

Appendix 6.1 Ecological Management Plan

BARRY WATERFRONT CONSORTIUM

THE QUAYS

WHOLE SITE ECOLOGICAL MITIGATION STRATEGY

13 JULY 2012



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| Issue | Revision | Stage | Date | Prepared by | Approved by | Signed |
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| A | | Draft planning | 28 February 2012 | Annabelle Phillips | Dr Matthew Watts (Director) |  |
| B | Revision to Figure 1 | Planning | 12 April 2012 | Annabelle Phillips | Dr Matthew Watts (Director) |  |
| C | Minor amendments following comments from Vale of Glamorgan Council Ecologist | Planning | 13 July 2012 | Annabelle Phillips | Dr Matthew Watts (Director) |  |

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1.0 INTRODUCTION

- 1.1 Soltys Brewster Ecology were commissioned to devise an ecological mitigation strategy for The Quays development in Barry. The Quays development is spread over approximately 41ha of land located around the former dock area of Barry Waterfront. Construction at the site is to be undertaken through a series of phases, with Phase 1 due to begin in summer 2012 in the area known as West Pond (see location and phasing plans in Appendix I).
- 1.2 The site currently comprises of a mosaic of habitats dominated by semi-improved grassland, early successional and ruderal vegetation, scrub and bare ground. The habitats support a variety of bird, bat and invertebrate species, with a population of reptiles (Slow Worms *Anguis fragilis*) identified in the area known as South Quay.
- 1.3 The extensive scale of the works within the application boundary and the requirement to surcharge all areas of the site constrains the possibility of retaining existing habitats and features at ground level. Mitigation has therefore focussed on the protection of adjoining habitats/features and maximising the biodiversity value of new planting/open space, with provision of specific on-site mitigation measures for existing species/ features of value.
- 1.4 A number of planning conditions are of relevance to the ecological mitigation to be implemented as part of the development. The full list of planning conditions relating to site ecology is included in Appendix II, with those of particular relevance to the Mitigation Strategy detailed below:

Full Conditions

- 7 *No development shall commence until such time as a detailed scheme for the provision of the proposed habitat mitigation / creation shall be submitted to and approved in writing with the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme.*
- 9 *No development shall commence until a survey of the site for badgers has been undertaken and prepared by competent persons with suitable qualifications, licenses and experience, and a report submitted to and approved in writing with the Local Planning Authority. The timing of the survey shall be appropriate to confirm the absence of badgers from the site immediately prior to work commencing and to ensure that it is undertaken using nationally recognised survey guidelines / methods where available and working to best practice standards.*

Outline conditions

- 25 *Before the commencement of any construction works on the first of any building approved in each phase of the development site a detailed scheme for the provision of the proposed habitat mitigation / creation*

relating to that phase, shall be submitted to and approved in writing with the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme.

- 26 *Before the commencement of works on site full details of a scheme for the provision of artificial bird nesting sites, which shall equate to a minimum of one fifth of the total number of residential units to be developed across South Quay, shall be submitted to and approved in writing with the Local Planning Authority, and the development shall be implemented thereafter in accordance with the approved scheme, unless any variations are agreed in writing with the Local Planning Authority.*
- 30 *Prior to the construction of any buildings on site, full details of a scheme to provide bat roosting locations across the site shall be submitted to and approved in writing with the by the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme, unless any variations are agreed in writing with the Local Planning Authority.*
- 31 *Before the commencement of each phase of the development as agreed in regard of Condition No. 8 above, a survey of the site for badgers shall be undertaken and prepared by competent persons with suitable qualifications, licenses and experience, and a report submitted to and approved in writing with the Local Planning Authority. The timing of the survey shall be appropriate to confirm the absence of badgers from the site immediately prior to work commencing and to ensure that it is undertaken using nationally recognised survey guidelines / methods where available and working to best practice standards.*
- 32 *Any vegetation clearance across the site shall be undertaken outside the nesting season, which is generally recognised to be from March to August inclusive, unless it can be demonstrated through submission to the Local Planning Authority of an appropriate survey immediately prior to works commencing that nesting birds are absent or a method statement for works is agreed in writing with the Local Planning Authority and fully implemented prior to works commencing.*

1.5 The purpose of this document is to set out a strategy for the provision of the proposed habitat mitigation/creation across the entire site. Details for the proposed habitat mitigation relating to Phase 1 (West Pond) have been identified in this document (Section 4.0), as well as in *The Quays - Development Phase 1 - Ecological Mitigation Strategy* (SBE, 2012).

