Bentinck Tip and Void
Annesley

Ecological Mitigation Management and Monitoring Plan

Version 1.1

November 2007
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1.0 INTRODUCTION

1.1 Development Proposals

A planning application for the restoration of Bentinck Tip and Void has been submitted. The proposals include the in-filling of Bentinck Void with non-hazardous waste and the re-profiling and restoration of Bentinck Tip with inert wastes, ameliorated with compost, processed on site. To achieve this, ancillary developments would be required, including a new access road linking the site with the public highway network. The site will be progressively restored to a gently rolling landscape of grassland, woodland and open water.

The landfill and restoration proposals are currently at the planning application stage. The proposals will subsequently progress through further stages of design and the Integrated Pollution Prevention Control (IPPC) Authorisation process. This version of the EMP has been prepared to a level commensurate with the current stage of project development and implementation. It establishes the mitigation strategy, design and management principles necessary to ensure effective delivery of the ecological vision for the site.

1.2 Ecological Mitigation Management and Monitoring Plan Structure

This Ecological Mitigation Management and Monitoring Plan (EMP) sets out the strategy for ecological mitigation and long-term management of Bentinck Tip and Void. The plan provides:

- a ecological vision for the future of the site;
- a strategy for ecological management of the site;
- detailed designs for habitat creation;
- management objectives and prescriptions; and
- a programme for monitoring and review.

These measures are required to ensure the effective delivery of the ecological measures outlined in the Environment Statement which accompanied the planning application and subsequent documents.

This is a working document. Detailed habitat creation, design and management prescriptions will develop and evolve throughout the lifetime of the EMP. The monitoring and review programme will enable modifications to the EMP to be discussed, evaluated and incorporated into updated versions of the EMP. It is proposed that the review of the EMP will involve a management group of the relevant stakeholders and consultees, with a function to pass on pertinent information to a wider audience.

The EMP addresses all aspects of the proposed development and will ensure that ecological issues are a priority throughout the construction, operational and restoration phases of the development.

This document constitutes Version I of the EMP. Management tasks will be reviewed annually and The EMP will be reviewed every five years.

2.0 IDENTIFICATION OF PRINCIPLE ECOLOGICAL FEATURES

2.1 Introduction

Ecological surveys have been undertaken at the site since 1999; these surveys represent a detailed and comprehensive dataset of the current baseline ecological conditions at the site.

A review of all the existing data and data collected specifically to inform the current application has been undertaken to identify the principle ecological features occurring at Bentinck. These features are defined as those that are of greater than local ecological value, using the criteria for ecological assessment described by IEEM (2006). There are many other ecological features of the site that are of lesser importance but still contribute to the overall diversity of the site. It is therefore intended that much of the habitat creation and management proposed will benefit a significantly greater range of biodiversity than that specifically highlighted.

2.2 Identification of Principle Ecological Features

Review of baseline ecological survey undertaken in support of the current application has identified the following principle ecological features:

- tufa-forming springs;
- marshy, calcareous and neutral grassland of Bentinck Void;
- aquatic and marginal flora of waterbodies around Bentinck Void;
- populations of orchid species;
- water vole population;
- bat populations;
- brown hare population;
- breeding bird assemblage;
- wintering bird assemblage;
- amphibians, principally the great crested newt population;
- reptile populations; and
- invertebrates.

The following section provides a brief summary of the current baseline ecological interest and an evaluation of each of these features. Further information relating to baseline conditions in 2007 are presented in separate reports. Further baseline information for preceding years is presented in the ES supporting the current planning application.

2.3 Habitats and Flora

Four features of botanical interest have been identified.

Approximately seven individual tufa-forming springs and seepages have been identified around the banks of the Void Lake at Bentinck. Many of these features appear to be actively forming tufa, a calcium carbonate precipitate that forms where calcium-rich groundwater emerges. In natural situations these are usually associated with a particular range of wetland plant and moss species, including the characteristic fern-leaved hook-moss (*Cratoneuron filicinum*). Tufa springs are considered to be of Regional ecological importance.

Aquatic vegetation in a number of the waterbodies around Bentinck Void meet the criteria for SINC designation and are therefore of County ecological importance. Of particular note is a

small population of greater tussock sedge (*Carex paniculata*) on the western bank of Bentinck Void which is a locally uncommon species.

The grassland habitats at Bentinck Void are of relatively recent origin and are described as developing mesotrophic or calcareous grasslands. The species assemblage of marshy grassland species qualifies under the SINC criteria. Calcareous and neutral grassland habitats are also considered to be of County ecological importance. These grassland habitats support quite extensive populations of three species of orchid: bee, southern marsh orchid and common spotted orchid. Whilst neither rare nor protected, these species have Local amenity and cultural significance.

2.4 Mammals

2.4.1 Water Vole

Water voles have been recorded at the Bentinck site since 1999. Survey undertaken in 2007 suggest a population at the site of at least three breeding females. This is comparable to 1999 survey estimates of four breeding adults. In line with draft SINC criteria, the application site is likely to be considered of at least County value to water voles.

The presence of extensive areas of sub-optimal habitat; including dry ditches, hard bankside substrates and the presence of rats; suggests that the population of water voles at Bentinck at carrying capacity would remain small and would not be significantly larger than the size of the population at present.

2.4.2 Bats

The site supports no above ground built structures that are considered to be suitable for roosting bats. The site supports no mature trees or other above ground features that are considered to be suitable for roosting bats.

A culvert runs under Bentinck Tip and out of the application site. The final section of this culvert supports a roost of brown long eared bats approximately 250m from the northern boundary. This roost is assessed as regularly used by small numbers of bats and, due to its location and climatic conditions; it is possible that the roost could be used throughout the year; although it is considered to be unsuitable as a maternity roost.

Four species of bats have been confirmed as using the site for foraging and/or commuting: common pipistrelle, soprano pipistrelle; noctule and Daubenton's. Brown long-eared bats have been recorded as roosting nearby and it is likely that this species also forages within the site. Bats are regularly recorded as foraging over lagoons 2, 3, 4 and 5 and the Void Lake and also forage over other waterbodies on the site. The large expanse of un-restored coal tip is also occasionally used by foraging bats, notably pipistrelle and noctule. Whilst observations are limited, bats are also likely to forage and commute along woodland and hedgerow habitat features. It is considered that the bat foraging habitat at the site is important for populations of bats at a Local level.

2.4.3 Brown Hare

Brown hare have been consistently observed at the site since 1997. The species has been recorded on the southern pastures of the application site; on the northern and north-eastern spoil mounds of the Void; on the spoil mounds adjacent to Annesley Woodhouse Quarry SSSI; and in sparsely-vegetated spoil on the Tip. Brown hare are a UK BAP Priority species and this population is considered to be of Local ecological value.

2.5 Birds

2.5.1 Breeding Birds

A total of 65 bird species were recorded during the 2007 breeding bird surveys. Of these, 39 species were confirmed breeding species or probable breeders. Only one Schedule 1 species, little ringed plover, was recorded as breeding and this species has regularly bred at the site in the past. An additional seven species of high conservation concern were recorded breeding on the site: grey partridge, linnet, reed bunting, song thrush and skylark, grasshopper warbler and yellowhammer. This assemblage meets published SINC criteria and is therefore of County ecological value.

2.5.2 Wintering Birds

Many bird species are associated with the large lagoons on the Tip, or the flooded void during the winter months. These waterbodies are especially attractive to passage wildfowl and wading birds of conservation concern, including regular visitors such as golden plover, lapwing, greenshank, lesser black-backed gull, green sandpiper and widgeon. A number of species are less regularly recorded, including Mediterranean gull, Icelandic gull and oystercatcher. Wintering bird surveys are currently on-going, but for the purpose of this document, the wintering bird population has been assessed as of at least County ecological value.

2.6 Reptiles

The site supports large areas of suitable reptile habitat including basking and foraging habitats, such as south facing slopes, tussocky grassland, scrub and waterbodies with shallow sloping margins.

Detailed survey of the application site has confirmed the presence of two species of reptile; grass snake and common lizard. Previous records of the presence of adder have not been confirmed and adder has not been recorded at the site since the unconfirmed record in 1998. According to the published guidelines[1], the site supports a good population of grass snake and a low population of common lizard. The reptile assemblage is considered to be of District ecological value.

2.7 Amphibians

The site supports populations of great crested newts, common frog, common toad and smooth newts.

The 2007 survey observed that the great crested newt population remains centred on the Void Lagoons, ponds 2, 3 and 4 (refer to Drawing EMP1); with these three ponds supporting the greatest numbers of adult newts. Ponds 21, 22 and 23, which are at the north-east extremity of the application site were surveyed for the first time and a small population of great crested newts was observed in pond 23. Great crested newts were observed to be more widely distributed than in 2006, with new records of small numbers of non-breeding newts from ponds 10b, 10d and 14.

