

A417 Missing Link
TR010056

6.4 Environmental Statement
Appendix 8.19 White-Clawed Crayfish
Technical Report

Planning Act 2008

APFP Regulation 5(2)(a)
Infrastructure Planning (Applications: Prescribed Forms and
Procedure) Regulations 2009

Volume 6

May 2021

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed Forms
and Procedure) Regulations 2009**

A417 Missing Link

Development Consent Order 202[x]

**6.4 Environmental Statement
Appendix 8.19 White-Clawed Crayfish Technical Report**

Regulation Number:	5(2)(a)
Planning Inspectorate Scheme Reference	TR010056
Application Document Reference	6.4
Author:	A417 Missing Link

Version	Date	Status of Version
C01	May 2021	Application Submission

Table of contents

Executive summary	
1. Introduction	1
1.1. Background	1
1.2. Scheme Proposal	1
1.3. Scope of Report	3
1.4. Study Area	3
1.5. Legislation	4
1.6. Status of white-clawed crayfish	4
1.7. White-clawed crayfish ecology	5
2. Methodology	7
2.1. Desk study	7
2.2. Habitat assessment	7
2.3. White-clawed crayfish surveys	7
2.4. Constraints	9
3. Results	10
3.1. Desk study	10
3.2. Habitat Assessment	10
3.3. Manual search	13
3.4. Trapping Survey	14
4. Conclusions and recommendations	15
4.1. Norman's Brook	15
4.2. Upper Frome	15
Appendices	16
Appendix A White-clawed crayfish survey areas	17
Appendix B White-clawed crayfish survey results	18

Figures

Figure 1.1 Current A417 route and scheme extent	1
Figure 1.2 A417 Missing link proposed option 30	2
Figure 3: Normans Brook	11
Figure 4: Upper Frome – unsuitable northern section (north of Reach 5):	12
Figure 5: Upper Frome – Reach 1	13

Executive Summary

The proposed A417 Missing Link scheme (hereafter referred to as ‘the scheme’) aims to provide a dual carriageway to a stretch of single carriageway between the Cowley roundabout and Crickley Hill in Gloucestershire; the 5.5 kilometre section is the only remaining section of single carriageway. The scheme would increase capacity by creating a free-flowing link between the Brockworth Bypass and Cowley roundabout and remove the at-grade junction with the A436, resulting in a continuous flow between the M4 Junction 15 (Swindon) and the M5 Junction 11a (Gloucester/Cheltenham).

Field surveys to identify white-clawed crayfish *Austropotamobius pallipes* signs were undertaken by Five Rivers Environmental Contracting on behalf of Mott MacDonald in 2018. The scheme has potential to directly impact 1 watercourse with potential to support white-clawed crayfish, Norman’s Brook, and indirectly impact a second watercourse with potential to support white-clawed crayfish, the Upper Frome. White-clawed crayfish surveys were undertaken in October 2018, including manual searching and trapping surveys. Trapping surveys were restricted to the Upper Frome due to a lack of sufficient water depth along Norman’s Brook. No evidence of white-clawed crayfish or any non-native crayfish species was found during the surveys of either watercourse.

No records of white-clawed crayfish were returned within 2 kilometres of the scheme from Gloucestershire Centre for Environmental Records, however, communications with Natural England, Gloucestershire Wildlife Trust and the Environment Agency confirmed the presence of white-clawed crayfish further downstream along the Upper Frome (approximately 3 kilometres south of the scheme), as well as within streams in the Cotswold Beechwoods Special Area of Conservation (approximately 4 kilometres southwest of the scheme).

Norman’s Brook will be directly impacted during the works, including the potential diversion of part of the watercourse. Whist surveys indicate the likely absence of white-clawed crayfish, there is a potential that a very small remnant population may be present. It is recommended that pre-construction surveys are undertaken to update the crayfish surveys. These should be undertaken during the optimum survey period between mid-July and mid-September. Additionally, it is recommended that a precautionary approach is taken during the diversion of the watercourse and that a detailed refugia survey is undertaken during the dewatering of the watercourse to ensure that any remnant populations are identified. A precautionary mitigation plan should be in place to minimise any delays during construction and to ensure the conservation status of white-clawed crayfish is maintained.

Surveys of the Upper Frome indicate the likely absence of white-clawed crayfish from the reaches of the watercourse surveyed. However, there is a known

