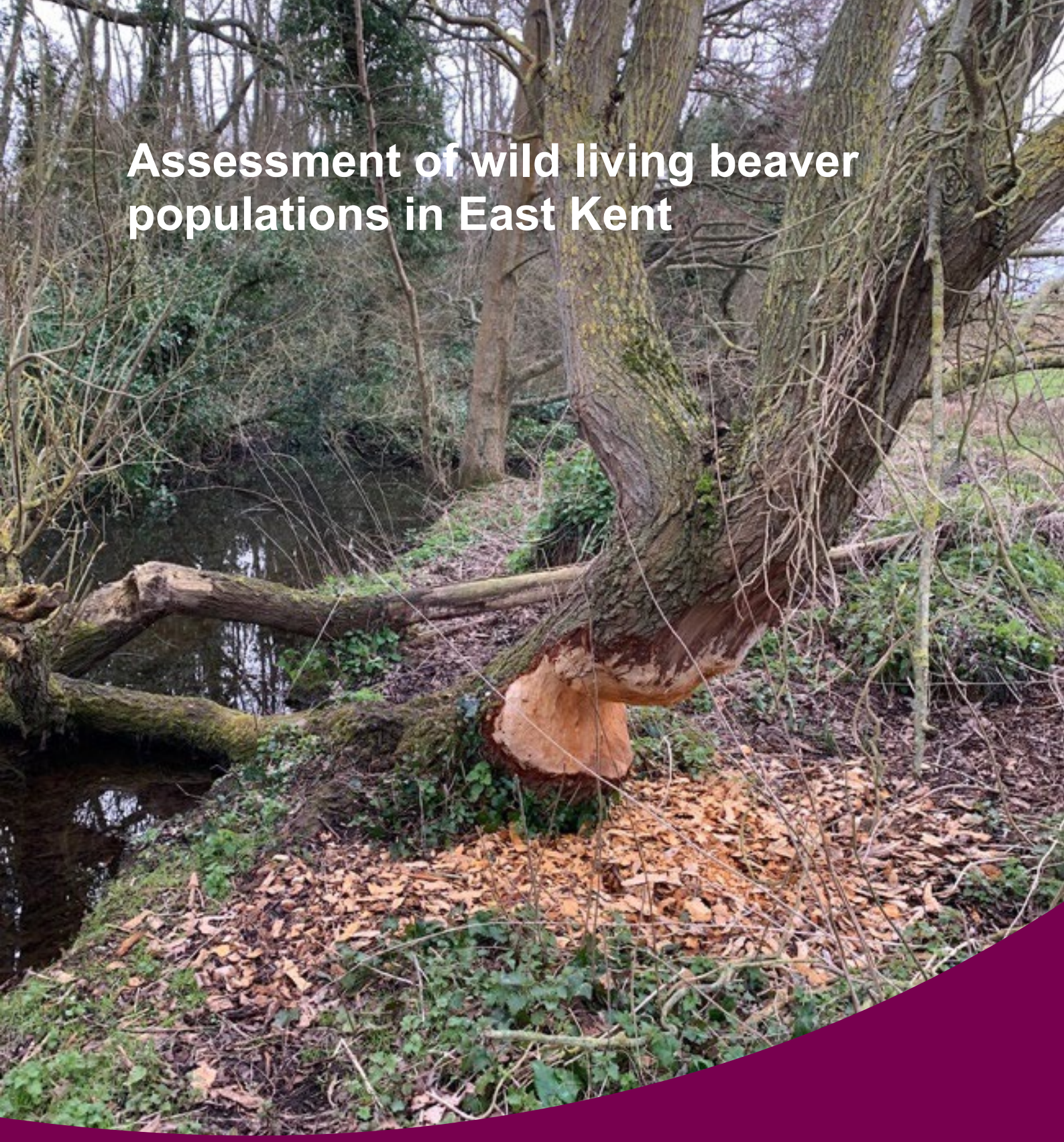

Assessment of wild living beaver populations in East Kent

Natural England Commissioned Report NECR559

May 2024

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Keywords

Beaver, *Castor fiber*, distribution, Stour, population estimate

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Citation

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Foreword

This report was commissioned to inform Natural England's advice to government on the reintroduction of beavers in England.

Outside of the River Otter and enclosed populations, there are known to be populations of beavers in an additional ten separate locations. Our understanding of the distribution, population size and origins of these beaver populations is limited. The reintroduction of further beavers is a topic of increasing interest in England and with the future of wild reintroductions yet to be decided, it is paramount that data are gathered to further understand these existing populations.

The findings will be used to promote co-existence with beavers throughout the River Stour and associated catchments in East Kent. This will be achieved by helping to understand any impacts and benefits, where they are distributed in the catchments, and in the development of a management strategy.

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Executive summary

Following increasing reports of wild beavers in East Kent, Natural England commissioned a survey of beaver activity within the Stour catchment. These surveys were undertaken during December 2022 – March 2023 on foot and by canoe. The survey areas were the Great Stour (Chartham to Plucks Gutter including Lampen Stream, River Wantsum and West Marsh Sewer); Little Stour (Plucks Gutter to Chapel Well Spring including Black Hole Dike, Wingham River and Nailbourne); River Stour (Plucks Gutter to Pegwell Bay including the Richborough Stream and Western Monkton Stream); and North and South Stream (including Ham Fen Nature Reserve and the Worth/Hacklinge Marshes).

A total of 2,157 beaver field signs were recorded, with cut wood being the most common. The data indicates that an established beaver population has been present over the long-term (>10 years) and has readily colonised the Lower Great Stour catchment. The capacity of this population to expand has been significantly restricted by both a sea/coastal environment but also by restricted riverine connectivity through Canterbury, resulting in a high density through a partially restricted area of catchment.

Territories exist in close proximity, although territory capacity has been further increased by a series of high-quality marsh/lake complexes which significantly increase the area of available beaver habitat. These systems not only offer multiple individual small water bodies, which are easier for territory defence, but are also highly connected with each other, with interconnecting ditch systems, as well as the wider river. Therefore, beaver densities are high and defining territorial boundaries, especially along the main river system and within the marshes themselves, was complicated and difficult to define. This is a dynamic population with core areas of permanent territory establishment, with limited but flexible boundaries between individual territories, and some restrictions in capacity for significant expansions. However, as indicated by clusters of activity to the south of Canterbury, and in the northern Thanet areas, beavers are beginning to ‘jump’ and once they are occurring in significantly higher numbers in these areas, population growth and distribution will occur over the next 5-7 years.

The conservative estimate of 51 territories, with an additional 19 areas of activity has been suggested. Again, note that these 19 areas of activity could be in the process of becoming territories and, in theory, could be treated as such in any proposed monitoring and mitigation strategies.

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Introduction

Wild populations of beavers have been identified in small numbers in England since the early 2000s (Heydon and others, 2021). Currently, those beavers living on the River Otter in Devon constitute the only authorised free-living population in England, whilst numerous enclosed projects exist (Howe and Crutchley 2020). In August 2020, the UK government announced the River Otter beaver population could remain and naturally expand its range after the successful five-year River Otter Beaver Trial (Howe and Crutchley 2020). In 2021, Defra carried out a national public consultation on the approach to further beaver reintroductions and their management in England. On 1st October 2022 beavers living in the wild in England were given legal protection as a European Protected Species (EPS).

Outside the River Otter catchment and the enclosure sites, several populations originating from escapes from enclosures and private collections and/or unofficial release have been identified. There are records of small populations of beavers living on the following ten catchments:

- River Stour catchments, East Kent
- River Tamar, Cornwall and Devon
- River Avon (including the Frome and By Brook), Somerset, and Wiltshire
- River Taw (including the Little Dart), Devon
- River Exe, Devon
- River Wye, Herefordshire and Welsh border
- River Torridge, Devon
- River Stour, Dorset
- River Avon, Hampshire
- River Brue, Somerset

Catchment-scale beaver surveys have only previously been undertaken in Scotland, the River Avon, River Otter and on the River Wye (incorporating Wales and England), therefore data of such coverage in a British context is lacking for other areas where known wild beaver populations exist.

Numerous beaver field signs and animal sightings have been reported to Natural England from East Kent in recent years (see Figure 1. for an overview, provided by Natural England). To date, these have been concentrated on the Great Stour between locations to the east of Canterbury towards Westbere Marshes, around Upstreet and Stodmarsh National Nature Reserve (NNR). Additional sightings have occurred along the Little Stour, including records northeast of Wickhambreaux and along the River Wingham. Numerous sightings have also been made at various points along the River Stour between Stourmouth and Sandwich. Around the

Hacklinge Marshes, northwest of Deal, there have been sightings of beavers and field signs throughout the marshes.

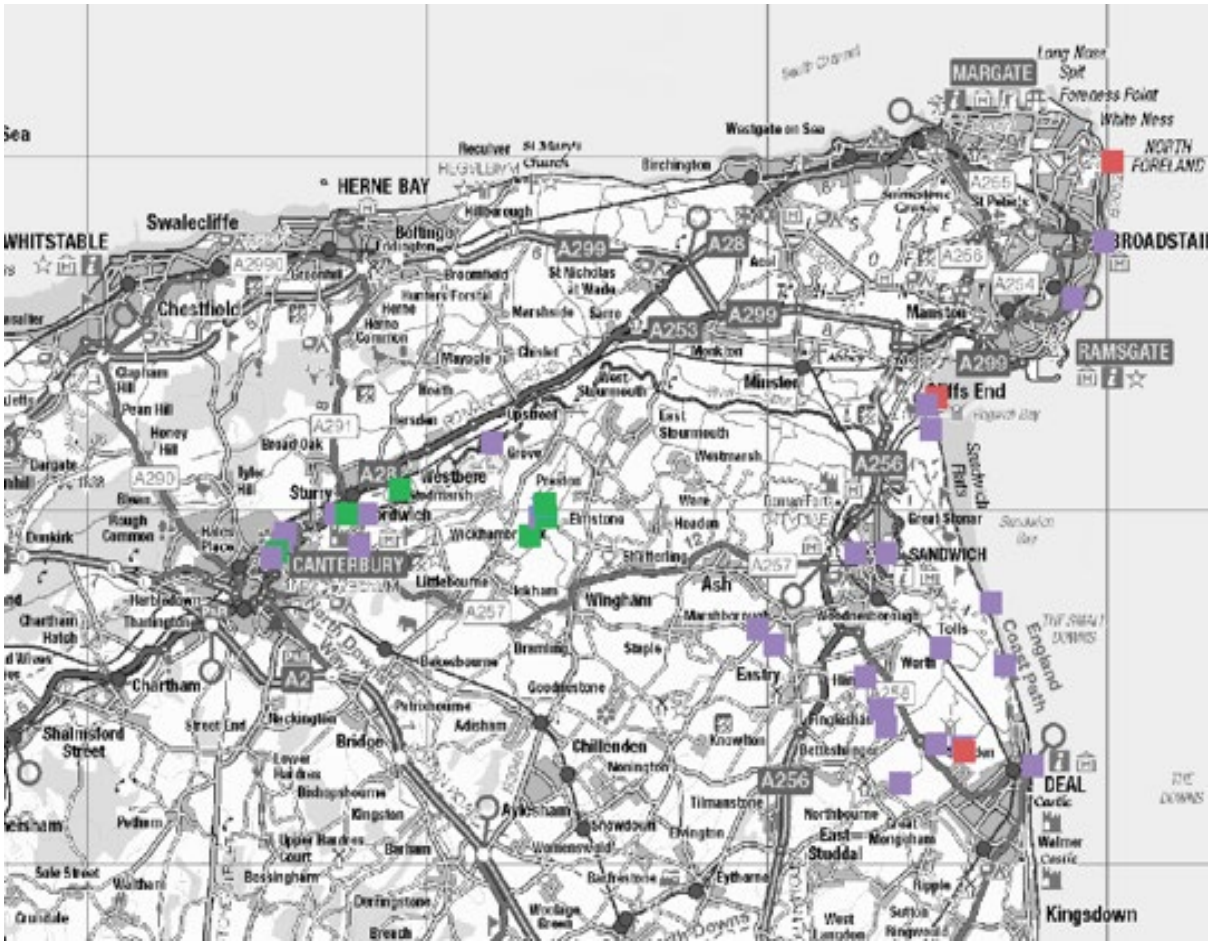

Figure 1: A map of records of beavers in East Kent, provided by Natural England.

(Purple ■ Records visual sightings of beaver, Green ■ Records of beaver feeding signs, Red ■ Records of beaver carcasses). © Crown Copyright and database rights [2023]. Ordnance Survey AC0000851168. Map credit: Natural England

Project Scope

This team was led by the Beaver Trust and experts from the University of Exeter who have extensive experience with beaver field sign survey techniques and, more importantly, how these data can be translated into meaningful mapping of population distribution, highlighting potential conflicts and mitigation requirements. Using the standardised field sign methodology outlined below (and peer-reviewed in Campbell-Palmer and others, 2021), we undertook a full survey of the Stour catchment, initially focusing on rivers with identified beaver presence then expanding the survey area to check for presence/absence within the wider catchment. Local knowledge on beaver sites, vital assistance with landowner engagement and additional survey effort was provided by members of the East Kent Beaver Advisory Group (EKBAG) and Kent Wildlife Trust (KWT). The survey areas to be prioritised were:

- Great Stour (Chartham to Plucks Gutter including Lampen Stream, River Wantsum and West Marsh Sewer)
- Little Stour (Plucks Gutter to Chapel Well Spring including Black Hole Dike, Wingham River and Nailbourne)
- River Stour (Plucks Gutter to Pegwell Bay including the Richborough Stream, Ash Levels, Minster Marshes and Western Monkton Stream)
- North and South Stream (including Ham Fen Nature Reserve and the Worth/Hacklinge Marshes)

A full data set to act as a baseline for future survey analysis is provided.

Aims

- To undertake a field survey (Dec 2022 to March 2023) to record and map beaver field signs throughout the survey area using a standardised methodology (see Campbell-Palmer and others 2021, Campbell-Palmer and others 2020, Campbell-Palmer and others 2018 & Campbell and others 2012).

- To analyse and interpret the raw survey data and undertake modelling to indicate beaver distribution, numbers and locations of potential beaver territories.

- To produce a report output including project scope; description of methodology; recommendations including areas to survey in the future; and details of any beaver impacts recorded.

- To provide raw survey data to Natural England.

Methods

Landowner permission

Natural England provided an initial list of landowner access permissions, especially related to those giving previous access to survey work. Contact was made via email and phone to any landowners provided. Additional intelligence enabled further approaches to be made with assistance from various landowners and the local Wildlife Trusts colleagues.

