Translocation 2018 of the little whirlpool ramshorn snail to [redacted]

Highways England

26 November 2018

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Contents

1 Introduction

The little whirlpool ramshorn snail *Anisus vorticulus* is a small, aquatic snail with a dorsoventrally flattened shell approximately 5 mm in diameter. It is a UK Biodiversity Action Plan Priority Species and the only British non-marine gastropod which is a European Protected Species. It is also listed in Annex II of the EU Habitats and Species Directive and therefore requires the designation of Special Areas for Conservation (SAC) (Annex II). In the UK, populations of *Anisus vorticulus* have been declining since the 1960s and, although the precise cause is not clear, it is thought that drainage, over frequent dredging, and eutrophication are all likely to be contributing factors (JNCC, 2007; Van Damme, 2012).

Anisus vorticulus is also challenged by extreme dispersal limitation, which may prevent it expanding its range into suitable habitat even if conditions improve (Niggebrugge et al. 2007). Using translocation to assist with expanding the range of the species may therefore be appropriate, and to this end a pilot translocation (the Pilot Translocation) of *Anisus vorticulus* was conducted in the summer of 2016 to test both the feasibility of such action and the response of the species to it (AECOM/Abrehart Ecology 2016a). The Pilot Translocation involved the movement of 800 *Anisus vorticulus* from [redacted] (Figure 1), following an in-depth analysis of the habitat preferences of *Anisus vorticulus* to identify suitable donor sites (AECOM/Abrehart Ecology 2016b).

An initial monitoring survey of the Pilot Translocation, conducted in late October 2016, gave promising results regarding the survivorship of *Anisus vorticulus* at the receptor sites and their continued presence at the donor sites. Monitoring surveys will continue biannually over a period of five years (as per the terms of the translocation licence) and are reported under separate cover.

As per the feasibility report for the conservation translocation of *Anisus vorticulus* (AECOM, 2015a), a staged translocation was proposed, by which additional translocations could be implemented in subsequent years, with the methodology of translocation being adapted after each small-scale movement of *Anisus vorticulus*. The Pilot Translocation of the species represented the first stage of the conservation translocation project. The Pilot Translocation of 800 *Anisus vorticulus* from [redacted] took place in May 2016, with the second translocation (Translocation 2017) spread over a six-month period in 2017 (June and further in October/November 2017). During Translocation 2017, an initial 1,000 *Anisus vorticulus* were moved in June 2017, with a further 2,000 animals moved in October/November 2017.

The current report presents the third translocation exercise of the project (working title of “Translocation 2018”, to differentiate it from the Pilot Translocation AECOM/Abrehart Ecology (2016a.) and the subsequent Translocation AECOM/Abrehart Ecology (2018b).

The scoping study to find suitable donor sites and detailed surveys to ascertain the environmental suitability (both abiotic and biotic factors) of both donor and receptor sites have been previously documented and as such this current report should be read in conjunction with both AECOM/Abrehart Ecology (2017a) *Translocation of the little whirlpool ramshorn snail: Scoping survey 2016*, and AECOM/Abrehart Ecology (2017b) *Translocation of the little whirlpool ramshorn snail: Detailed surveys 2016/2017*.

Translocating to [redacted] was more involved than to the two previous translocation sites [redacted]. As [redacted] has exceptional invertebrate fauna, it was important to ensure that moving *Anisus vorticulus* into the site would have as little impact as possible. To try to ensure this the [redacted] Here the provision of a preliminary assessment of the project is considered as to whether it fulfils [redacted] conservation priorities, an additional report ‘assessment of a reintroduction project against current IUCN guidelines for reintroduction’ was produced. This identified Pre-project activities, Planning, preparation and release stages and finally Post-release activities (Appendix B).

These reports were produced then assessed by [redacted] after which they required permission from the [redacted]. This was approved by the [redacted] in October 2018. In addition to this we had to allay fears of PR ‘risks’ of association with the project (Acle straight widening). Once these permissions had been approved by [redacted] a Natural England (NE)

SSSI consent order was obtained in late October 2018 to undertake the removal of *Anisus vorticulus* from a SSSI and to place them onto another SSSI. Finally, a long-term monitoring plan was established to allow the translocation to go ahead. This was to agree to undertake the monitoring surveys already planned over the next five year with additional monitoring surveys requested.

Translocation 2018 used donor populations from [redacted]. The receptor sites were located in suitable early - mid successional ditches at [redacted].

Figure 1. Location of [redacted], ditches part of Translocation 2018.

1.1.1 Donor sites

[redacted] were again selected as potential donor ditches for the Translocation 2018. Additional donor sites at [redacted], were also chosen for inclusion in Translocation 2018. The new donor sites at [redacted] are all sites studied by Abrehart Ecology, looking at monthly population and community variation of *Anisus vorticulus*. [redacted] has been included in Translocation 2018 as it is in a very similar habitat to that of [redacted] (the proposed receptor site) (location shown in Figure 3). This [redacted] had a known population of *Anisus vorticulus* within its ditches (AECOM/AbrehartEcology 2017b). Surveys conducted by Abrehart Ecology in 2016/17 found the snail density at this site to be suitable to act as a donor population. Additionally, [redacted] was included as a donor site as it is the only fenland site to support *Anisus vorticulus* and is [redacted] These characteristics were considered important as the proposed receptor site at [redacted] is also in a [redacted] and being a fen too it was important to ensure that populations from a range of sites be included in the translocation (Figure 3).

Furthermore, it was considered environmentally appropriate to collect donor populations from a wider variety of sites to limit stress on the [redacted] population.

1.1.2 Receptor site

As reported in AECOM/Abrehart Ecology, (2018a, 2018c), in the summer and autumn of 2017, many sites across the Norfolk Broads National Park were surveyed to select additional receptor sites for Translocation 2018.

[redacted] was chosen. [redacted] This site was chosen as it appeared suitable from the scoping and full survey results. The habitat is outside what was known to be suitable for *Anisus vorticulus*, but, following a survey at [redacted] in 2016 and 2017, which produced a number of samples within the ditch system that supported *Anisus vorticulus*. [redacted] was a new marsh system for *Anisus vorticulus* which is considered a very important find, both due to its location and the habitat. [redacted] are not grazing marshes although they do have limited grazing within them from small numbers of Highland Cattle lightly grazing the marshes during the summer. [redacted] are true fen habitats with a deep peat layer and [redacted]. The true fen habitat is water logged with a complex of calcareous tall herb with reed, rushes and saw sedge (some commercially cut). The water level in the ditches is high and such there is almost no poaching along the ditch margins. This is very different to most of the grazing marsh ditches which generally have at least some poaching.

[redacted] is the best example of fen habitat for plants and invertebrates in the UK [redacted] has no grazing although is managed for invertebrates with areas being cut on a rotation on an ad hoc basis. The ditch clearance across the site is regular at between 5 and 10 year rotation. The water level across the site is high and like [redacted] this site too is [redacted]. The proposed receptor sites in the northern section of [redacted] were chosen due to several biotic and abiotic factors indicating that they could be suitable to support *Anisus vorticulus*. An additional important factor in the assessment (beyond biotic and abiotic factors directly relatable to the ditches) was ensuring the land owner was content with the introduction of *Anisus vorticulus* onto their land and prepared to manage the ditches accordingly. This aspect was difficult to realise, although is now in place.

[redacted] supported a wide range of mollusc species (24 aquatic species, including two Red Data Book (RBD) species – *Pisidium pseudosphaerium* and *Segmentina nitida*) as found during previous detailed surveys. Each sample site had a consistently high number of species from 16 to 19 species per site. The [redacted] has no historic records for *Anisus vorticulus* but is such an invertebrate rich site that had a broadly similar mollusc community to [redacted] that it was deemed very suitable for this translocation. The site is [redacted] and has had very few, saline incursion events, which is important for the species not only in the short term but the long term too. The water quality on the site is exceptional for the Broads and is an important aspect of the continued management on the site.

2 Methods

2.1 Licence requirements

Natural England licences were required for each phase of this project, as the project has developed it was agreed with [redacted] (Natural England senior invertebrate specialist) to combine all past licences into one to cover the entire project including surveying (disturbing *Anisus vorticulus),* collecting full aquatic invertebrate samples for laboratory analysis (killing *Anisus vorticulus*), and for the translocation across the three sites ([redacted]

All survey and translocation work are now undertaken with the licence 2018-35924-SCI-SCI. All licences associated with the Conservation Translocation project – for all stages are listed in Appendix A for reference.

2.2 Translocation method

Prior to the commencement of Translocation 2018 (during October), sampling surveys were conducted at all potential translocation donor and receptor sites across [redacted] (Figure 2). The sampling survey focused chiefly on ascertaining the presence/absence of live *Anisus vorticulus* at the receptor sites, and the continuing persistence and necessary abundance of *Anisus vorticulus* at the donor sites.

Data and sample collection was conducted by a pair of surveyors, including an experienced, on-site mollusc surveyor ([redacted], Ecologist and National Mollusc Specialist) and a second team member responsible for recording ditch features, abiotic variables, and botanical diversity ([redacted] and [redacted] Ecologists at Abrehart Ecology). At each sample location, ditch characteristics and a range of other environmental features were recorded (repeating the 2015 survey used in finding sites for the previous translocations in 2016 and 2017, AECOM 2015c). Parameters included exposed and submerged bank profiles, channel width and depth, and levels of grazing, poaching and shelving. Abiotic parameters were recorded in the surface 10cm of water, including pH and conductivity (measured using a HI98129 pH/Conductivity Tester; Hanna Instruments), dissolved oxygen and temperature (measured using a PD0-520 Dissolved Oxygen metre; Lutron). Each sample point was recorded on an Archer2 sub metre dGPS.

2.2.1 Sampling and translocation

Pre-Translocation 2018 sampling (monitoring) at the donor ditches aimed to ensure that the previous harvesting for translocations had caused no long-term negative effects on *Anisus vorticulus* populations and that the sites were still suitable to acts as donor sites. In addition to checking the abundance of *Anisus vorticulus* in the donor ditches, the wider mollusc community was assessed to ensure that the disturbance has not caused any long-term shifts in species composition and / or abundance.