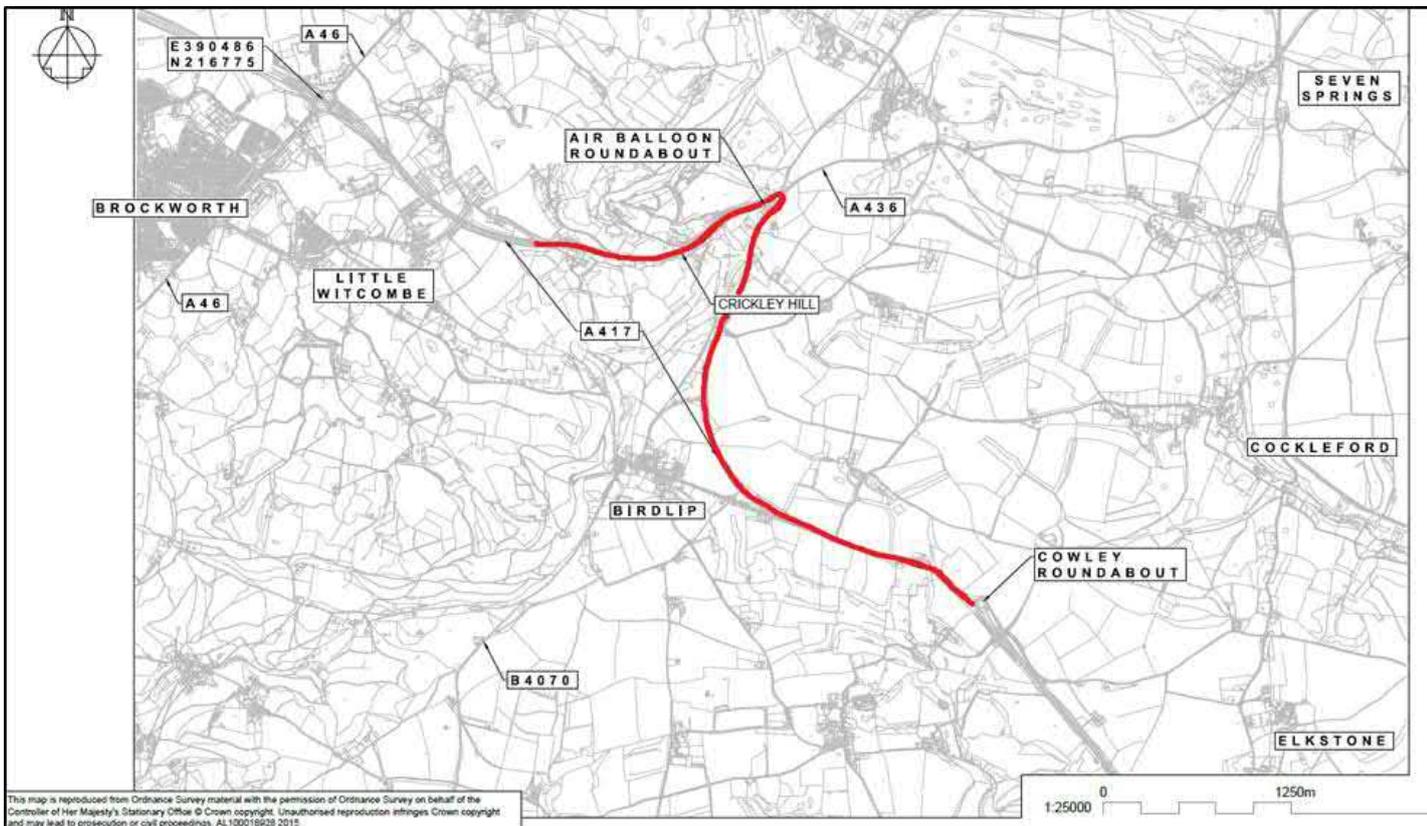
population downstream identified during the desk study. Therefore, mitigation should be implemented to ensure that the scheme does not affect water flows or water quality of water entering the Upper Frome, to ensure no adverse effect on downstream white-clawed crayfish populations. It is recommended that pre-construction surveys are undertaken to update the white-clawed crayfish surveys on the Upper Frome. These should be undertaken during the optimum survey period between mid-July and mid-September.

1. Introduction

1.1. Background

1.1.1. The A417/A419 provides an important link between the Midlands/North and South of England, between Gloucester and Swindon, and as an alternative to the M5/M4 route via Bristol. The section of the A417 near Birdlip, known as the 'missing link', forms the only section of single carriageway along the route, with an at-grade junction located at the 'Air Balloon' public house. The single carriageway is located between the Cowley roundabout and the base of Crickley Hill, a 5.5 kilometre stretch shown on Figure 1.1 below.

Figure 1.1 Current A417 route and scheme extent



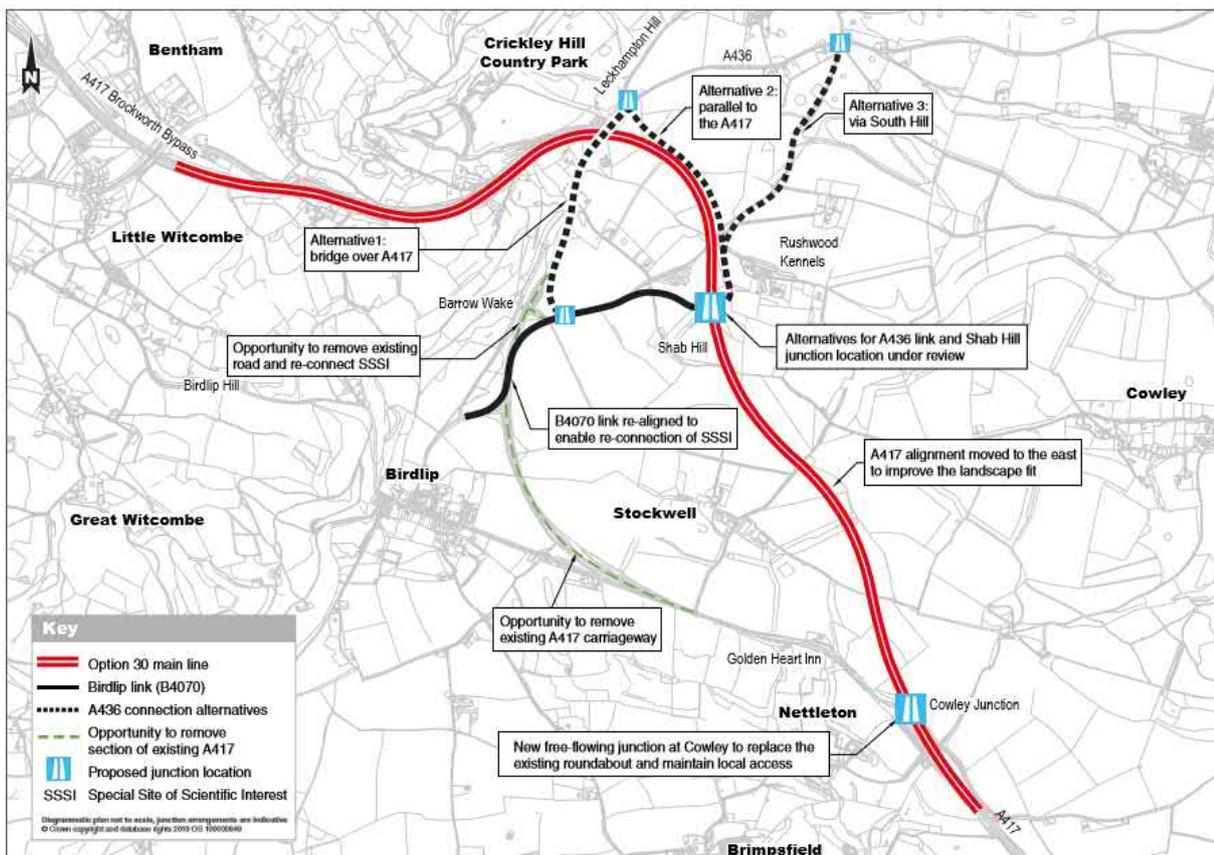
Source: GiGi GIS Portal. Crown Copyright 2016 100030649

