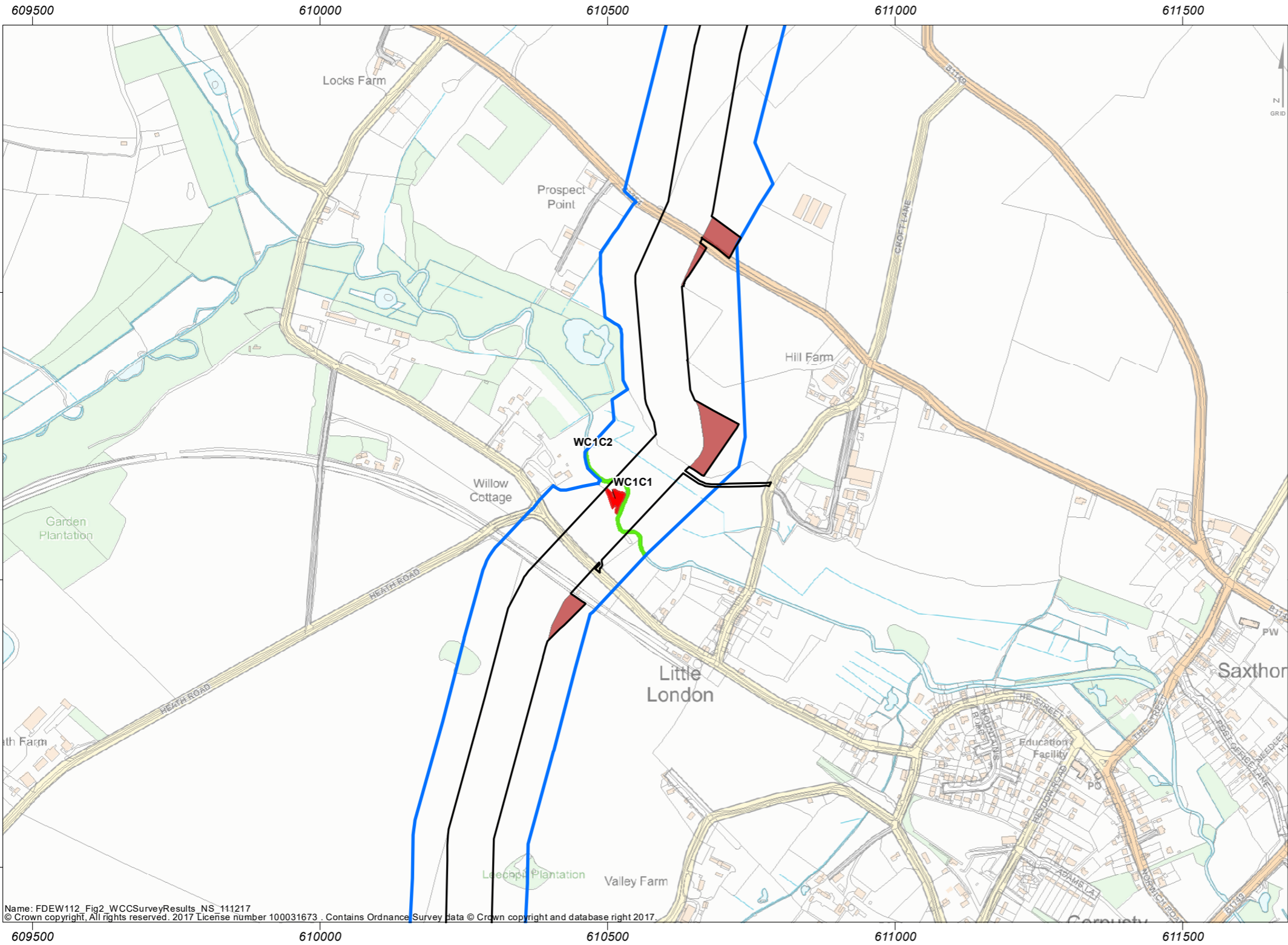
REV	REMARK	DATE
01	Initial Issue	09/11/2017

Hornsea Project Three  
 Figure: 2.3  
 White-clawed Crayfish Survey Results.

Doc no: FDEW112/24909/1  
 Created by: NS  
 Checked by: AS  
 Approved by: NS



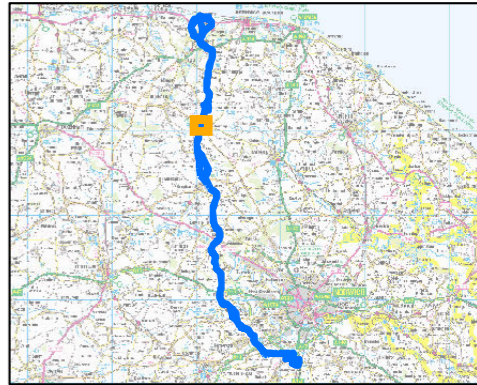
Name: FDEW112\_Fig2\_WCCSurveyResults\_NS\_111217  
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**White-clawed Crayfish Habitat Suitability Assessment Category**

- High Suitability
- Unsuitable
- White-clawed Crayfish Survey Area
- Storage Area
- Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



Reference System : OSGB36      Scale@A3:1:7,964  
 Projection : BNG                      Vertical reference: Newlyn