For consistency, samples were collected using the same sweep netting method as the Pilot Translocation monitoring report (AECOM/Abrehart Ecology 2016c, first described in AECOM/Abrehart Ecology 2016a). This method was developed to minimise disturbance at the receptor sites, by taking smaller samples than using a typical sweep net protocol (as was used in the detailed surveys described in AECOM/Abrehart Ecology 2015, 2016a, and 2017b). It is acknowledged that the simplification of the sweep technique may result in a slightly lower detection rate for *Anisus vorticulus* than the method described in AECOM/Abrehart Ecology 2016a. However, minimising disruption of mollusc / aquatic invertebrate populations during translocation sweeps was considered a priority.

The material collected during the sweep was placed in a white gridded tray filled with water from the same sample area. Molluscs were released from the collected vegetation by agitating the contents of the tray, after which excess vegetation was then removed. The floating contents of the tray (chiefly vegetation and larger invertebrate species) were poured back into the ditch, with molluscs retained in the bottom of the tray; it is accepted that a small proportion of *Anisus vorticulus* may be lost at this stage, attached to some of the

floating vegetation, but previous tests of this method have shown such losses to be negligible ([redacted], *pers. obs.*). The material remaining was then evenly distributed across the tray for assessment. Any *Anisus vorticulus* present were individually counted and photographed for subsequent estimation of age (see Section 2.3). After identification, the snails were carefully placed into small plastic containers (with water taken from the sample area) for translocation to receptor sites ([redacted]).

Anisus vorticulus were released into receptor ditches in groups of 100 animals. Release points were 1 m apart, in 5m sections adjacent to banks / bankside vegetation, [redacted] for future monitoring; with detailed GPS references taken using an Archer2 sub metre dGPS. Release points were selected based on previously identified habitat structure, considered optimal for *Anisus vorticulus*, including plant species present, bank structure, and stage of succession (mid-management cycle).

2.3 Life stage classification

All *Anisus vorticulus* collected from the donor sites were photographed on grid-marked laminated sheets, to allow more detailed assessment of the age profile / recruitment of the population during subsequent monitoring surveys. Using the photographs, the shell diameter of all individuals was measured using ImageJ software (v1.50i; Rasband 1997-2016). The scale for measurements was set using the grid squares of the paper in each photograph. Shells were measured from the edge of the shell aperture, through the central point of the whorl of the shell, to the opposite outer edge of the shell (Figure 2). All measurements were taken in millimetres.

The *Anisus vorticulus* were classed by age according to their size following the guidelines devised by Glöer & Groh (2007). Those with a diameter <2.5mm were classed as juveniles; small adults were classed as between 2.5-3mm (this was the size at which copulation was first observed; Glöer & Groh 2007); large adults were classed as having a diameter >3mm.

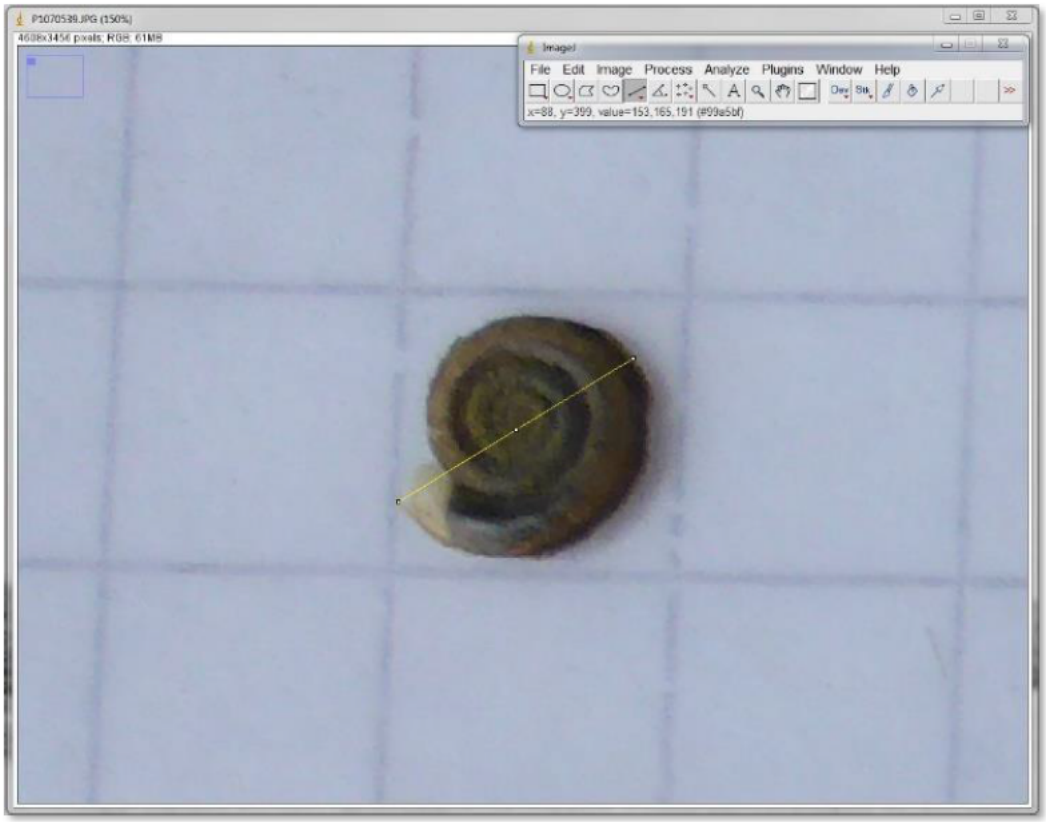

Figure 2. Measurement of shell diameter using Image J software. The full diameter of the shell was measured in each case, from the outer edge of the aperture, passing through the central whorl, to the opposite edge.

3 Results

3.1 Pre-Translocation 2018 sampling

Prior to Translocation 2018, sampling surveys were conducted at all donor and receptor sites to be used in the translocation. The survey focused chiefly on confirming the absence of *Anisus vorticulus* at the receptor site and confirming the persistence and necessary abundance of *Anisus vorticulus* at the donor sites. Samples were collected using the same sweep net method described in Section 2.2.1.

Anisus vorticulus was confirmed as absent from the receptor site [redacted]. A summary of the pre-translocation sampling of the donor sites is presented in Section 3.1.1.

3.1.1 Population status at donor sites

As described in Section 2.2.1, prior to Translocation 2018, all donor ditches were sampled to ensure that *Anisus vorticulus* persisted and that the populations were still viable to act as a donor populations. Live *Anisus vorticulus* were found in good numbers within donor ditches at [redacted] (Appendix C) and the donor ditches at [redacted] (Appendix C). In addition to these sites three additional sites were surveyed for *Anisus vorticulus* as part of another project (Broads Authority 2018) all showed great potential as donor sites, these were at [redacted]. Good numbers were found at these sites with exceptional numbers at [redacted] with up to 700 Anisus vorticulus collected in a single sweep sample.

The pre-translocation sampling indicated that the ditches at all potential donor sites were still suitable for translocation. Results indicated a range of densities across the eight sites, with some sites [redacted] supporting very high densities with over 400 snails, of varying age classes, in a single sweep. This showed that the ditches across the eight sites were still suitable to act as donors for the Translocation 2018.

3.2 Life stages of translocated *Anisus vorticulus*

The translocation was carried out in October/November 2018, numbers of *Anisus vorticulus* across the sites were relatively high this year and good numbers were found across the survey periods.

The *Anisus vorticulus* translocated to [redacted] were all photographed and measured, to ensure that the age class of the translocated populations of *Anisus vorticulus* at each receptor location was recorded. This was in order to enable assessment of whether *Anisus vorticulus* was breeding at each site. This will also show if any particular donor population is more resilient to being moved over any other population.

	Site								
Size	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**Total**
<2.5mm	335	96	94	72	125	1816	1408	11	**3957**
2.51-3.0mm	80	14	0	7	55	244	87	17	**504**
>3.01mm	85	2	5	12	64	45	47	12	**272**
Total	**500**	**112**	**99**	**91**	**244**	**2105**	**1542**	**40**	**4733**

Table 1. Size classes of *Anisus vorticulus* collected for the translocation to [redacted] from each donor site.

Table 1 presents the numbers of adults (>3.01 mm), young adults (2.51-3.0mm**)** and juvenile (<2.5mm) *Anisus vorticulus* that were harvested for translocation from each donor site. Overall, as shown in Table 2, more than 83% of the *Anisus vorticulus* moved to [redacted] were within the size class 'juvenile', 10% were 'young adults' and just under 6% were 'adults' according to size classes proposed by Glöer & Groh (2007). The percentage of each age class between sites varied considerably with juveniles comprising 96% of the translocated population at one of the Acle ditches compared to 28% in

the population at [redacted] where only 40 *Anisus vorticulus* were collected from two samples. [redacted] also had a low percentage of juveniles at 50% and again the number collected in the two samples was low to moderate with just 244 individuals collected. All the other sites had a much higher (67-95) percent of juveniles and accordingly the adults were all in low numbers.

Size	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Overall %
<2.5mm	67	85.71	94.95	79.12	51.23	86.27	91.31	27.5	83.6
2.51-3.0mm	16	12.5	0	7.69	22.54	11.59	5.64	42.5	10.65
>3.01mm	17	1.79	5.05	13.19	26.23	2.14	3.05	30	5.75

Table 2. Percentages of size classes per donor site

3.3 Translocation to [redacted] Marshes

In November 2018, 4,733 *Anisus vorticulus* were collected from [redacted] 211), [redacted] (40), [redacted] (91), [redacted] (500) [redacted] and [redacted] (1542), [redacted] (244) and [redacted] (2105) in [redacted] The harvested *Anisus vorticulus* were moved to eight sub sites at [redacted], at six of these sub sites, 500 *Anisus vorticulus* were deposited (100 *Anisus vorticulus* were placed at five points at each sub site, spaced 1m apart). The last two translocation sites 7 and 8 were to the south west of the site with 1733 Anisus vorticulus split between the two sites. Locations of release points are shown in Figure 3.