1.6 The layout and timings for the development at South Quay and East Quay have yet to be finalised, although it is anticipated construction at South Quay will begin in summer 2016, with construction at East Quay from summer 2020. Indicative specification for the ecological mitigation and habitat creation in these locations

have been identified in Sections 5.0 and 6.0, although these specifications may be subject to revision dependent upon the final site layout/ timing of works.

- 1.7 The strategy for habitat mitigation/ creation is to be agreed with the local authority prior to the commencement of any construction works at the site.

2.0 SUMMARY OF BASELINE CONDITIONS

- 2.1. The ecological baseline conditions at the site were established by a combination of desk study and field surveys undertaken in 2008 and 2009. The existing ecological resource across the entire site is dominated by unmanaged neutral grassland, early successional vegetation, ruderal vegetation and scrub. Further description of the existing site conditions can be found in the following section and in The Extended Phase 1 Habitat Survey Report (SBE, 2008), Phase 2 Survey Summary Report (SBE, 2009) and the Ecology Chapter of the Barry Waterfront Environmental Statement (NLP, 2009).

Habitats and Vegetation communities

Grassland

- 2.2. The extent of grassland habitat at the site established during the Extended Phase I Habitat Survey is shown by means of maps and Target Notes in Appendix III. Subsequent mapping of grassland communities using the National Vegetation Classification (NVC) identified most of the semi-improved grassland as one of two communities of neutral grassland (OV23c and OV23d), with calcareous grassland (CG3 community) restricted to the limestone cliff overlooking South Quay.
- 2.3. A number of plant species of national or local rarity were recorded during the site surveys. These included Childing Pink *Petrorhagia nanteuilim* (a nationally rare plant, protected under the Wildlife and Countryside Act 1981 (as amended)), Corky Fruited Water- Dropwort *Oenanthe pimpinelloides* and Corn Parsley *Petroselinum segetum* (both locally rare). The Corky Fruited Water- Dropwort was found in grassland to the south of West Pond, with the Corn Parsley and Childing Pink at East Quay. The Childing Pink is located outside, but adjacent to the planning application boundary – no colonies of this species were noted within the application site.
- 2.4. The grassland communities, whilst of limited intrinsic diversity, do represent a notable ecological resource in terms of area coverage and there are no other comparable grassland habitats at a local geographical scale.

Early successional vegetation

- 2.5. The site includes extensive areas of early successional vegetation (classified as Ephemeral/short perennial in the Phase 1 Habitat Survey, Appendix III) across the site, especially in the South Quay area. Underlying substrates were variable, but were all freely draining, and on the whole comprised an irregular mixture of crushed hard materials (brick, concrete, pebbles). This vegetation appeared to be the most diverse within the site, with a wide range of herbs, grasses and mosses present. East Quay also supported an extensive area

of Brownfield vegetation colonised over calcareous stone chippings, which appear to be at least moderately diverse and supported notable plant species (see Section 2.3 above).

Scrub

- 2.6. Small areas of scrub was present across much of the site, mostly as scattered bushes in grassland and ephemeral vegetation (species including Gorse *Ulex europaeus*, Buddleja *Buddleja davidii*, Bramble *Rubus fruticosus* and Hawthorn *Crataegus monogyna*). Dense stands of similar species were also present on banks and cliffs (e.g. in West Pond and South Quay) and along many of the existing and decommissioned railway lines. The scrub was generally considered to be of low botanical value, although it was considered to have potential to support nesting birds.

Scattered Trees

- 2.7. Few trees were present on the site and those that were present were either as a result of historical landscape planting or associated with the dense scrub areas. Tree species included Willow *Salix sp*, Maples *Acer sp* and Leyland Cypress *Cupressocyparis leylandii*. None of these trees were particularly large or mature and were considered to be of negligible ecological value.

Fauna

Amphibians

- 2.8. The presence of ephemeral standing water at West Pond was considered potentially suitable to support common amphibians such as Palmate Newt *Lissotriton helveticus* or Common Frog *Rana temporaria*. This water feature was not considered of particular potential for Great Crested Newts *Triturus cristatus* based on the known habitat preferences of the species and the presence of limiting factors such as little/no aquatic vegetation. Amphibian surveys found no evidence to suggest any amphibian species were present at the site.

Reptiles

- 2.9. Much of the site area was considered potentially capable of supporting reptile populations, particularly in the grassland and vegetated areas across South Quay, West Pond and East Quay. Reptile surveys undertaken across the site in 2008 confirmed the presence of Slow Worm at the site, although the population was limited to the eastern end of South Quay, along the base of the cliff and within the grounds of the former NERC building. It is considered unlikely that the reptile population would have spread into other areas of the site due the largely unsuitable nature of the intermediate habitats (predominantly bare ground and ephemeral/short perennial vegetation).