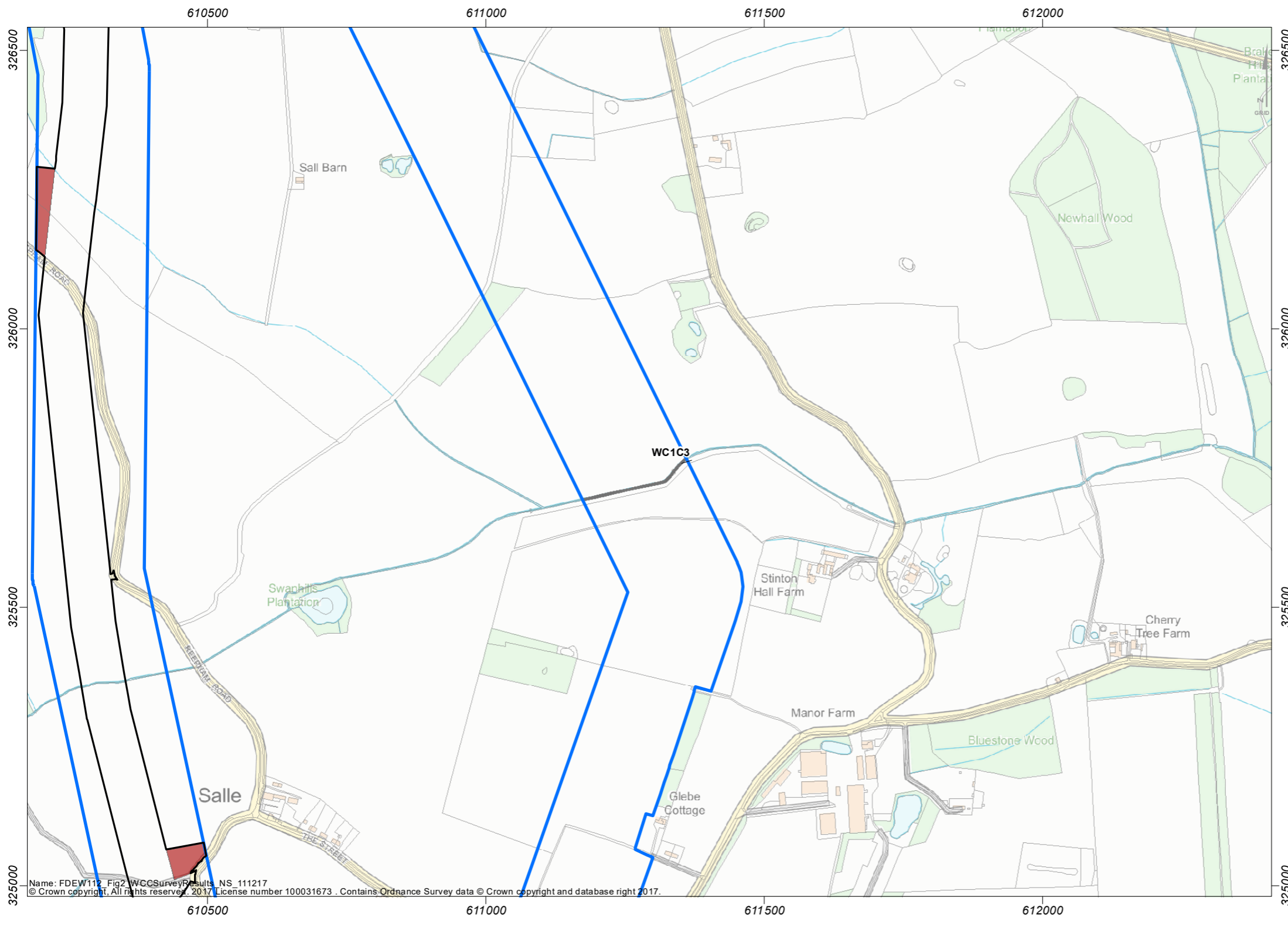


REV	REMARK	DATE
01	Initial Issue	09/11/2017

Hornsea Project Three  
 Figure: 2.4  
 White-clawed Crayfish Survey Results.

Doc no: FDEW112/24910/1  
 Created by: NS  
 Checked by: AS  
 Approved by: NS





**White-clawed Crayfish Habitat Suitability Assessment Category**

- Waterbody not Accessible for Survey
- White-clawed Crayfish Survey Area
- Storage Area
- Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



Reference System : OSGB36  
 Projection : BNG  
 Scale@A3:1:7,964  
 Vertical reference: Newlyn



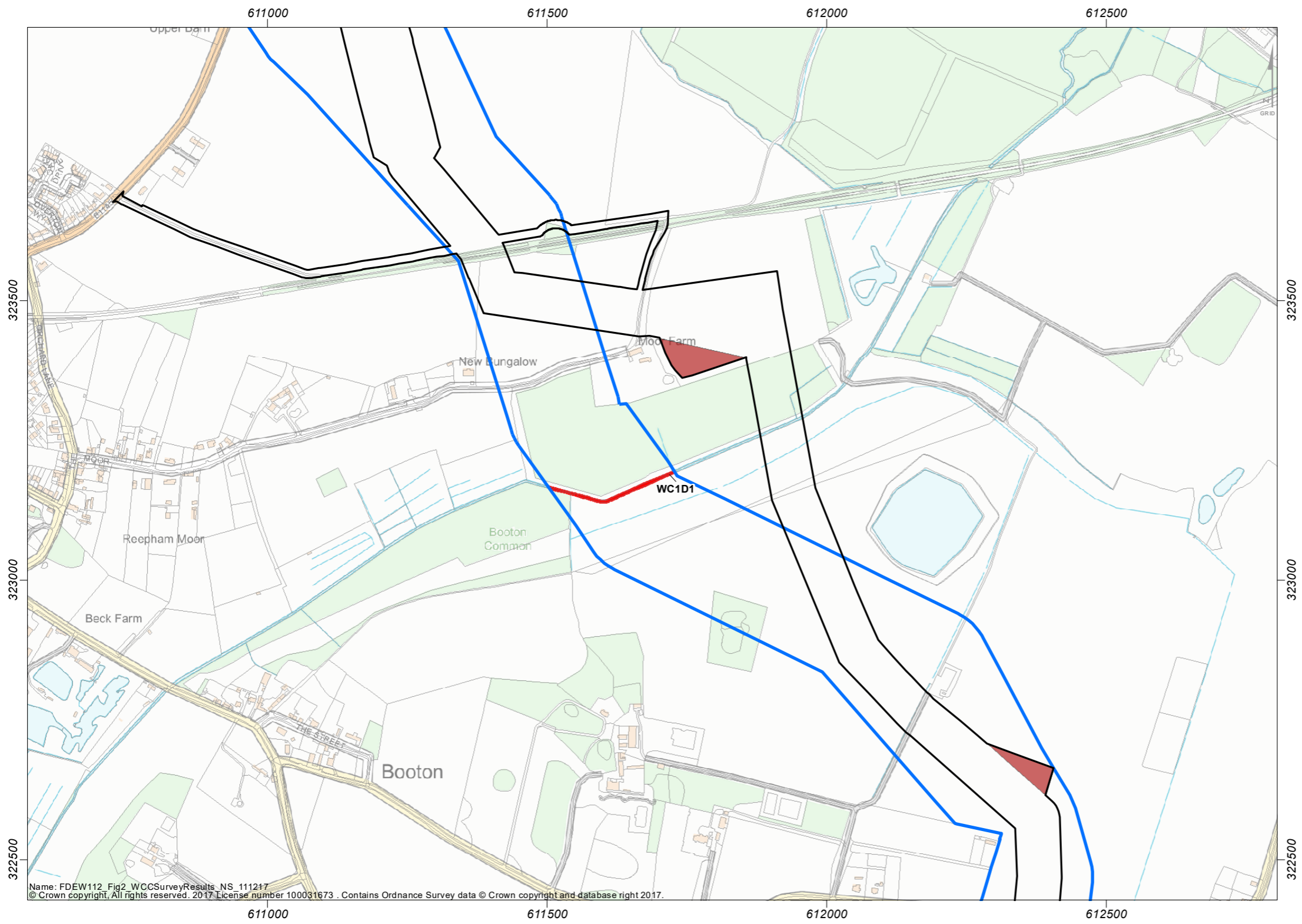
REV	REMARK	DATE
01	Initial Issue	09/11/2017

Hornsea Project Three  
 Figure: 2.5  
 White-clawed Crayfish Survey Results.