The majority of the donor collection was made as part of the monthly monitoring project, in which 4,233 *Anisus vorticulus* were collected and used in the translocation, with the remaining 500 coming from a collection at a single ditch at [redacted]

Figure 3. Locations of receptor sites at [redacted] for Phase 3 of *Anisus vorticulus* Translocation 2018.

[redacted]

4 Discussion

4.1 Selection of new translocation sites

The Pilot Translocation conducted in 2016 (AECOM/Abrehart Ecology, 2016a) focussed translocation effort on ditches within the [redacted] area. A significant component of the Translocation 2018 effort was the identification and understanding current management of new receptor sites and donor ditches. The new sites used for Translocation 2018 were selected based on the following factors: a known population of *Anisus vorticulus* [redacted] for donor sites; and for receptor sites, a strong correlation with botanical and invertebrate communities, but no current population - [redacted]. Importantly, for receptor sites, was landowner permission to introduce a protected mollusc species into the ditches and grant access for future monitoring works.

4.2 Monitoring

The Pilot Translocation methodology was largely repeated in Translocation 2018 with small refinements in relation to seasonality. The translocation methods were consistent with previous translocation effort in order to ensure consistency in results and to allow further iterations of the translocation method (Abrehart Ecology 2016) should they be required. In the current study no more translocations are planned. However, as per the requirements of the NE Licence to translocate *Anisus vorticulus* there will be five years of monitoring at the donor and receptor sites. In addition, in order to be able to translocate Anisus vorticulus to [redacted] the RSPB insisted that a monitoring programme was established. This is to ensure that long term monitoring is carried out on the site. The additional surveys will be annually from 2019-23 with an additional survey in 2028. The results and discussion of this translocation will be presented within the 2019 Monitoring Update Report.

5 Acknowledgements

Thanks to [redacted] for granting access to the survey sites, and for their support and interest in the project. Thanks too to Suffolk Wildlife Trust in particular [redacted] for his help and support with access and information on his sites. To [redacted] for access to [redacted] of Natural England for granting access to [redacted] and to [redacted] for access and discussions [redacted] and for seeing the translocation through. And to [redacted] (NE) for arranging the SSSI consent.

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Appendix A - Licences

23292 SCI-SCI – Anisus vorticulus

26279 SCI-SCI – Fen raft Spider

31348 SCI-SCI - Norfolk Hawker

29518 SCI-SCI – Anisus vorticulus

30930 SCI-SCI – Anisus vorticulus

35924 SCI-SCI – Anisus vorticulus

Appendix B – RSPB Translocation proposals

THE ROYAL SOCIETY FOR THE PROTECTION OF BIRDS

A STRATEGY FOR THE TRANSLOCATION OF WILDLIFE TO AND FROM RSPB RESERVES

Proposal

Translocation of Little Whirlpool Ramshorn Snail (*Anisus vorticulus*) to [redacted] [redacted] Norfolk. 2018

Proposed by Abrehart Ecology Ltd. On behalf of
Highways England and AECOM

abrehart ecology Ltd

A preliminary assessment of a reintroduction project to consider whether it fulfils RSPB's conservation priorities, presented for the little whirlpool ramshorn snail, *Anisus vorticulus*.

1. **Is the species native?**
   YES. *Anisus vorticulus*, has existed in the Broads national park for several hundred years and there are post glacial records from Suffolk and Cambridgeshire

2. **Has the species been lost from a significant part of its former UK range? YES.** *Anisus vorticulus* has always been greatly restricted in its distribution in the UK. It is currently restricted to the [redacted] and [redacted] it was never widespread, always rare. It has been lost from ponds that used to support it and a number of marsh systems within [redacted].

   Recent surveys have shown the distribution has loosely remained the same, with some new populations being discovered and some lost.

   It is a UK BAP priority species, RDB1 (Endangered) and considered one of the most threatened mollusc species in the UK. It is an European protected species (EPS) and an EPS licence is required to survey and to translocate it.

3. **Is the species internationally threatened?**
   YES. In Europe, it is rare throughout its range in central and southern Europe with populations in Denmark. In the UK *Anisus vorticulus* is restricted to marsh drains with clean still water and dense aquatic flora with limited emergent flora.

4. **Was the reduction in range due to man's influence?**
   PARTIALLY. It is considered that previous reasons for the population decline relate to:
   a) The clearance regimes of the ditches across all sites. Reducing the mid successional ditches required for the species;
   b) Pollution across some sites with eutrophication; and
   c) Increased ditch pH across sites.

5. **Have the causes of the species' loss been rectified/ reduced/ eliminated?**
   No, the reasons for the decline are still assumed to be eutrophication and poor management though we are carrying out additional work looking into reasons for the declines. At [redacted] we carried out a preliminary survey in the summer of 2017 and found that the ditches appear to be suitable to support *Anisus vorticulus*. There was a good range of molluscs species found including *Segmentina nitida* (a good associate species) The pH is within the values we believe *A. vorticulus* requires.

6. **Is the species likely to re-colonise/colonise the release location(s) naturally within 10 years? PROBABLY NOT**. Over the last 2 years we have tried to move populations

to three sites, one population has increased significantly one has not survived and the third is expanding this latter site is only six months to year into their translocation. At the proposed translocation site at [redacted] there are no records within [redacted] but a new population was discovered at [redacted], which is the first population within [redacted]. The aim being that if it can be established it can populate surrounding ditches. Within a site they have been very slow to colonise suitable habitat within 20m of where they were placed. This species is known to have low dispersal potential.

7. **Is the re-introduced species likely to have a significant impact on any native species?**
   NO. Introducing *Anisus vorticulus* to such a rich site will have no impact on the ecosystem and will only aid in the restoration of the species at a new site to expand a population that appears to be currently retracting in range.

8. **Is the species already present at the release locality?**
   NO. No habitat creation will be required as the condition of the ditches is already suitable.

9. **Does sufficient habitat exist to support a self-sustaining breeding population? YES.** The microhabitat requirements we believe of *A. vorticulus* are present on the site, with well vegetated ditches already supporting a moderately rich mollusc community. It will be important to try and increase the length of clearance from 5 years to 8-10 years. There are no mid to late successional ditches on site and this extended ditch clearance process may aid the recovery of the ditch invertebrate fauna on the site too. We are only suggesting placing *Anisus vorticulus* in three ditches and will be monitoring 30m sections in each ditch for its continued survival and expansion. Varying ditch clearance regimes will create a more varied age structure of the ditches which will in turn aid diversity.

10. **Can the release locality's long-term suitability be assured?**
    YES. The introduction sites are within [redacted].

Appendix3.
ASSESSMENT OF A REINTRODUCTION PROJECT AGAINST CURRENT IUCN GUIDELINES FOR REINTRODUCTION (using Anisus vorticulus).

This document assesses the re-introduction of species against the IUCN/SSC guidelines. The numbering of paragraphs matches the numbering of the published IUCN/SSC Guideline as follows:

4. PRE-PROJECT ACTIVITIES

a) Biological

i) Feasibility study and background research
ii) Previous re-introductions
iii) Choice of release site and type
iv) Evaluation of re-introduction site
v) Availability of suitable release stock
vi) Release of captive stock

b) Socio-economic and legal requirements

5. PLANNING, PREPARATION AND RELEASE STAGES

6. POST-RELEASE ACTIVITIES APPENDICES

4. . PRE-PROJECT ACTIVITIES

a) Biological

i) Feasibility study and background research

1. *An assessment should be made of the taxonomic status of individuals to be re-introduced. They should preferably be of the same subspecies or race as those which were extirpated, unless adequate numbers are not available. An investigation of historical information about the loss and fate of individuals from the re-introduction area, as well as molecular genetic studies, should be undertaken in case of doubt as to individuals' taxonomic status. A study of genetic variation within and between populations of this and related taxa can also be helpful. Special care is needed when the population has long been extinct.*
There is currently no distinction made in terms of sub-species within the taxon *Anisus vorticulus*

The individuals to be re-introduced belong to a population at Acle and another population within another fenland site at [redacted] There are no historic records for the site [redacted]

No molecular genetic studies are considered to be required.

2. *Detailed studies should be made of the status and biology of wild populations (if they exist) to determine the species' critical needs. For animals, this would include descriptions of habitat preferences, intraspecific variation and adaptations to local ecological conditions, social behaviour, group composition, home range size, shelter and food requirements, foraging and feeding behaviour, predators and diseases*

Detailed studies have been ongoing to the past three years as part of this project looking at associations with mollusc and botanical assemblages. It is thought that they feed on algae and diatoms on the surface of leaves of aquatic macrophytes within the ditches.

Clean water is thought to be of vital importance to this species survival along with a pH of around 7. Where the pH increases to above 8 *Anisus vorticulus* is rarely found ([redacted] pers comm.). Despite detailed survey work on *Anisus vorticulus* is currently only known from clean water ditches, these can be well vegetated of hold filamentous algae the water quality appears to be key.

3. *The species, if any, that has filled the void created by the loss of the species concerned, should be determined; an understanding of the effect the re-introduced species will have on the ecosystem is important for ascertaining the success of the re-introduced population.*

There are no species that fill the absence of this species that will be affected by this introduction. *Anisus vorticulus* will have little impact on the ecosystem as a whole apart from restoring an important element to the fen system (more relaxed ditch clearance) with monitoring of three sites at [redacted] for a minimum of five years following on from the translocation.

4. *The build-up of the released population should be modelled under various sets of conditions, in order to specify the optimal number and composition of individuals to be released per year and the numbers of years necessary to promote establishment of a viable population.*

This type of translocation has been carried out at three sites so far within the broads as part of this project. This is a pioneering project and we are already seeing successes in two of the moved populations. There is no information of any attempt of this translocation and as such this project will help inform future translocation in conjunction with two other types of movement and management.

So far we have only carried out one release at each translocation site. This appears to have been enough at two trial sites. The third site may need another additional translocation.

We are also undertaking monthly monitoring of seven *Anisus vorticulus* sites over a 12 month period to establish the breeding cycle and optimal time to survey. This pioneering project will provide much of the data on which further introductions of this species of mollusc. Monitoring of success will be in place and the findings fed back into developing the best possible re-establishment for this species.