Contact landowners/occupiers to arrange access

Existing records are held and managed by EKBAG and the Kent and Medway Biological Recording Centre (KMBRC), and these were made available to the contractors. For the purpose of the planned surveys, Natural England identified known landowners and shared the information with the EKBAG for review and further known additions. Landowners were contacted through the EKBAG, which, prior to the surveys, ran a series of co-existence events involving local landowners and other interested stakeholders, making them aware of the surveys and the need for survey access.

Liaison with the East Kent Beaver Advisory Group

This team is actively involved in the EKBAG with strong relationships based on trust and shared experience. Initial conversations were undertaken to highlight the importance of the survey work and building survey capacity for the future. Stakeholders had already expressed a willingness to support the proposed study.

Survey methods

Identify the location of suitable beaver habitat

Beavers have been reported both officially to Natural England and anecdotally, at various locations throughout the Lower Stour catchment, East Kent, for many years. The EKBAG was established to support the coexistence of people and beavers, providing advice and guidance to landowners/managers on how to achieve this. Up until winter 2022/23, no complete survey of beaver presence and distribution had been completed in East Kent. Therefore, the need for a robust assessment of the wild-living beavers in this catchment was recognised. Catchment scale beaver surveys have only previously been undertaken in Scotland (Tay and Forth

catchments), the River Avon, the River Otter and the River Wye (incorporating Wales and England), therefore experience of such coverage in a British context is limited.

Natural England provided locations of previously reported field signs as a guide to beaver presence. Using these, along with extensive local knowledge and close association with the EKBAG and associated landowners, the team established a comprehensive list of beaver presence to further shape field sign survey efforts. Additionally, suitable beaver habitat was modelled, and this information was used to further identify connected areas with suitable habitat to determine potential areas warranting further survey.

Ensure waterway licences or permits

The Environment Agency was notified of surveys due to take place on the main rivers and assisted with any permissions required, and the River Stour (Kent) Internal Drainage Board (IDB) was notified of surveys due to take place on ordinary watercourses and also assisted with any permissions required. Both partners sit on the EKBAG and were aware of the proposed surveys, enabling them to support where needed. Initial conversations with the Environment Agency indicated that permits would not be required, though good lines of communication were maintained throughout.

Undertake full beaver field sign survey of East Kent water bodies to establish beaver presence and distribution

The survey area was based on confirmed and suspected records of beaver activity, along with extended field surveys to confirm the species' presence/absence outside areas of known and suspected existence, including watercourses with suitable habitat (based on hydrology and vegetation availability). While beavers display quite distinct and obvious field signs, at low densities and within more naturalised water courses, these may be relatively inconspicuous and are easily missed or mistaken for other species.

Mapping field signs can help to identify beaver distribution, allow an assessment of their habitat use, and estimate the number of active territories present within an area. Field surveys consisted of surveying a watercourse from either canoe or on foot, depending on watercourse suitability, accessibility and permission status. Canoe surveys are more likely to reveal more waterside activity with the potential for underreporting inland activity, whilst the opposite tends to be the case for surveys on foot. However, this approach is highly dependent on the structure and size of the watercourse, and the extent of bankside vegetation growth.

For each survey point the following data were collected;

1. Activity type (Sign)
2. Ordnance Survey (OS) grid reference
3. Photo No. (if appropriate)
4. Estimated age (fresh, old or mixed)
5. Dam dimensions
6. River or waterbody name
7. Land use (dominant along watercourse and surrounding area, i.e. within a 100 m radius)
8. Beaver activity effort (low, medium or high)
9. Management impact (NA, low, medium or high)
10. Any other comments
11. Recorder initials

Beaver field signs (see Table 1. for the type of signs recorded) were logged as point data using GPS-equipped mobile phone devices (a mix of iOS and Android) using the Avenza Maps mapping app (Avenza Systems Inc. version 3.13.1). This method allowed the same core data to be collected as in for previous British surveys allowing direct comparison both between British populations and between years for any future surveys in Kent, in a standardised format reducing the chance of transcriber error or variation between different surveyors or devices. All data were collected in the mobile app before being transferred via email for backup and processing.

'Beaver activity effort' (an estimated measure of energy expended by beaver in creating a recorded feeding sign) was categorised as: low (eg <5 small (<10 cm diameter) tree trunks/woody stems within 10 m radius); medium (eg 5-10 small diameter trunks/stems within 10 m radius); or high (eg >10- small diameter trunk/stems within 10 m).

'Management impact 'was categorised subjectively based on the perceived impact at the time of survey as: 'NA' if impact was deemed unperceivable with no mitigation required; 'low' if affecting a small area and/or could have been easily mitigated without excessive costs or resources (eg small scale tree felling); 'high' if a large area was affected and/or mitigation was resource intensive (eg, flood bank collapse, multiple collapsed burrows or flooding of large area of crops); with 'medium' ranging between these. Measuring this impact involves a level of subjectivity, so the perceived impact was recorded by surveyors as far as possible using a simple score of 'NA', 'low', 'medium', or 'high', without obtaining the views of the landowners/managers in question. It is also critical to note these were signs that 'could' have management implications rather than where actual management implications had manifested themselves. The recording of management impact also does not negate or dismiss the possibility that beaver activity in that area could have other benefits, i.e. a beaver dam, resulting in localised flooding on private land may

be recorded as a high management impact. However, as shown in numerous studies (see Brazier and others, 2020 for a recent review) this same dam may bring significant biodiversity and hydrological benefits. Weighing up the costs versus benefits of individual beaver impacts is important as beavers return to our landscapes.

The 'sign' types recorded were the commonly recorded field signs of beaver activity that can be robustly identified by an expert survey team. A full list of sign types is tabulated below:

Table 1. Sign types recorded along with code used herein and description

Code	Field sign	Description
C	Woody Feeding	Cutting or gnawing of woody vegetation (shrubs, saplings and trees)
H	Soft Feeding	Feeding on herbaceous vegetation
Ag	Crop Feeding	Feeding on agricultural crops. The area affected was measured as m²
D	Dam	Dams were classified as active/maintained or old/breached. Height and width were recorded in m.
CA	Cache	Cut, stored woody vegetation
DI	Canal/Digging	Beaver digging into substrate or creation of canals leading inland to access more foraging grounds
BU	Burrow	Entrances are usually below normal water levels and can extend inland forming complex underground systems
L	Lodge	Dwellings where the nest chamber protrudes from the surface and has been built up using sticks and mud
SM	Scent Mound	A pile of material (usually mud) scraped together by the beaver on which a distinctive scent (castoreum/ anal-gland secretion) is deposited
SS	Scent Site	A small area of concentrated multiple scent mounds
FS	Feeding Station	This is a location at the edge of the water to which a beaver repeatedly takes, for consumption, material obtained elsewhere
FT	Foraging Trail	Created by the frequent passing of a beaver from the water to a location inland

Figure 2. Field sign survey from canoe along River Stour Photo. Photo credit: Beaver Trust

Figure 3. Beaver lodge on Greater Stour with extensive food cache. Photo credit: Beaver Trust

Figure 4. Scent mound at Stodmarsh NNR. Photo credit: Beaver Trust

Raw survey data and summary reporting

Field data were quality-assured, processed and backed up weekly. All subsequent mapping and geospatial analysis was undertaken in QGIS 3.16.4 (QGIS.org. 2021) and R 4.0.4 (R Core Team (2021). Figure 5 provides a workflow summary of the data processing and analysis. All backdrop mapping layers utilise OS data (Crown copyright and database right, 2020) or open access Open Street Map data (copyrighted OpenStreetMap contributors) and Google satellite imagery: Open-Source Google imagery © OpenStreetmap (and) contributors CC-BY-SA. Full details of the data collection and processing methodology can be found in Campbell-Palmer et al. (2020) and Campbell-Palmer et al. (2021).

Analysis of survey data and territory estimation

Beavers are highly territorial and will actively defend an area comprising a food resource, shelter, overwintering and breeding sites. These tend to follow the shorelines of the river or waterbody inhabited. Territory and group size vary greatly within beaver populations (Wilsson 1971; Nolet & Rosell 1994; Herr & Rosell 2004). For example, territory size ranged from 1.1 to 6.8 km of bank length (average 3.7±1.7 km) in Norway based on pair cohesion studies (McClanahan and others 2020). Previous studies have recorded averages of ~3 km, though this was highly variable with water course complexity and habitat quality (Herr & Rosell 2004; Campbell et al. 2005). Overlap between territories is minimal (0.5-2.2%), though up to 10% has been observed and it is typically influenced by population density, habitat type and resource availability (Herr & Rosell 2004). Therefore, at a landscape scale the distribution of beaver territories is often highly discontinuous (Parker and others 2001; Schulte 1998).

Beaver territories have been defined previously using a number of methods: scent mound (see Figure 4.) mapping as indicators of territory borders (Campbell and others 2005); biologging individuals (GPS/RF tags e.g. Campbell and others 2005; Graf and others 2016); riverbank length with minimum convex polygons or kernel methods (Herr & Rosell 2004); or patterns of beaver field sign density (Fustec and others 2001). Early colonisation of new habitats/areas is often slow and represented by low numbers of pioneer individuals. As mating opportunities increase, new territories become established and population density increases. In expanding beaver populations, active territories tend to be further apart as family units select the highest quality habitat (Nolet & Rosell 1994), but as population density increases infilling occurs, territories come closer together and territorial behaviours (including aggression and scent marking) increase (Hartman 1995, Rosell and others 1998). During spring, scent marking tends to increase in frequency, especially at higher population densities. This is also the time that sub-adults, after reaching sexual maturity (~20 months), disperse from their natal territories to seek territories and

mating opportunities of their own (Hartman 1996). At higher population densities dispersal may be delayed with individuals as old as seven years remaining with their parental families to assist with kit rearing and natal territory defence as new territories become scarcer (Mayer and others 2017). As beaver populations establish, population growth can increase more rapidly until carrying capacity is reached (Hartman 1994). At carrying capacity beaver population density will have a regulatory effect on numbers, especially on reproductive rates (only one pair will breed within each territory) and survival of dispersers (Parker & Rosell 2014; Campbell and others 2005). At this stage in population development, territories tend to be smaller, and fecundity is reduced, although this can vary between sites and be influenced by other factors (Campbell and others 2005; Campbell and others 2017).

Estimation of territories from survey data

To provide a quantitative and replicable analysis of estimated change in territory numbers and range, an automated classification approach, based upon density and location of recorded signs was used to model the spatial distribution and number of territories. Kernel density estimation analysis (KDE) was undertaken and then combined with expert knowledge of the survey area to reach a final estimate of territories. Kernel density analysis calculates the density of features in a neighbourhood around those features, thereby allowing the identification of spatially explicit clusters of beaver activity that are assumed to relate to estimated territories (Campbell-Palmer and others, 2018, 2020). The methodological workflow behind this territory modelling is outlined in Figure 5, illustrating how the outputs from kernel density analysis were converted to territories. Additionally, this workflow and the associated data analysis R package has now been peer-reviewed and published, providing a framework for standardised field surveys and analysis to be undertaken across Great Britain (Graham and others, 2022).

In summary, survey sign points are used to create a kernel density raster for each survey season using the {spatialEco} R package (Evans 2021). Weights were applied to the points based on their effort category class; low, medium, and high classes had weights of 1, $1e^{+03}$ and $1e^{+06}$ respectively. A low threshold value of $1e^{-10}$ was used to remove areas of extremely low density, increasing the chance of distinguishing between coincident regions of high-density signs.

The sign density raster layers are then used to generate multi-polygon regions of activity, which define the boundary of the density raster (activity regions) and that defines all regions of density > 95^{th} percentile (central places). These high-density foraging areas were considered to describe the central places of beaver activity as beavers feed in higher densities closer to their dwelling. If an activity region intersected a central place region, the activity region was classified as a possible territory. If an activity region intersected either a dam or dwelling, this was also flagged as further confirmation.

Using key field signs (lodges, food caches, active feeding stations, burrows, scent marking and dams) as confirmatory signs, adds an extra layer of confidence to estimations where such signs were observed. For example, active territories are more confidently assigned when active food caches are present at lodges from autumn to early spring. Similarly, territorial boundaries are more confidently assigned when scent marking is noticeably active. Using the updated methodology, the presence (or absence) of key signs in each automated territory is flagged giving an extra layer of information for subsequent expert interpretation.

It is recognised that: (1) there may be difficulties in determining between continuous or high density areas of beaver activity; (2) the resolution required for landscape-scale modelling may not pick up locally separate territories, i.e. in neighbouring lochs/reaches; (3) occasionally it was not possible to carry out full surveys in all areas due to access constraints, resulting in low sign density; (4) the visibility of field signs during the survey period was limited by natural phenomena, i.e. snow and flooding during the winter months and vegetation during the summer. Therefore, whilst the automated approach gives foundation areas of activity upon which to base territory estimations, it should be cross-referenced with key signs and expert knowledge and interpretation by the authors as described in Campbell-Palmer and others, (2018) to determine the final territory boundaries and number.