Doc no: FDEW112/24911/1  
 Created by: NS  
 Checked by: AS  
 Approved by: NS



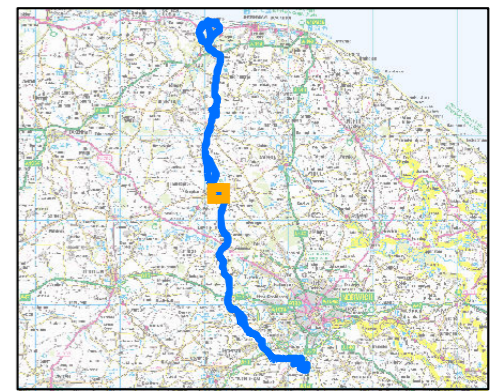
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**White-clawed Crayfish Habitat Suitability Assessment Category**

- High Suitability
- White-clawed Crayfish Survey Area
- Storage Area
- Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



Reference System : OSGB36  
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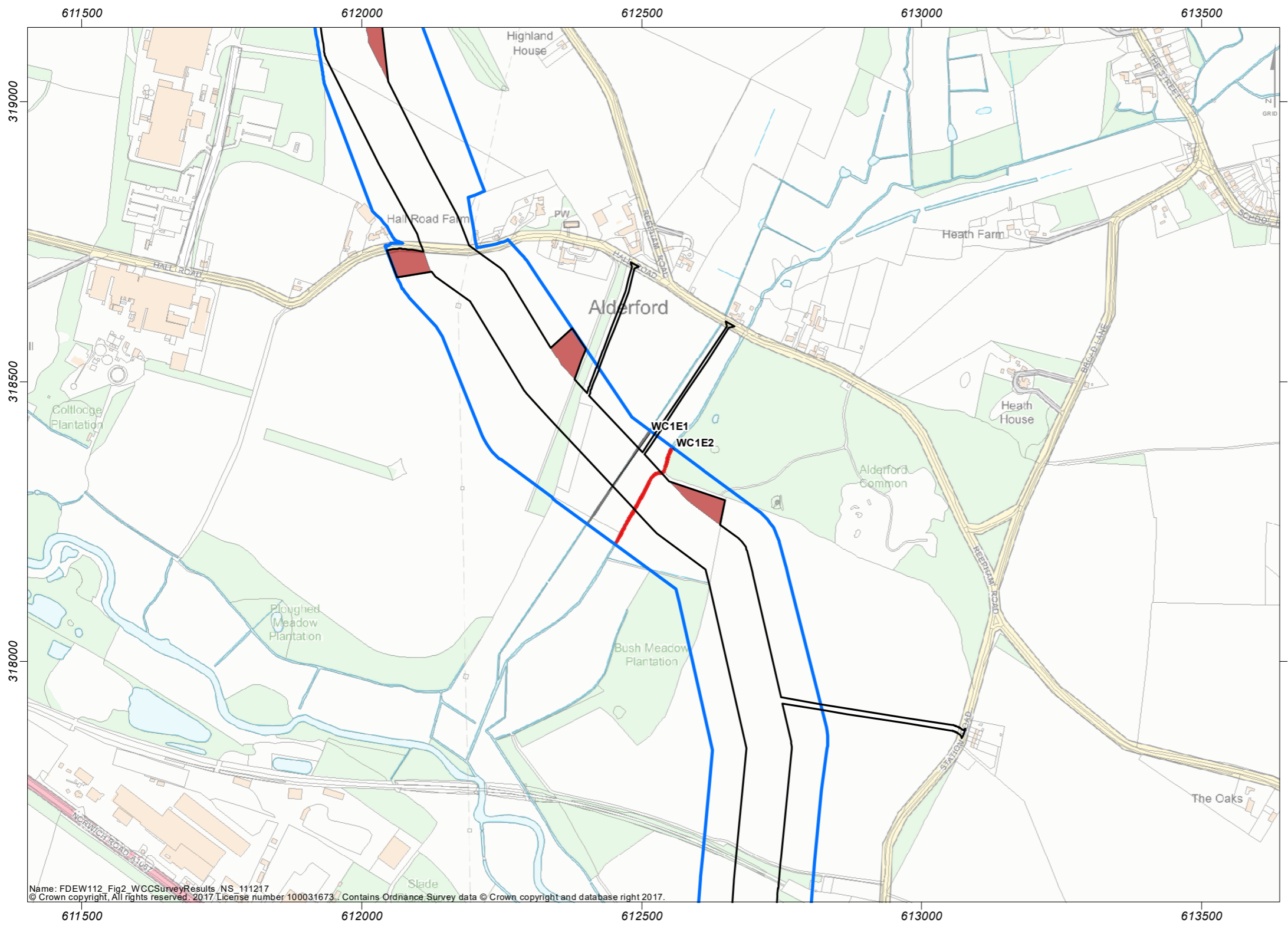
REV	REMARK	DATE
01	Initial Issue	09/11/2017

Hornsea Project Three  
 Figure: 2.6  
 White-clawed Crayfish Survey Results.

Doc no: FDEW112/24912/1  
 Created by: NS  
 Checked by: AS  
 Approved by: NS

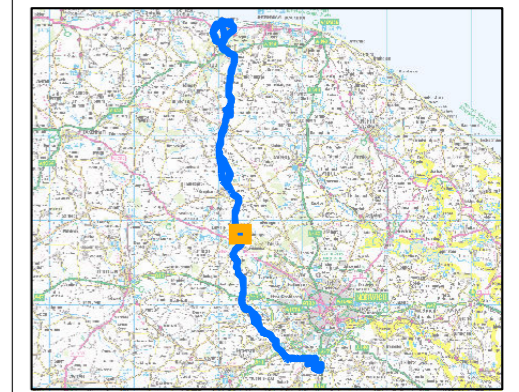


Name: FDEW112\_Fig2\_WCCSurveyResults\_NS\_111217  
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- White-clawed Crayfish Habitat Suitability Assessment Category**
- High Suitability
  - Waterbody not Accessible for Survey
  - White-clawed Crayfish Survey Area
  - Storage Area
  - Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.