5. *A Population and Habitat Viability Analysis will aid in identifying significant environmental and population variables and assessing their potential interactions, which would guide long-term population management.*

Yes – Multi variate analysis was carried out as part of the initial translocation work at [redacted]. This showed affiliations with a number of species of mollusc and

vegetation. Both groupings are found at [redacted]. As part of the larger study additional multi-variate statistics work is being carried out on a larger number of samples. This will inform to a greater degree the associations across the Broads NP.

ii) Previous re-introductions

1. *Thorough research into previous re-introductions of the same or similar species and wide-ranging contacts with persons having relevant expertise should be conducted prior to and while developing re-introduction protocol.*

Translocating *Anisus vorticulus* or any other small aquatic mollusc has not been carried out previously. This is new to this project started in 2015 for the Highways Agency on the Acle straight population. As no one else has undertaken this type of work we have not had any collaborations with others in the field.

iii) Choice of release site and type

1. The site [redacted] is within the historic range of the species. No special habitat will need to be created, only a loosening in the ditch clearance work, from a 5 year rotation to a 8-10 year rotation. A re-survey of the site looking for specific habitat will be undertaken prior to the translocation. With discussions with the site manager to ensure that the areas we are looking to translocate to will not affect any planned work on the site in the future.

2. *A conservation/benign introduction should be undertaken only as a last resort when no opportunities for re-introduction into the original site or range exist and only when a significant contribution to the conservation of the species will result.*

This is an introduction within its original range. These proposed re-introductions are considered important to attempt to create new populations in suitable habitat where it has become lost from others within the Broads NP over the past 20 years. As a fenland site it will be important to see if this additional fen habitat site can support this species. It is known that with rising sea levels that all the sites within the broads are at risk. If this works for [redacted] then in the future it may be possible to move to an areas above sea level where habitats are suitable and within the historic range [redacted] Another translocation for *Anisus vorticulus* is about to start at [redacted] in the autumn of 2018. This is an attempt to increase the population across the site.

3. *The re-introduction area should have assured, long-term protection (whether formal or otherwise).*

The introduction site is within EU Special Areas of Conservation.

iv) Evaluation of re-introduction site

1. *Availability of suitable habitat: re-introductions should only take place where the habitat and landscape requirements of the species are satisfied, and likely to be sustained for the foreseeable future. The possibility of natural habitat change since extirpation must be considered. Likewise, a change in the legal/ political or cultural environment since species extirpation needs to be ascertained and evaluated as a possible constraint. The area should have sufficient carrying capacity to sustain growth of the re-introduced population and support a viable (self-sustaining) population in the long run.*

At the proposed introduction site we have considered that the quality of the ditches on the site indicate they are suitable habitat to support *Anisus vorticulus*. The length of ditch that could support *Anisus vorticulus* is 2km, across the northern portion of the site (see attached

map). Due to excellent management by [redacted] on this site for invertebrates it is considered a safe site to carry out this translocation. [redacted]. The microhabitat requirements of *Anisus vorticulus* are likely to occur naturally on site and the high quality of other invertebrate species on site indicates a higher chance for success. Increasing the length of time between ditch clearance will increase the diversity of the ditch structures and aid a number of species on the site. We consider that the areas have sufficient potential carrying capacity to sustain growth of the re-introduced population and support a viable (self-sustaining) population in the long run.

2. *Identification and elimination, or reduction to a sufficient level, of previous causes of decline: could include disease; over-hunting; over-collection; pollution; poisoning; competition with or predation by introduced species; habitat loss; adverse effects of earlier research or management programmes; competition with domestic livestock, which may be seasonal. Where the release site has undergone substantial degradation caused by human activity, a habitat restoration programme should be initiated before the re-introduction is carried out.*
It is considered that previous reasons for population decline relate to;

a) The gradual change in age structure of the ditch ages from an irregular clearance to every 5 years (mainly under HLS agreements) resulting in an early successional age range as opposed to a variety of early to late succession.
b) Water quality degradation which appears to have slowed down with the implementation of the WFD.

Habitat improvements are ongoing on the site and changes to ditch clearance strategies on the site will only improve the species structure on the site.

v) Availability of suitable release stock

1. *It is desirable that source animals come from wild populations. If there is a choice of wild populations to supply founder stock for translocation, the source population should ideally be closely related genetically to the original native stock and show similar ecological characteristics (morphology, physiology, behaviour, habitat preference) to the original sub-population.*
The source animals come from a wild populations located only a few kilometres from the re-introduction sites. [redacted]

2. *Removal of individuals for re-introduction must not endanger the captive stock population or the wild source population. Stock must be guaranteed available on a regular and predictable basis, meeting specifications of the project protocol.*
Individuals should only be removed from a wild population after the effects of translocation on the donor population have been assessed, and after it is guaranteed that these effects will not be negative.
Detailed survey work over the past three years (2015-2018) has found five new extensive populations with up to 400 animals found in a single sample in a suitable ditch of over 100m. Indicating that at some sites there are huge populations.

Monitoring at all donor and receptor sites are being undertaken concurrently with each translocation. With continuing surveys for five years following the translocation.

We have already removed animals from the donor ditches in the spring and autumn and found that recruitment is similar over both periods. Moving 1500 animals to three sites on [redacted] will have no affect on the populations at [redacted]. Should it be difficult to find enough animals at these sites we have alternative sites at [redacted] This would represent such a small percentage of the population that it will not impact it at any of the donor sites. It is proposed that the *Anisus vorticulus* are gathered and translocated in the autumn of 2018.
Given the relatively high summer mortality in the spring of adults it is better to translocate in the autumn.

3. *If captive or artificially propagated stock is to be used, it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology.*
The stock used will be from the nearest extant wild population and one ten miles to the south that has been part of the translocation project from the start.

4. *Re-introductions should not be carried out merely because captive stocks exist, nor solely as a means of disposing of surplus stock.*
This is not the case with this species.

5. *Prospective release stock, including stock that is a gift between governments, must be subjected to a thorough veterinary screening process before shipment from original source. Any animals found to be infected or which test positive for non-endemic or contagious pathogens with a potential impact on population levels, must be removed from the consignment, and the uninfected, negative remainder must be placed in strict quarantine for a suitable period before retest. If clear after re-testing, the animals may be placed for shipment. Since infection with serious disease can be acquired during shipment, especially if this is intercontinental, great care must be taken to minimize this risk. Stock must meet all health regulations prescribed by the veterinary authorities of the recipient country and adequate provisions must be made for quarantine if necessary.*
Not required due to taxonomic group and short distance movement?

vi) Release of captive stock

1. *Most species of mammal and birds rely heavily on individual experience and learning as juveniles for their survival; they should be given the opportunity to acquire the necessary information to enable survival in the wild, through training in their captive environment; a captive bred individual's probability of survival should approximate that of a wild counterpart.*
Not applicable to invertebrates

2. *Care should be taken to ensure that potentially dangerous captive bred animals (such as large carnivores or primates) are not so confident in the presence of humans that they might be a danger to local inhabitants and/or their livestock.*
Not applicable to invertebrates

b) Socio-economic and legal requirements

1. *Re-introductions are generally long-term projects that require the commitment of long-term*

financial and political support.
This work is part of agreed work for mitigation on *Anisus vorticulus* funded by Highways England.

2. *Socio-economic studies should be made to assess impacts, costs and benefits of the re-introduction programme to local human populations.*
Not applicable to this invertebrate species

3. *A thorough assessment of attitudes of local people to the proposed project is necessary to ensure long term protection of the re-introduced population, especially if the cause of species' decline was due to human factors (e.g. over-hunting, over-collection, loss or alteration of habitat). The programme should be fully understood, accepted and supported by local communities.*
Not applicable to insects, through the involvement of [redacted] making him aware of the needs of this species in terms of the microhabitat required.

4. *Where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these in the re-introduction area. If these measures are inadequate, the re-introduction should be abandoned or alternative release areas sought.*
The involvement of the management group the local land owners and land managers are aware of the needs of this species in terms of the microhabitat required.

5. *The policy of the country to re-introductions and to the species concerned should be assessed. This might include checking existing provincial, national and international legislation and regulations, and provision of new measures and required permits as necessary. Re-introduction must take place with the full permission and involvement of all relevant government agencies of the recipient or host country. This is particularly important in re-introductions in border areas, or involving more than one state or when a re-introduced population can expand into other states, provinces or territories.*
Natural England fully supports this work and we already have a EPS licence to undertake this aspect of the project should it be approved [redacted]

6. *If the species poses potential risk to life or property, these risks should be minimised and adequate provision made for compensation where necessary; where all other solutions fail, removal or destruction of the released individual should be considered. In the case of migratory/mobile species, provisions should be made for crossing of international/state boundaries.*
There is considered to be no potential risk to life or property

5. PLANNING, PREPARATION AND RELEASE STAGES

1. *Approval of relevant government agencies and land owners, and co-ordination with national and international conservation organizations.*
This has been achieved with the provision of an EPS licence to undertake the work and will feed into the Article 17 work and national Species Action framework management group.

2. *Construction of a multidisciplinary team with access to expert technical advice for all phases of the programme.*
This has been achieved through the project running through AECOM as main project

managers with Abrehart Ecology Ltd. undertaking all the survey work, preparation and reporting. Steering group meetings are held to show progress of works to date.

3. *Identification of short- and long-term success indicators and prediction of programme duration, in the context of agreed aims and objectives.*
Six monthly surveys are carried out on all donor and receptor sites for the 5 year duration of the translocation. This shows the expansion of the species along and across a section of ditch to show whether there is continued presence or not at each receptor site.

4. *Securing adequate funding for all programme phases.*
This has been achieved through agreement with Highways England.

5. *Design of pre- and post- release monitoring programme so that each re-introduction is a carefully designed experiment, with the capability to test methodology with scientifically collected data. Monitoring the health of individuals, as well as the survival, is important; intervention may be necessary if the situation proves unforeseeably favourable.*
Detailed surveys of all donor and receptor sites is undertaken every six months with each animal collected photographed and aged as part of the study. The populations are assessed with past data collected from each site.