1.2. Scheme Proposal

1.2.1 The proposed scheme would provide a dual carriageway to improve the current Missing Link section of single carriageway of the A417 between Cowley roundabout and Crickley Hill.

- 1.2.1. Any proposed scheme would aim to increase capacity by creating a free-flowing link between the Brockworth Bypass and the Cowley roundabout and remove the at-grade junction with the A436 (Air Balloon roundabout). This Missing Link will provide a free-flowing journey between Swindon (M4 Junction 15) and Gloucester / Cheltenham (M5 Junction 11).
- 1.2.2 The preferred route for the scheme was confirmed as Option 30 by the Secretary of State in March 2019 (see Figure 1.2 below). The Scheme comprises the construction of a new dual carriageway to replace the existing single carriageway section between Brockworth bypass and Cowley Roundabout. It is predominately an “offline” Scheme but approximately a third of the route follows the existing A417 route corridor at Crickley Hill.
- 1.2.3 A new link road would be built between the slip road junction at Shab Hill and the existing A417 to connect traffic to and from Birdlip and the A436 with the new A417. This new link road would end in a new roundabout near Barrow Wake.

Figure 1.2 A417 Missing link proposed option 30



- 1.2.4 Figure 1.2 above shows how there are three A436 link road alternative connections. Alternative 2, parallel to the A417, is the selected route proceeded with for assessment in the Environmental Statement.

1.3. Scope of Report

1.3.1 The objectives of the report are to present the findings of surveys for white-clawed crayfish, which were undertaken on two watercourses which will be potentially impacted by the A417 Missing Link Scheme. This report provides the methodologies used, survey results and any constraints. This report does not provide an assessment of potential impacts or provide recommendations for mitigation.

1.4. Study Area

1.4.1. Guidance on ecological assessments recommends that all ecological features that occur within a zone of influence (Zol) for a proposed scheme are investigated (CIEEM, 2016)¹. The potential Zol for white clawed crayfish includes:

- areas to be directly within the land take for the proposed scheme and access that could cause loss or degradation of suitable aquatic habitat.
- aquatic habitat which could be indirectly affected by the scheme such as through changes in water levels, including any hydrologically connected habitat.

1.4.2. For the A417 Missing Link Scheme, a total of two watercourses were assessed as potentially being impacted and therefore were scoped in for white-clawed crayfish surveys, including:

- Norman's Brook (formerly Horsbere Brook). Stream running parallel with existing A417 to west of Barrow Wake. Watercourse will be directly impacted by Option 30 with potential diversions and culverting.
- River Frome Upper Tributaries. Located 110m southwest of the scheme at its closest point. No direct impacts. Potential for impacts to water levels and flow if Option 30 affects aquifers which feed the tributaries.

1.4.3. The two watercourses selected for survey were the only two watercourses identified at the time of survey with potential to be directly or indirectly impacted by the proposed scheme.

¹ Chartered Institute of Ecology and Environmental Management (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal

1.5. Legislation

1.5.1. White-clawed crayfish are protected under European and National legislation. They are listed under Annexes II and V of the European Council Directive 92/43/EEC the Habitats Directive 1992, transposed into UK Legislation through the Conservation of Habitats and Species Regulations 2017. This legislation requires:

- The identification and designation of important sites for white-clawed crayfish as Special Areas of Conservation (SACs)
- Taking from the wild and exploitation of white-clawed crayfish to be subject to management measures.

1.5.2. White-clawed crayfish are also protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) which makes it an offence to:

- Intentionally take [capture] a wild white-clawed crayfish
- Sell, offer or expose for sale, or have in one's possession or transport for the purpose for sale, any live or dead wild white-clawed crayfish, or any part derived from it.

1.5.3. Also, of relevance for the white-clawed crayfish surveys is legislation relating to North American signal crayfish *Pacifastacus leniusculus*. This highly invasive species has a significant adverse effect on native wildlife and habitats, including white-clawed crayfish, and is therefore included in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). It is an offence to release into the wild any animal listed under Schedule 9.

1.6. Status of white-clawed crayfish

1.6.1. White-clawed crayfish were once widespread across Europe and Britain but suffered significant decline during the mid to late 1900's and are now internationally and nationally rare. A major threat to native white-clawed crayfish is posed by the introduction of non-native species of crayfish, which have been farmed in Britain since the late 1970s. Soon after the introduction of non-native crayfish farming, crayfish plague (a virulent disease caused by the fungus *Aphanomyces astaci*) broke out and spread rapidly, causing drastic losses of native crayfish in rivers in England. It is believed that this disease was introduced and is spread by the most frequently farmed species, the North American signal crayfish, a carrier of the disease. Crayfish plague can be introduced into a waterbody not only by entry of signal crayfish but also by water, fish or equipment that has been in contact with signal crayfish. This greatly

increases the risk to remaining white-clawed crayfish populations. It is only in areas free of disease that white-clawed crayfish are likely to survive in the future.