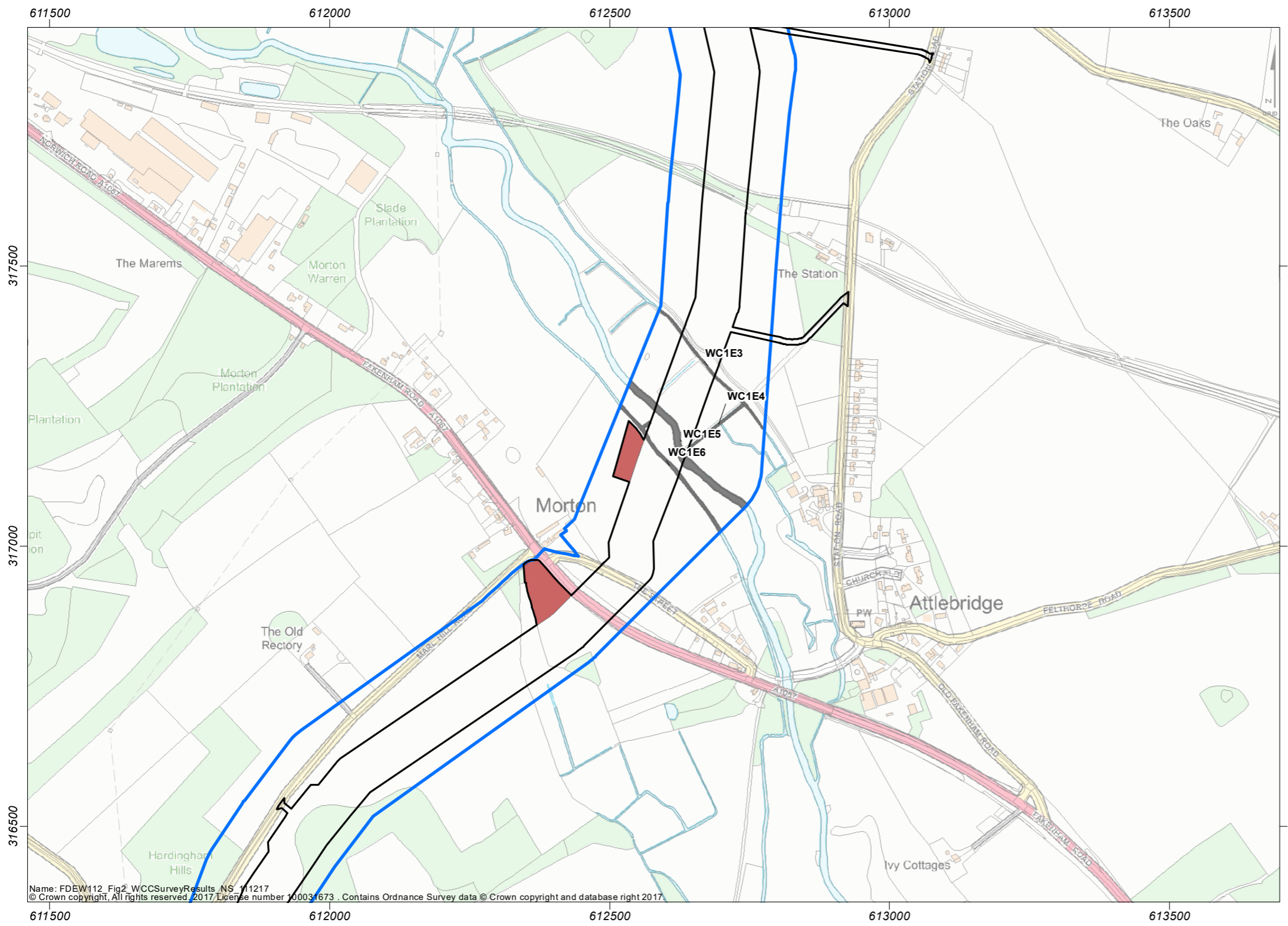


Reference System : OSGB36  
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 Scale@A3:1:7,964  
 Vertical reference: Newlyn

0 210 Metres

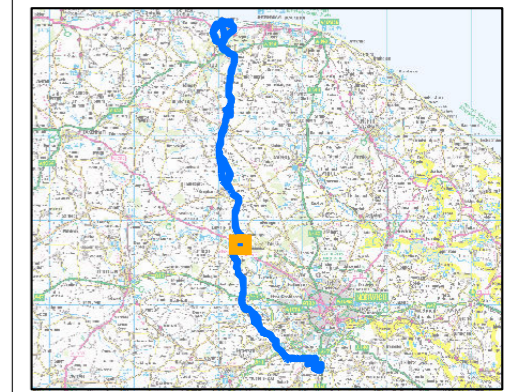
REV	REMARK	DATE
01	Initial Issue	09/11/2017

**Hornsea Project Three**  
 Figure: 2.7  
 White-clawed Crayfish Survey Results.



- White-clawed Crayfish Habitat Suitability Assessment Category**
- Waterbody not Accessible for Survey
  - White-clawed Crayfish Survey Area
  - Storage Area
  - Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.

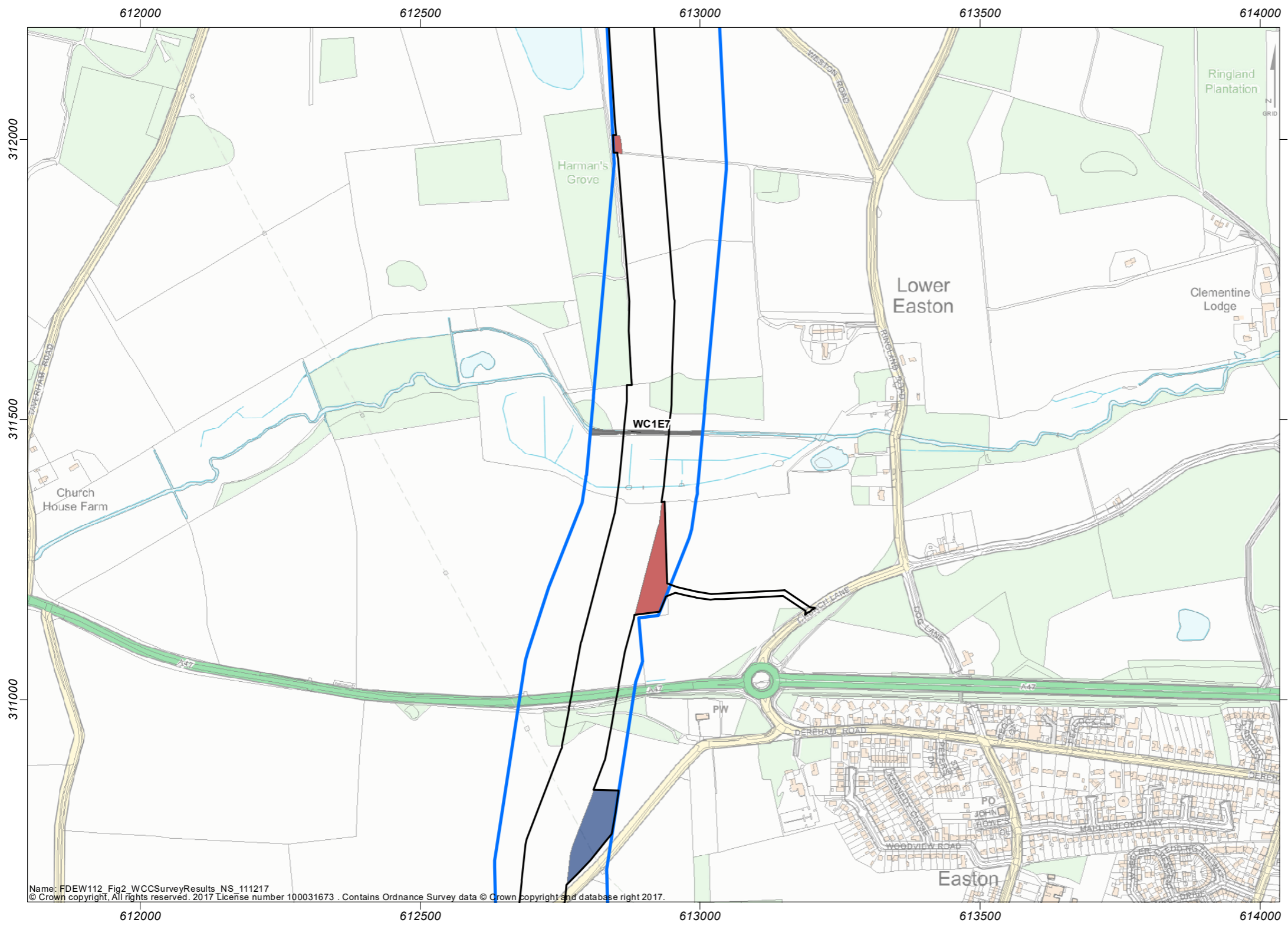


Reference System : OSGB36  
 Projection : BNG  
 Scale@A3:1:7,964  
 Vertical reference: Newlyn

0 210 Metres

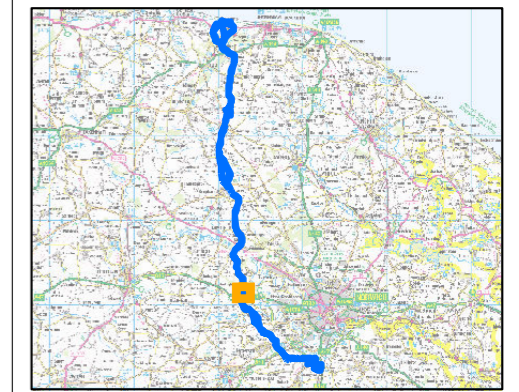
REV	REMARK	DATE
01	Initial Issue	09/11/2017