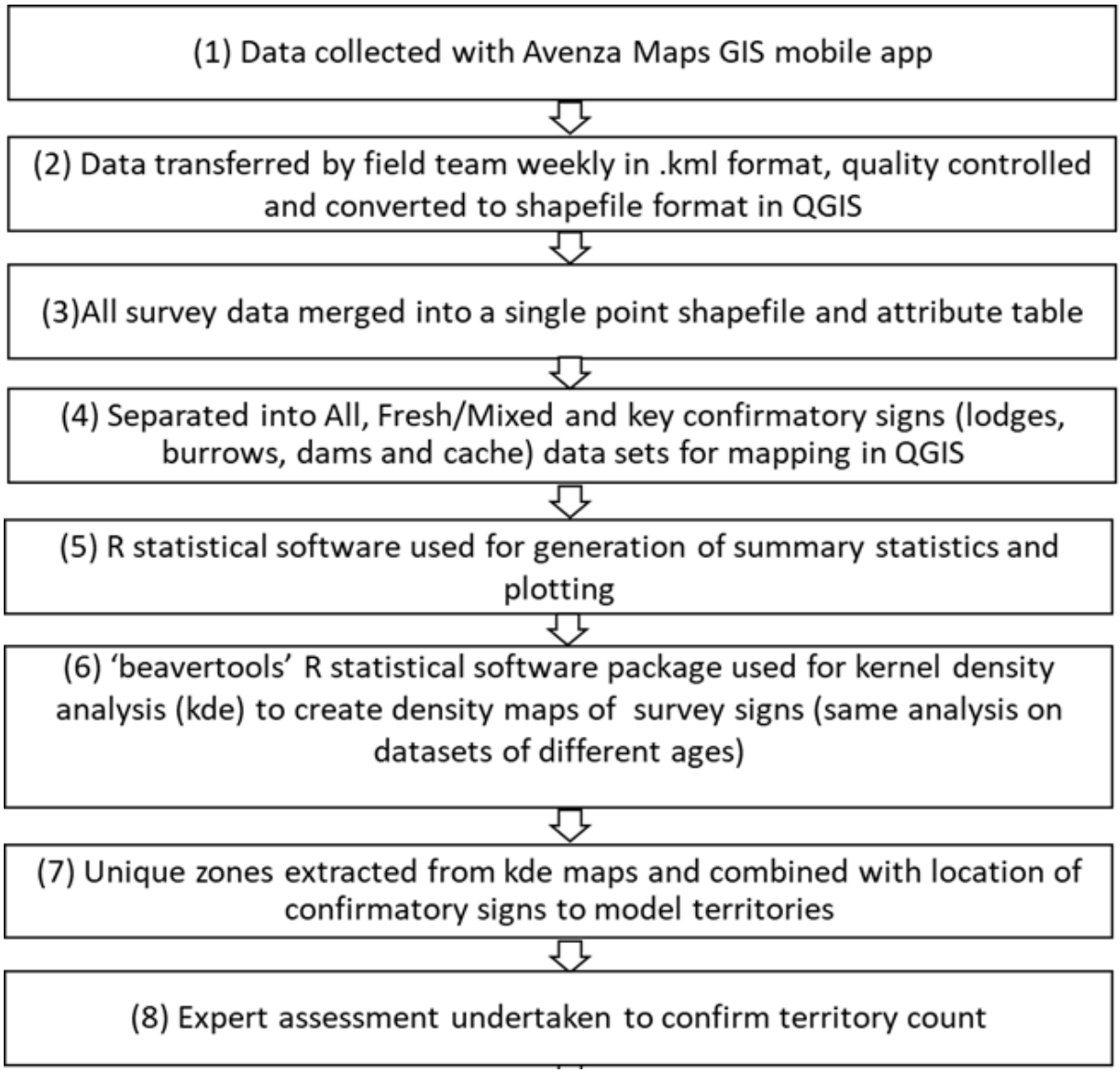

Figure 5. Full data collection and processing flow chart. Steps 1-3 were undertaken in the phase 1 data collection phase of this project; we now propose undertaking steps 4-8.

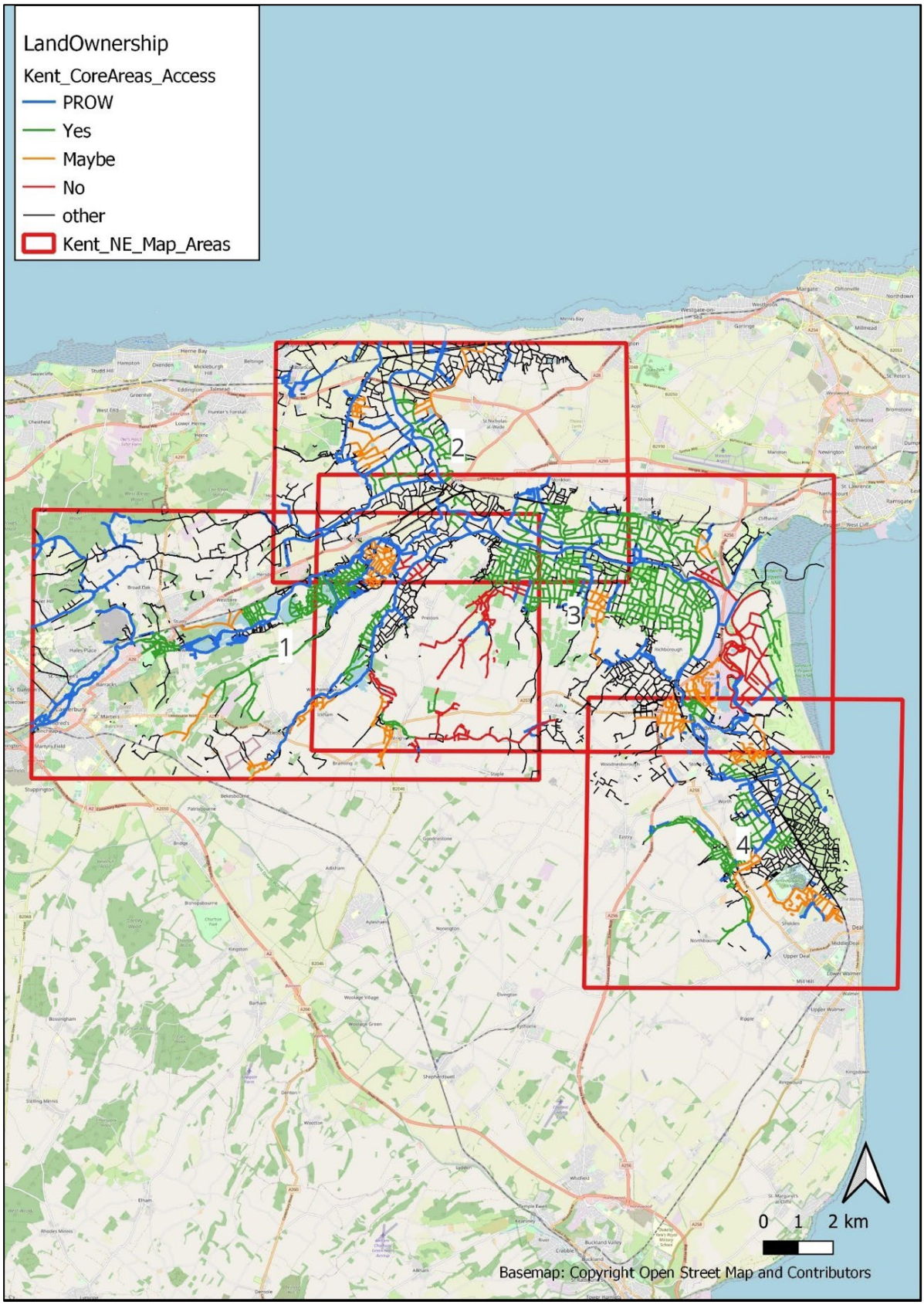

Figure 6. Mapping of riparian land access for undertaking survey (relative to Natural England maps of core areas provided) following public engagement and a mapping exercise. Map credit: Alan Puttock

Results

Landowner permission

Approximately 66 landowners associated with the study area were contacted by Kent Wildlife Trust or Natural England to request permission to undertake the survey. Forty two gave permission for the survey to take place. It should be noted that some landowners did not respond following contact or explicitly refused access permission and because of this, we are able to report a conservative estimate of beaver feeding signs and likely distributions. As illustrated in Figure 6, the majority of land along main water ways were public rights of way or the team was granted permission to survey. It is believed that any outlying areas which were not assessed would not change the strategic spatial pattern of beaver activity mapped.

Survey data

Survey data were subject to additional quality control and ground truthing using expert and local knowledge to assure that it was suitable for analysis. Once processed in GIS software, survey data was presented to core expert members of the field team to quality control and ensure representative and complete.

To accompany this report, the following datasets are provided to allow Natural England and project partners to utilise the data in future:

Accompanying datasets:
Kent2023_SurveyData (provided in ESRI shapefile and geopackage formats): all recorded survey points and associated survey attribute data.
Kent2023_SurveyTracks (provided in ESRI shapefile and geopackage formats): all field survey tracks taken by field teams during survey.
Kent2023_SurveyDataProcessed.xlsx (exported full survey record in excel format with associated British National Grid X and Y coordinates).

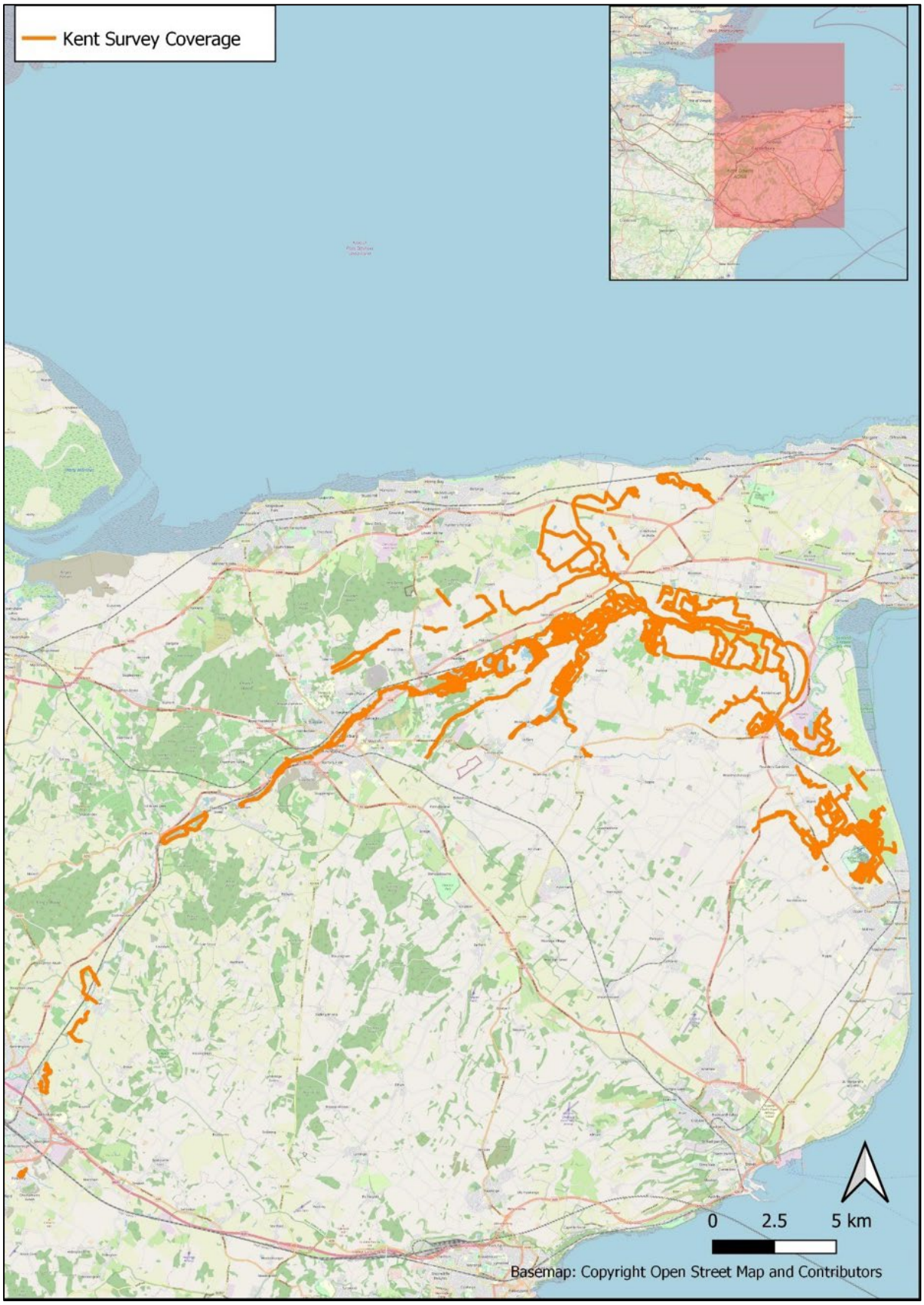

Figure 7. Field survey team recorded tracks, covering 51.27 km throughout the field survey by a mix of foot and canoe. Map credit: Alan Puttock

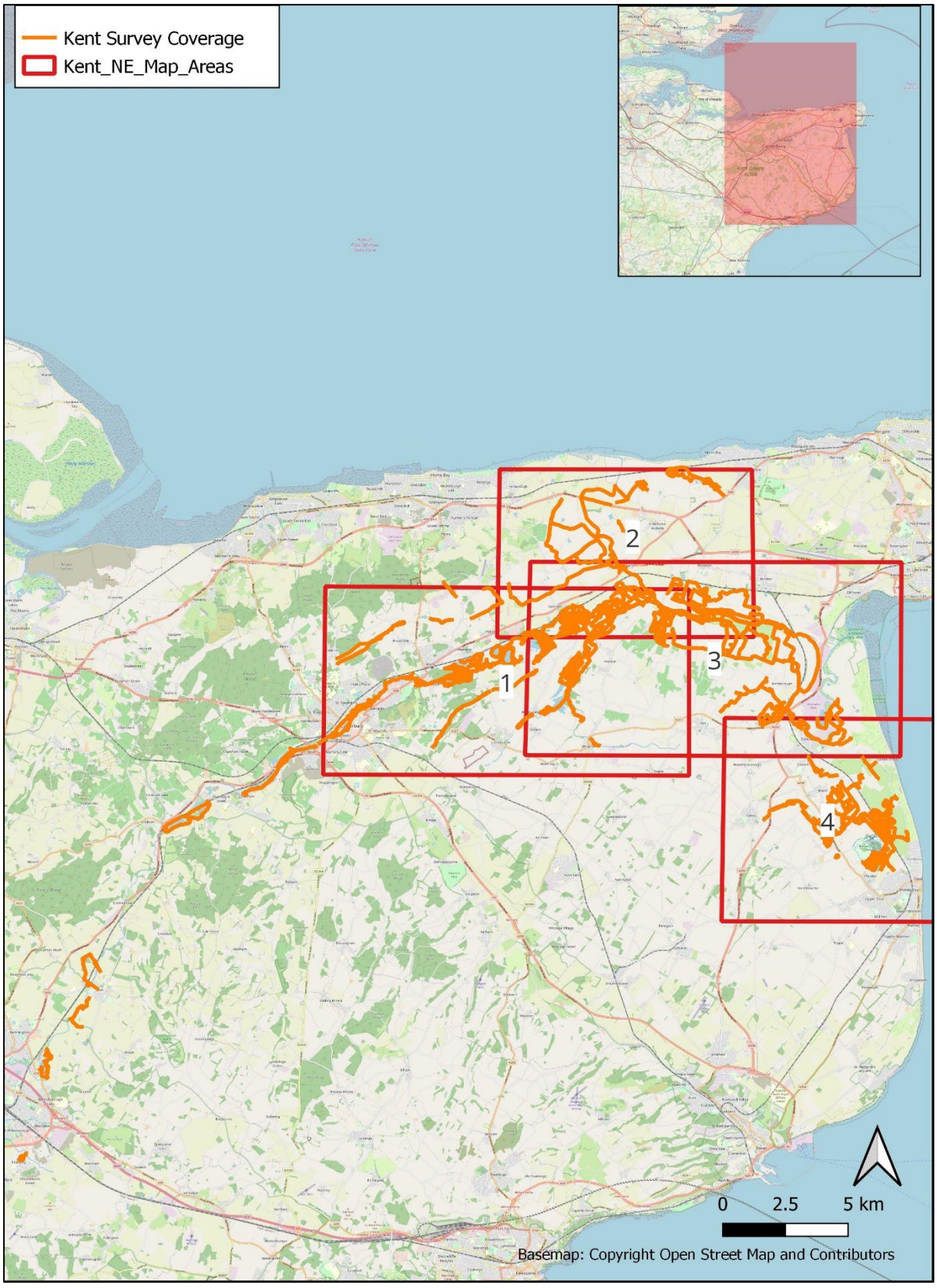

Figure 8. Field survey team recorded tracks, covering 51.27 km throughout the field survey relative to 'core area' maps provided by Natural England for survey extent. Note the Nailbourne was the only core section not covered as this is seasonally dry. Map credit: Alan Puttock