It is considered likely that despite the increased distribution of great crested newts throughout the application site the population functions as a single meta-population. It is

[1] Froglife Advice Sheet 10 'Reptile Survey – An introduction to planning, conducting and interpreting surveys fro snake and lizard conservation' Nov 1999.

unlikely that any waterbodies outside the application site are a significant part of the meta-population found at the application site.

The 2007 survey observed a maximum count of 83 adult great crested newts during a single torch count. Whilst this result alone does not meet the criterion of an "exceptional"[2] population of this species, the four year mean peak count of 122 confirms that the application site supports an "exceptional" population of great crested newts and is amongst the largest recorded populations in the county. The amphibian assemblage is assessed as of at least Regional ecological value.

2.8 Invertebrates

A total of twenty-three invertebrate species with formal conservation status were recorded in 2007. These species, with the addition of a number of other local and uncommon species, are considered to contribute to an invertebrate assemblage of Regional ecological importance. The majority of species of nature conservation interest are associated with wetland and water margins, suggesting a high nature conservation value for these habitat components with the assemblage of wetland soldier-flies particularly noteworthy.

The fauna of the drier elements of the site is regarded as of lesser interest with current records including no very rare species and few Nationally Scarce species. These habitats are assessed as of County ecological value.

[2] based on criteria in the Herpetofauna Workers' Manual (1998)

3.0 EMP STRATEGY - VISION, AIMS AND OBJECTIVES

3.1 Ecological Vision for Bentinck

Bentinck will comprise a mosaic of terrestrial, wetland and aquatic habitats that link into and complement neighbouring sites of high biodiversity value. The site will support a diverse assemblage of species of local and national biodiversity value in a wide range of habitat types: including healthy populations of great crested newts, reptiles, water voles, breeding and wintering birds, bats and brown hare. The diversity of the habitats and flora of the site will be reflected at the smallest scale, with the site supporting a wide range of invertebrate species.

Bentinck will be managed by a team of individuals who are dedicated and passionate about ecological issues; led by a forum of experts from a range of stakeholder organisations and the local community.

Experience from the ecological mitigation and restoration of Bentinck will be shared with the wider scientific and ecological management community and will be seen as a best practice example of ecologically-led restoration.

3.2 Aims of Ecological Management Plan

The principle aims of this management plan are to:

- Minimise loss and disturbance of habitats and species during construction through careful planning and supervision.
- Design, create and manage receptor habitats well in advance of construction to allow establishment and natural colonisation prior to any animal translocations.
- To minimise animal translocations, but where necessary to undertake them in accordance with best practice and, where necessary under licence from Natural England.
- Manage and monitor habitats and species within receptor habitats during the operation of the site to maximise ecological value.
- Design and manage receptor habitats to provide source populations of flora and fauna for the re-colonisation of the restored phases of the site.
- Design and manage receptor habitats and subsequent restored phases of the site to ensure that viable assemblages of amphibians, reptiles, mammals and birds of at least equivalent size can be sustained at the site in the long-term.
- Establish protocols for the monitoring of the receptor habitats and restored phases of the site and learn from the experience to develop better restoration techniques.
- Collect data suitable for use in scientific studies and share experiences of habitat creation and mitigation successes to inform future schemes.
- Provide a framework to manage and maintain the ecological value of the restored site through long-term management.

The general aims for the EMP are to be delivered through three principle mechanisms:

- Habitat design and creation, including restoration landforms;
- Mitigation for protected and notable species; and
- Habitat management and monitoring.

3.3 Design, Mitigation and Management Objectives

There are specific landscape, ecological and geotechnical design objectives that have been set for the site. These objectives will provide the framework for the detailed landform design of receptor habitats and the restored site; a framework for ecological mitigation and management of the site. Drawing EMP2 shows the site restoration plan.

Landscape Design Objectives

- Creation of a sympathetic landform that contains similar gradients and features to aid its assimilation as far as possible into the gently rolling adjacent landscape;
- Integration of restored land into the surrounding landscape through replication of local landscape features, such as woodlands and hedged field patterns;

- The creation of pubic rights of way, through woodland, pasture and ecological habitats.

Ecological Design Objectives

- The creation of approximately 75 hectares of lowland meadow, principally neutral but also, where possible, the development of magnesian limestone (calcareous) grassland. The creation of lowland meadow (or unimproved neutral grassland) would contribute to the Nottinghamshire and UK Biodiversity Action Plan which has set targets and objectives for the re-creation of this type of priority habitat.
- The retention *in-situ* of 8.8ha of existing calcareous grassland.
- The retention *in-situ* of 4 tufa spring and 3 orchid swarms.
- The establishment of 25 hectares of species-rich neutral marshy grassland/lowland meadow.

- The creation of approximately 40 ponds north of Salmon Lane (i.e. excluding the access road) either to receive surface run-off from the restoration landform and / or also to act as receptor sites for great crested newt translocation.

- An additional 13 ponds would be created along the access road.
- The creation of areas of open water, would provide habitat for breeding, wintering and passerine birds, the inclusion of shingle islands and shorelines would encourage species such as Little Ringed Plover and the shoreline margins would promote further species diversity.

- The promotion of natural regeneration, wherever possible on the site, allowing the development of habitats of local provenance to buffer existing habitats of high value, e.g. adjacent designated sites, Annesley Woodhouse SSSI and Bog's Farm SSSI.

- The planting and management of 30ha of locally native broadleaved woodlands, including wet woodland and shrub edges, and 2.2km of new species-rich hedgerows.

- Long-term management of grassland areas to maximise their ecological interest.

- Use of locally appropriate species in planting mixes for restoration and mitigation habitat creation, principally comprising species that currently occur at the site.

Geotechnical Objectives

- Care has been taken to ensure that the restored slopes do not exceed gradients of 1:2.

Species Mitigation Objectives

- To undertake translocation in accordance with best practice, minimising stress to animals and leaving the development areas free from great crested newts by investing a minimum of 90 suitable days capture effort to translocate individuals.
- To undertake translocation in accordance with best practice, minimising stress to animals and leaving the development areas free from reptile species by investing in a minimum of 90 suitable days capture effort to translocate individuals from the existing population of grass snake and common lizard.

- To undertake translocation in accordance with best practice leaving the development areas free from water voles by investing a minimum of 10 suitable days capture effort. Live traps would be checked 3 times daily to minimise stress of captured animals.

- To install an exclusion fencing design (e.g. Drawing EMP3) that minimises the risks of animals straying into the development area whilst it is active, but does not compromise the natural migration patterns of fauna.

Implementation, Management and Monitoring Objectives

- To implement the EMP in line with a detailed timetable, with detailed objectives and annual management tasks, as outlined in Section 7.
- To monitor the populations of great crested newts annually, using the same methods established in 2006 and 2007 surveys to allow data comparison.

- To monitor populations of water voles using standard survey methods, i.e. Strachan and Moorhouse (2006) as used in 2007 survey, to allow data comparison.

- To monitor populations of reptiles, using the same methods established in 2007 surveys, i.e. Froglife (1999), to allow data comparison.

- To monitor habitat quality of created receptor habitats through an annual habitat survey undertaken between April – July to feedback and inform the management plan.

- Make the data from the results of monitoring surveys available to relevant organisations and stakeholders.

- Review the EMP on a 5-year programme with a commitment to managing the site for 25 years.

4.0 HABITAT DESIGN, CREATION AND ENHANCEMENT

4.1 Introduction

The objectives set out above have been used to inform detailed habitat design, creation and enhancement guidelines for each important ecological feature, as identified in Section 3 of this report. In many cases, habitat design guidelines for one feature will benefit features other than those species and habitats that have specifically been highlighted. The over-riding principles for habitat design is to maximise the value of habitats; whether they have been created, enhanced or retained during the development; to ensure that the final restored site provides the maximum biodiversity value for the range of species and habitats that have been targeted.

As stated in Section 2, principle ecological features have been identified as:

- habitats and flora: including grasslands, tufa springs, orchid populations and aquatic habitats;
- mammals: including bats and water vole;
- birds, including breeding and wintering birds;
- amphibians, principally great crested newts;
- reptiles; and
- invertebrates, principally those of wetland and marginal aquatic habitats.

4.2 General Site Layout and Mitigation Areas

Drawing EMP1 shows the existing habitats of the application site. The proposed development will only have a direct effect on a proportion of the site, with remaining areas retained and managed for nature conservation. Within the area that will not be disturbed by the proposed development, four ecological mitigation areas have been specifically targeted for habitat creation and enhancement, these are:

- Northern Area;
- North-Eastern Area;
- Eastern Area; and
- Southern Area;

Habitat creation designs for each of these four areas are presented on Drawings EMP4 – EMP7. In addition, habitats that will be created and managed specifically for nature conservation will also be created along the proposed Access Road.