- 1.6.2. North American signal crayfish and other non-native crayfish are larger and more aggressive than the native species and produce more young. Consequently, the introduced species pose a threat not only because some are disease-carriers, but also through predation and competition with white-clawed crayfish. In Britain North American signal crayfish are now well-established in the wild.
- 1.6.3. Following the introduction of the North American signal crayfish and associated outbreaks of crayfish plague, most of the remaining populations are concentrated in northern and central England. The remaining populations of white-clawed crayfish are threatened by non-native crayfish introduction and the spread of crayfish plague, as well as habitat loss, degradation, pollution and water abstraction.

1.7. White-clawed crayfish ecology

- 1.7.1. White-clawed crayfish occur in a wide range of waterbodies including both running and still water habitats. They can be found in a wide range of habitats including chalk rivers, clay rivers, upland streams, canals and reservoirs.
- 1.7.2. Typical habitats include fresh water streams less than 1 metre deep, slow flowing glides, still waterbodies and pools. White-clawed crayfish prefer waterbodies that are alkaline rich with a high PH level (preferably between 6.8-8.6) and largely unpolluted. Their distribution is largely determined by geology and water quality, with crayfish occurring in areas with relatively hard, mineral-rich waters.
- 1.7.3. Suitable refuge areas in the watercourse and surrounding habitat are very important as this protects them from predation and from being washed away in high flows. They use a variety of refuges both natural and artificial, depending on habitat availability. They typically favour habitats with an underlying substrate of fine gravel / sand with some pebbles, overlaid with aggregations of boulders and large cobbles. Areas of undercut bank and overhanging trees and in-channel vegetation are also important habitat features. However, white-clawed crayfish are also known to inhabit watercourses with deep muddy substrates and little aquatic vegetation.
- 1.7.4. White-clawed crayfish activity varies by season, in response to temperature, river flow and annual cycle of growth, breeding and periods of inactivity. Breeding typically takes place between September and November when water temperatures drop below 10°C for an extended period. During the breeding season different areas within the watercourse may be used for shelter and

feeding. During the winter period, between December to March, they spend most of their time in torpor in refuges, until the water temperatures increases. Females carry their eggs over the winter period, they hatch on her and then remain for a period before they disperse. Young disperse in the water from June onwards.

- 1.7.5. Their diet includes a wide range of food including fallen leaves, aquatic vegetation, dead fish, aquatic invertebrates such as snails and caddis-fly larvae. Where available, calcified plants are of particular value to their diet as they provide a ready source of calcium.

2. Methodology

2.1. Desk study

- 2.1.1. As part of the preliminary ecological appraisal of the scheme, biological records were acquired from the Gloucestershire Centre for Environmental Records (GCER) in 2017. This included a search for protected and notable species within 2 kilometres from the scheme, where data was available.
- 2.1.2. Information on local white clawed crayfish records was also obtained through discussions with Natural England and Gloucestershire Wildlife Trust during A417 Environmental Working Group meetings in 2018. This information was provided verbally during these Environmental Working Group Meetings. A meeting was held with the Environment Agency on 10.04.2019 during which known locations of crayfish populations were discussed.

2.2. Habitat assessment

- 2.2.1. During the extended phase 1 habitat surveys under taken in May 2017, an initial assessment of habitat suitability was completed identifying all watercourses suitable for white-clawed crayfish within the ZoI of the scheme. More detailed habitat suitability assessments were also undertaken during the surveys in October 2018.

2.3. White-clawed crayfish surveys

- 2.3.1. To determine the presence/likely absence of white-clawed crayfish from the surveyed watercourses, surveys were undertaken by Five Rivers Environmental Contracting. All white-clawed crayfish surveys were led by surveyors holding a Natural England Class Survey Licence (CL11).
- 2.3.2. The survey methodology followed the protocol outlined in the JNCC CSM Guidance for Freshwater Fauna (CSM Protocol 2²) which is based on the method in LIFE in UK Rivers Project (Peay, 2003³).
- 2.3.3. During the surveys, field-based water quality parameters including temperature (°C), pH, dissolved oxygen (DO; mg/l and %) and conductivity ($\mu\text{S cm}^{-1}$) were recorded using a hand held calibrated YSI Pro-plus meter.

² http://jncc.defra.gov.uk/pdf/CMS_Freshwaterfauna_201510.pdf

³ Peay, S. (2003). Monitoring the white-clawed crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers Monitoring Series No.1. English Nature, Peterborough.

2.3.4. A strict biosecurity policy was adhered to at all times to prevent the spread of non-native species or pathogens (i.e. crayfish plague). This protocol included:

- Ensuring all equipment was checked, cleaned and dried as per biosecurity policy before leaving the office.
- All equipment was visually inspected between sites/survey days for any non-native species, cleaned and disinfected with Virkon.
- At the end of the surveys all equipment was visually checked and cleaned prior to loading the vehicle.
- On return to office all equipment was disinfected using Virkon and dried thoroughly.

Manual Search

2.3.5. At sites that were suitable, the 'standard method' of manual search of suitable crayfish refuges was undertaken. Manual searching involved facing upstream, gently lifting, sliding/turning and returning potential refuges and looking for crayfish. A refuge may be a single stone (or other item of physical refuge), but if stones were overlapping then multiple stones were lifted until the gravel substrate (or finer substrate) was reached. Where this was undertaken, this counted as 1 refuge.