6. *Appropriate health and genetic screening of release stock,*
This is not considered possible or necessary for this case

7. *Determination of release strategy (acclimatization of release stock to release area; behavioural training - including hunting and feeding; group composition, number, release patterns and techniques; timing).*
There is a working group where this has been agreed.

8. *Establishment of policies on interventions (see below).*

9. *Development of conservation education for long-term support; professional training of individuals involved in the long-term programme; public relations through the mass media and in local community; involvement where possible of local people in the programme.*
As part of this and additional projects on the species we will be having meetings with local land owners to discuss future management of the ditches where it occurs.

10. *The welfare of animals for release is of paramount concern through all these stages.*
Securing the welfare of the molluscs at all times is a major part of this work and molluscs collected are released on the same day.

6. POST-RELEASE ACTIVITIES

1. *Post release monitoring is required of all (or sample of) individuals. This most vital aspect may be by direct (e.g. tagging, telemetry) or indirect (e.g. spoor, informants) methods as suitable. Demographic, ecological and behavioural studies of released stock must be undertaken. Study of processes of long-term adaptation by individuals and the population. Collection and investigation of mortalities. Interventions (e.g. supplemental feeding; veterinary aid; horticultural aid) when necessary.*

This is being done through the Highways England funded mitigation work.

2. *Decisions for revision, rescheduling, or discontinuation of programme where necessary.*
Should *Anisus vorticulus* not establish it is unlikely to be repeated at this site until additional research is carried out into why it was not successful.

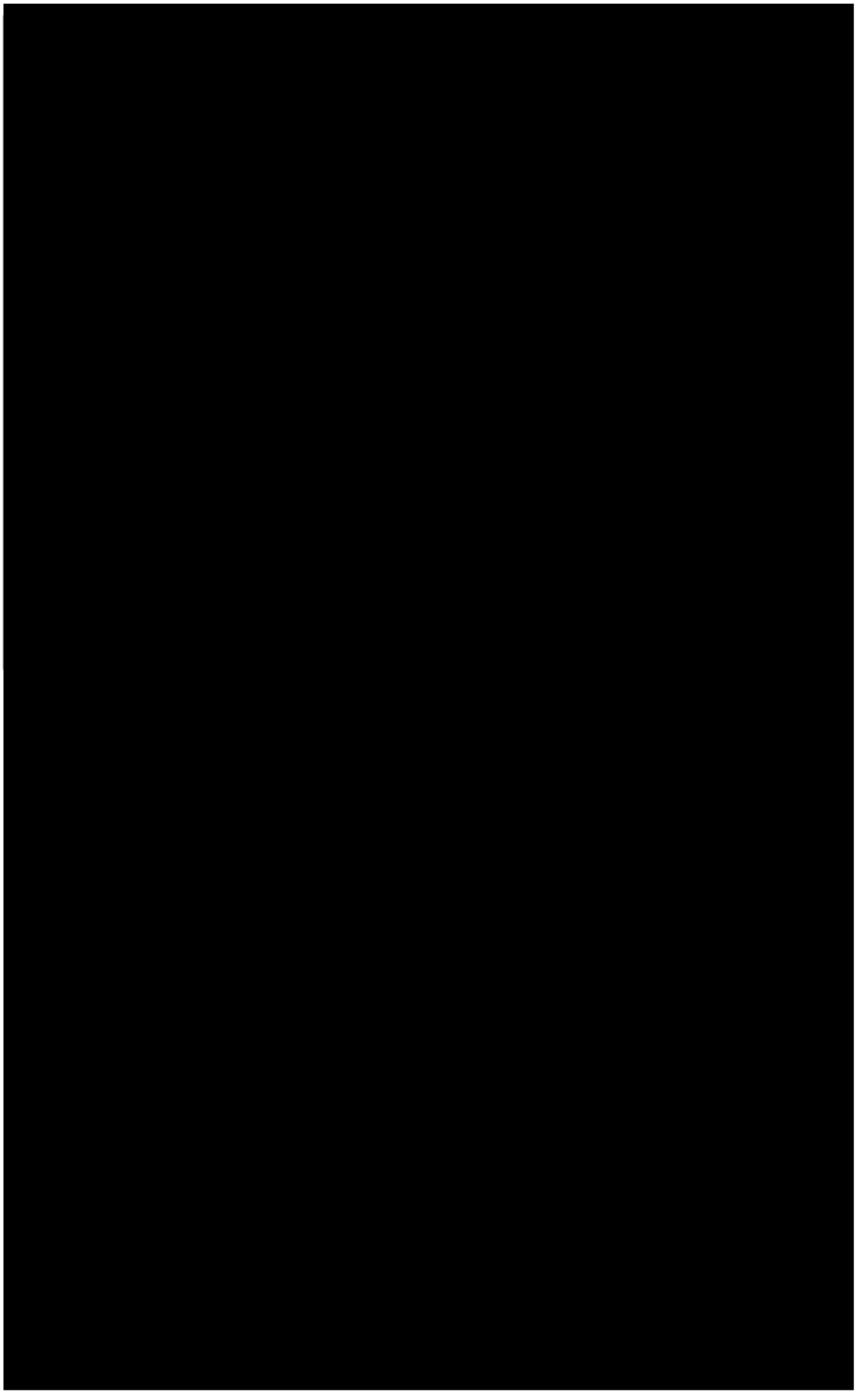
3. *Habitat protection or restoration to continue where necessary.*
This will be achieved through monitoring and discussions with site managers.

4. *Continuing public relations activities, including education and mass media coverage.* Papers are being written on *Anisus vorticulus* and meetings will be held to demonstrate the achievements of the project.

5. *Evaluation of cost-effectiveness and success of re-introduction techniques.*
This piece of work in running concurrently with two other projects, a translocation at [redacted] and a translocation at an additional site in Norfolk for the Inland Drainage Board. The success of these projects will be compared to establish which is most successful and which was most cost effective.

6. *Regular publications in scientific and popular literature.*
Papers are currently being written on different aspects of this project.

[redacted] 2017 survey data from scoping report



[redacted] **(Area 2)**

Ditches in Area 2 were surveyed using the detailed survey methodology in August 2017. A total of 8 sample points were surveyed across the area. [redacted] is extremely well managed due to the high quality of the habitat for invertebrates [redacted]. Prior to surveying, there were no historic records of *Anisus vorticulus* in the surrounding area or on the site itself.

The width of the surveyed ditches was mainly 2-3m, but this varied from <1m to >4m. Water depth was similarly varied, between 0.25m – 1m (although generally between 0.5m - 0.75m). Water quality appeared good, with little to no turbidity at the majority of sites however, there was moderate turbidity in two ditches, and occasional filamentous algae in places. pH was slightly above neutral on average (7.23), while conductivity ranged from 461-845µS/S. The adjacent land at all sampling points was fenland marginal habitat with either sedges or *Phragmites australis* along the edge of the dykes. There was very limited mid successional habitat along the margins of the dykes across the site. They were deep (>1m) with steep sides and moderate silt depth. All adjacent land use was semi-improved fenland marshes with high botanical diversity. The water level was high in the dykes creating a wet margin to the dykes. This created swampy areas of submerged vegetation, and potentially micro-habitats suitable for *Anisus vorticulus.* At other sites the species has been observed to be more abundant in swampy marginal areas at the edges of ditches than in the open water (T. Abrehart, pers. obvs).

Vegetation

Bankside vegetation across the site was dominated by sedges (largely greater pond sedge with more occasional, narrow areas of lesser pond-sedge) with frequent *Phragmites australis* and occasional grasses. Additional margin vegetation included *Sium latifolium* and *Typha angustifolia* with *Juncus subnodulosus* across the site.

[redacted] contained ditches at a very similar age range with limited levels of succession, these generally supported a diverse flora. The marginal vegetation was consistent across the site with a similar uniform flora. Along the ditch margins the vegetation was dominated with tall Phragmites australis and Carex species. Management in some of the ditch margins had been to cut the vegetation lower of the vegetation communities were of a lower stature, i.e. dominated with *Dryopteris cristata* communities

The aquatic macrophyte cover within the dykes was rich with abundant *Hydrocharis morsus-ranae* across most of the dykes and in the deeper dykes *Nuphar lutea* was present. *Utricularia vulgaris* was common across the site with occasional *Elodea canadensis*. Duckweeds were limited to *Lemna trisulca, Lemna minor and Spirodelia polyrhiza. Myriophyllum verticillatum* was frequent within the water channels themselves, while ivy-leaved duckweed *Lemna trisulca* present at all sample points, but not in high densities. Frogbit *Hydrocharis morsus-ranae* was scattered across the site with some of the ditches supporting a high density of plants. Filamentous algae was observed in some areas, but was not common or abundant.