As each of the ecological mitigation areas will be designed to benefit a range of species and the retained areas of the site will be enhanced or managed to provide further benefit to species and habitats; the habitat design, creation and enhancement guidelines below are listed by principle ecological feature.

4.3 Habitats and Flora

4.3.1 Retained Habitats

The development plan includes the retention *in-situ* of 8.8ha of existing grassland habitats on the eastern slopes of Bentinck Void that have been identified as of the highest ecological value. These slopes support perhaps the most varied grassland vegetation on the site;

incorporating dense ruderal grassland, bare ground, 4 tufa-rich seepages and large concentrations of orchids in three separate swarms[3]. These habitats will be separated from the adjacent landfill installation by permanent fencing and will be managed to ensure that their ecological interest is maintained.

Existing ponds in North-eastern Area (Ponds 22 and 23) and in the Northern Area (ponds 16, 17 and 18) would be retained and enhanced through the removal of dumped rubbish and fly-tipped waste. The margins of ponds in the Northern Area and Pond 22 would be enhanced through re-profiling the lagoon banks to create gently sloping margins and planting aquatic and marginal species.

In addition, restored, species-poor grasslands on the northern and western flanks of the Tip would also be retained and managed to maximise their biodiversity value.

4.3.2 Created Habitats and Translocated Flora

A wide range of habitats would be created in each of the four mitigation areas. Notable populations of plants would also be translocated into these areas. In summary, habitat creation in the four mitigation areas would include:

- Northern Area: new ponds with aquatic and marginal vegetation, species-rich meadow grassland, scrub and woodland.
- North-eastern Area: a new pond with shallow marginal areas.
- Southern Area: new ditch habitat, two new ponds with marginal areas, translocation of greater tussock sedge, orchids and tufa-forming wetland vegetation.

- Eastern Area: significant area of new ponds, scrub and woodland planting, new ditch habitats, translocation of orchids and tufa-forming wetland vegetation.

It is proposed to create these habitats in advance of landfilling activities to ensure that the habitats are well-established prior to any fauna translocations.

Depending upon the substrate quality in the Eastern Area, larger volumes (e.g. $30m^3$ – sufficient to cover $100m^2$ at 300mm depth) of nutrient poor calcareous substrate would be excavated from the resources within the development area to cover spoil mounds created from pond digging. This nutrient poor substrate would be used to extend the areas of substrate suitable for translocated orchid populations and tufa-spring vegetation.

4.3.3 Restored Habitats

It is proposed that the majority of the site would be restored to a mixture of 30ha of locally native broad leaved woodland and lowland meadows, divided by an additional 2.2km of species-rich hedgerow field boundaries. Broadleaved woodland would comprise two broad habitat types which will specified based upon the character of restoration materials:

Dry woodland consisting predominately *Quercus robur* (pedunculate oak) and *Betula pendula* (silver birch) and major shrub component of *Coryllus avellana* (hazel) and *Crataegus monogyna* (hawthorn); and wet woodland consisting predominantly *Alnus glutinosa* (alder) and major shrub component of *Crataegus monogyna* (hawthorn) and *Viburnum opulus* (guelder rose). Hedgerows and shrub planting would principally comprise

[3] SLR Consulting Ltd (2007) **Botanical Survey and Evaluation** Ref: 403.0197.00299/botany07

the following species: hawthorn (*Crataegus monogyna)*, blackthorn (*Prunus spinosa),* hazel (*Corylus avellana)* and guelder rose (*Viburnum opulus)*.

Substrates used for creation of productive grassland habitats, e.g. neutral meadows and marshy grassland, and woodlands on the Tip would ameliorated through the incorporation of 0.1m of compost added to the restoration surface which would be incorporated up to a depth of 0.2m. Compost would ensure better survivorship of trees by providing additional nutrients and water-retaining capacity to the substrate.

Three principle types of grassland habitat would also be created:

- neutral marshy grassland;
- magnesian limestone (calcareous) grassland; and
- unimproved dry neutral grassland.

The distribution of each of these habitat types would be determined by the substrate types, ground permeability and topography. The general distribution of each grassland type is shown on Drawing EMP2.

Numerous new ponds with marginal aquatic habitats would also be created on the restored Bentinck Void.

Further details regarding site restoration are provided in Chapter 3 of the ES – Development Proposals.

4.4 Mammals

4.4.1 Bats

The creation of ponds, wetlands and associated terrestrial habitat for water voles, amphibia, reptiles and invertebrates will represent valuable foraging resources for bats by providing a mosaic of habitats likely to support a wide range and high biomass of insects. The planting of woodland carr, hedgerows and broad-leaved woodland in receptor habitats and during the phased restoration of the Tip and Void will also provide new vegetation corridors suitable for bat commuting and foraging activity.

The existing buildings in the northern receptor site will be inspected for structural stability. If structurally sound and suitable to be maintained without encouraging vandalism, they will be enhanced and made suitable for use by roosting bats. Doors and windows would be partially blocked to reduce draughts and prevent unauthorized access. Features, such as bat boxes, wooden roosting pockets and crevices would be created on internal walls that would be suitable for a number of species of bat.

The use of buildings within the site as an educational resource will be discussed with the local community during the early stages of the development and opportunities to create a bat roost as an educational feature of the site will be explored.

4.4.2 Water Vole

The southern area receptor site will include 300m of linear ditch-like waterbodies, varying in width between 5 and 10m, with two small ponds, 50m^2. and 120m^2 respectively. This habitat will provide approximately 700m of bankside habitat which will be designed and managed principally for water voles. Depending on habitat quality, the length of a breeding female

water vole territory varies between 30m and 150m[4] and therefore it is considered that sufficient habitat for three breeding females would be created in this area alone.

Bank materials would be of a soft substrate to enable water vole burrowing. The existing ground will be investigated and it is expected that the material will be natural soils, which are expected to be suitable for water vole burrowing.

Banks would be graded to an appropriate angle, approximately 1:1 to 1:1.5. Bank edges would be sinuous in outline and ledge areas would be established, creating a range of micro-habitats for flora and fauna. Soils used should be guaranteed uncontaminated and contain less than 5% volume of stones greater than 25mm.

Where possible, turfs from existing vegetation would be removed prior to works and replaced on the constructed banks, supplemented by translocated aquatic vegetation from existing wetland habitats on site.

Areas not turfed should be re-seeded with grasses, sedges (*Carex* sp.) and rushes (*Juncus* sp.) at 10gm^2. Aquatic and marginal plants e.g. branched bur-reed (*Sparganium erectum*) water plantain (*Alisma plantago-aquatica*) and lesser reed-mace (*Typha angustifolia*) from elsewhere on the site or from nursery stock would be planted into the created habitats.

Created habitats should be allowed a minimum of a single growing season, i.e. March-September and ground cover of vegetation should be a minimum of 70% before translocating any animals to the area.

The Northern Area will be enhanced for water voles by modifying the banks of the existing lagoons to create wider marginal areas and shelves, which would be planted with a range of locally appropriate aquatic and marginal species. Additional bankside habitats suitable for water voles would also be created in the Eastern Area and North-eastern area using similar design guidelines.

Example Planting Plan for the Southern Area

The species selection has been based on locally appropriate natural associations that will not only help to stabilise the banks of the ditches but are considered important for great crested newt and water vole. Where possible, plants will be sourced from within the site, from water bodies that will be lost due to development.

Due to the presence of fish in some of the open water bodies on the site plants shall be sourced from waterbodies that do not support fish. Where insufficient material is available to adequately vegetate the created habitats, species on the list below may be sourced from an approved supplier.

The banks of the ditches that are not re-turfed with existing material will be sown with a 20% wildflower and 80% grass mixture that will not only stabilise the banks but will also provide cover and food for a variety of organisms including water vole. The proposed 20/80 mixture for sowing onto the banks is detailed in Table 1.