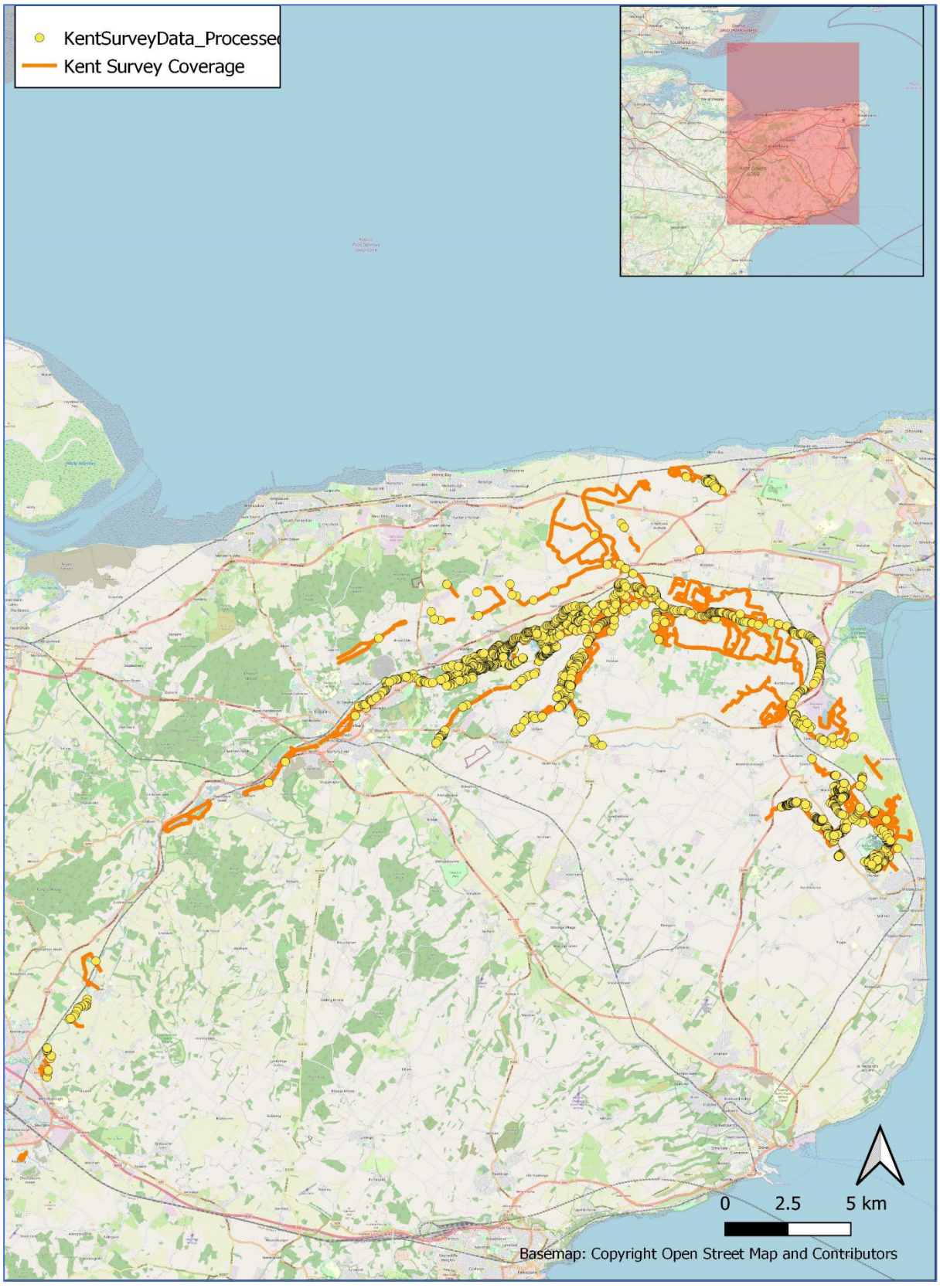

Figure 9. All processed survey data recorded by the field teams. The vast majority of these are beaver field signs (n >2100 but also a small number (n < 100) of other points of interest regarding surveys recorded and included for completeness but excluded from subsequent mapping of signs. Map credit: Alan Puttock

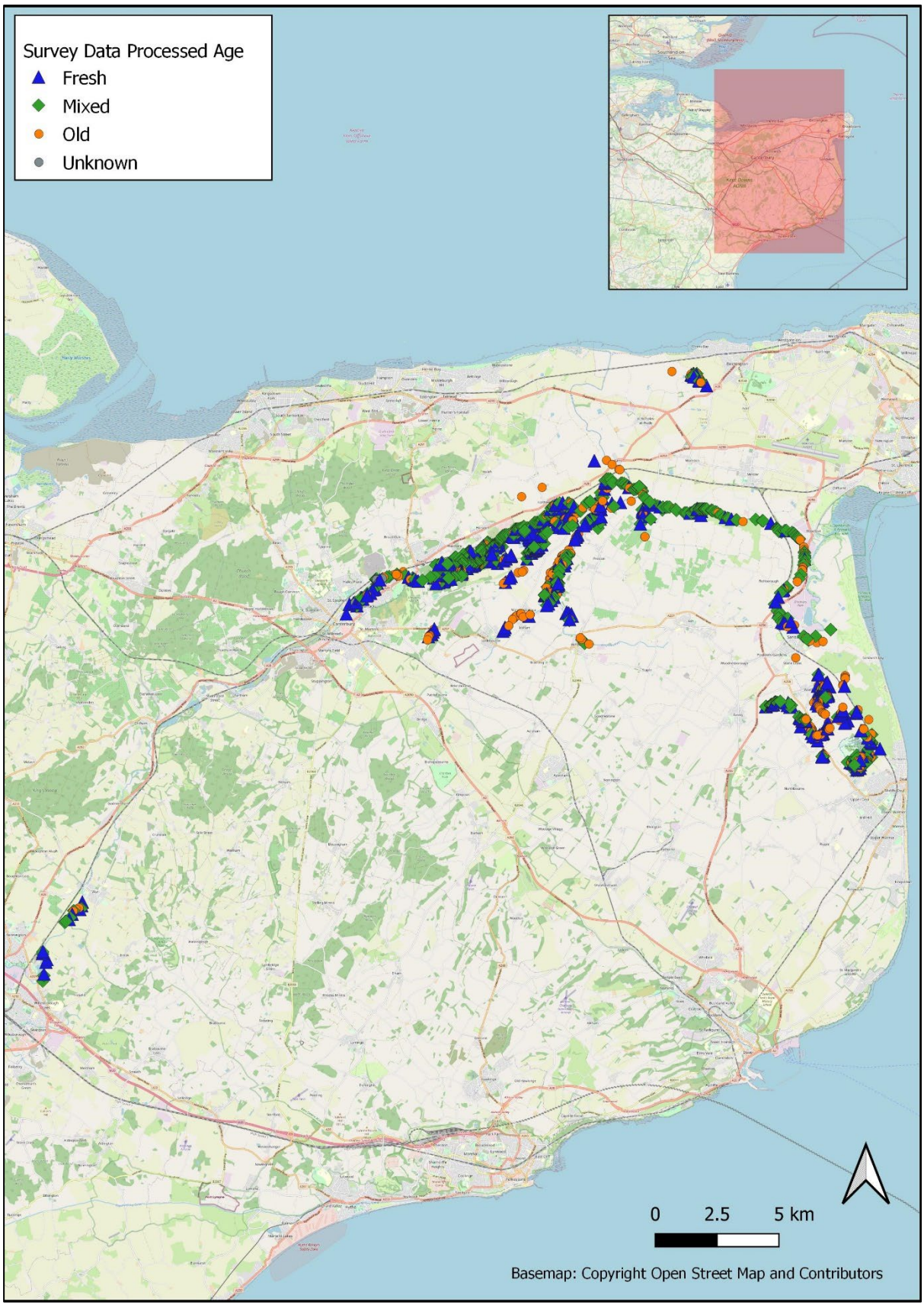

Figure 10. All recorded beaver field signs by age. Map credit: Alan Puttock

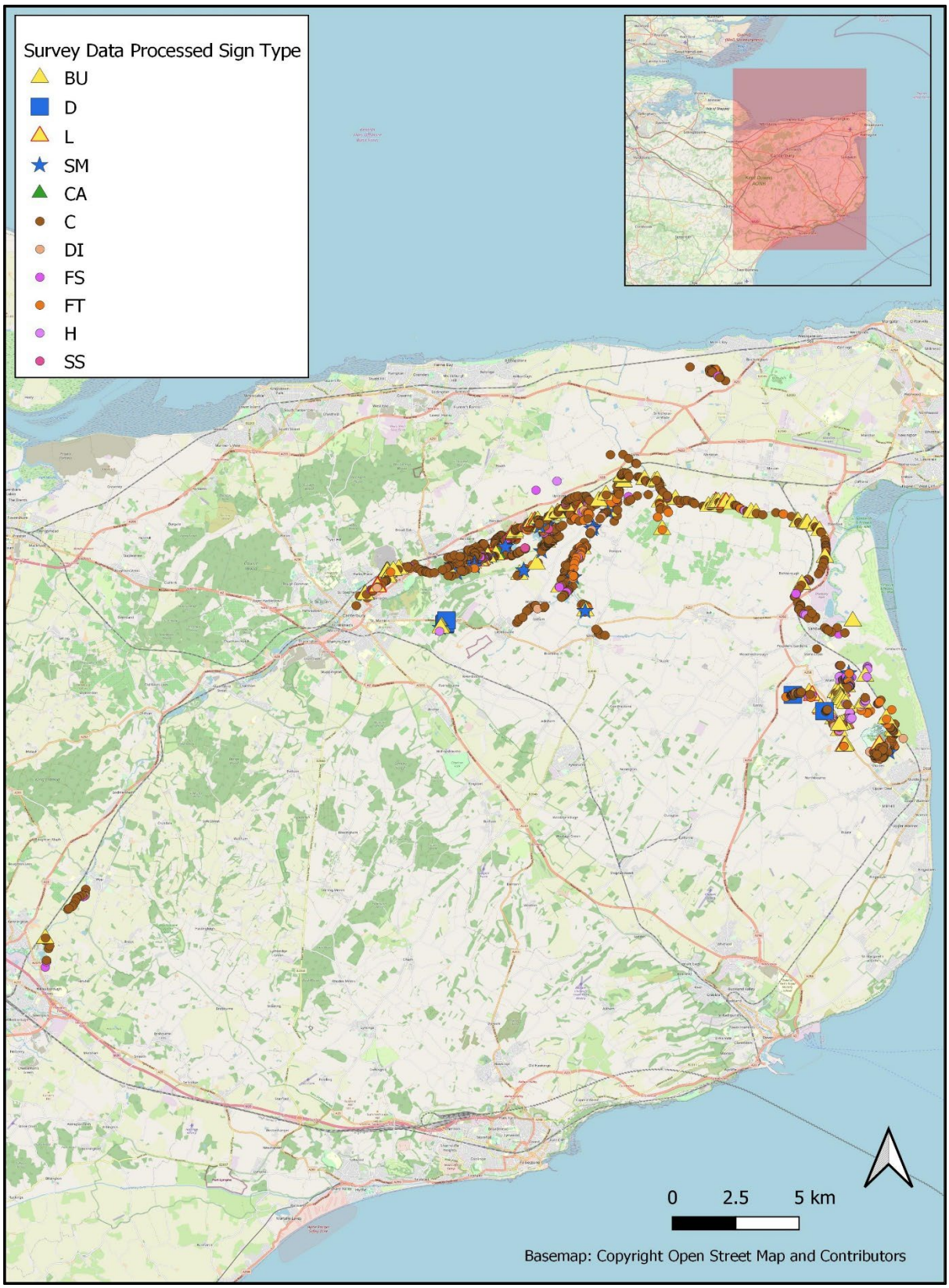

Figure 11. All recorded beaver field signs by sign type. Field sign coding: C = wood feeding, H = soft feeding, Ag = crop feeding, D = Dam, CA = food cache, DI = canal/digging, BU = burrow, L = lodge, SM = scent mound, SS =scent site, FS = feeding station, FT = foraging trail. Map credit: Alan Puttock

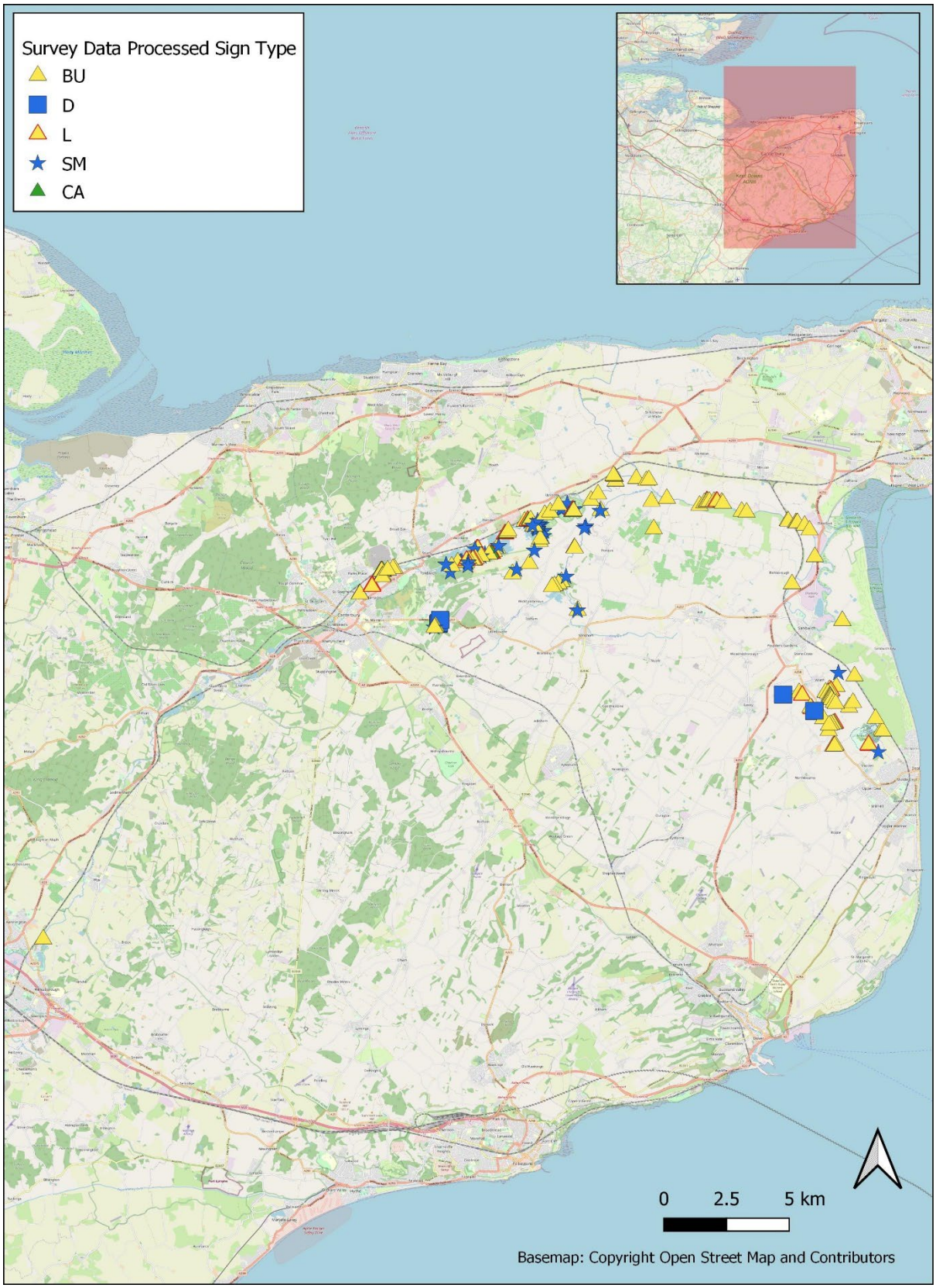

Figure 12. A subset of key non-feeding/coppicing beaver signs. As in Table 1 field sign coding: C = wood feeding, H = soft feeding, Ag = crop feeding, D = Dam, Ca = food cache, DI = canal/ digging, BI = burrow, L =lodge, SM = scent mound, SS =scent site, FS = feeding station, FT = foraging trail. Map credit: Alan Puttock