2.3.6. For manual search, the site must at the time of visit:

- Have areas of suitable crayfish habitat in water depth <400mm
- Water flow <20 cm s⁻¹
- Relatively smooth water surface
- Clarity that enabled a clear view of the bed substrate in areas with potentially searchable physical habitat for white-clawed crayfish
- Water turbidity must be low to ensure crayfish can be seen and caught for species identification

Trapping

2.3.7. Where conditions prevent a complete manual search, the trapping methodology was used. Baited traps were left overnight and crayfish enter the traps and cannot escape.

-
- 2.3.8. Environment Agency consent is required to use crayfish traps and consent was granted for the surveys in October 2018.
 - 2.3.9. Trapping was avoided if rain was forecast or if a watercourse was still under moderate or high flow after rainfall. A trapping session was not valid if there was an increase in flow between trap setting and 4 hours after sunset.
 - 2.3.10. The trapping survey involved setting of mesh-traps, with funnelled entrances at either end which were baited with an attractant and deployed overnight when crayfish most actively forage. Funnel traps were deployed within areas of the survey sections where they could be fully submersed and associated with suitable refuge habitat.

2.4. Constraints

- 2.4.1. The optimal survey window for undertaking white-clawed crayfish surveys is after the breeding season between mid-July and mid-September. Surveys should avoid late-May and June when females may be carrying newly hatched young. The surveys for the A417 missing link scheme in 2018 were undertaken in October which is outside of this optimal survey window. However, the surveys were undertaken at a time of year when crayfish are still active and water temperatures recorded during the surveys were suitable for surveys (9.4°C). It is therefore considered that the surveys were undertaken at an appropriate time of year to detect the presence or likely absence of white clawed crayfish on the surveyed watercourses.
- 2.4.2. The surveys provide a snapshot of activity at the site and therefore there is always the risk of protected species being overlooked, either owing to the timing of the survey or the scarcity of the species at the site.
- 2.4.3. Conditions on site meant that some areas were difficult to access, owing to the density of vegetation, including an 80 metre stretch of the Upper Frome. However, an assessment of these areas was made as far as was practicable, and surveys were undertaken upstream and downstream of these areas where habitat was suitable. Therefore this is not considered a significant constraint. However, there is a risk that any crayfish present and confined to these inaccessible areas would have been overlooked.
- 2.4.4. Access to sections of Norman's Brook between SO 92356 15705 and SO 92137 15783 was not possible at the time of survey due to landowner restrictions. Surveys were undertaken upstream of this, however, there is a risk that any crayfish present and confined to these inaccessible areas would have been overlooked.

3. Results

3.1. Desk study

- 3.1.1. No records for white-clawed crayfish were returned from the GCER Biological Data Search within 2 kilometres of the scheme. From communications with Gloucestershire Wildlife Trust and Natural England, there are known populations of white-clawed crayfish on the wider Upper Frome (approximately 3 kilometres south of the scheme) and within streams within the Cotswolds Beechwoods SAC to the west of Cranham (approximately 4 kilometres southwest of the scheme).
- 3.1.2. At a meeting with the Environment Agency in April 2019, the Environment Agency confirmed that there were populations of white-clawed crayfish within the following watercourses: Climperwell Brook (exact location of records not given but closest point to scheme is at SO91921196, approximately 3.2 kilometres southwest of the A417); Painswick Stream (exact location of records not given but closest point to scheme is at SO91221159, approximately 3.96 kilometres southwest of the A417); and, Slad Brook (exact location of records not given but closest point to scheme is at SO88860899, approximately 7.3 kilometres southwest of the A417).

3.2. Habitat Assessment

Norman's Brook

- 3.2.1. Norman's Brook (currently shown on Ordnance Survey mapping as Horsbere brook but tracer surveys in 2018 confirmed that its Norman's Brook), is a small stream with a steep gradient, and is heavily shaded in a deeply incised channel (Figure 1). The wetted width of the stream at the time of survey was between 0.1 and 1.3 metres wide. The water level was shallow with very low flow and quite heavily silted with frequent woody debris in the stream. During the survey there were obvious issues with run-off, likely from the existing A417, with grey/oily film present in areas of slow flow.
- 3.2.2. A number of culverts were present along the surveyed section of the watercourse (up to 40 metres long) and there was a section of multiple low-head concrete weirs. The watercourse links to the open channel of Norman's Brook via a very long culvert.
- 3.2.3. The water levels within this watercourse appear to fluctuate significantly depending on rainfall and it is likely that the watercourse is dry during times of low rainfall.

- 3.2.4. The watercourse included numerous suitable refuges for crayfish including small and large cobbles, tree roots, undercut banks and woody debris in the water. The water is mineral rich with calcium deposits noted. There was however very limited aquatic or emergent vegetation. The likely ephemeral nature of the watercourse reduces its potential to support a viable population of white-clawed crayfish and the silty water with evidence of pollution reduces the overall suitability of the habitat

Figure 3: Normans Brook



Upper Frome

- 3.2.5. The areas of the watercourse within closest proximity to the scheme comprise a narrow stream between 0.1 and 0.4 metres wide which is very shallow and confined to field boundary ditches. The water levels are likely to frequently dry out depending on weather conditions. Sections are heavily poached by livestock. The stretch of watercourse north of Ordnance Survey grid reference SO 94382 13285 was assessed as being unsuitable for white-clawed crayfish (Figure 2). This is the section of watercourse within closest proximity to the A417 scheme.
- 3.2.6. The lower sections of the surveyed area of the Upper Frome, south of SO 94382 13285, were assessed as being more suitable for white-clawed crayfish with deeper water and a range of suitable refugia including small and large cobbles, boulders, tree roots, undercut banks and woody debris.