**Hornsea Project Three**  
 Figure: 2.8  
 White-clawed Crayfish Survey Results.



- ### White-clawed Crayfish Habitat Suitability Assessment Category
- Waterbody not Accessible for Survey
  - White-clawed Crayfish Survey Area
  - Storage Area
  - Compound
  - Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



Reference System : OSGB36  
 Projection : BNG  
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 Vertical reference: Newlyn

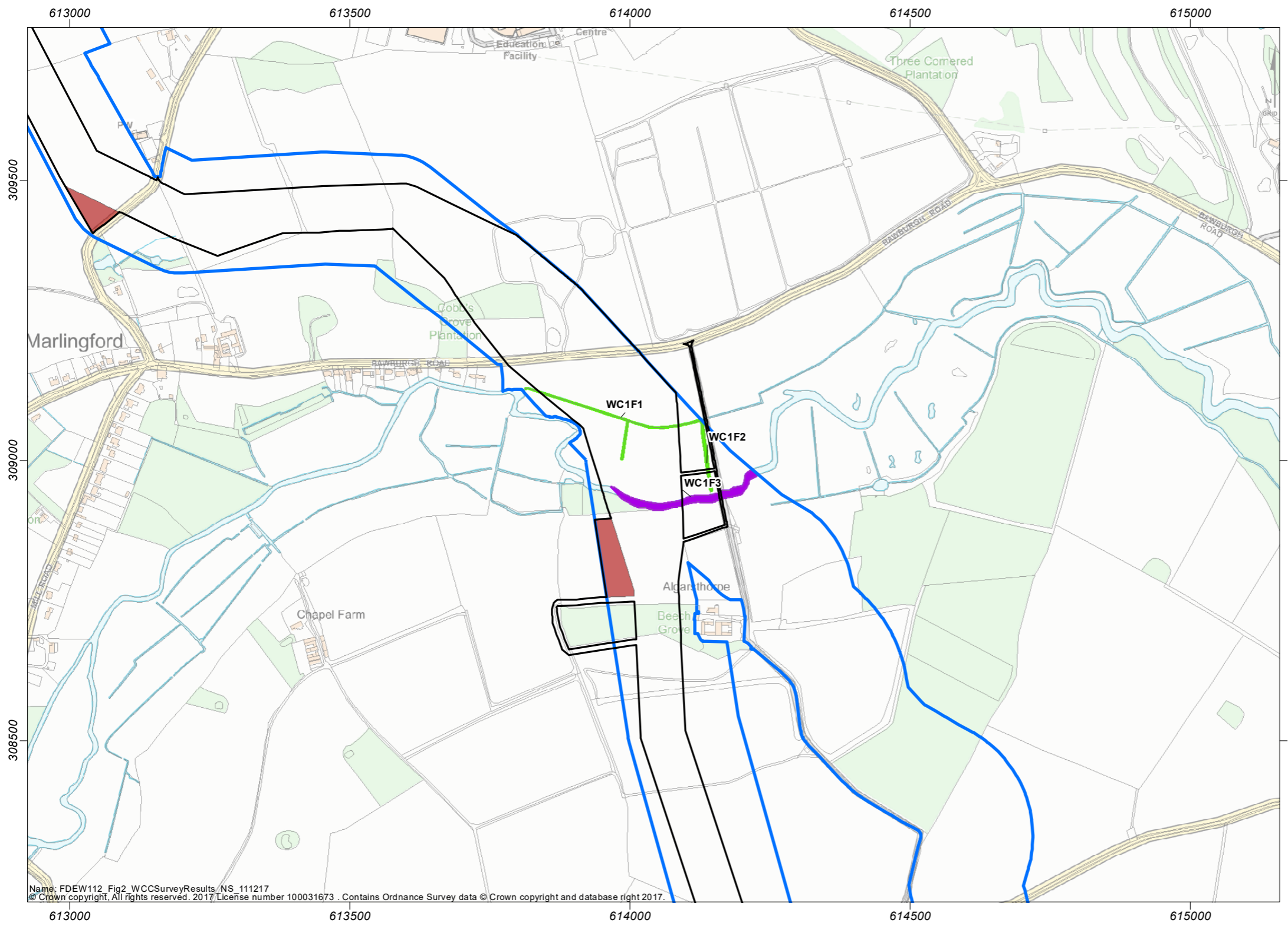
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REV	REMARK	DATE
01	Initial Issue	09/11/2017

**Hornsea Project Three**  
 Figure: 2.9  
 White-clawed Crayfish Survey Results.

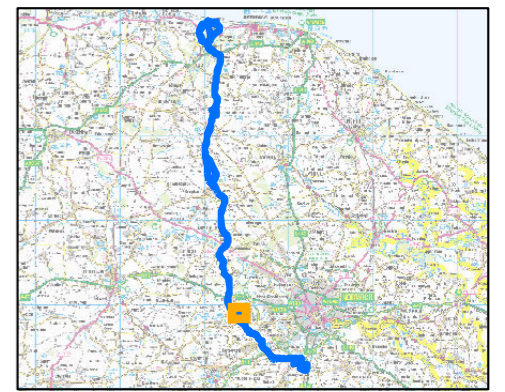
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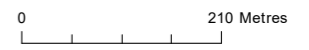


- White-clawed Crayfish Habitat Suitability Assessment Category**
- Confirmed Present
  - Unsuitable
  - White-clawed Crayfish Survey Area
  - Storage Area
  - Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