[4] Strachan, R. & Moorhouse, T. (2006) *Water vole Conservation Handbook (Second Edition)*

Table 1: Proposed Wildflower and Grass Mixture

Seed	Common Name	Scientific Name	%
Grasses (80%)	Red fescue	*Festuca rubra agg.*	30
	Meadow foxtail	*Alopecurus pratensis*	10
	Cocksfoot	*Dactylis glomerata*	10
	Meadow fescue	*Festuca pratensis*	10
	Yorkshire fog	*Holcus lanatus*	10
	Rough meadow-grass	*Poa trivialis*	10
Wildflowers (20%)	Bird's-foot-trefoil	*Lotus corniculatus*	3
	Ribwort plantain	*Plantago lanceolata*	2
	Selfheal	*Prunella vulgaris*	2
	Red Clover	*Trifolium pratense*	2
	Black Medick	*Medicago lupilina*	1.5
	Yarrow	*Achillea millefolium*	1
	Black knapweed	*Centaurea nigra*	1
	Hemp agrimony	*Eupatorium cannibinum*	1
	Meadowsweet	*Filipendula ulmaria*	1
	St John's Wort	*Hypericum perforatum*	1
	Oxeye Daisy	*Leucanthemum vulgare*	1
	Cow Parsley	*Anthriscus sylvestris*	0.5
	soft rush	*Juncus effusus*	1
	hairy tare	*Vicia hirsute*	1
	lesser trefoil	*Trifolium dubium*	1
	common vetch	*Vicia sativa*	1

The 20/80 mixture will be sown as soon as is practically possible after the construction, ideally from March to early May or from August to late September. The sowing rate will be 5g of seed mixture over each square metre from the bank top down to the water level.

It is also proposed to plant species detailed in Table 2 using individual plant plugs, either translocated specimens or from nursery stock at a density of 1 plant per 10m.

Table 2: Proposed Aquatic, Emergent and Marginal Plants

Zone	Common Name	Scientific Name	No. of Plants
	Soft rush	*Juncus effusus*	
	water figwort	*Scrophularia aquatica*	
	Water forget-me-not	*Myosotis scorpioides*	
	Marshwort	*Apium inundatum.*	
Aquatic	Common water-starwort	*Callitriche stagnalis agg*	
	Broad-leaved pondweed	*Potamogeton natans*	

It is proposed all emergent/marginal species will be planted on shelves at or within 0.5m of the average summer water level.

All planting of the aquatic and emergent/marginal vegetation will be undertaken at least 4-6 weeks after the construction of the ditches to allow for the water levels to stabilise. Ideally planting will take place in either May/June or September/October.

4.5 Birds

Associated with the early phases of the restoration of the Tip, it is proposed to enlarge the waterbodies to the north of the site, creating a significantly larger waterbody, with approximately 950m^2 of shingle island, shoreline, and spit habitat. These habitats would provide suitable areas for breeding little ringed plover, plus many wintering waterfowl and wetland birds. The shingle island and shoreline would be constructed using a 1m surface layer of suitable sandy and gravelly material.

As detailed in Section 4.3.3 Restored Habitats, the creation of areas of open water in the northern, eastern and southern mitigation areas and upon the final restoration of the site would provide habitat for breeding, wintering and passage birds. The creation of woodland, hedgerow and open grassland habitats will also benefit a wide range of wintering and breeding birds on the restoration of the site.

4.6 Amphibians, principally Great Crested Newts

A diverse range of habitats will be created for great crested newts within the development. It is proposed that both aquatic and terrestrial habitats will be created, whilst some existing habitats will be retained and enhanced. Suitable habitats for great crested newts will be created in each of the four separate mitigation habitats. It is currently proposed to only translocate amphibians to the largest of these four areas, the Eastern Area. The other three areas are considered to be sufficiently close and connected by suitable habitats to allow natural migration from this main area once the population is established.

North-Eastern Area

This area currently supports a small non-breeding population of great crested newts and smooth newts in pond 23. It is proposed to remove the dumped rubbish and litter from this and neighboring pond 22. A new pond 10x10m will be created south and west of the existing ponds. The pond will be dug using a mini-digger; accessed from the existing trackway. Spoil will be disposed of on site, and used to create a hibernacula mound. The pond will be located in an area with sparse vegetation cover; any turf of existing vegetation will be placed on the banks or mound and allowed to re-generate.

The works would be carried out in autumn/winter of Year 1. No specific mitigation measures for the existing small great crested newt population are proposed with the exception of the avoidance of disturbance of existing habitats.

Eastern Area

This area currently supports improved grassland, surrounded by hedgerows, with a small area of broad-leaved plantation and scrub bank. The grassland has little intrinsic wildlife value. Hedgerows are likely to be used by amphibians currently for migration and possibly hibernation.

It is proposed to create 11 separate ponds:

- Pond a: 880m^2
- Pond b: 160 m^2
- Pond c: 60 m^2

- Pond d: 800 m^2
- Pond e: 180 m^2
- Pond f: 640m^2
- Pond g = 85m^2
- Pond h = 280m^2
- Pond i = 420m^2
- Pond j = 780m^2
- Pond k = 490m^2

The proposed ponds will create a maximum of 4775m^2 of aquatic, marginal and wetland habitats. The ponds will be partially lined with clay to ensure that presence of water is maintained throughout the summer. Ponds will not be fully lined to allow the establishment of varied aquatic and marginal flora and to allow the development of wetlands on different substrates.

Detailed designs for these ponds will be prepared prior to their construction. Pond designs will include the following features:

- large open areas suitable for courtship;
- extensive areas of marginal vegetation, including reedbeds;
- shallow aquatic habitats and drawdown areas;
- deep, up to 2m, areas of water.

At least 2 of the ponds, Pond c and Pond e, will be isolated from the other ponds and ditches and will be shallow partially ephemeral features, designed to dry up in a hot dry summer, e.g. once every 5-10 years. A hydrological investigation, including the assessment of precipitation, runoff and groundwater availability, will be conducted prior construction to confirm the exact location and construction methods of these ponds.

Hibernacula, using wood and brick rubble, will be created in the vicinity of Ponds a, b and e to maximise the habitat potential for amphibians. Amphibians will still be able to access existing hibernacula in hedgerows and retained embankments and additional embankments of spoil will also be created in the area that are likely to include natural cracks and hollows suitable for amphibian hibernation.

Grassland habitats surrounding this pond group will be enhanced through a low intensity management regime including a cut of 25% of the total grassland habitat every year at the end of the summer, creating a four-year rotation cycle. In addition, woodland and scrub planting will be undertaken to create additional habitats suitable for amphibians in the areas around the newly created ponds/as detailed in Section 4.3.3 Restored Habitats, above.

Southern Area

The southern area will comprise 300m of linear ditch-like waterbodies, varying in width between 5 and 10m, two smaller ponds. This habitat will largely be created and managed for water voles, but will be available for great crested newts to colonise naturally from the Eastern Area.

Access Road

13 ponds of sizes ranging from 800m^2 to 50m^2 will be created along the access road. These ponds will be designed along similar lines to those in the main receptor site (eastern area) and suitable for the long-term colonisation by great crested newts.

4.7 Reptiles

Terrestrial habitats created for amphibians described above will be broadly suitable for reptile species found at the site. The hibernacula banks around Pond a in particular will provide an extensive area of south-facing slope which would be suitable for basking reptiles.

Extensive areas of suitable habitat for reptiles remains undisturbed during the proposed development and the long-term management of these areas will benefit this group. Habitat creation and management elsewhere across the site will also benefit this group.

4.8 Invertebrates

Habitat design and creation for notable species of invertebrate is fraught with difficulties. These invertebrates typically have restricted habitat requirements and our understanding of these requirements is poor. In many cases, the most appropriate design solution is to re-create habitats similar to those where the adult invertebrates are typically found. For this reason, the following microhabitats will be incorporated into the broader habitats scheduled for inclusion at the site:

Terrestrial Habitats

- Dry calcareous grasslands with a high proportion of *Lotus*, *Trifolium* and *Compositae*;
- Dry partially vegetated banks, with varying substrates including sandy and shaley and gravelly slopes;

- Ponds with mud, sand and earth substrates - some left to naturally colonise with plants, some planted from nursery, some planted from translocated material;

- A variety of water depths, from 5cm shallows and margins to deeper water up to 2m;
- small and shady ponds with very few oxygenating plants;
- Small and larger ponds with a high density of aquatic and marginal vegetation, including brooklime, wetland speedwells and figwort;

- Reedbeds, including *Phragmites*, *Typha* and big *Carex* sp.;
- Heavily vegetated ditches, with variety of heavy and light shade from scrub.
- Extensive areas of surface wet or very shallowly flooded ground, most of it (but not all) seasonally dry (though preferably not too dry) in some to most years so as to prevent organic build-up, with rabbit grazing in the dry season sufficient to maintain a mosaic of vegetation structure, with short/open turf/veg over about 50%.

5.0 MITIGATION IMPLEMENTATION MECHANISMS

5.1 Introduction

The following section provides detail of the mitigation for each ecological feature and how this will be implemented. The mechanisms for mitigation for great crested newts will be governed by an EPS license, which will have to be separately approved by Natural England. The mitigation methods presented here will form the basis of this license application. Mitigation for other species and habitats will follow either published best practice methodologies or have been developed through the practical experience of SLR ecologists.