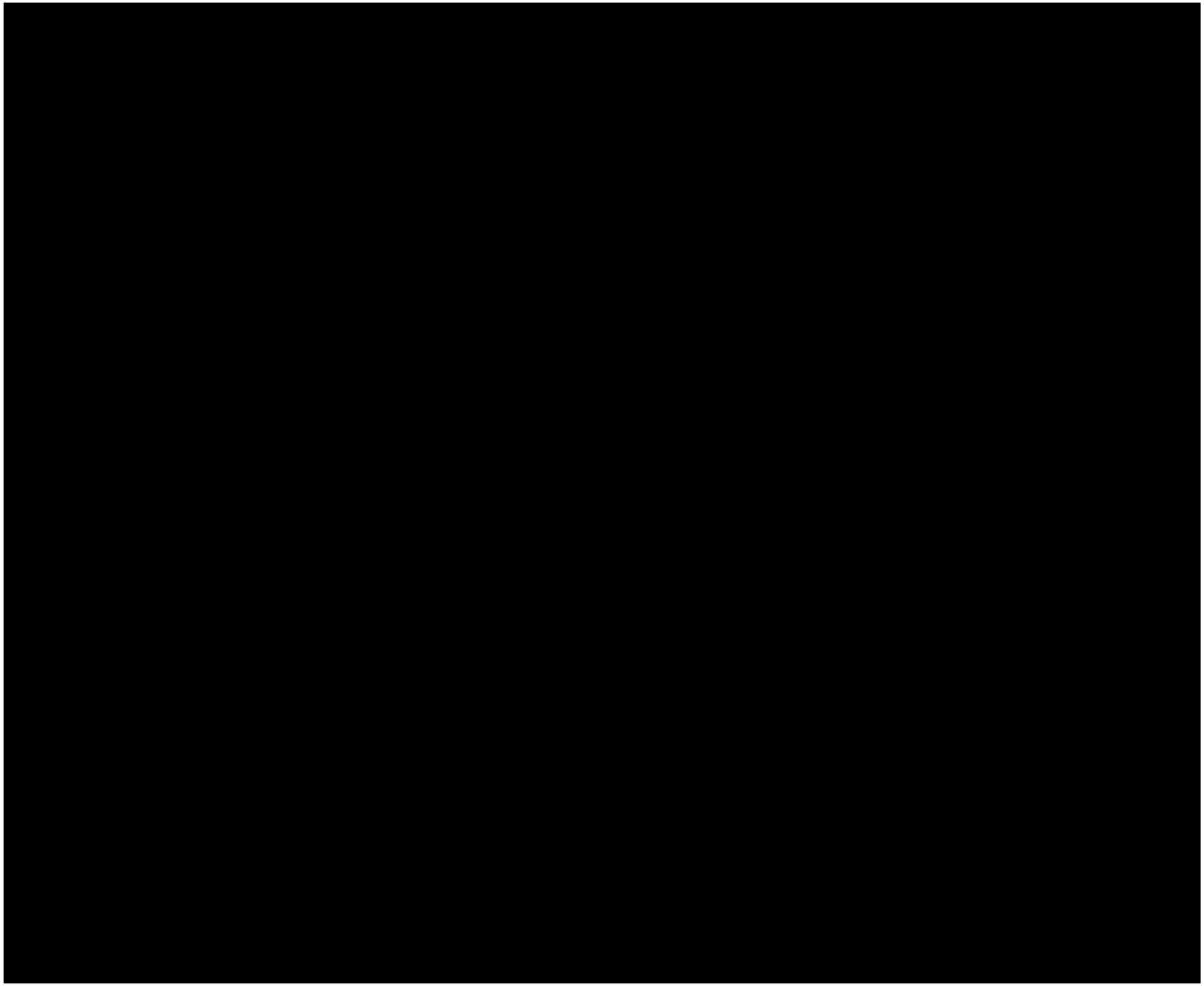
Molluscs

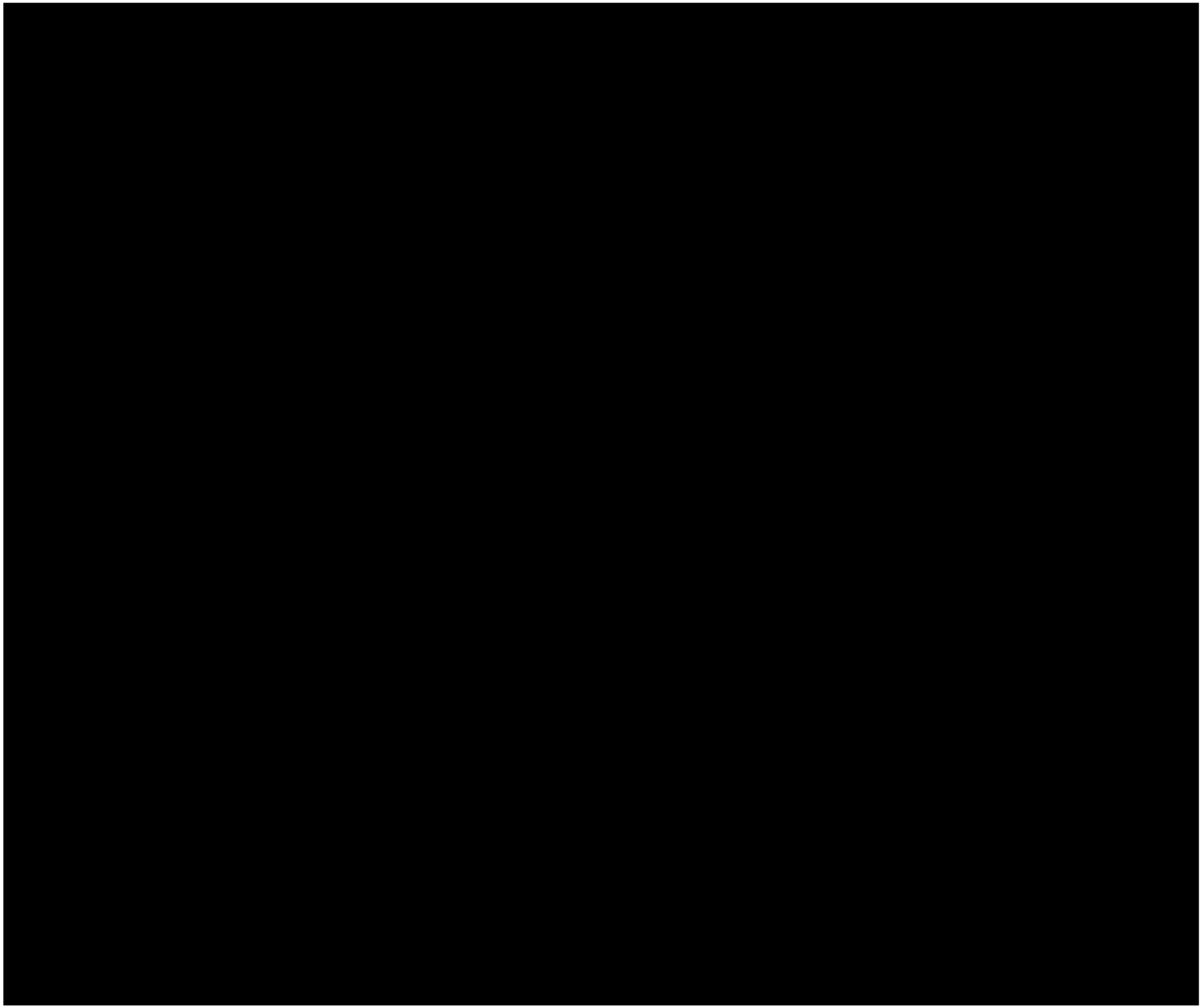
No *Anisus vorticulus* was found at any of the sample points visited. Mollusc communities were otherwise species-rich across the survey area, averaging 20 species per sample point (maximum 22, minimum 13 species). Shining ramshorn snail was occasionally observed in low numbers, and flat valve snail *Valvata cristata* was scattered– both these species are associated with diverse mollusc communities and have been suggested as indicator species for suitable *Anisus vorticulus* habitat (AECOM/Abrehart Ecology 2016b). Additional species of interest found at [redacted] were the bivalve *Pisidium pseudosphaerium*, which was found at several sample points but generally in low numbers. Other species frequently observed at the site

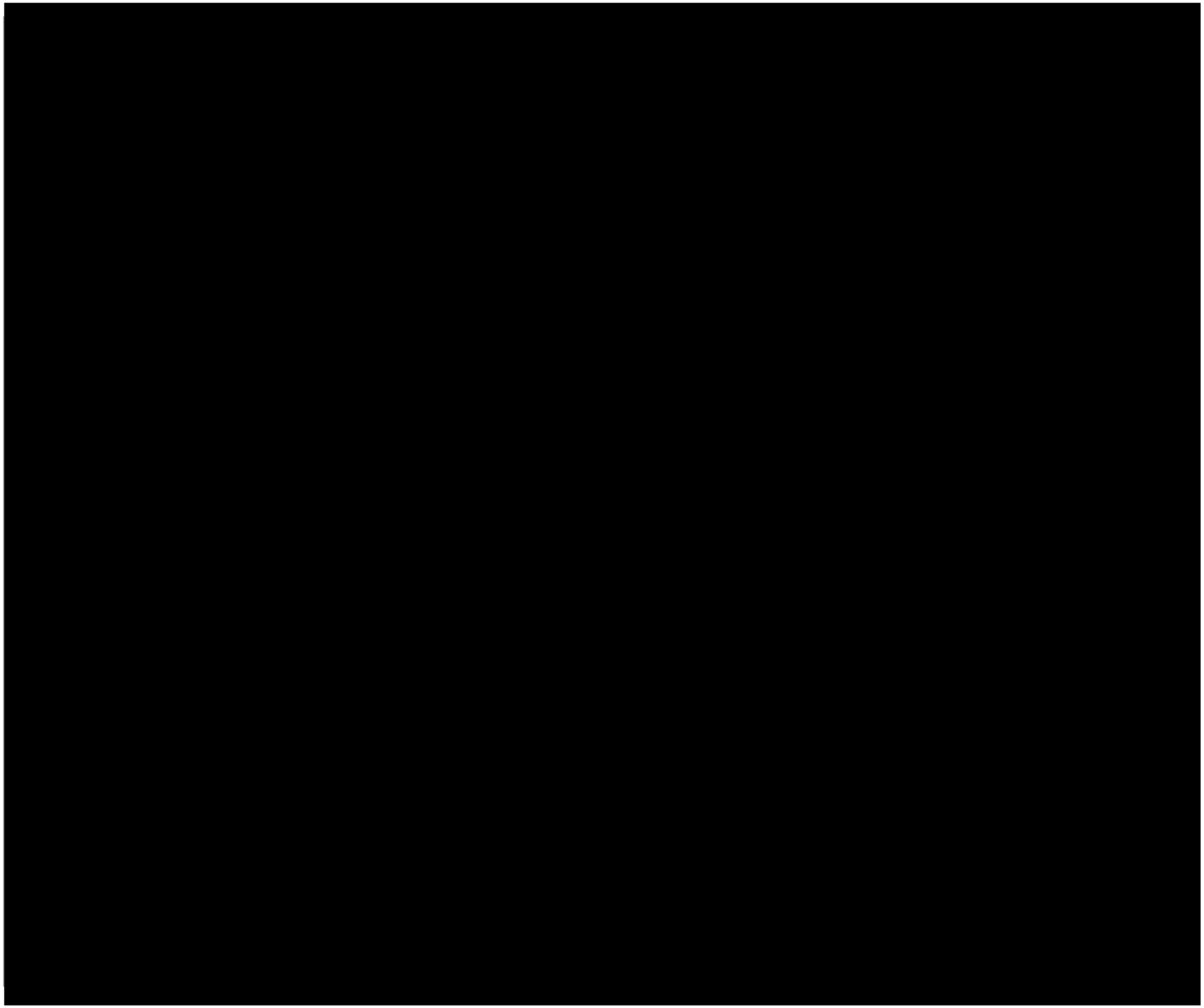
included wandering pond snail *Radix balthica,* common bladder snail *Physa fontinalis,* Leach's Bithynia *Bithynia leachii,* common Bithynia, margined ramshorn snail *Planorbis planorbis,* and twisted ram's horn *Bathyomphalus contortus.*