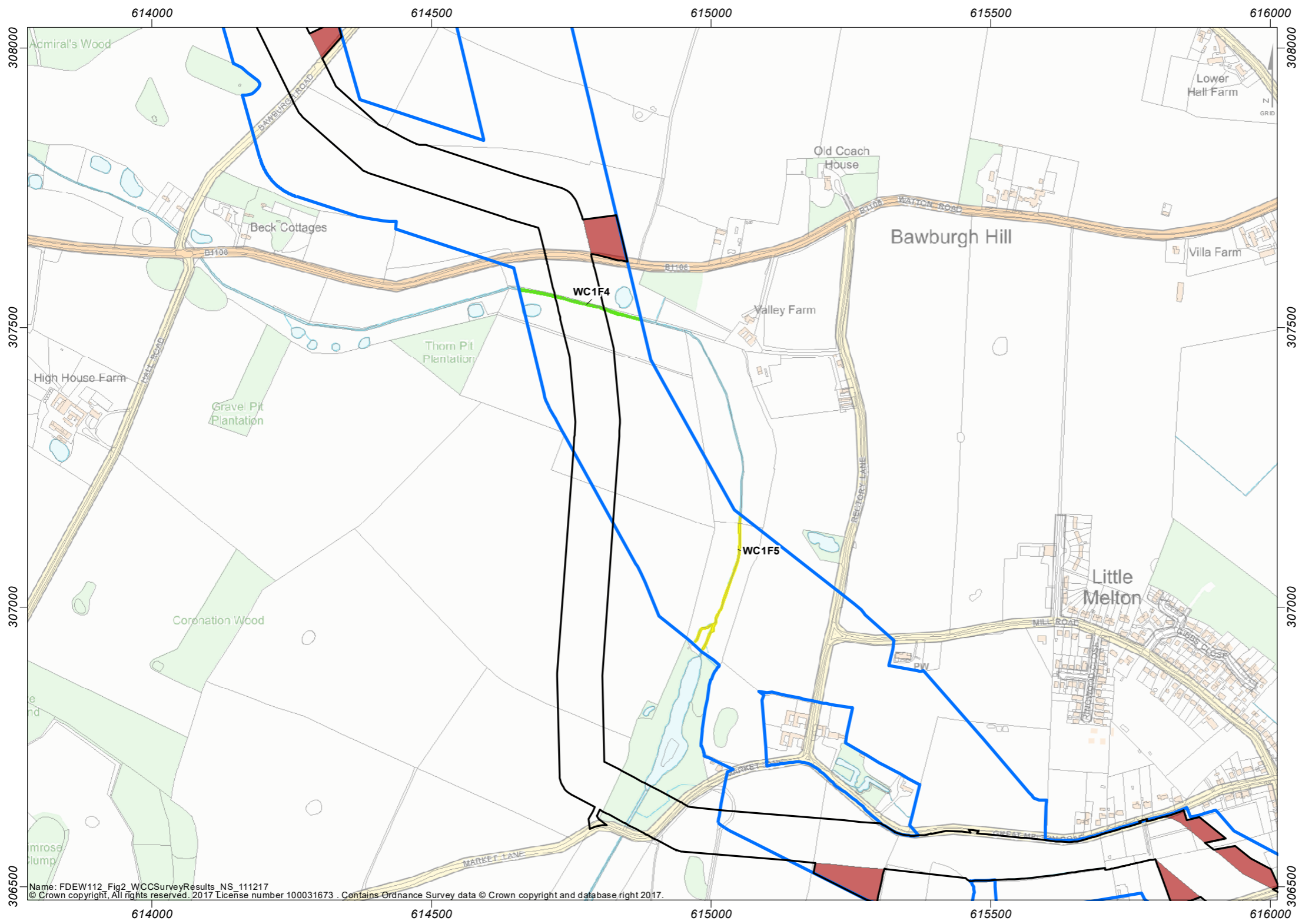
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 Vertical reference: Newlyn



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**Hornsea Project Three**  
 Figure: 2.10  
 White-clawed Crayfish Survey Results.

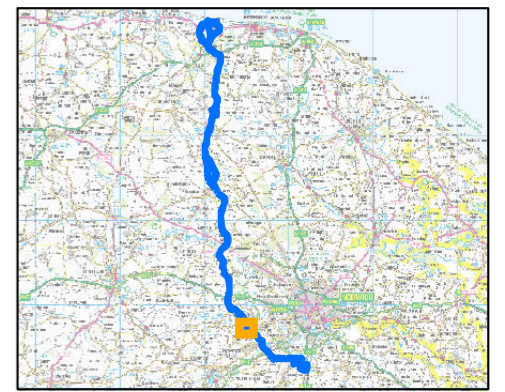
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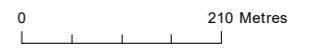
**White-clawed Crayfish Habitat Suitability Assessment Category**

- Low Suitability
- Unsuitable
- White-clawed Crayfish Survey Area
- Storage Area
- Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



Reference System : OSGB36  
 Projection : BNG  
 Scale@A3:1:7,964  
 Vertical reference: Newlyn

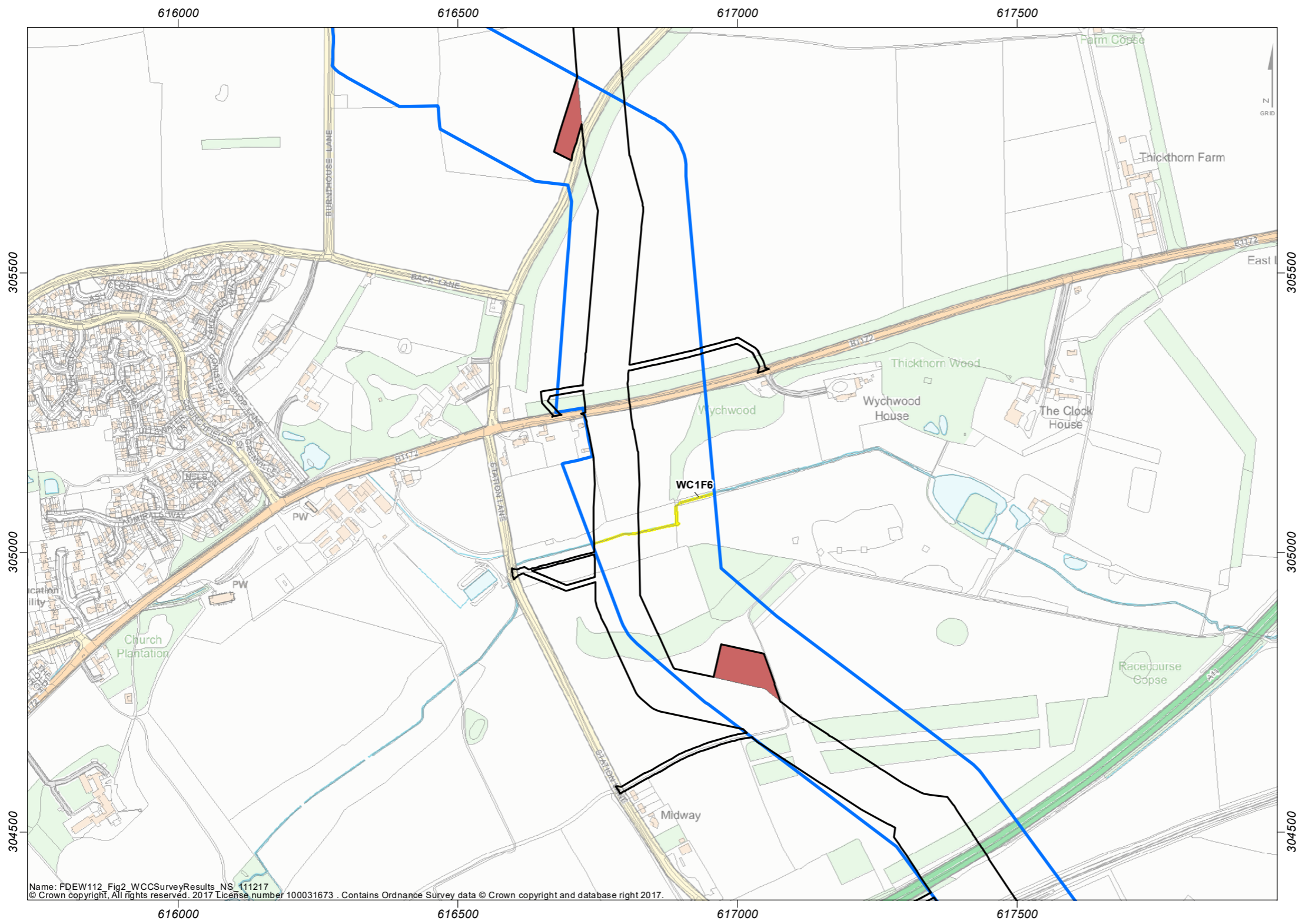


REV	REMARK	DATE
01	Initial Issue	09/11/2017

Hornsea Project Three  
 Figure: 2.11  
 White-clawed Crayfish Survey Results.