- 3.2.7. The watercourse comprises a small stream largely running through a mix of coniferous plantation and semi-natural deciduous woodland. Throughout the length of the surveyed watercourse there were areas of shallow gradient with slow flowing water, pools, and areas with steeper gradient with an abundance of small drops and pools with meanders present. Calcium build-ups were recorded on water drops and areas of shallow, fast flowing water, indicating the mineral rich nature of the water. The downstream section included larger settlement ponds with deep silty substrate and deep leaf litter.

Figure 4: Upper Frome – unsuitable northern section (north of Reach 5):



Figure 5: Upper Frome – Reach 1



3.3. Manual search

Norman's Brook

- 3.3.1. The Norman's Brook survey area was divided up into 3 reaches, the locations of which are shown in Appendix A. Detailed descriptions of each reach are provided in Appendix B. Reach 1 is 155 metres in length (between SO92361570 and SO92491569). Reach 2 is 275 metres long (between SO92491569 and SO92761571). Reach 3 is 130 metres long (between SO92761571 and SO92891574).
- 3.3.2. Each reach was subject to a detailed manual search of suitable refugia along the length of the reach. Suitable refugia included small cobbles (65 - 150mm); large cobbles (150 - 260mm); tree roots; undercut banks; woody debris; and urban debris. A total of 100 refugia were manually searched on each reach. Manual surveys were undertaken on the 24 October 2018.
- 3.3.3. No evidence of white-clawed crayfish, or any non-native crayfish species was recorded during the manual search survey on any of the 3 reaches.

Upper Frome

- 3.3.4. The Upper Frome survey area was divided up into 5 reaches, the locations of which are shown in Appendix A. Detailed descriptions of each reach are

provided in Appendix B. Reach 1 is 200 metres in length (between SO94681265 and SO94621282). Reach 2 is 125 metres long (between SO94621282 and SO94561294). Reach 3 is 130 metres long (between SO94561294 and SO94521306). Reach 4 is 140 metres long (between SO94521306 and SO94421315) and Reach 5 is 165 metres long (between SO94421315 and SO 94382 13285). Within Reach 4, a section approximately 80 metres long could not be surveyed as it was inaccessible due to dense trees and vegetation within the channel.

- 3.3.5. Each reach was subject to a detailed manual search of suitable refugia along the length of the reach. Suitable refugia included boulders; small cobbles (65 - 150mm); large cobbles (150 - 260mm); tree roots; undercut banks; woody debris; and urban debris. A total of 100 refugia were manually searched on each reach. Manual surveys were undertaken on the 25 October 2018.
- 3.3.6. No evidence of white-clawed crayfish or any non-native crayfish species was recorded during the manual search survey on any of the 5 reaches.

3.4. Trapping Survey

Norman's Brook

- 3.4.1. There were no suitable areas to set traps within any of the Norman's Brook reaches, with the water being too shallow. No trapping surveys were undertaken along Norman's Brook.

Upper Frome

- 3.4.2. A total of 15 traps were set up along 4 of the reaches. Reach 5 was not suitable for setting traps due to shallow water. Traps were set on 25 October 2018 and collected on 26 October 2018.
- 3.4.3. No evidence of white-clawed crayfish or any non-native crayfish species was recorded during the trapping survey on any of the 5 reaches.

4. Conclusions and recommendations

4.1. Norman's Brook

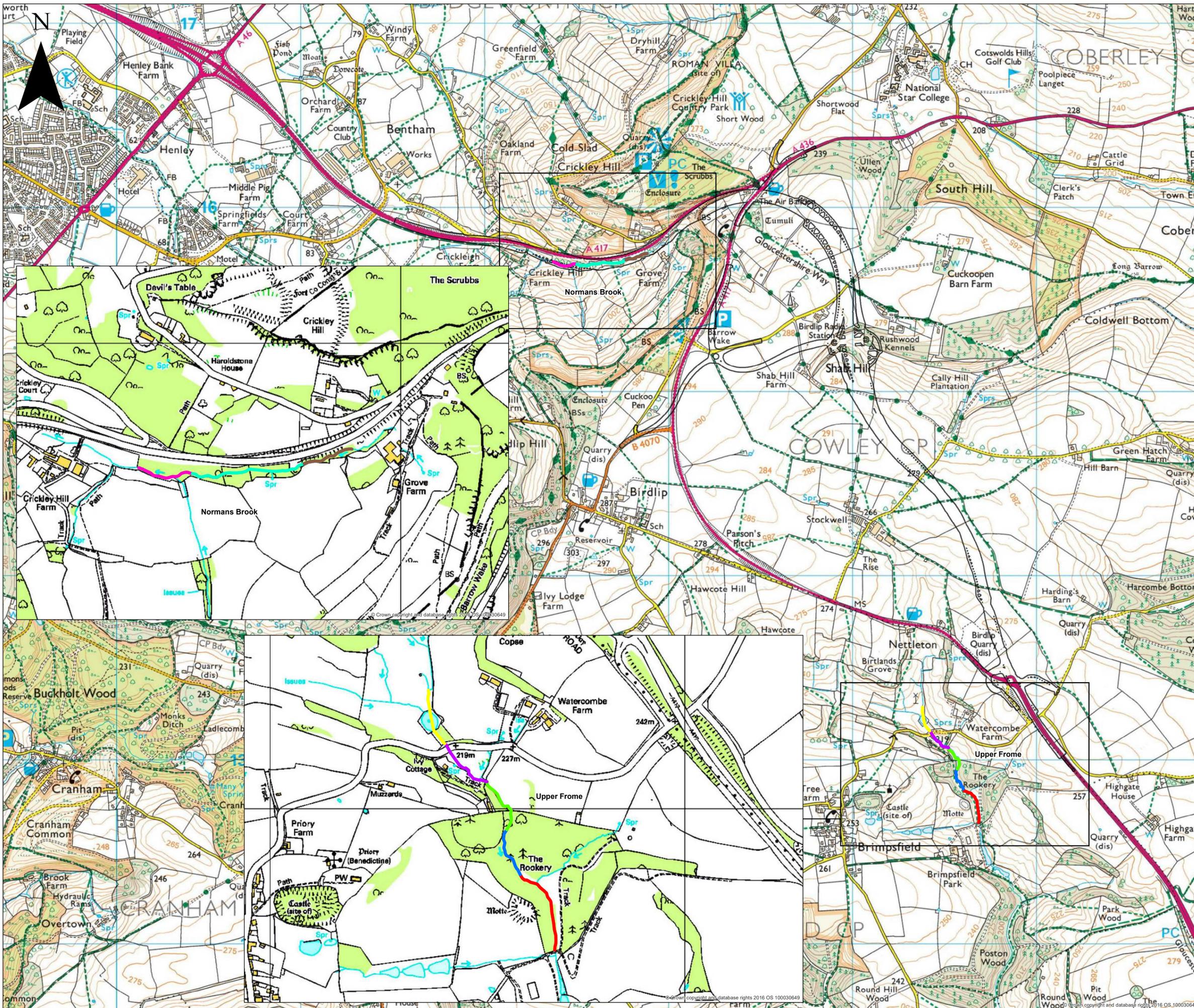
4.1.1. Surveys of Norman's Brook identified no evidence of white-clawed crayfish or any non-native crayfish species. This indicates the likely absence of white-clawed crayfish from the watercourse. However, as the watercourse provides suitable conditions, there is a potential that a very small remnant population may have been missed during the survey, especially as some downstream sections were not accessible during the survey. It is likely that the watercourse will be directly impacted during the works, including the potential diversion of part of the watercourse. It is recommended that pre-construction surveys are undertaken to update the crayfish surveys. These should be undertaken during the optimum survey period between mid-July and mid-September. Additionally, it is recommended that a precautionary approach is taken during the diversion of the watercourse and that a detailed refugia survey is undertaken during the dewatering of the watercourse to ensure that any remnant populations are identified. A precautionary mitigation plan should be in place to minimise any delays during construction and to ensure the conservation status of white-clawed crayfish is maintained.