5.2 Great Crested Newts

5.2.1 Mitigation Strategy

The basic principles behind the mitigation scheme are as follows:

- The creation and enhancement of great crested newt habitat in the Eastern Area. These areas would provide suitable breeding sites, through the creation of new pond habitats; hibernation and terrestrial foraging habitats.
- The capture and translocation of adult and juvenile great crested newts from the development area of Bentinck Tip and Void to the safe receptor site in the Eastern Area prior to development.
- Target capture effort to maximise the chances of capturing newts from all life stages through capture across a spring and autumn season as a minimum.
- Receptor habitats to be created within 200m of the original habitats and within 600m of Pond 23 in the North-eastern Area, a small pond confirmed to support great crested newts where habitats will be enhanced in winter 2007.
- The receptor habitats in the Eastern Area include terrestrial habitat connections to existing habitats, such as mature hedgerows, unmanaged semi-improved grassland and woodland plantation and scrub which will ensure a diverse range of habitat types are available to newts.
- Exclusion fencing design (Drawing EMP2) minimises the risks of animals straying into the development area whilst it is active, but does not compromise the natural migration patterns of fauna.
- Following completion of the restoration of the development, full access to the site will be available for amphibians. The restored site includes a large number of ponds that would be suitable for colonisation by great crested newts.
- 5 yearly reviews of management and monitoring plan, with a commitment to manage and maintain created habitats for 25 years.

Further information on these principles is provided below.

5.2.2 Receptor Site Selection - Existing Great Crested Newt Status

The main receptor site at the Eastern Area does not support great crested newts breeding habitats but is within the typical range that great crested newts may forage.

5.2.3 Location, Ownership and Status

The Eastern Mitigation Area and all other main mitigation areas (North-eastern, Southern, Northern) are within land under control of Waste Recycling Limited (WRL) and will remain for the period of the development and an aftercare period. The access road and its habitats will

remain in the control of WRL for the period of the development and restoration, later being passed back into control of the landowner.

5.2.4 Habitat Size and Boundaries

The Eastern Area habitat that would be enhanced and specifically managed for the benefit of great crested newt is approximately 176ha in size. It is proposed to create eleven ponds with a total maximum area of 4775m^2 of aquatic, marginal and wetland habitats in this area alone. Some of these ponds will be connected by ditches to assist with the maintenance of water levels and to provide a sheltered conduit for the movement of newts. The created ponds have a slightly larger total area than the current main breeding ponds: lagoons 2, 3 and 4, and will provide a significantly more diverse range of aquatic habitats.

In addition, prior to translocation of great crested newts, two small ponds would be created in the Southern Area; one pond in the North-eastern Area and a further three ponds in the Northern Area. It is not currently suggested that amphibians would be translocated to these other waterbodies, although they may be used for if populations captured are exceptionally large. A further thirteen water bodies along the access route would also be available for future colonisation by amphibians.

To the east of the Eastern Area are pastoral fields, bounded by hedgerows with the residential fringe of Kirby in Ashfield a minimum of 150m away. To the south and north, amphibians will be allowed free access to Annesley Bentinck Quarry SSSI and other habitats. To the west and north-west, amphibians will be discouraged from entering operational areas of the site by an amphibian-proof exclusion fence (Drawing EMP2).

5.2.5 Habitat Creation, Restoration and/or Enhancement

It is proposed to enhance the Eastern Area through the creation of a variety of ponds, wetlands, hibernacula and scrub planting. In addition, a ditch network and additional habitat creation and enhancement works will be undertaken as detailed in Drawing EMP6. This land is considered to be the best available option for habitat creation.

5.2.6 Aquatic Habitats

In the Eastern Area, it is proposed to create eleven new ponds. These ponds will vary in size between 60m^2 and 880m^2 in area. Pond depth and profile will vary across the pond group, as indicated on Drawing EMP6. Typically, ponds will have a maximum depth of 200 cm with extensive marginal areas approximately 30cm deep. The ponds will be dug within the approximate locations marked on Drawing EMP6. It is anticipated that at least 2 of the smaller ponds will be ephemeral water bodies.

Ponds would be created during the autumn and winter and allowed to naturally fill with water. Regular monitoring will take place, and it is proposed that ponds would be planted between 3 and 6 months after creation. A range of aquatic and marginal plants would be planted in seven of the new ponds, with the remaining four allowed to naturally colonise.

Marginal planting would include a minimum of 4 different locally native species, including the following previously recorded from Bentinck: brooklime (*Veronica beccabunga*), branched bur-reed (*Sparganium erectum*), fennel pondweed (*Potamogeton pectinatus*), broad-leaved pondweed (*Potamogeton natans*), water plantain (*Alisma plantago-aquatica*), marshwort (*Apium inundatum*), water figwort (*Scrophularia aquatica*), lesser pondweed (*Potamogeton pusillus*) and charophtye (*Chara vulgaris* var. *vulgaris*).

Whilst some initial planting would be required, it is expected that a diverse aquatic and marginal flora would develop with time through ecological succession. Artificial egg-laying strips will be placed in new ponds in the first year to supplement planting.

Where possible, planting stock will be moved from existing waterbodies that are not known to support fish (as recorded in 2007). Specimens of greater tussock sedge (*Carex paniculata*) would be translocated from the Void lake to the Southern Area ditch habitats, which would minimise the risk of moving fish eggs from the Void lake to great crested newt ponds. If other sources are not available or sufficient to plant the ponds to the required specification, additional aquatic plants may be sourced from nursery stock.

Mitigation ponds in the Eastern Area will be assessed against the following criteria prior to the translocation of any amphibians. Great crested newts would be moved to those ponds considered the most suitable to support breeding. In the unlikely event that none of the ponds are considered to be suitable for breeding great crested newts prior to translocation commencing further works would be undertaken to make the ponds more suitable. For instance, additional planting or using artificial egg-strips, creating more cover habitats and filling with water to raise levels. If none of the ponds can be made suitable for all life-stages of great crested newts, it is feasible that translocation would be delayed until the ponds were considered suitable.

The suitability of newly created pond habitat would be determined by the licensee using criteria based upon the Habitat Suitability Index (Oldham et al (2000); for instance:

- Pond area
- Number of years drying out (water depth)
- Water quality
- Amount of shade
- Number of water fowl
- Presence/absence of fish
- Number of ponds within 1km
- Presence and area of suitable terrestrial habitat within 500m
- Percentage macrophyte cover of pond surface.

5.2.7 Terrestrial Habitats

A series of artificial amphibian hibernacula will also be created. Clean brick rubble or other suitable material would be loose tipped and topped with topsoil/stripped vegetation to encourage quick re-establishment of vegetation cover, in a number of locations around the Eastern Area, as marked on Drawing EMP6. These hibernacula will be located near to the ponds, in order to increase the value of the terrestrial habitat for amphibians.

Terrestrial habitats in the Eastern area would be planted with clumps of scrub and management of existing grassland would be relaxed to allow a tall sward to develop. A proportion of the sub-soil from the pond excavations would be shaped into micro-topographical hummock and hollow features, maximising the niches available for amphibians and invertebrates within the area.

5.2.8 Habitat Connectivity

New ditch lines will connect the newly created pond habitats, providing a sheltered habitat for migration of amphibians. There will be open access to newly created ponds in the

Southern Area and North-eastern Area, and an extensive area of otherwise connected and undisturbed terrestrial habitats.

5.2.9 Integration with Other Species/Habitat Requirements

The enhancements proposed above for great crested newts form part of the mitigation and compensation measures for Bentinck; which are described in more detail below.

5.2.10 Capture Exclusion and Translocation - Timing, Effort and Method

The capture and exclusion of great crested newt would be undertaken primarily using the following methods:

- drift fencing with pitfall traps;
- bottle trapping of ponds;
- egg search of suitable vegetation;
- day-time hand searching of suitable existing and artificial terrestrial refugia;
- night-time transects of sparsely vegetated ground;
- selected netting and hand-searching of ponds at end of capture period;
- selected clearance of vegetation and removal of refugia; and
- one-way fencing along the eastern boundary of the proposed landfill installation to allow passive migration into the site.

Drawing EMP2 shows the proposed layout of the amphibian-proof drift fencing and pitfall traps at Bentinck. Its layout has been designed to provide maximum opportunities for interception of migrating amphibians. This is based upon targeting fencing and pitfalls in areas where most newt activity is likely to be occurring.

The newt fence design would broadly follow the specifications set out in the 'Great Crested Newt Mitigation Guidelines' i.e. the fence would form a vertical or sloping barrier approximately 50cm above ground buried to approximately 20cm with an overlap on top to prevent animals climbing over. Fencing would be broadly of two types:

- external boundary fencing would be a semi-permanent either upright or one-way amphibian-proof barrier maintained for at least 5 years following translocation; and
- internal drift fencing would be an upright amphibian-proof barrier maintained for the duration of the capture period.

All fencing would be removed upon the final restoration of the site.