Doc no: FDEW112/24917/1  
 Created by: NS  
 Checked by: AS  
 Approved by: NS



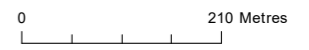


- White-clawed Crayfish Habitat Suitability Assessment Category**
- Low Suitability
  - White-clawed Crayfish Survey Area
  - Storage Area
  - Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



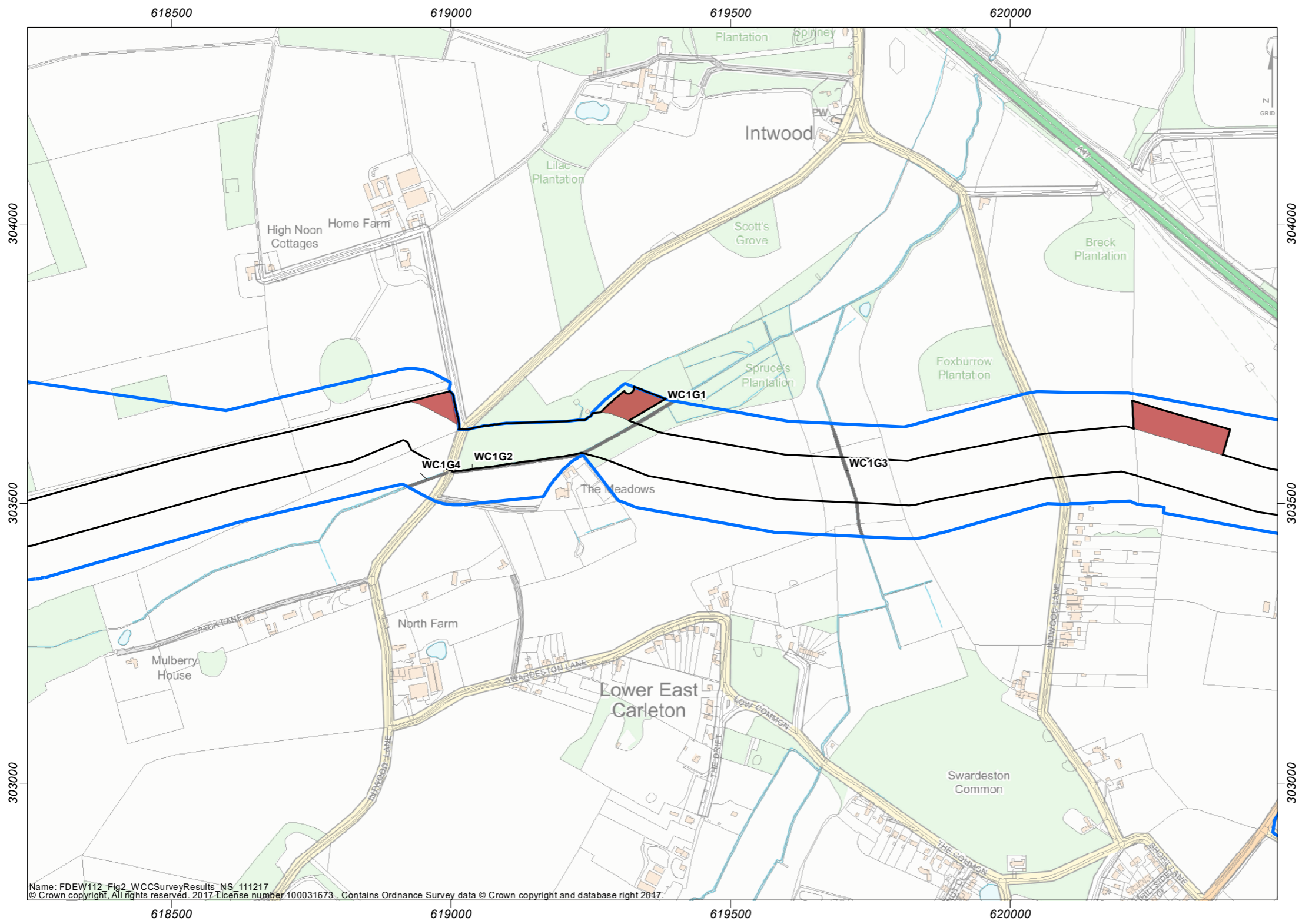
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REV	REMARK	DATE
01	Initial Issue	09/11/2017

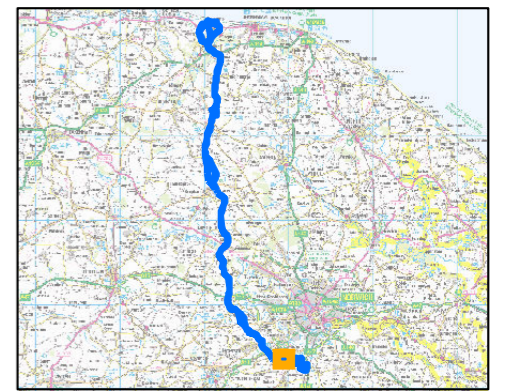
**Hornsea Project Three**  
 Figure: 2.12  
 White-clawed Crayfish Survey Results.

Name: FDEW112\_Fig2\_WCCSurveyResults\_NS\_111217  
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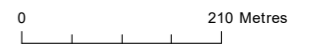


- White-clawed Crayfish Habitat Suitability Assessment Category**
- Waterbody not Accessible for Survey
  - White-clawed Crayfish Survey Area
  - Storage Area
  - Hornsea Three onshore cable corridor

Note: this set of figures does not include sections of the onshore cable corridor where no features were surveyed.



Reference System : OSGB36  
 Projection : BNG  
 Scale@A3:1:7,964  
 Vertical reference: Newlyn



REV	REMARK	DATE
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**Hornsea Project Three**  
 Figure: 2.13  
 White-clawed Crayfish Survey Results.

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### A.3 White-clawed crayfish habitat photographs



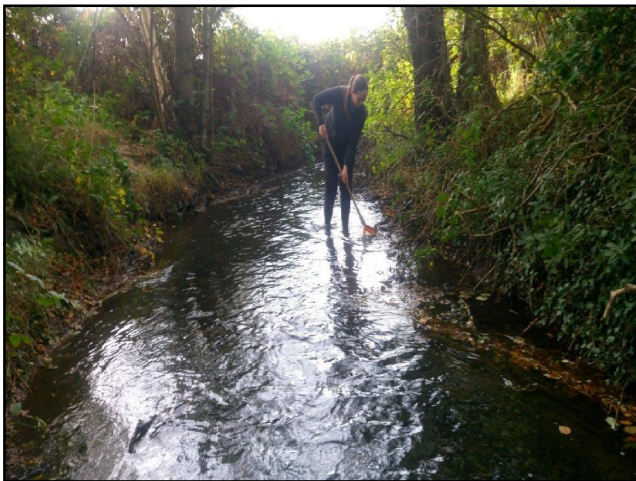
Photograph 1:  
Location WC1A3. Weybourne/Spring Beck. No crayfish recorded.



Photograph 2:  
Location WC1C1. River Bure. Signal crayfish recorded.



Photograph 3:  
Signal crayfish recorded at Location WC1C1 on the River Bure.



Photograph 4:  
Location WC1E2. Trout Stream. Good habitat but no crayfish recorded.



Photograph 5:  
Location WC1F3. River Yare. The only site where white-clawed crayfish was recorded.