4.2. Upper Frome

4.2.1. Surveys of the Upper Frome indicate the likely absence of white-clawed crayfish from the reaches of the watercourse surveyed. However, there is a known population downstream of the surveyed reaches identified during the desk study. Therefore, any hydrological impacts on the Upper Frome as a result of the scheme must consider adverse impacts on downstream white-clawed crayfish populations. Mitigation should be implemented to ensure that the scheme does not affect water flows or water quality of water entering the Upper Frome, to ensure no adverse effect on downstream white-clawed crayfish populations. It is recommended that pre-construction surveys are undertaken to update the white-clawed crayfish surveys. These should be undertaken during the optimum survey period between mid-July and mid-September.

Appendices

Appendix A White-clawed crayfish survey areas



Legend

Option 30 Scheme Plan
(at time of survey)

Normans Brook Reaches

- 1 (Pink line)
- 2 (Cyan line)
- 3 (Brown line)

Upper Frome Reaches

- 1 (Red line)
- 2 (Blue line)
- 3 (Green line)
- 4 (Purple line)
- 5 (Yellow line)

P01	04/07/2019	DRAWING PRODUCED	WG	VH	SM
Rev	Date	Amendment Details	Drawn	Chk'd	App'd

Mott MacDonald Sweco

highways england

Client: **highways england**

Drawing Status	FOR INFORMATION	Suitability	S2
Project Title	A417 MISSING LINK		
Drawing Title	White-Clawed Crayfish Survey Reaches		

Scale	1:0	Designed	WG	Drawn	WG	Checked	VH	Approved	SM
Original Size	A1	Date	04/07/2019	Date	04/07/2019	Date	04/07/2019	Date	04/07/2019
Drawing Number	HE P19	Originator	551505 - MMSJV	Volume	EBD	Project Ref. No.		551505	
Location	000	Type	DR	Role	LE	Number	00049	Revision	P01

FILE LOCATION: P:\Southampton\HWA\GIS\Projects\353982 - A417\Ecology\GIS_2019\SURVEY_MAPS\White Clawed Crayfish\HXD\White_Clawed_Crayfish_Reaches.mxd

Appendix B White-clawed crayfish survey results

Watercourse	Date	Reach	U/S NGR	D/S NGR	Reach Length (m)	Water Temp (C)	pH	Wetted Width (m)	Refuges Manually Searched	Refuge Types Present/Searched	Traps Set	Crayfish (Present / Absent)	Total No. Crayfish	Habitat	Bullhead (Present / Absent)	Description
														(None / Present / Frequent / Abundant)		
Norman's Brook	24/10/2018	1	SO 92501 15702	SO 92374 15708	155	9.4	8.14	0.1 - 1.3	100	Small Cobble (65 - 150mm) Large Cobble (150 - 260mm) Tree root Undercut bank Woody Debris Urban Debris	0 - No suitable habitat	Absent	0	Present	Absent	Small stream, heavily shaded in deeply incised channel. Very low flow and quite heavily silted. Lots of woody debris in stream. Obvious issues with run-off - grey/oily film present in areas of slow flow. Nowhere suitable depth for trapping.
Norman's Brook	24/10/2018	2	SO 92770 15722	SO 92501 15702	275	9.4	8.14	0.2 - 1.2	100	Small Cobble (65 - 150mm) Large Cobble (150 - 260mm) Tree root Undercut bank Woody Debris Urban Debris	0 - No suitable habitat	Absent	0	Present	Absent	Small stream, steep gradient, heavily shaded in deeply incised channel. Becomes smaller upstream. Very low flow and quite heavily silted. Lots of woody debris in stream. Obvious issues with run-off - grey/oily film present in areas of slow flow. 40m culvert present halfway through reach and a section of multiple low-head concrete weirs. Nowhere suitable depth for trapping.