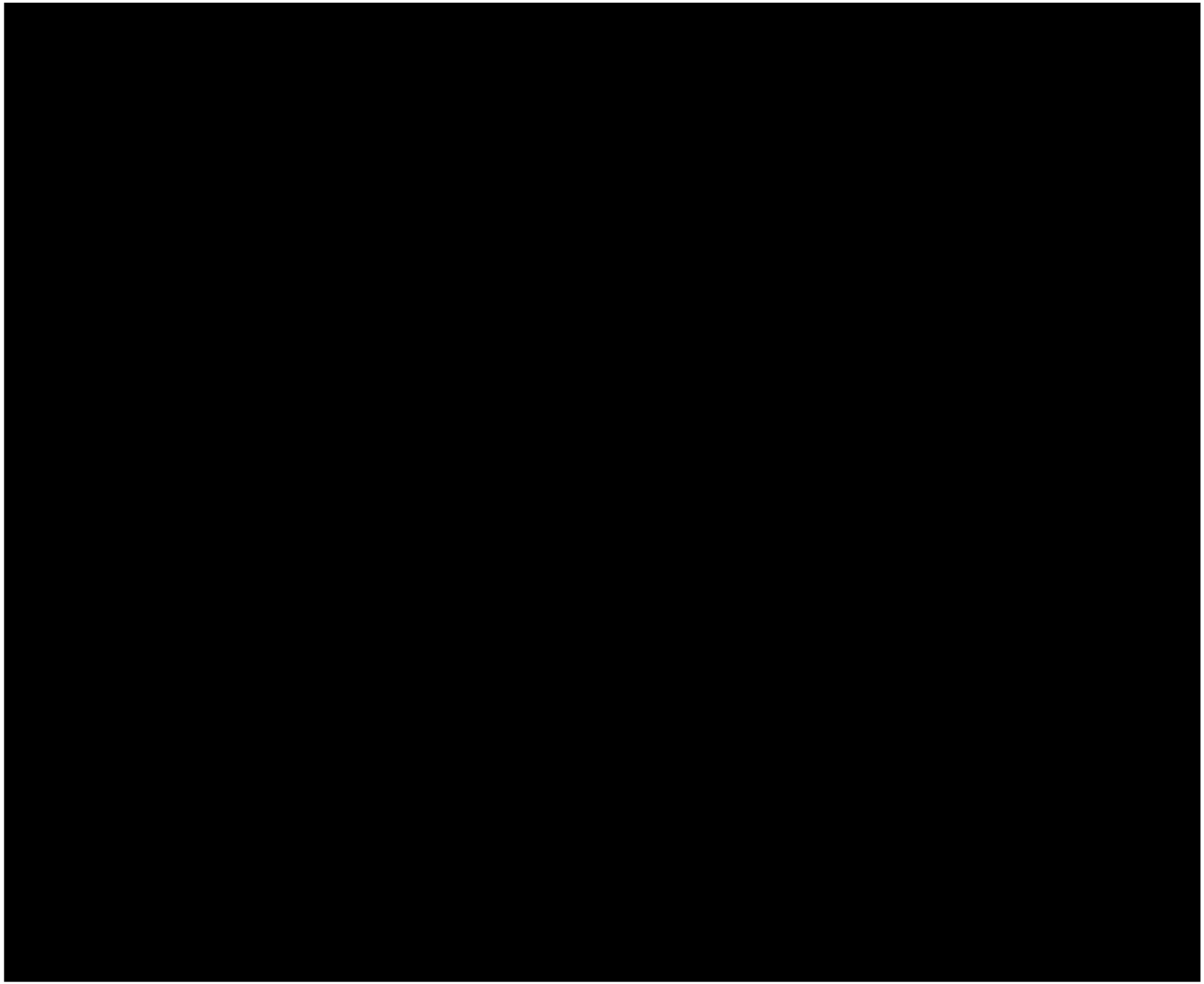
The diverse mollusc communities the presence of indicator species (shining ramshorn snail and flat valve snail), combined with the diverse vegetation communities observed at the site and the management of the area, make [redacted] a good potential receptor site for a future translocation of *Anisus vorticulus.*

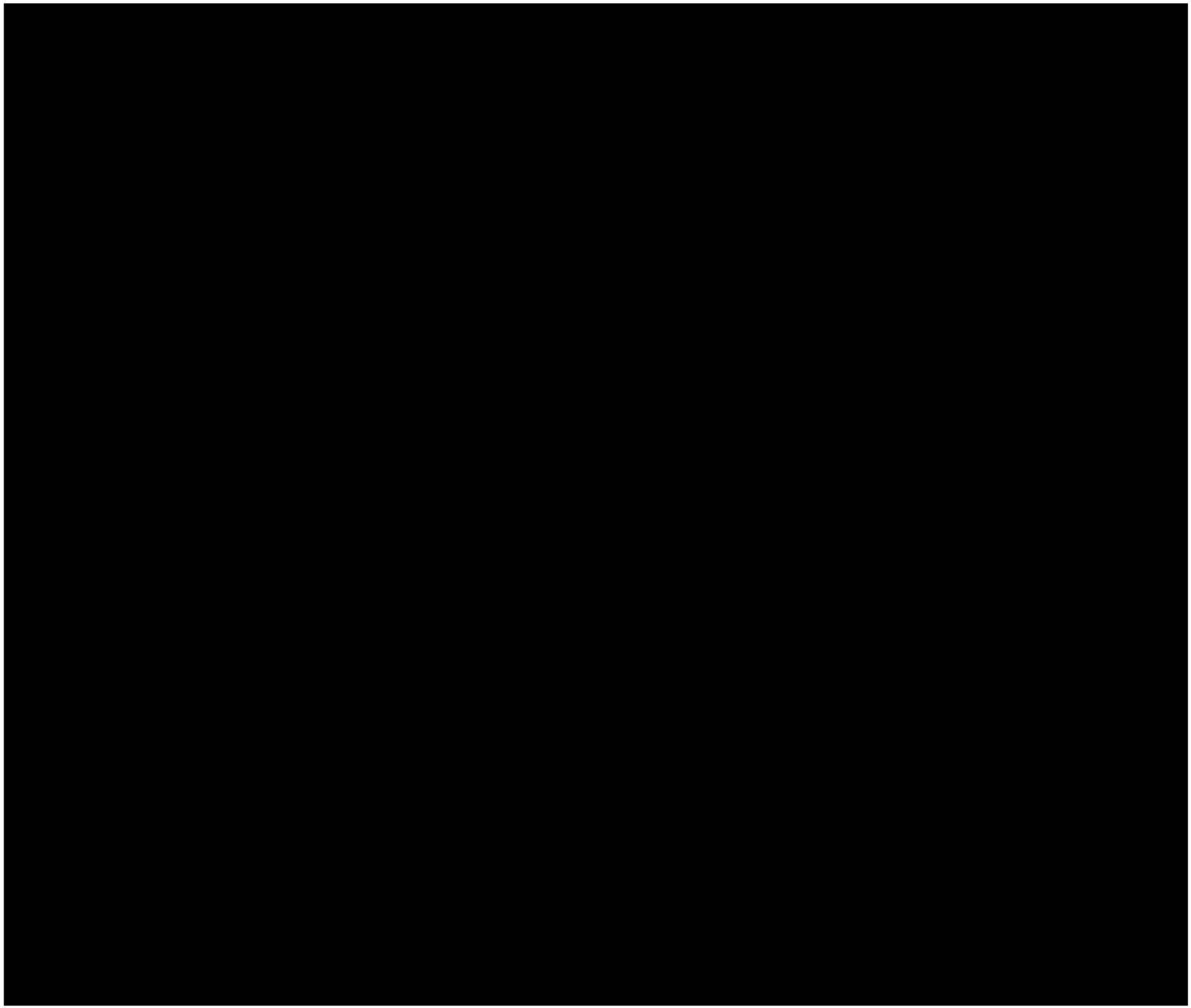
Appendix C – Figures of donor and receptor sites in Norfolk and Suffolk 2018