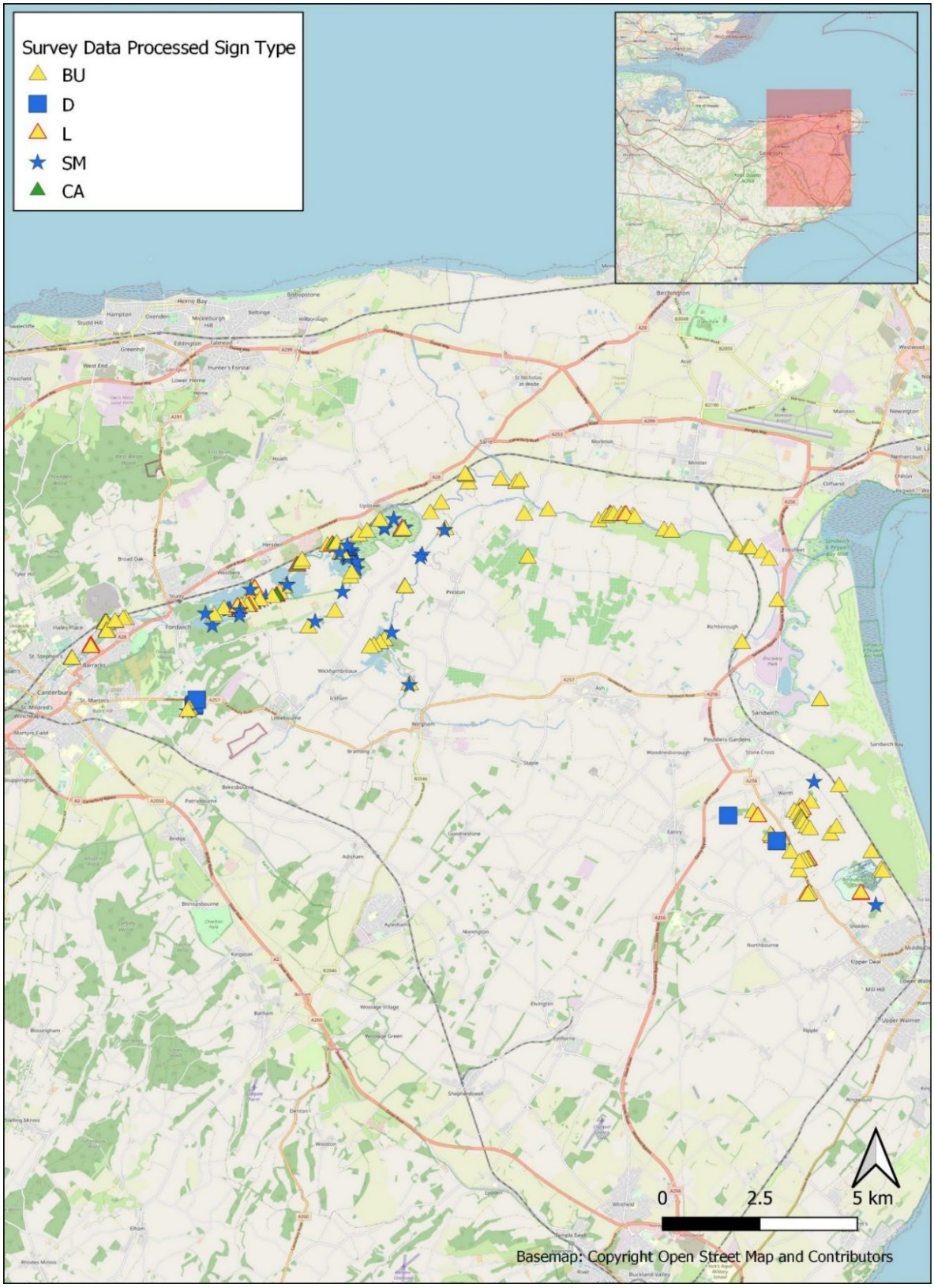

Figure 13. A subset of key non-feeding/coppicing beaver signs for key survey area. As in Table 1, field sign coding: C = wood feeding, H = soft feeding, AG = crop feeding, D = Dam, CA = food cache, DI = canal/digging, BU = burrow, L = lodge, SM = scent mound, SS = scent site, FS = feeding station, FT = foraging trail. Map credit: Alan Puttock

Survey data summary

The following figures provide a graphical data summary of the 2023 Kent beaver survey, visualising patterns in age of signs recorded, type of sign recorded, feeding effect and the land use where signs were recorded.

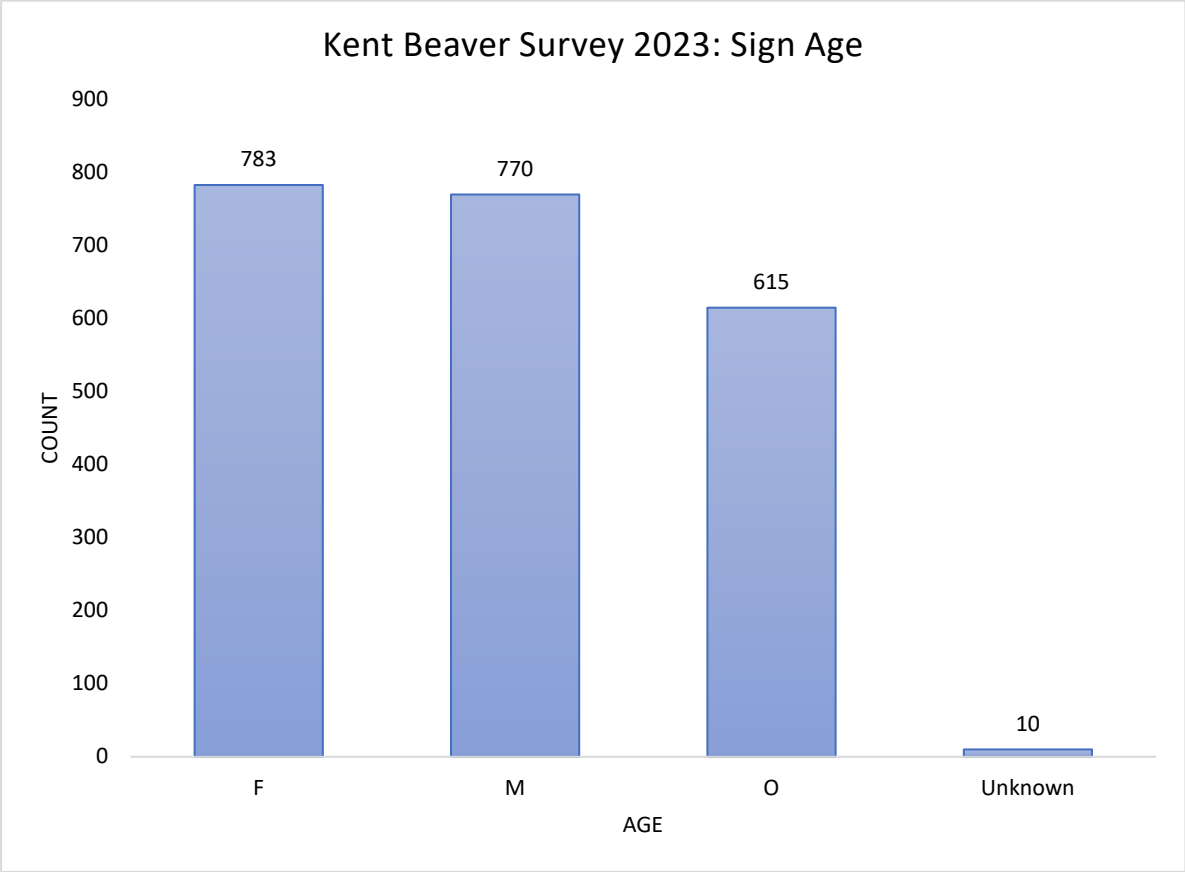

Figure 14. Age of all recorded beaver signs. F = fresh, M = mixed and O = old.

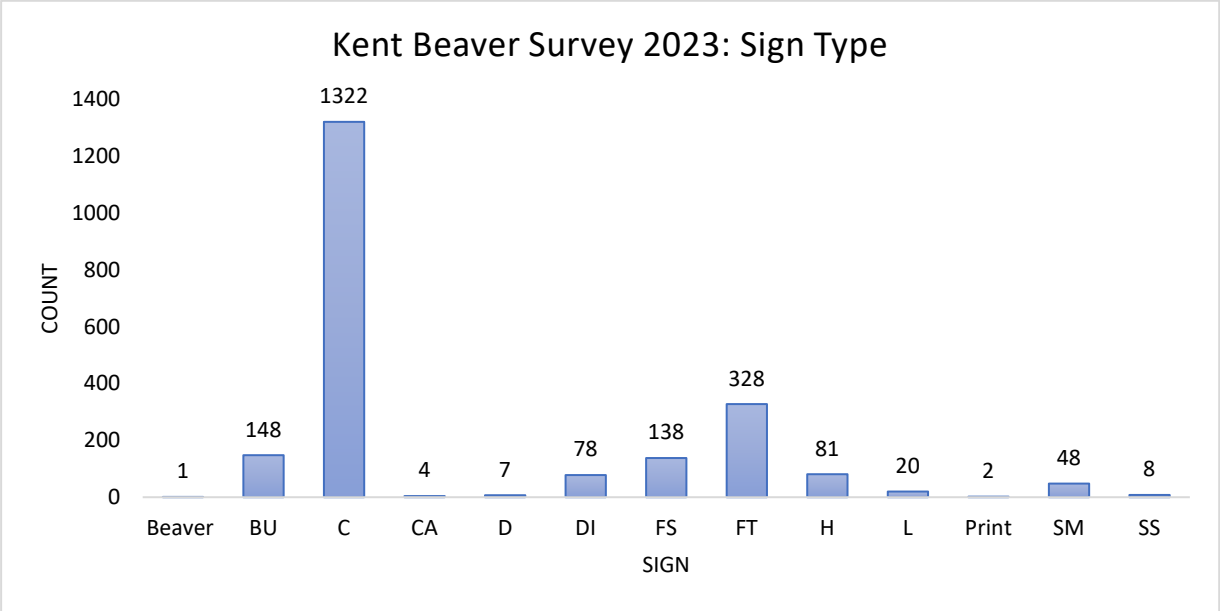

Figure 15. Sign type of all recorded beaver signs. As in Table 1 field sign coding: C = wood feeding, H = soft feeding, Ag = crop feeding, D = Dam, CA = food cache, DI = canal/digging, BU = burrow, L =lodge, SM = scent mound, SS =scent site, FS = feeding station, FT = foraging trail.

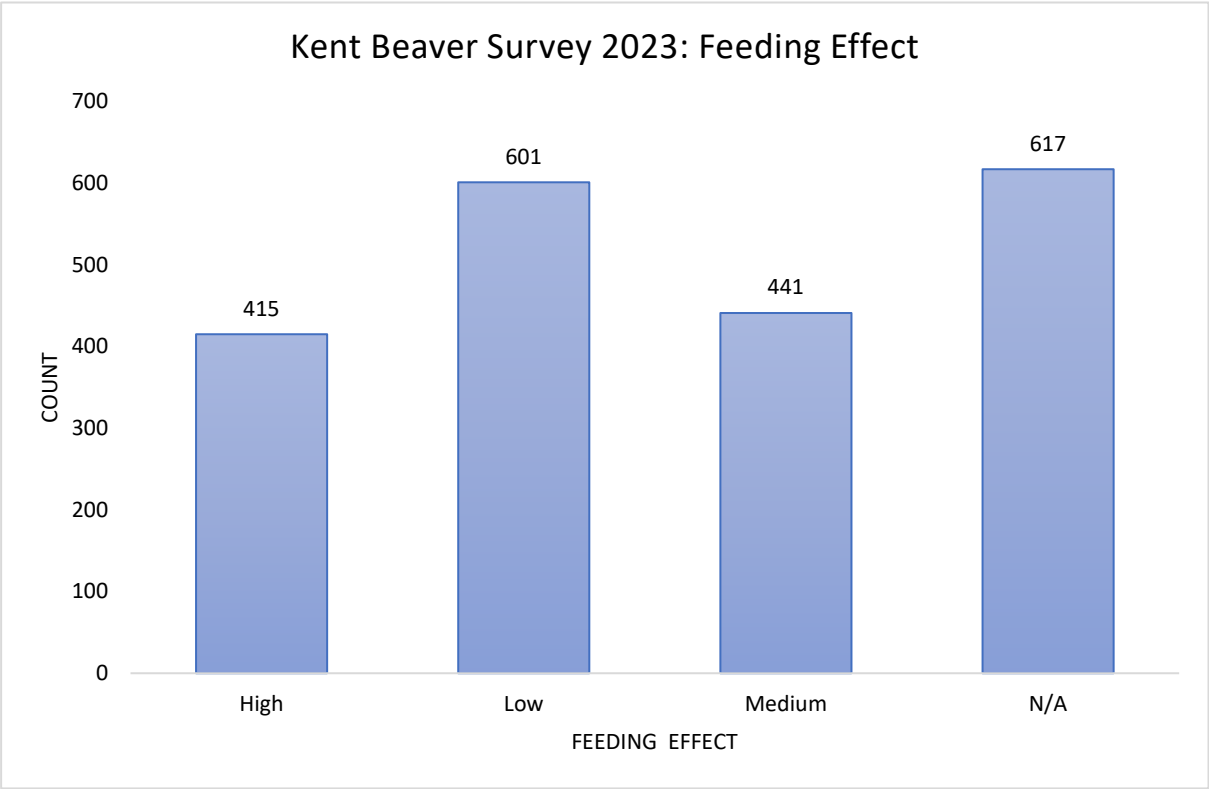

Figure 16. 'Feeding effect' of all recorded beaver signs.