Pitfall traps would be installed at strategic locations along upright fencing. Pitfall traps would include limited cover in the base (such as a piece of turf or layer of moss) to avoid desiccation or predation of captured animals, as well as a suitable 'mammal ladder' such as a stick, to allow any small mammals such as shrews or field mice to escape out of the pitfall trap such they fall into it. Pitfall traps would be placed alongside both sides of the majority of the upright drift fencing, at a minimum frequency of 8m intervals. In addition, terrestrial refugia, such as carpet tiles, squares of roofing felt of some such similar material, would also be place along the fence line between the pitfall traps and across suitable area of terrestrial habitat, to provide a place under which amphibians can shelter. It is proposed that a minimum of 100 pitfall traps and 100 terrestrial refugia per hectare of suitable habitat would be installed, as specified in the guidelines for a 'large' sized population.

Fencing and traps would be installed by a competent contractor experienced in great crested newt mitigation projects and under the instruction and supervision of the licence holder or an accredited agent. All fencing would be completed by the end of February in the first year of capture. When capture is not taking place, all pitfall traps would be tightly lidded and both traps and drift fencing would be inspected on a fortnightly basis to ensure that no disturbance of vandalism had occurred.

Areas of rough grassland and other suitable terrestrial habitats would be hand searched and modified, e.g. through strimming grass to approximately 5cm height, to make them less suitable for amphibian use and to encourage amphibians to seek out other areas of shelter, thus increasing the chances of capturing them. Artificial refugia would be used throughout suitable terrestrial habitat areas at a density of >100 refugia per hectare to capture terrestrial amphibians.

Prior to installation of the drift fencing, the areas to be fenced will be inspected by an ecologist. Where areas of thick vegetation occur on the fencing line, these will be checked and strimmed or otherwise disturbed in advance to 'displace' animals that could be present. Likewise, hand searches of potential areas of refuge would also be undertaken to reduce the risk of harm to any animals seeking shelter in these areas.

In order to capture great crested newts that may be present within ponds, bottle traps will be used during the breeding season (mid-March – mid-June). The bottle trapping methodology would follow that which is set out in the 'Great Crested Newt Mitigation Guidelines'[5]. Bottle traps would be used throughout the pond areas at densities equivalent to 1 bottle trap per 5m of shoreline. Bottle trapping would be undertaken for a minimum of 30 nights during the breeding season, undertaken with regular intervals between each trapping night.

Night searching, using high-powered survey torches will be undertaken in sparsely vegetated areas of the Tip, along pre-defined transects. Searches will take place between start of translocation period until mid-May on evenings where the night time temperature exceeds 5ºC after rain or where there is damp/wet ground conditions. 20 nights night searching will be undertaken at regular intervals throughout the capture period.

Egg searches will be undertaken regularly during the capture period, on at least 30 mornings from end of March to the end of June. Eggs would be translocated to new aquatic habitats that are suitable to support larval amphibians.

At the end of the capture period, ponds known to support great crested newts will be hand searched and netted using a 1mm mesh hand net to capture any remaining amphibians, including larvae, which would be translocated to the receptor habitats. The ponds will be drained/removed under the supervision of the licence holder or accredited agent.

Based upon our assessment of an exceptional population, we propose to undertake a capture period based upon a total of 90 suitable days, suitable being defined by the EN Mitigation guidelines. These days will be split with between 45 – 60 days undertaken during the spring breeding season and 30-45 days during the autumn migration season. The end of the capture, after these 90 suitable days, would be confirmed when there have been at least 5 suitable capture days with no great crested newts being trapped or found through hand searches.

Pitfall traps and artificial refugia would be checked daily during the capture period by licensed and trained ecologists. Cut vegetation, earth and stone refuges and water from a

[5] English Nature (August 2001) *Great Crested Newt Mitigation Guidelines*. English Nature, Peterborough

locally available source, would all be available to maintain moisture and cover in pitfall traps during periods of prolonged dry weather, to avoid amphibians from becoming dehydrated when captured within the pitfall traps and reduce the risk of predation. Mammal ladders will also be placed in each pitfall to allow any small mammals captured to escape. None-target native animals captured in the pitfall traps would be released nearby in a safe location.

On completion of the translocation all pitfall traps would be removed and backfilled. Internal drift fencing would be removed and checked for any amphibians that could remain.

During the capture programme all captured adult, sub-adult, eggs and larval great crested newts and other species of amphibians will be transferred to suitable aquatic habitat within the Eastern Area. In the event that more than 1000 individuals are captured, suitable ponds in the southern, northern or north-eastern area may be used to as receptor habitats. Not less than 25 adult newts would be moved to any new area to ensure stability and viability of that sub-population.

5.2.11 Habitat Management and Maintenance

WRL will manage the enhanced great crested newt habitats to ensure that the amphibian interest of the site is conserved and enhanced.

An annual visit would be made to the site by an appropriately qualified ecologist to assess the management and maintenance requirements of the existing and created habitats for the duration of the landfill and a minimum five year period after restoration.

The colonisation of newly created habitats by fish is a risk. The presence of fish would be monitored during annual surveys, by torching and bottle trapping, which are reasonably effective at identifying the presence of fish in confined waterbodies.

Currently, there are few products available to control unwanted fish populations, Rotenone[6] is the most commonly used piscicide and has undesirable characteristics such as acting as a non-specific insecticide. Research of Rotenone's use has been tested at other sites, e.g. Orton Pit[7] with encouraging results. Electro-fishing of waterbodies is less likely to be harmful to non-target organisms and may be recommended if fish colonisation of newly created habitats occurs, but would not be fully effective.

5.2.12 Population Monitoring

The great crested newt population would be monitored following translocation to measure the success of the mitigation programme. In accordance with guidelines published by English Nature, a population size class assessment would be undertaken, using the methods established in baseline surveys for 2006 and 2007, for 10 years following translocation.

5.3 Water Vole

A mitigation and compensation strategy is proposed to minimise disturbance and provide adequate mitigation to water voles and their habitats during the proposed development in accordance with standard guidelines[8]. The main elements of the mitigation proposals are:

[6] http://www.pan-uk.org/pestnews/Actives/rotenone.htm

[7] http://www.froglife.org/Reports/rotenone%20fish%20control%20for%20GCN%20conservation.pdf

[8] Strachan, R. & Moorhouse, T. (2006) *Water vole Conservation Handbook (Second Edition)*

- Where possible, avoid development disturbance to known water vole habitat through protection of key habitats, including the remnant section of the Cuttail Brook and three of the lagoons in the Northern Mitigation Area.
- Compensate for the loss of water vole habitat by the creation of new habitats in the first phase of development in the Southern Mitigation Area, which will include approximately 300m of ditch habitat.

- Instigate management of these newly-created habitats to provide adequate replacements in terms of foraging, territory, breeding and resting habitat. Bank materials would be of a soft substrate to enable water vole burrowing.

- Ensure that the timing of any disturbance to water vole habitat is the most appropriate time to minimise disruption to the animals.

- Where necessary, exclude water voles from habitats that cannot be avoided by development through habitat modification and trapping at an appropriate time of year.

- Where appropriate, reduce the possibility of water voles accessing development land; especially where there is a risk that they would be harmed by construction operations, through fencing or habitat modification.

- Ensure control of brown rat as part of the landfilling operation.
- Post-translocation monitoring of water vole population numbers and distribution for the 25 year management plan period.

- Continue to manage aquatic and terrestrial habitats through 5 yearly reviews of this management and monitoring plan, with a commitment to manage and maintain these habitats for 25 years.

5.3.1 Water Vole Ditch Management Decision Flow Chart

It is proposed that all ditch and waterbody management, maintenance and clearance operations would be conducted using following flow diagram:

Table 3: Water Vole Management Decision Flow Chart

1. Does the proposed operation require ground disturbance, de-silting operations or mowing bankside habitats?

If **NO** – no further measures are required.

If **YES** – Q2.

2. Does the area affected support known water vole habitat in use, as identified in the Water Vole Survey Report 2007?

If **NO** – Q3.

If **YES** – Q4.

3. Does the area affected support potential water vole habitat as identified in the Water Vole Survey Report 2007 or water vole habitat created as mitigation?

If **NO** – no further measures are required. If in the unlikely event that water voles are observed during the operation, stop work and contact an ecologist for advice.

If **YES** – contact an ecologist. Mowing operations and minor ditch works may proceed with a method statement, approved by an ecologist. Where more significant works are proposed, it is recommended that an update survey is carried out and the ecologist will advise on the next steps to facilitate the operation. It is likely that if the habitat remains unoccupied and is unlikely to support water voles, work may proceed with caution with a method statement. If there remains a risk that water voles are present, habitat modification is likely to be the most appropriate mitigation tool.