Photograph 6:  
White-clawed crayfish recorded at Location WC1F3 – River Yare.

Reference System : N/A  
Projection : N/A  
Scale@A3: N/A  
Vertical reference: N/A

REV	REMARK	DATE
01	Initial Issue	13/12/2017

Hornsea Project Three  
Figure 3.1:  
Crayfish Survey Photographs

## Appendix B Survey results

Table B.1: Crayfish survey results.

Code	Waterbody Name	Catchment	Crayfish Species	Habitat suitability for White-clawed Crayfish ( <i>Austropamobius pallipes</i> )	Habitat Description
WC1A3	Weybourne / Spring Beck	Weybourne / Spring Beck	No	Relatively low suitability - small, shallow channel with limited refugia. In the Weybourne the white-clawed crayfish introduction stretch, best habitat is under the undercut walled banks (unsuitable silty stretches upstream and downstream).	i) Cable crossing section: deeply cut channel with high banks heavily shaded by dense bankside scrub. Small flinty and gravel substrate and shallow depth. Some limited aquatic vegetation including patches of fool's water-cress ( <i>Apium nodiflorum</i> ). ii) Weybourne section: small narrow channel that has been canalised with reinforced stone banks, being scoured and uncut along the eastern bank. Substrate is gravelly with few larger refugia. 1 m wide and 0.05 m deep.
WC1A1	A former gravel pit	Not applicable	No (habitat unsuitable)	Not suitable; completely dry except a small stagnant area of standing water.	The waterbody within the former gravel extraction site is completely dry apart from a small ditch section of stagnant water fringed with some common reed ( <i>Phragmites australis</i> ). The vegetation within the pit comprises terrestrial grasses and tall ruderals including willowherbs, thistles, nettles as well as bramble. 5 m wide and 0.2 m deep.
WC1A2	A reedbed	Weybourne / Spring Beck	No (habitat unsuitable)	Not suitable; dense reedbed with brackish water.	A dense reedbed with dominant common reed forming an impenetrable. 2 m wide and 1.2 m deep.
WC1B2	A field drain	River Glaven	No (habitat unsuitable)	Not suitable; small choked channel with no refugia, low flows and poor aquatic diversity.	Willowherbs and nettles along overgrown banks; firm substrate. 0.5 m wide and 0.05 m deep.
WC1C1	River Bure	River Bure	Signal crayfish ( <i>Pacifastacus leniusculus</i> )	Moderate suitability; clay banks for burrowing and submerged tree roots for refugia for juveniles. Although habitat is potentially suitable, the presence of a large signal crayfish population means the native crayfish is unlikely to be present (check nearest historical records)	Meandering section of River Bure shaded by bankside alder ( <i>Alnus glutinosa</i> ). Himalayan balsam ( <i>Impatiens glandulifera</i> ) and nettles grow along the steep sloping banks. Channel is gravelly with some silty berms and clay vertical banks are peppered with significant signal crayfish burrows leading to erosion - mainly within northern banks. Marginal and aquatic vegetation including fool's water-cress, pendulous sedge ( <i>Carex pendula</i> ) and a forget-me-not ( <i>Myosotis spp</i> ) species. 5 m wide and 0.5 m deep.
WC1C2	Oxbow lake	River Bure	No (habitat unsuitable)	Not suitable; stagnant anoxic water	The 'oxbow' type pond is cut off from the main River Bure excepting very high flows. It is heavily shaded and has accumulated many years' worth of leaf litter resulting in a deep anoxic layer of silt. 4 m wide and 0.2 m deep.
WC1D1	Reepham Beck (Booton Common)	River Wensum	Signal crayfish ( <i>Pacifastacus leniusculus</i> )	Moderate suitability. The banks are mainly silty and there a few opportunities for crayfish burrows. Best habitat is woody debris and submerged tree roots for refugia for juveniles.	Straight mainly silty channel heavily shaded by overhanging trees. Sparse marginal and aquatic vegetation and little in the way of potential refugia. 3 m wide and 0.4 m deep.

Code	Waterbody Name	Catchment	Crayfish Species	Habitat suitability for White-clawed Crayfish ( <i>Austropotamobius pallipes</i> )	Habitat Description
WC1E2	Trout Stream	River Wensum	No	Moderate suitability; abundance of refugia (cobbles, roots and vertical banks)	Chalk stream habitat with flint and chalk substrate shaded by overhanging alder and hawthorn. 3 m wide and 0.2 m deep. Otter ( <i>Lutra lutra</i> ) holt with fresh spraint; under tree roots on western bank 15 m north of bend. Bullheads and freshwater invertebrates including banded demoiselle and shrimp.
WC1F1	Field drain near River Yare	River Yare	No (habitat unsuitable)	Not suitable; completely dry and choked with vegetation.	Completely dry at time of survey choked with pond sedge. Open pasture to either side; hard rush along banks. 0.8 m wide and dry.
WC1F2	Field drain near River Yare	River Yare	No (habitat unsuitable)	Not suitable; completely dry and choked with vegetation.	Completely dry at time of survey choked with reed sweet-grass and common nettles. Overhung by a line of alder.
WC1F3	River Yare	River Yare	White-clawed crayfish ( <i>Austropotamobius pallipes</i> )	High suitability; ample refugia including vertical clay banks, dense marginal reed sweet-grass and large stones around bridge. Suspected crayfish burrows down stream of bridge.	Wide and in places deep river channel which is flanked by open pasture and supports a good array of marginal and emergent vegetation including reed sweet-grass ( <i>Glyceria maxima</i> ), water mint ( <i>Mentha citrate</i> ) and brooklime ( <i>Veronica beccabunga</i> ). Silty and gravel substrate with larger stones concentrated under and downstream of the bridge. Cattle poaching of shallow margins downstream. 7 m wide and 1.2 m deep. Bullhead, Stone Loach ( <i>Barbatula barbatula</i> ), minnow ( <i>Phoxinus phoxinus</i> ); range of invertebrates including caddisfly ( <i>Trichoptera spp</i> ), banded demoiselle ( <i>Calopteryx splendens</i> ) and several species of mollusc. Suspected American mink ( <i>Neovison vison</i> ) scat on old Mink raft upstream of bridge.
WC1F4	Field drain	River Yare	No (habitat unsuitable)	Not suitable; heavily shaded small channel with little or no refugia and low flows.	Heavily shaded by hawthorn ( <i>Crataegus monogyna</i> ) and ash ( <i>Fraxinus excelsior</i> ) with ivy ( <i>Hedera spp</i> ) cover. Silty channel with low flows. 1 m wide and 0.05 m deep.
WC1F5	Field drain	River Yare	No	Low suitability: narrow open channel with low flows and limited refugia.	Small open channel cutting through pasture; some gravel riffles with fine stony and silty substrate. Areas of fool's water-cress and brooklime. Some cattle poaching. 0.5 m wide and 0.1 m deep. stickleback and caddisfly.
WC1F6	Field drain	River Yare	No	Low suitability; small choked channel with little refugia and low flows.	Canalised straight ditch section with steep vegetated banks; narrow channel choked with emergent vegetation including bur-reed ( <i>Sparganium erectum</i> ), bulrush ( <i>Typha latifolia</i> ) and water-cress ( <i>Nasturtium officinale</i> ). Firm gravel substrate with some silt accumulations. 1 m wide and 0.1 m deep.