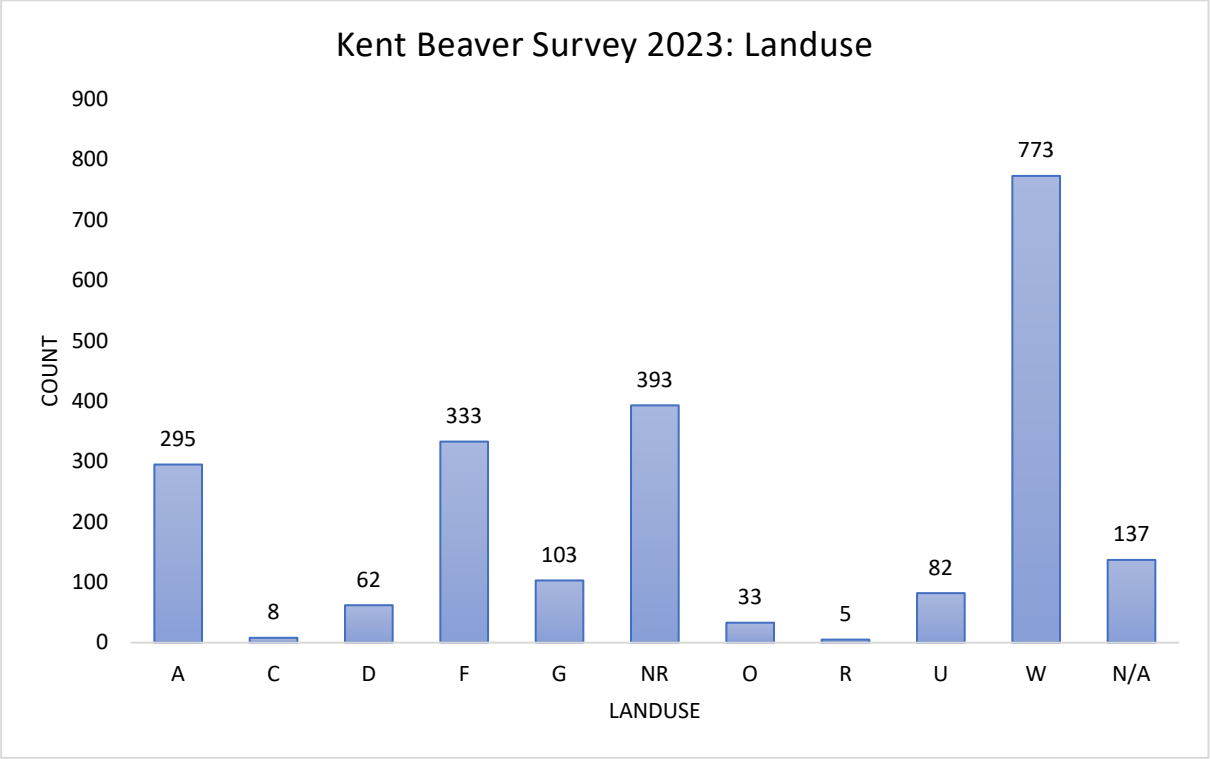

Figure 17. Land use of all recorded beaver signs. Land use coding: A = agriculture, C = conifer/commercial, D = deciduous, F = fishing/recreation, G = grassland, NR = nature reserve, O = other, R = residential, U = road/rail, W = wetland.

Table 2. Age of signs

Age	Number of Signs	%
Fresh	786	36.44
Mixed	749	34.72
Old	612	28.37
Unknown	10	0.46

Beaver impacts recorded during the survey

Beaver impacts and potential for conflict were recorded variably across the survey area, noting that for some field signs (for example, beaver dams), whether they are positive or negative impacts can be subjective to different audiences and stakeholders. Key impacts were recorded below, focusing on more significant conflicts and/or those requiring monitoring and potential mitigation. These impacts were mainly concentrated in areas where beaver density is likely to be higher and that beavers have been resident over several years. The hydrology of a system, proximity of a feature to the water course and bank composition all significantly influence potential conflicts.

It is likely that beaver digging and burrowing activity is currently the most significant potential conflict in East Kent, especially given the difficulty of observing burrow locations and associated mitigation. Therefore, monitoring requirements of vulnerable or sensitive areas is a likely ongoing resource requirement. More unique to this area of Kent is large-scale water level management, expansive ditch systems and their close proximity, meaning beavers may more frequently attempt to connect adjacent waterways through digging activities. Dam activity was not a common feature in this area, most likely as the majority of water courses, even narrow ones, were especially deep, which again is likely to encourage burrowing activities.

A particular feature of this area are large numbers of fishing lakes with high commercial value. These are typically in close proximity to the main rivers and are extensively fenced for otter exclusion. Many of these are also richly vegetated, with stable water levels, offering high habitat suitability for beavers. It should be noted that while otter fencing may deter more frequent beaver colonisation, it is not beaver proof, particularly along narrow banks and/or those lining rivers in which beavers could readily burrow. Examples of fishing lakes into which beavers had circumnavigated fencing were apparent. This may raise concerns over stock loss (due to fish escapes), changing water levels and tree impacts. It should also be noted there could be a risk of beavers becoming contained within such infrastructure, potentially requiring trapping and removal as a management action in the future. Other impacts recorded included evidence of summer crop feeding and loss of specimen trees of value.

Table 3. Management Impact recorded for signs

Management Impact	Number of Signs	%
High	17	0.76
Medium	69	3.10
Low	643	28.92
NA/None	1494	67.21

Figure 18. Burrowing activity in close proximity (<15m from tracks) to railway along Great Stour. Photo credit: Beaver Trust

Figures 19a and b. Cricket bat willow felled around Newnham Farm subsequent tree protection mitigation. Photos credit: Beaver Trust

Figure 20. Crop feeding along Great Stour. Photo credit: Beaver Trust

Figures 21 a and b. Canal digging impacting on footpaths around Vauxhall Lake and Westbere. Photo credit: Beaver Trust

Figure 22. Canal digging impacting on footpath around Westbere. Photo credit: Beaver Trust

Figure 23. Partially collapsed burrow around Hacklinge Marshes. Photo credit: Beaver Trust

Figures 24 a and b. Gnawed gates at Stodmarsh NNR. Photos credit: Beaver Trust

Figure 25. Otter fencing at Chilham lakes. Photo credit: Beaver Trust

Areas of activity and territory analysis

As undertaken in other free-living beaver surveys across Great Britain (most recently the Exe and Taw, see Campbell-Palmer et al., (in press), the stepwise process to identify the likely active territories is represented in modelling outputs below (Figures 26 - 34). These have been split into confidence, with ‘territories’ representing areas that are highly likely to be a current active territory, and areas of activity (AoA) indicating an area of activity that goes beyond a few field signs. In these latter areas we are less confident that they represent an active family territory; they are more likely to represent an area in which a singleton may be residing (potentially dispersing from a family group at an age of > 2 years old or an unpaired adult for example), or they may represent the fringes of an active territory. These areas are equally likely to become abandoned or become a territory in the following seasons.

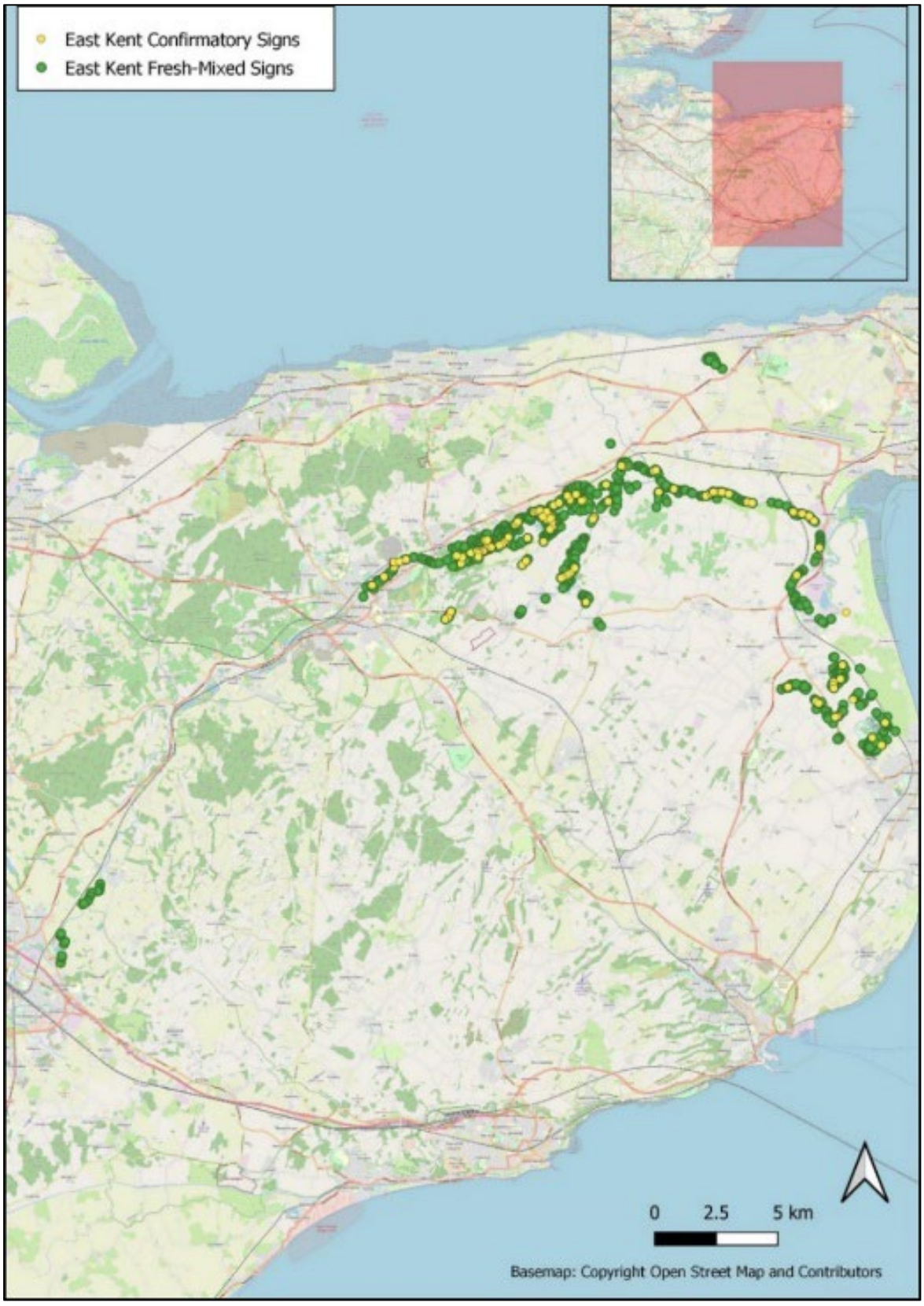

Figure 26. Data used for territory delineation, i.e. fresh and mixed signs, in addition to key dam and dwelling signs used for confirmation or increased confidence in territory identification. Map credit: Alan Puttock

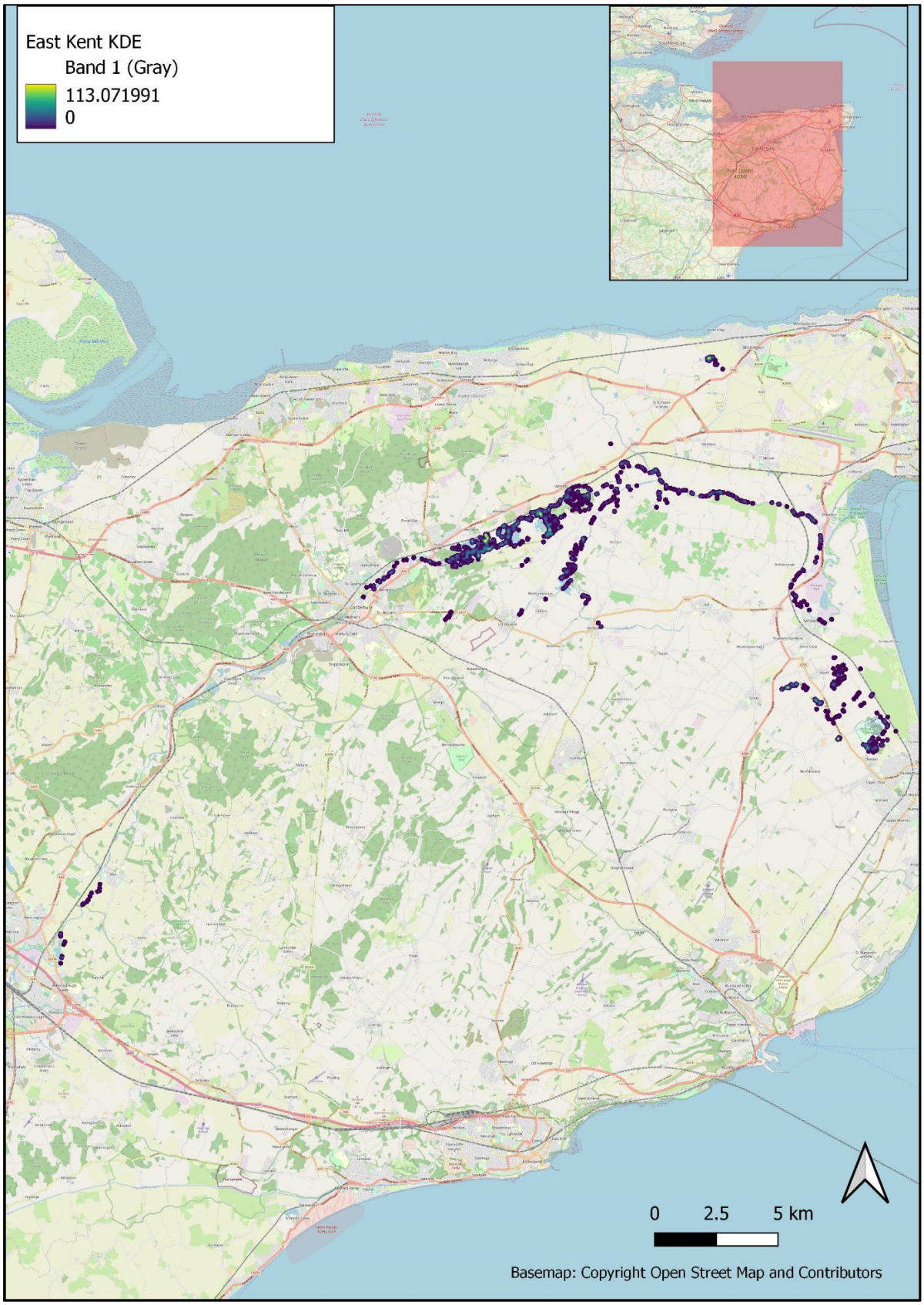

Figure 27. 'Heatmapping' of fresh and mixed signs via KDE analysis to enable automated territory determination. Map credit: Alan Puttock