4. Further mitigation measures are likely to be required. Contact an ecologist and conduct an update survey between April and October. If the habitats still support a population of water voles and the ground disturbance is extensive, capture and translocation may be required. A specific scheme of mitigation will be designed by the ecologist in conjunction with site engineers responsible for the operation.

5.3.2 Habitat Modification

Wherever possible, potential water vole habitat will be retained during site operations and water voles access maintained to allow future colonization.

Habitats that are suitable for water voles, but where no signs have been reported, would be managed prior to any development disturbance to create short grassland by strimming or mowing. Where appropriate, sward height of between 5cm and 15cm would be maintained throughout the growing season prior to disturbance. Vegetation from the waters edge to 1m back from the bank top should be cut to this height. Prior to each cut, the area should be walked over and surveyed for recent signs of water voles. If recent water vole burrows are observed then habitat modification may no longer be the most suitable method of mitigation.

5.3.3 Water Vole Capture and Translocation

If required, live mammal trapping would be employed to remove water voles from known habitats prior to development related disturbance.

Trapping would only be undertaken during the active season for water voles, i.e. after the spring emergence in March (determined by the presence of fresh latrines and field signs) and before the first frosts in September/October. Where possible, trapping would be avoided during the period when females are most likely to have dependant young, between June and August.

Published research recommends "*the ideal time of year for exclusion is April, after the water voles have emerged from winter activities and prior to having young. Alternatively late August/September is a good time of year since the population is at an all time high for the year and when any mortality in young still in burrows that are abandoned by females, will not contribute to a local population fall. It is however more likely that a female will carry her young to an alternative site*"[9].

Live mammal traps suitable for water voles, e.g. Sherman traps or kangaroo rat traps, would be placed at a minimum density of 1 trap per 20 m of suitable habitat, sited wherever possible outside burrow entrances, at latrine sites or feeding stations. Traps would be pre-baited with suitable food, such as apple and carrot, and dry bedding material, e.g. straw. Bedding and bait would be replaced as required, usually every other day. Traps would be covered with grass turf to reduce temperature fluctuations within the trap.

The traps would generally be checked three times per day, morning, mid-afternoon and evening. In extremely hot weather, i.e. forecast daily maximum above 20^0C, traps would be closed during the day and re-set in the evening. In extreme cold weather, i.e. where the night-time temperatures are predicted to fall below 3^0C, traps would be closed overnight.

Experience of other trapping programmes for water vole has shown that the vast majority of voles are captured overnight. Therefore, in some instances, it may be acceptable to set traps overnight and check them in the morning and evening only.

All other native mammals captured would also be translocated. In the unlikely event that shrews are regularly caught by the traps, a license from Natural England would be sought.

Best practice suggested that reasonable effort would have been expended when no animals have been captured for five clear days of suitable weather.

Whilst no licenses are required for any of the actions listed above, trapping and disturbance to water vole habitats should be supervised by an appropriately qualified ecologist trained in handling and trapping of small mammals.

5.4 Bats, Brown Hare and other Mammals

Specific mitigation for other species occurring on the site including brown hare and foraging bats is not proposed. Details of habitat creation and design to maximize opportunities for these species are provided in the preceding section.

5.5 Breeding Birds

To avoid destruction of any nests of breeding birds all suitable nesting habitat would be removed from the development area outside the breeding season (1st March to 31st July). If clearance of vegetation during the bird breeding season is unavoidable, an appropriately qualified ecologist will undertake a survey for nesting birds prior to any disturbance activities.

[9] English Nature Research Report RR 415 (199x) 'Water Vole Mitigation Techniques – A questionnaire research project'.

If an active bird nest is found in vegetation to be removed, the area would be retained and clearance operations would recommence only when the nest is no longer in use.

It is possible that the bare ground on the Tip could support breeding little ringed plover, a Schedule 1 bird. This bird may choose to breed even in actively restored areas of the tip. An annual survey in spring by a suitably qualified ornithologist would be undertaken to identify nests. An appropriate buffer zone would be established around any nests of little ringed plover which would be respected until the breeding attempt had concluded. It is not practical to remove or modify this species' nesting habitat outside the breeding season as this species breeds in bare areas.

Wildfowl and wetland birds that may breed on the margins of waterbodies, e.g. coot, mallard and moorhen have a breeding season that finishes later than many species. The end of the 'close' season for birds listed on Schedule 2 part I of WCA 1981, including the three species mentioned above, i.e. 1st September - 31st January, is an appropriate time to timetable works that could affect the margins of waterbodies, such as draining or de-silting works, where late-breeding wildfowl could be raising young.

5.6 Reptiles

Mitigation for populations of grass snake and common lizard is principally addressed in the preceding section in relation to amphibians. The key elements of the mitigation strategy for amphibians that are relevant to reptiles are:

- The creation and enhancement of aquatic and terrestrial habitats in the Eastern Area. Through the creation of new pond habitats; hibernation and terrestrial foraging habitats.
- The creation of suitable breeding sites for grass snake, by creating large compost heap piles within the Eastern Area.
- The capture and translocation of reptiles from the development area of Bentinck Tip and Void to the safe receptor site in the Eastern Area prior to development.
- Target capture effort to maximise the chances of capturing reptiles from all life stages through capture across a spring and autumn season as a minimum.
- The receptor habitats in the Eastern Area include terrestrial habitat connections to existing habitats, such as mature hedgerows, unmanaged semi-improved grassland and woodland plantation and scrub which will ensure a diverse range of habitat types are available to translocated reptiles.
- Exclusion fencing design (Drawing EMP2) minimises the risks of animals straying into the development area whilst it is active, but does not compromise the natural migration patterns of fauna.
- Following completion of the restoration of the development, full access to the site will be available for reptiles.

5.7 Invertebrates

Taxon specific mitigation measures for invertebrates are not proposed. Invertebrate populations require habitats supporting suitable micro-climatic, topographic and substrate conditions. Through the proposed translocation of poor top-soils; orchid swarms and wetland plants to mitigation areas it is highly likely that some invertebrate populations will be assisted in colonizing new habitats.

WRL is currently planning the translocation of populations of grizzled and dingy skipper at another of its operational sites. The success of the current project will be evaluated and, if appropriate, may be used at Bentinck. However, it is anticipated that the early creation of

mitigation areas will allow the natural colonization of many invertebrate species currently associated with Bentinck.

5.8 Flora

In addition to habitat creation and design which is detailed in preceding sections, taxon specific mitigation measures will be implemented for:

- orchid swarms;
- charophytes;
- tufa spring vegetation and
- greater tussock sedge.

Significant areas of bee orchid *Ophrys apifera*, common spotted orchid *Dactylorhiza fuchsii*, and southern marsh orchid *Dactylorhiza praetermissa* have been identified in baseline surveys[10]. Orchid swarms 1 to 7 will be translocated using a modified excavator bucket to minimise the disturbance of soil layers. Turfs will be translocated directly to receptor sites previously identified as supporting suitable low-nutrient substrate. Approximately 50% of the translocated material, i.e. swarms 5, 6 and 7 will be moved to the Eastern Mitigation Area and will be placed directly on low mounds of sub-soil created from excavating the ponds. The remaining material from swarms 1, 2, 3 and 4 will be translocated to suitable areas in the Southern Mitigation Area.

Vegetation within Tufa Spring 7, a small tufa seepage of just a few square metres which supports large patches of fern-leaved hook-moss and spear moss, amongst abundant carnation sedge and fleabane, and occasional colt's-foot, creeping bent-grass, self-heal, alder seedlings and common spotted orchid will be translocated to a shallow wetland area within the Eastern Mitigation Area. Vegetation within Tufa Spring 1 will be moved to the Southern Mitigation Area. The exact locations will be determined following analysis of the water chemistry and substrate of the receptor site to maximise the chance of success of the translocation.

Approximately five well-established plants of greater tussock sedge occur on the western margin of the Void. These plants will be translocated to the Southern Mitigation Area to a suitable damp marginal habitat.

Vegetative fragments of charophytes will be translocated from Lagoons 2, 3 and 4 to three of the larger waterbodies created in the Eastern Mitigation Area. All vegetation removed from existing waterbodies would be thoroughly checked for the presence of fish or other inappropriate organisms such as invasive aquatic plants *Crassula sp* and *Azolla sp* prior to translocation.

[10] Bentinck Botanical Survey and Evaluation 2007 (SLR Consulting Ltd.)

6.0 MANAGEMENT AND MONITORING OBJECTIVES AND PRESCRIPTIONS

The following section sets our management prescriptions and monitoring objectives for the first 5 years of this plan. These objectives will be reviewed and updated on a 5 year programme for the 25 year management plan period.