Watercourse	Date	Reach	U/S NGR	D/S NGR	Reach Length (m)	Water Temp (C)	pH	Wetted Width (m)	Refuges Manually Searched	Refuge Types Present/Searched	Traps Set	Crayfish (Present / Absent)	Total No. Crayfish	Habitat	Bullhead (Present / Absent)	Description
														(None / Present / Frequent / Abundant)		
Norman's Brook	24/10/2018	3	SO 92881 15758	SO 92770 15722	130	9.4	8.14	0.1 - 1.2	100	Small Cobble (65 - 150mm) Large Cobble (150 - 260mm) Tree root Undercut bank Woody Debris Urban Debris	0 - No suitable habitat	Absent	0	Present	Absent	Very small stream, steep gradient, heavily shaded in deeply incised channel. Becomes smaller upstream. Very low flow and quite heavily silted. Lots of woody debris in stream. Obvious issues with run-off - grey/oily film present in areas of slow flow. 12m culvert present halfway through reach and a section of multiple low-head concrete weirs. Nowhere suitable depth for trapping.
Upper Frome	25/10/2018	1	SO 94645 12845	SO 94688 12659	200	9.4	8.24	0.5 - 3.0	100	Small Cobble (65 - 150mm) Large Cobble (150 - 260mm) Boulder Tree root Undercut bank Woody Debris Urban Debris	4	Absent	0	Present	Absent	Small stream with good flow variation running through coniferous and deciduous woodland creating heavy shading. Poned/settlement pond at d/s of site which was too deep/silty to wade. Large pond located further d/s. Lots of leaf litter and fallen trees in channel. Stream located just off public footpath. Max depth of 40cm - minimum of 2cm.

Watercourse	Date	Reach	U/S NGR	D/S NGR	Reach Length (m)	Water Temp (C)	pH	Wetted Width (m)	Refuges Manually Searched	Refuge Types Present/Searched	Traps Set	Crayfish (Present / Absent)	Total No. Crayfish	Habitat	Bullhead (Present / Absent)	Description
														(None / Present / Frequent / Abundant)		
Upper Frome	25/10/2018	2	SO 94573 12947	SO 94645 12845	125	9.4	8.24	0.7 - 2.0	100	Small Cobble (65 - 150mm) Large Cobble (150 - 260mm) Boulder Tree root Undercut bank Woody Debris Urban Debris	5	Absent	0	Present	Absent	Small stream in deciduous woodland, now outside of the conifer plantation d/s. Greater gradient with an abundance of small drops and pools with meanders present. Pools ideal for setting traps. Public footpath along one bank. Wider shallow riffles present. Lots of leaf litter and fallen/overhanging trees.
Upper Frome	25/10/2018	3	SO 94528 13069	SO 94573 12947	130	9.4	8.24	0.2 - 2.7	100	Small Cobble (65 - 150mm) Large Cobble (150 - 260mm) Boulder Tree root Undercut bank Woody Debris Urban Debris	5	Absent	0	Present	Absent	Small stream in deciduous woodland with good gradient, drops and pools present. Sand/calcium build-ups on water drops and areas of shallow, fast flowing water. U/s stream flows through area of improved pasture with heavy cattle poaching present with river creating boggy ground. Fallen/overhanging trees making some areas inaccessible.

Watercourse	Date	Reach	U/S NGR	D/S NGR	Reach Length (m)	Water Temp (C)	pH	Wetted Width (m)	Refuges Manually Searched	Refuge Types Present/Searched	Traps Set	Crayfish (Present / Absent)	Total No. Crayfish	Habitat	Bullhead (Present / Absent)	Description
														(None / Present / Frequent / Abundant)		
Upper Frome	25/10/2018	4	SO 94429 13160	SO 94528 13069	140	9.4	8.24	0.3 - 1.5	100	Small Cobble (65 - 150mm) Large Cobble (150 - 260mm) Boulder	1	Absent	0	Present	Absent	Small stream through deciduous woodland and scrubland. This site was shorter (around 100m) with an area of around 80m inaccessible due to dense trees and vegetation within the channel. Area limited by road bridge. All areas accessible were searched and one area was suitable for trapping.
Upper Frome	25/10/2018	5	SO 94382 13285	SO 94429 13160	165	9.4	8.24	0.2 - 0.8	100	Small Cobble (65 - 150mm) Large Cobble (150 - 260mm) Boulder Woody Debris Submerged Vegetation	0 - No suitable habitat	Absent	0	Present	Absent	Small stream north of road bridge with dense macrophyte cover and silt beds present. Areas were partially inaccessible due to fallen trees and bushes. Concrete weir with ponded/boggy area at midpoint. Ponded area was shallow, heavily shaded with black anoxic silt and fallen trees. U/s of ponded area the stream was very narrow flowing through improved pasture. Heavily poached area with little habitat present. Any cobbles/boulder present were checked. No areas

Watercourse	Date	Reach	U/S NGR	D/S NGR	Reach Length (m)	Water Temp (C)	pH	Wetted Width (m)	Refuges Manually Searched	Refuge Types Present/Searched	Traps Set	Crayfish (Present / Absent)	Total No. Crayfish	Habitat	Bullhead (Present / Absent)	Description
														(None / Present / Frequent / Abundant)		
																suitable for trapping.
Upper Frome	25/10/2018	5	N/A	SO 94382 13285	N/A	9.4	8.24	N/A	N/A	N/A	0 - No suitable habitat	N/A	0	Absent	Absent	Upstream of this NGR the stream is very small (0.1 to 0.4m wide), shallow and ditched and straightened. Conditions are not suitable for white clawed crayfish.