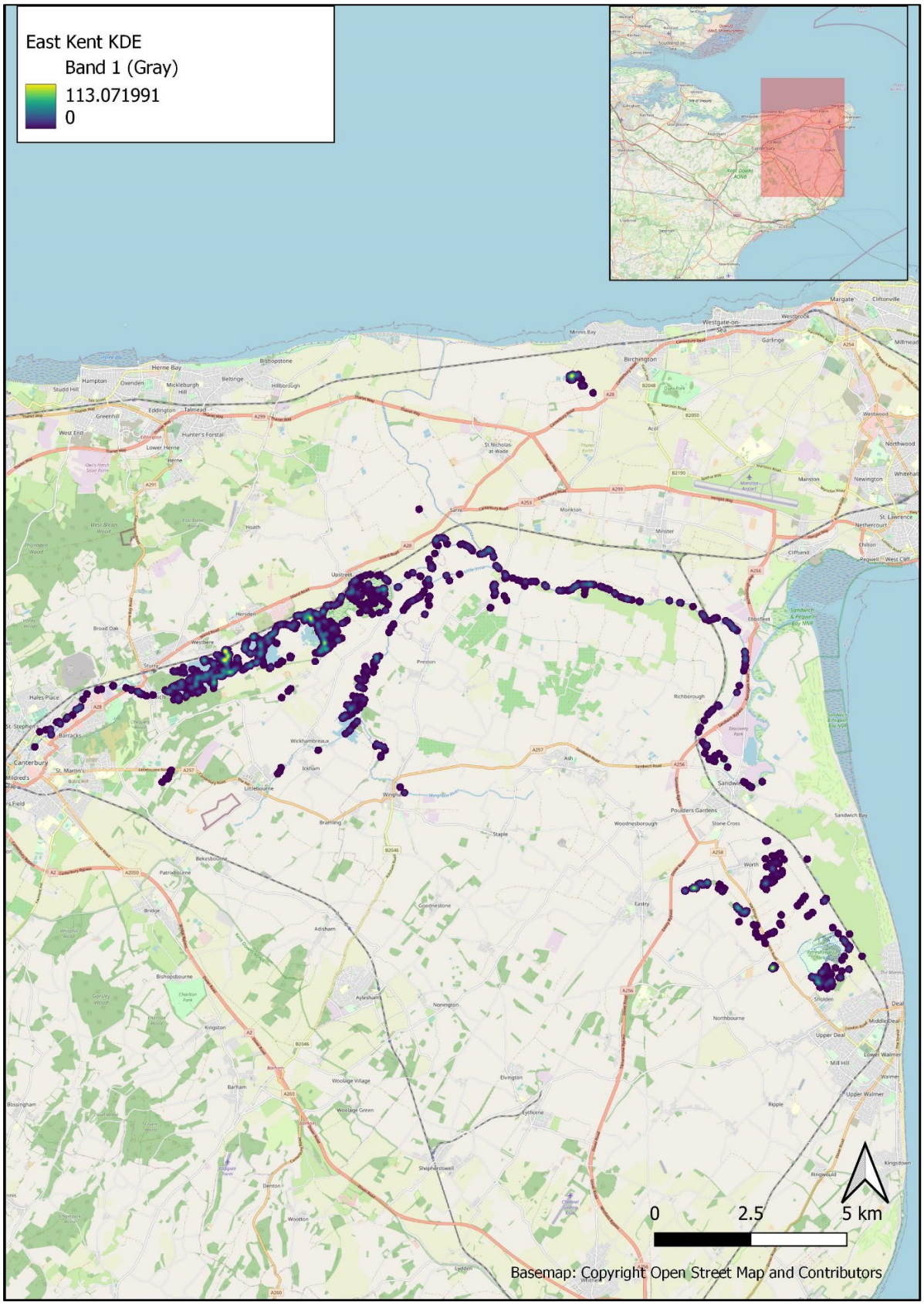

Figure 28. Core area 'heatmapping' of fresh and mixed signs via KDE analysis to enable automated territory determination. Map credit: Alan Puttock

Figure 29. All identified 'areas of activity' within the East Kent survey area labelled via non-sequential numbering. Map credit: Alan Puttock

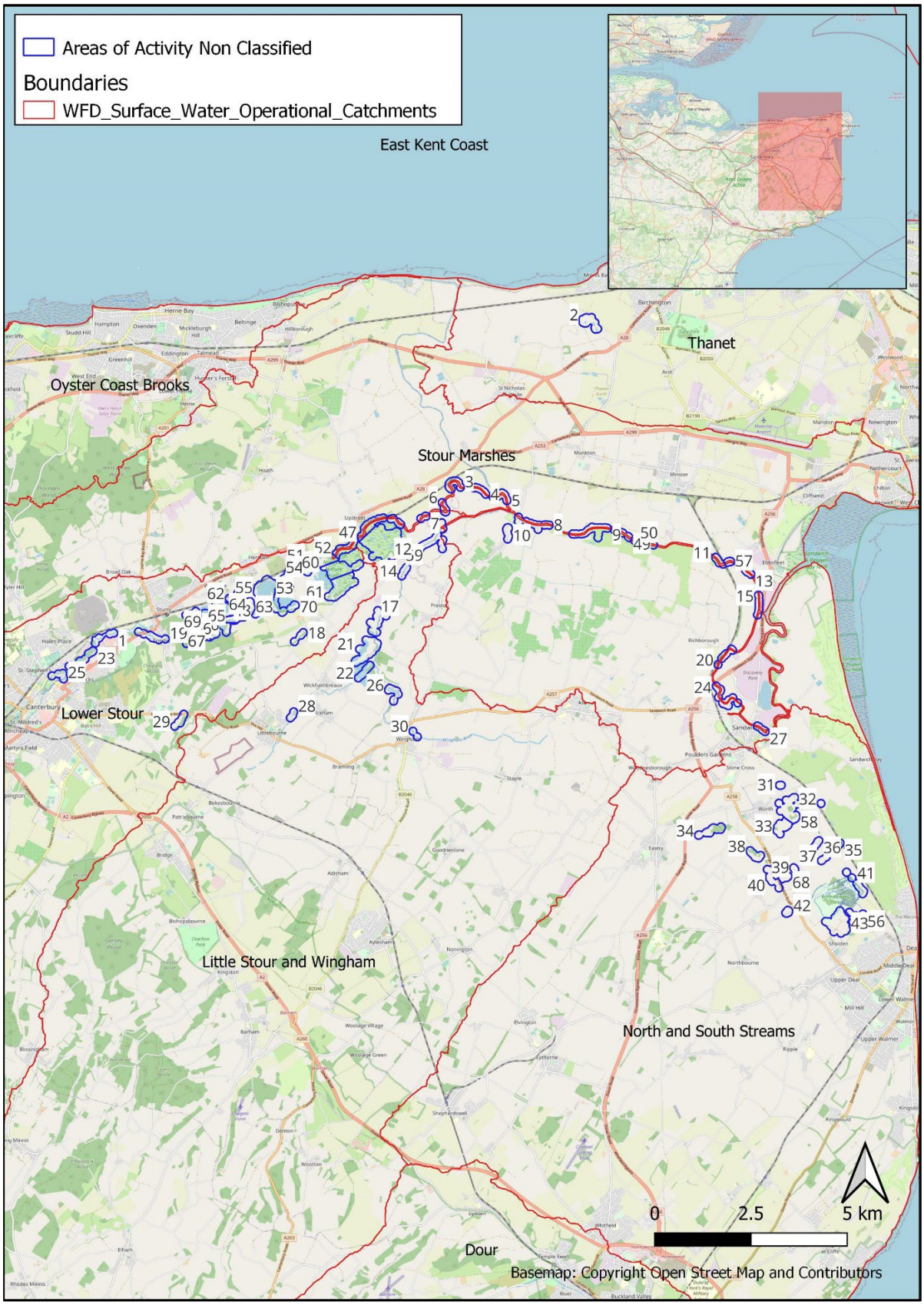

Figure 30. All identified 'areas of activity' within the East Kent core survey area labelled via non-sequential numbering. Map credit: Alan Puttock

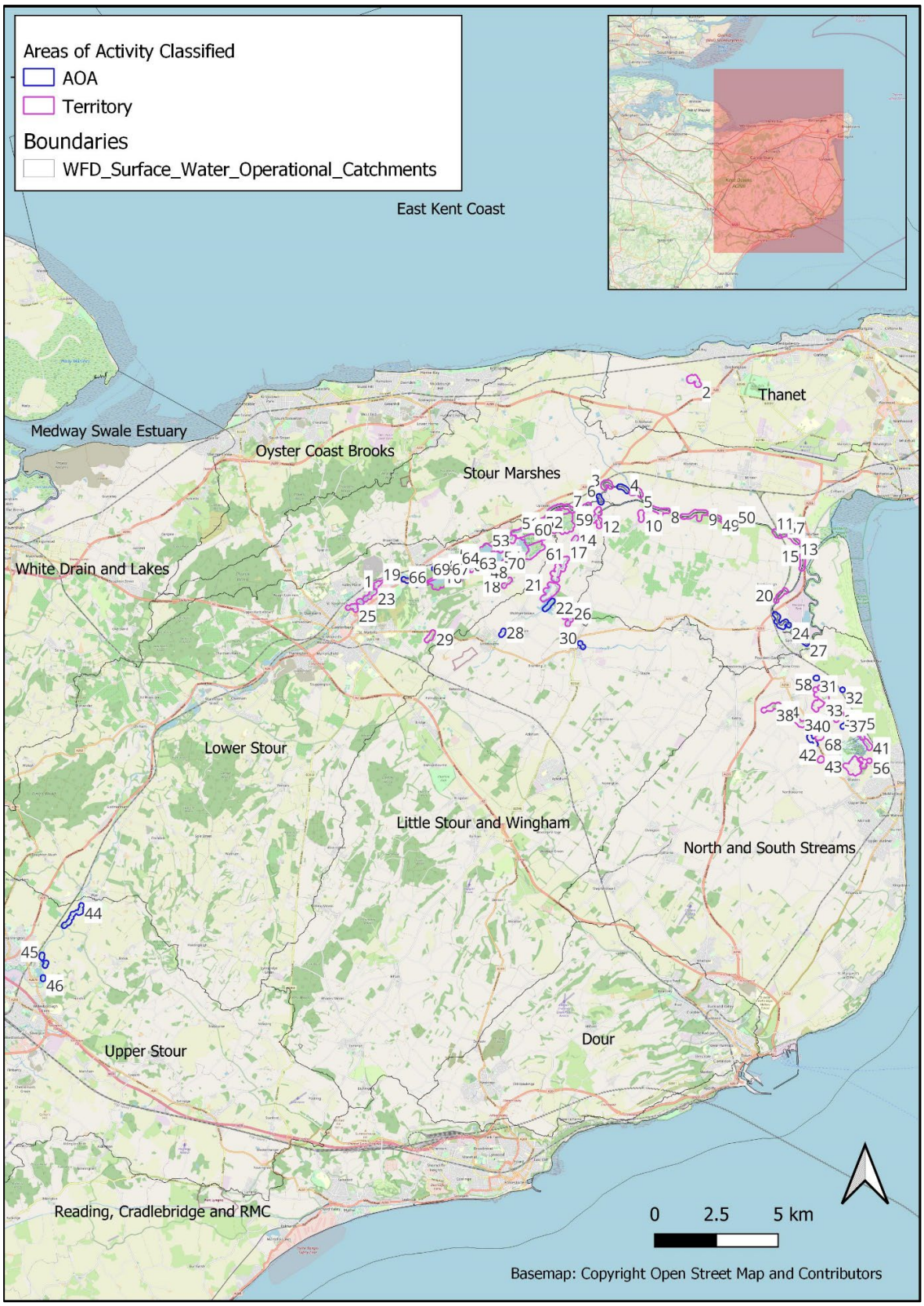

Figure 31. All identified 'areas of activity' within the East Kent core survey area labelled via non-sequential numbering. Map credit: Alan Puttock