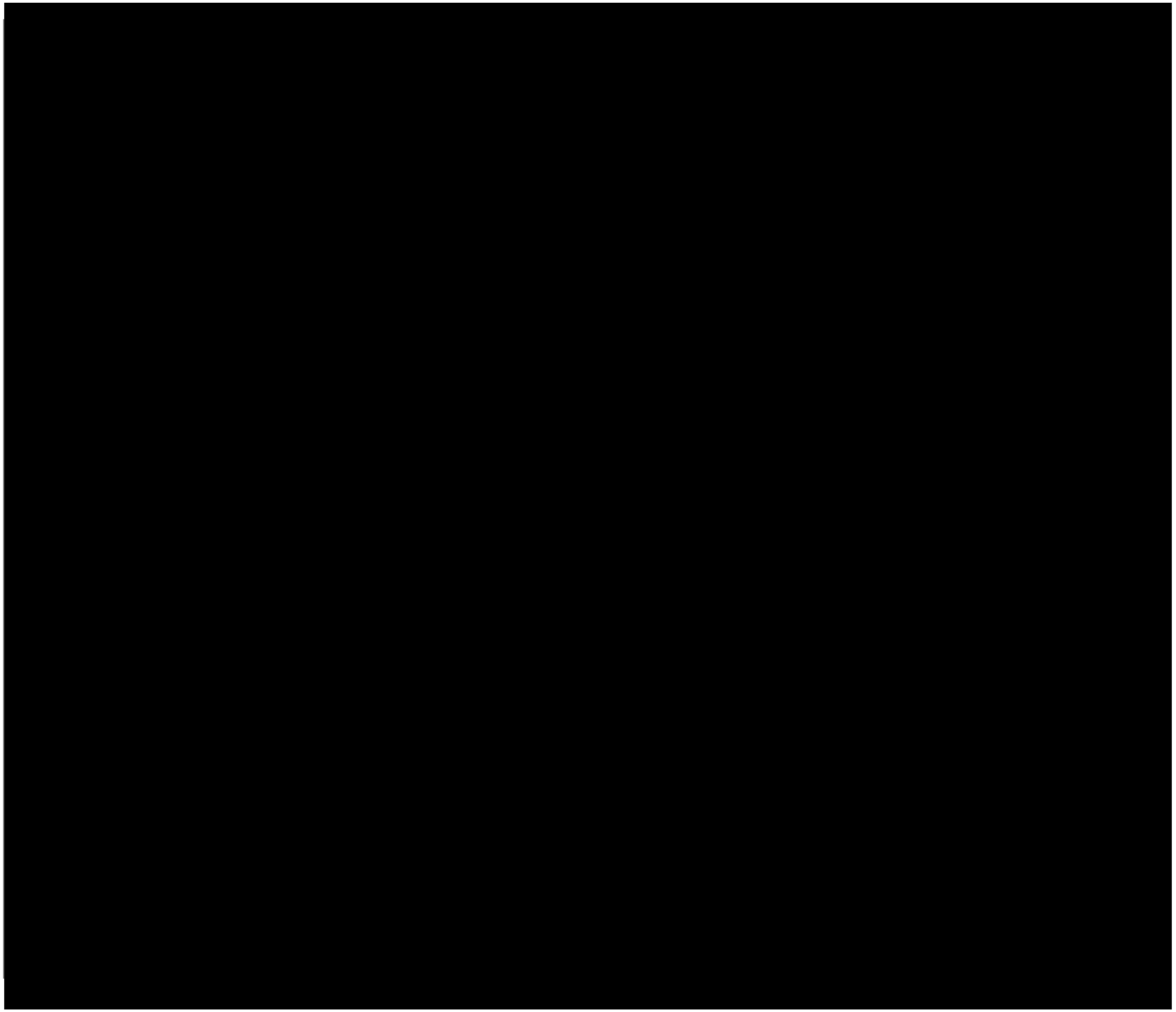


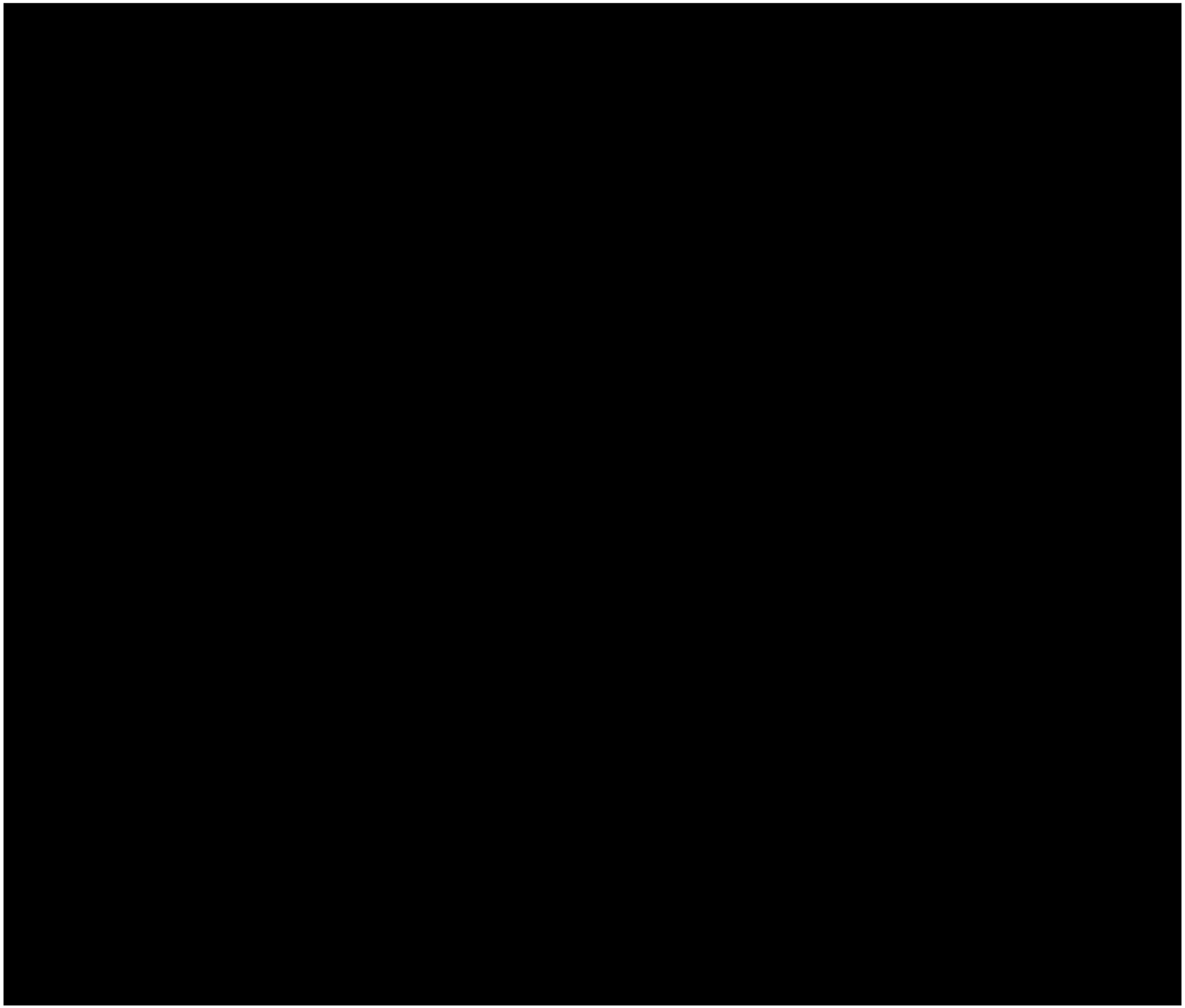


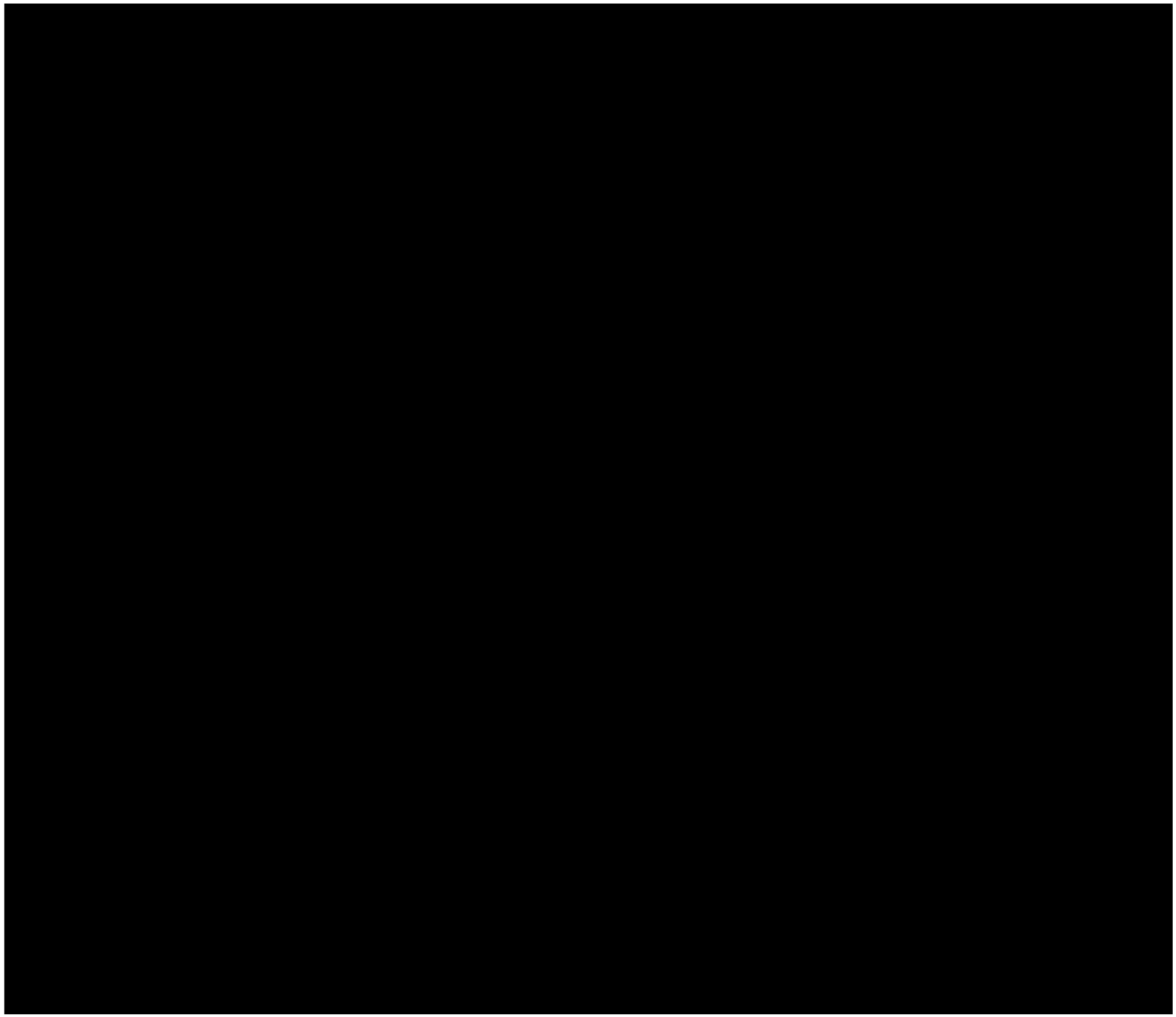












Appendix D – Photos of donor and receptor sites 2018