6.1 Management Prescriptions for Mitigation Areas

The following table provides outline management prescriptions for the four main mitigation areas. A detailed management plan for these areas and the rest of the site would be prepared prior to the commencement of development.

Table 4: Outline Habitat Management Prescriptions

Mitigation Area	Ecological Feature or Habitat	Management Prescriptions
Eastern Area	Grassland	Cut 25% of the total area of grassland every year, creating a 4 year rotation. Cut grass late in summer (August – October) to a height not less than 15cm). Remove cuttings to an on site compost pile.
	Woodland and scrub	Monitor new planting annually and re-plant any failures. Maintain weed-free zones around the base of newly planted trees. Clear wayleave in existing woodland plantation below overhead power line and maintain open through biennial scrub cutting. Cut hedgerows on a biennial rotation, cutting one side each year.
	Ponds and wetland	Where necessary, control invasive plant species and fish. Maintain coverage of aquatic plants at between 10% - 80% of total pond area, through targeted weed removal on a biennial rotation.
Northern Area	Grassland	Monitor establishment of created grassland habitats and begin management once average sward height reaches 20cm. Cut area of grassland every year in late summer (July – August) to a height not less than 10cm. Remove cuttings to an on site compost pile.
	Woodland and scrub	Monitor new planting annually and re-plant any failures. Maintain weed-free zones around the base of newly planted trees. Clear small glade 10x10m in the existing plantation.
	Ponds and wetland	Where necessary, control invasive plant species and fish. Maintain coverage of aquatic plants at between 10% - 80% of total pond area, through targeted weed removal on a biennial rotation.
North-eastern Area	Ponds	Where necessary, control invasive plant species and fish. Maintain coverage of aquatic plants at between 10% - 80% of total pond area, through targeted weed removal on a biennial rotation.
Southern Area	Ponds and ditches	Where necessary, control invasive plant species and fish.
	Grasslands	Cut area of grassland every year in late summer (July – August) to a height not less than 10cm. Remove cuttings to an on site compost pile.

6.2 Monitoring

The long-term performance of the mitigation areas and retained habitats within the site will be monitored in accordance with the measures and targets set out below. Where monitoring shows that targets have not been met additional management prescriptions will be implemented to achieve the favourable condition of the important ecological feature.

Table 5: Monitoring Targets for Important Ecological Features

Feature	Attribute	Measure	Target	Comments
Great crested newts	Population size	Population class size, measured annually	No decrease in population class size, subject to natural fluctuations.	Estimated average count – 100 adult GCN (+/- 20%)
	Fecundity	Annual egg search and adult breeding behaviour	Confirm evidence of breeding in at least 50% of created ponds 2 years after translocation.	If target not met, consider reasons through results from other monitoring
	Aquatic habitat	Habitat Suitability Index of created habitats	Maintain high HSI in all ponds and monitor changes of each attribute annually.	Instigate appropriate management, dependent upon results.
	Presence of fish	Survey to assess presence of fish, e.g. sticklebacks	Maintain ponds fish-free.	Where fish populations become apparent, consider control by draining down, Rotenone or other methods.
	Terrestrial habitats	Extent and quality of terrestrial habitats, using detailed habitat survey	Maintain a mix of approximately 20% scrub; 10% woodland; 50% dry grassland and 20% wet grassland and wetland habitats within area	Maintain sward heights of grassland at 15cm or above, consider light grazing by cattle or horses or topping with machinery every 2 years. Selected scrub removal and tree thinning may be required every 5 years
Water Vole	Population	Biennial survey	Site to support	Survey using methods

Feature	Attribute	Measure	Target	Comments
	size	of water vole habitats for field evidence	approximately 4 adult breeding territories	described in Strachan and Moorhouse (2006)
	Availability of habitat	Biennial survey of water vole potential habitats for suitability	Site to support approximately 1200m of suitable bankside habitats	Survey using methods described in Strachan and Moorhouse (2006)
Bats	Availability of habitat	Annual survey for foraging bats,	Maintain regular records of current species using the site.	Heterodyne activity survey to be conducted in conjunction with great crested newt surveys
	Roosting	Biennial check of modified buildings and bat boxes	Positive evidence of bat use	Any occupation by bats of created features would be beneficial
Reptiles	Species presence/ absence	Biennial survey for 5 years following translocation	Continued presence of common lizard and grass snake	Survey using terrestrial refugia
	Population Viability	Biennial survey for 5 years following translocation	Identification of breeding behaviour or sub-adult individuals	Survey using terrestrial refugia
Invertebrates	Invertebrate assemblage	Biennial survey	Monitor populations in retained habitats and compare with receptor habitat assemblages	1 day targeted terrestrial and aquatic survey by an experienced entomologist. Survey to focus on notable taxa recorded in 2007
Flora	Tufa springs	Biennial survey of retained tufa springs	No net loss of area (m^2) of retained tufa spring habitat	Survey to measure area and identify species present and abundance (DAFOR)
	Translocated orchid populations	Biennial survey of orchids	Maintenance of populations of 3 species of orchid: bee, southern marsh and common spotted.	Survey to measure area and identify species present and approximate count of spikes in mid-summer.

Feature	Attribute	Measure	Target	Comments
	Translocated orchid populations	Sward height	Maintain sward height within orchid areas at 10cm or below.	Strim and remove grass cuttings from orchid areas annually in spring (March-April) prior to flowering
	Translocated greater tussock sedge	Biennial survey	No net loss of plants	Survey to count number of plants.

7.0 OUTLINE TIMETABLE

The following timetable assumes that planning permission is granted by summer 2008. If permission is delayed beyond summer 2008, the implementation of EMP may be delayed by up to 12 months.

Table 6: Outline Implementation Timetable

Task and Phase	Location	Target Ecological Feature	Action	Timing
1a	Eastern Area	-	Conduct substrate sampling and trial pits in the Eastern Area to confirm pond locations and construction methods.	Winter 2007
1b	Void and Lagoons 2,3,4	Aquatic Flora	Collect specimens of existing aquatic plants and grow on in nursery	July 2008
1c	Eastern void banks, mound and Annesley Bentinck Quarry SSSI	Grassland flora	Collect seed from grassland and store for future use	July 2008
2a	North-eastern area	GCN	Create new pond and hibernacula	December 2007
2b	Eastern area	GCN	Create new ponds and hibernacula	August 2008-January 2009
2c	Southern area	Water vole	Create new ponds and ditch habitats	August 2008-January 2009
2d	Northern Area	Water vole	Create new small ponds and enhance existing habitats for water vole	August 2008-January 2009
2e	Void banks	Orchids	Mark extent of existing populations on the ground	June 2008
2f	Eastern Area	Orchids	Translocate orchid swarms to new habitats in Eastern and Southern Areas	September 2008 - February 2009
2g	Void banks	Tufa Springs	Translocation tufa spring wetland flora to Eastern and Southern Areas	September 2008 – February 2009
2h	Eastern Area	Invertebrates	Create micro-niches suitable for range of invertebrates	August 2008-January 2009
3	Access Road		Create new ponds and ditch habitats in line with the construction of the road	2008 – 2009
4	Northern Area	Wintering birds	Create large waterbody. Timing dependent upon phasing of Tip restoration. Waterbody will be created before all existing Tip lakes are drained	2009 - 2011
5	-	GCN; reptiles	Apply for EPS license for GCN. License will take NE 30 working days to process and may require modifications, requiring a further 30 days processing.	August 2008; expected October 2008-January 2009
6a	Site	GCN; reptiles	Erect amphibian-proof fencing	December 2008 – February 2009
6b	Eastern Area	GCN; reptiles	Commence translocation of GCN. 45-60 days (minimum) capture from Lagoons 2,3,4, void, remnant sections of Cuttail Brook and other on	March – May 2009

Task and Phase	Location	Target Ecological Feature	Action	Timing
			site habitats	
6c	Eastern Area	GCN; reptiles	Re-commence translocation of GCN. 30 days (minimum) capture from Lagoons 2,3,4, void, remnant sections of Cuttail Brook and other on site habitats that were not cleared during spring	September – October 2009
7	Cuttail Brook	Water voles	Translocate water vole populations from remnant sections of Cuttail Brook, if required.	April 2008 – August 2008
8	Northern Area	Bats	Assess stability of existing buildings and create bat roosting features. Timing may be influenced by final use or otherwise of buildings	2009 - 2010
9	Eastern Area, Northern Area	-	Advance tree and shrub planting	September 2008 – March 2009
10a	-	All	Monitoring surveys	March 2008 – October 2008; annually or biennially thereafter
10b	-	All	Biannual meeting of Stakeholder Management Group	March 2008; October 2008 and thereafter
10c	-	All	Review of management tasks in EMP	October 2008 and annually thereafter
10d	-	All	Full review of EMP	2013; 2018; 2023; 2028

8.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

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