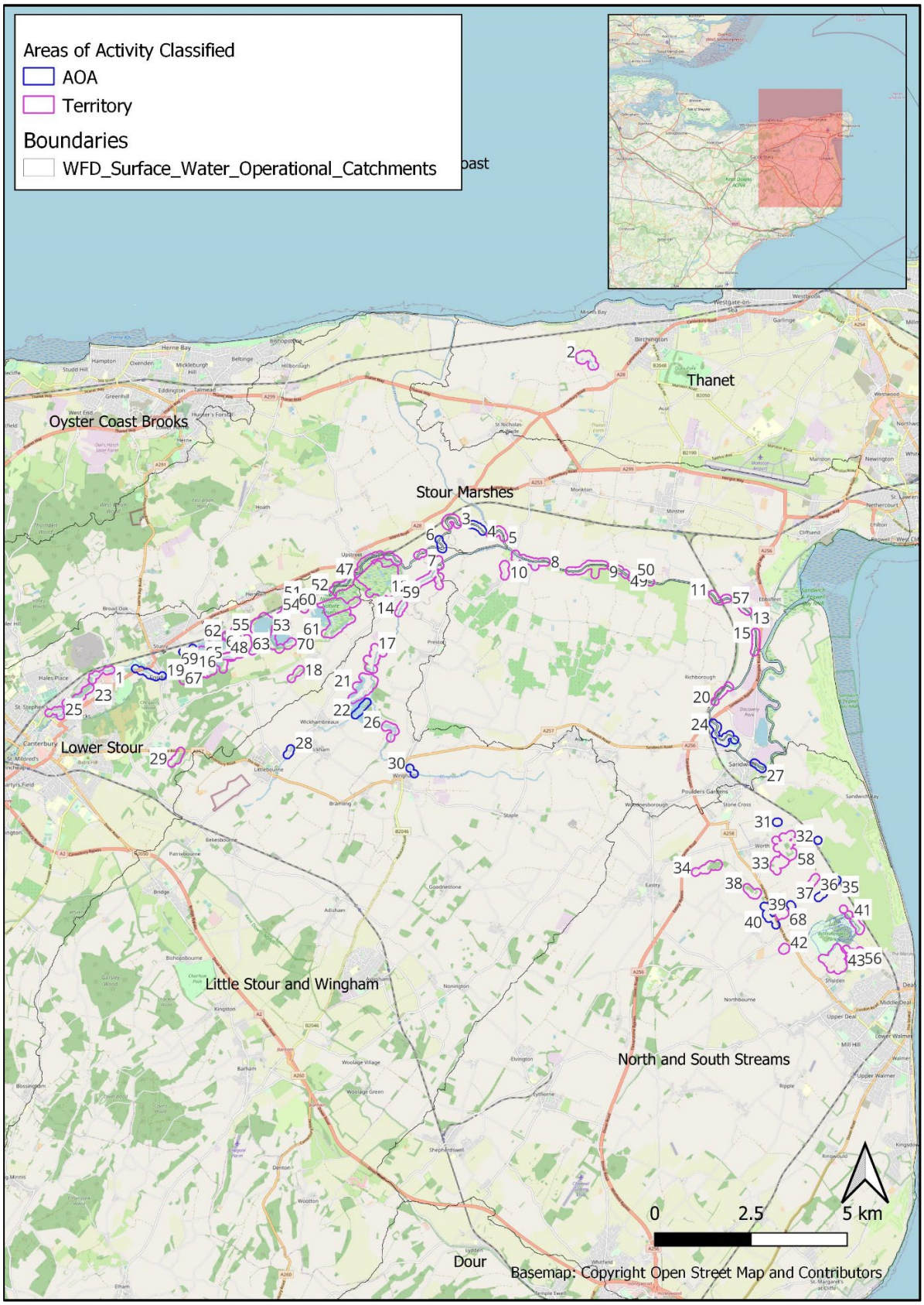

Figure 32. All identified 'areas of activity' within the East Kent core survey area labelled via non-sequential numbering. Map credit: Alan Puttock

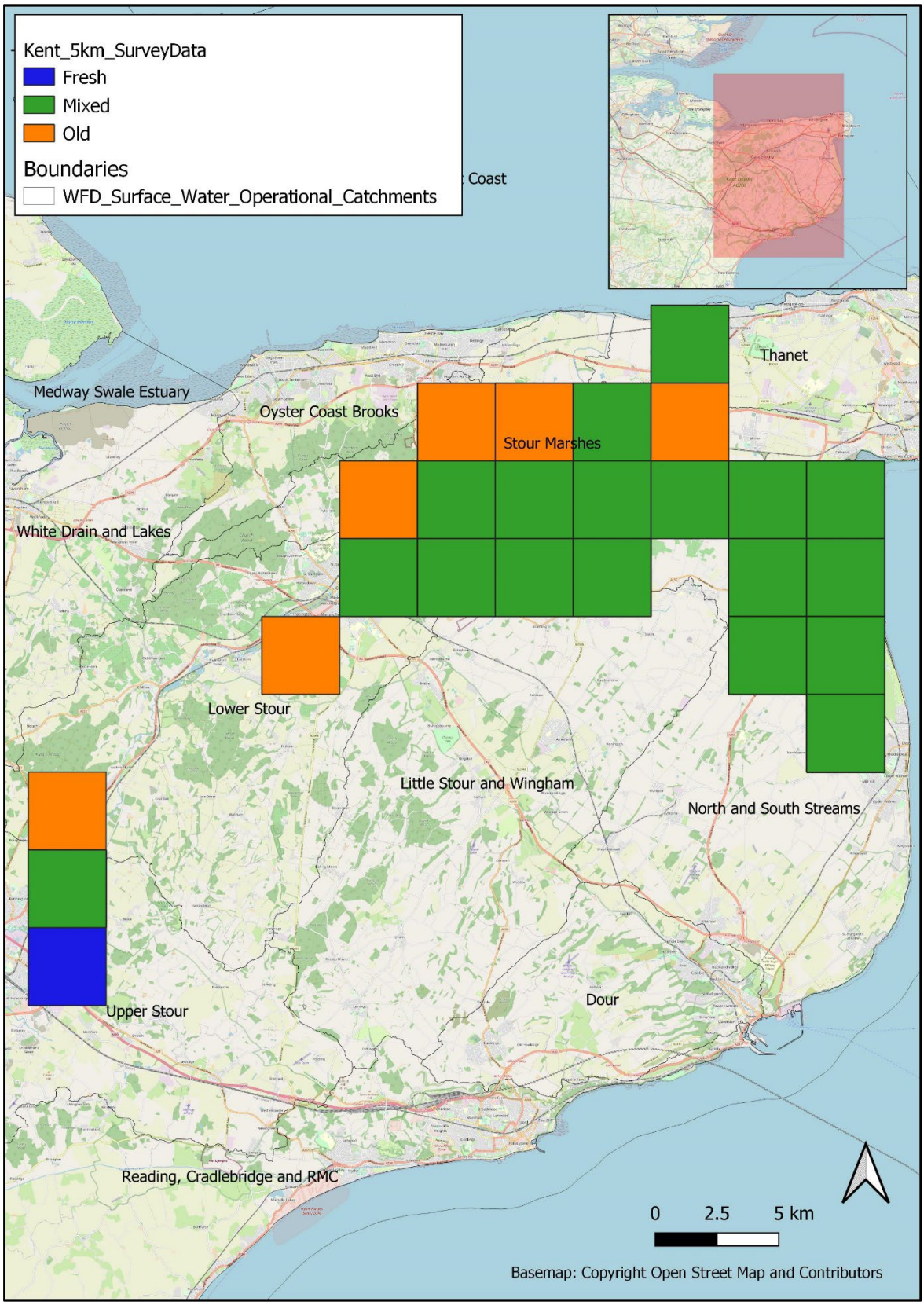

Figure 33. Gridded data anonymising exact location. Each 5 km square is classified by the dominant age of beaver signs falling within it. Map credit: Alan Puttock

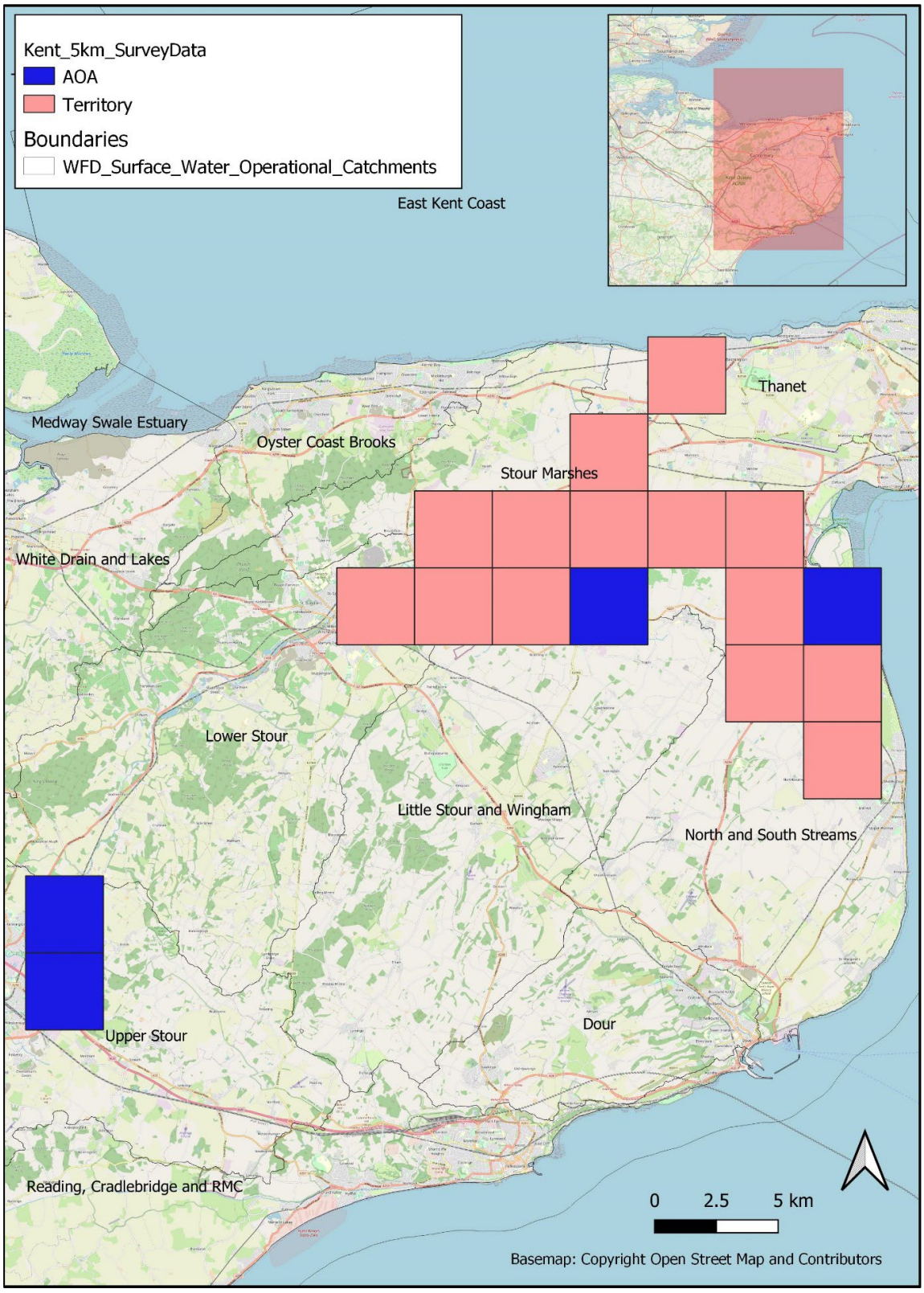

Figure 34. Gridded 5 km square data for territories and areas of activity. It is important to note that if a single territory intersects multiple squares, multiple 5km squares will be classified as containing part of a beaver territory. Map credit: Alan Puttock

Areas of activity and territory results summary

The data presented in this report indicates that an established beaver population has been present over the long-term (>10years) and has readily colonised the Lower Great Stour catchment. The capacity of this population to expand has been significantly restricted by both a sea/coastal environment but also by restricted riverine connectivity through Canterbury, resulting in a high density through a partially restricted area of catchment. Territories are therefore existing in close proximity, while territory capacity has been further increased by a series of high-quality marsh/lake complexes which significantly increase the area of available beaver habitat. These systems not only offer multiple individual small water bodies, which are easier for territory defence, but are also highly connected with each other, with interconnecting ditch systems, as well as the wider river. Therefore, beaver densities are high and defining territorial boundaries, especially along the main river system and within the marshes themselves, was complicated and more difficult to define. Areas of activity were used as an additional categorisation to assist definition between sections that could confidently be determined as active territories and those where beaver activity is likely to represent early territory establishment and population increase. Either way, this is a dynamic population with core areas of permanent territory establishment, with limited but flexible boundaries between individual territories, and some restrictions in capacity for significant expansions. However, as indicated by clusters of activity to the south of Canterbury, and in the northern Thanet areas, beavers are beginning to ‘jump’ into new tributaries and once they are occurring in any sort of numbers in these areas, population growth and distribution will occur over the next 5-7 years.

The conservative estimate of 51 territories, with an additional 19 areas of activity has been given. Again, noting that these 19 areas of activity could be in the process of becoming territories and, in theory, could be treated as such in any proposed monitoring and mitigation strategies.

Recommendations for future surveys

Initial findings from this report suggest beavers currently exist at fairly high densities along the main River Stour and several marshes, including Worth/Hacklinge Marshes, Stodmarsh and Westbere. Therefore, repeated survey efforts are probably not required beyond regular presence/absence observations of fresh field signs. Re-surveying of the outer sections of the core beaver occupied areas would be recommended, especially to highlight any infilling and range expansion, potentially across watershed boundaries into other catchments such as the Romney Marshes to the south of Ashford, the tributaries of the River Medway to the west, and into the River Medway itself. This survey did reveal beavers are present at low densities outside of the core areas identified by Natural England indicating colonisation and expansion. Survey effort was limited in these areas; therefore, it would be recommended that future surveys/resurvey efforts would cover some of these areas. Suggested areas include:

- The Great Stour, southwest of Canterbury and associated water bodies) to Ashford
- North of the Stour (River Wantsum and Chislet Marshes)
- Worth/Hacklinge Marshes
- Ashford area and associated water courses

Additionally, given the sensitivity of certain water courses to potential beaver burrowing impacts, regular monitoring of these areas would provide additional information ahead of any repeated survey efforts. These may include infrastructure close to water courses, flood banks, public rights of way and fishing lake embankments.

Conclusion

The aim of this study was to undertake a robust field sign survey to provide a raw data set for further analysis to determine current beaver distribution and estimate population numbers. Therefore, only summary survey statistics are presented here along with field sign type and distribution. From the initial survey results it can be determined that beavers are well distributed within the core areas and have been present for a number of years. A range of field sign types were observed with cut woody vegetation being the dominant field sign, though shelter features, especially burrows were regularly visible. Several lodges, especially along the Great Stour were observed, the vast majority of which had food caches present. Note, it is very likely that burrows have been under-reported given visibility associated with water depth and clarity. Very few dams were recorded, even though water course width along many of the systems would facilitate dam building, however, as water depths on the main river are typically >0.7m this is perhaps not surprising. Active scent marking was noted, especially along rivers where high-density beaver populations are suspected.

Beaver impacts were recorded, and though not extensive, these are likely to rise in certain areas and require ongoing monitoring, especially in areas of water management. Fishing lakes are also noted as a potential area of future conflict. Limited impacts on public rights of way were observed. Many of the foraging impacts could be easily managed with targeted tree protection and the encouragement of riparian vegetation buffers (for example willow planting which also has the advantage of reducing bank erosion). A casual observation was that most landowners directly engaged with were fairly positive about beaver presence and had lived alongside them for a number of years with no significant conflicts. Organisations such as the Environment Agency, were aware of beaver presence and have already implemented regular monitoring and maintenance programmes of their infrastructure.

The overall observations from the field sign survey were of a long-term resident population increasing in density over recent years, with evidence of territory infilling and territorial pressures, especially along the main river stems. More recently evidence of population expansion beyond the known core areas has occurred. It is likely that population expansion will occur to the southwest and north in the coming years and it is recommended that repeat surveys of the Great Stour and all the adjoining watersheds are undertaken in the future, via comparable survey methods and data analysis, to characterise this range expansion.

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