Bats

- 2.10. Bat surveys undertaken at the site identified no evidence that any building on site supported roosting bats and all buildings have since been demolished. Bat activity surveys revealed low levels of bat activity at the site, restricted to foraging along the linear scrub at West Pond, the foot of the cliff at South Quay and the lit footpath along the eastern boundary of West Pond. Bat activity was dominated by Common Pipistrelle *Pipistrellus pipistrellus*, with occasional passes by Noctule *Nyctalus noctula* and Myotis *Myotis sp.* These linear features are likely to provide clear navigational features used by commuting bats moving to and from other local feeding sites.

Birds

- 2.11. The assemblage of birds noted during surveys undertaken at the site were generally typical of the habitats and included up to 44 species, although some species were only seen flying over the site or associated with the dock basin. It was considered likely that 20 of the species seen were breeding on the site and of these seven are of conservation significance (Dunnock *Prunella modularis*, Herring Gull *Larus argentatus*, Lesser Black Back Gull *Larus fuscus*, Song Thrush *Turdus philomelos*, Skylark *Alauda arvensis*, Meadow Pipit *Anthus pratensis* and Linnet *Carduelis cannabina*), namely listed on UKBAP/Section 42/ Birds of Conservation Concern in the UK (Eaton et al., 2009).
- 2.12. Other species of note seen during the bird surveys included Short-eared Owl *Asio flammeus*, Eurasian Hobby *Falco subbuteo*, Black Redstart *Phoenicurus ochruros*, and Curlew *Numenius arquata*, none of which were considered to be resident on the site.

Invertebrates

- 2.13. A broad range of invertebrates were recorded on the site, most of which are common and ubiquitous although 11 were of some conservation status and 13 were considered locally or regionally uncommon. The areas and habitats considered to have the highest value to invertebrates on the site include the base of the cliff in South Quay, the pond area in West Pond, the herb-rich grasslands at East Quay and the grassland and peripheral scrub across the site as a whole.

Badgers

- 2.14. The Extended Phase 1 Habitat survey identified some evidence of the possible presence of Badgers *Meles meles* in parts of East Quay. However subsequent inspection found that the excavations present on site were unlikely to be suitable for use by Badgers, although it is possible that badgers may have foraged in the area in the past leaving some evidence of their presence. No field signs associated with badgers were recorded in

any other area of the site and a site walkover survey undertaken in December 2011 and January 2012 identified no evidence of use of the site by Badgers¹.

¹ In line with Full Planning Condition 9 and Outline Condition 31 a Badger survey will be undertaken within 4 weeks of the commencement of works.

3.0 MITIGATION OVERVIEW – ENTIRE SITE

- 3.1 This section provides an overview of the mitigation measures which will be implemented across the whole site. The ecological mitigation strategy developed for the whole site is illustrated in Figure 1 and was devised as part of the submitted impact assessment (Environmental Statement) in 2009. Prior to each phase of development, a detailed Ecological Mitigation Strategy will be produced with specification for the mitigation measures to be provided as part of the relevant phase. The specifications for Phase 1 of the development are included in Section 4.0 below and in *The Quays - Development Phase 1 - Ecological Mitigation Strategy* (SBE, 2012). Indicative specifications for South Quay and East Quay are included in Sections 5.0 and 6.0, with more detailed specification dependent upon final site layout and timing of works.
- 3.2 The nature and scale of the development and the requirement to surcharge all areas of the site has limited the opportunity for habitat retention. Mitigation and has therefore focussed on the protection of adjoining habitats and features, maximising the biodiversity value of new planting and open space and the provision of specific on-site mitigation measures for existing features and species of value.
- 3.3 The mitigation strategy developed for the entire site incorporates the following key features²:
- Retention of approximately 2500m² grassland areas for Skylark to the south of East Quay³;
 - Design of Public Open Space in East Quay to provide grassland (incorporating Rough and Meadow Grassland) of potential value to Skylark (approximately 9500m²)⁴;
 - Retention of approximately 6800m² of ABP land on East Quay to retain grassland habitat in-situ and provide potential resource to Skylark⁵;
 - Provision of approximately 3500m² wildflower meadow as part of public open space at East Quay⁶;
 - Creation of linear park swale and meadow strip habitat through West Pond;
 - Public space including grass, bulb, herbaceous, trees and shrub species selected to be beneficial to biodiversity;
 - Street tree network to contribute to foraging corridors for birds and bats;
 - Retention and protection of a strip at least 2m wide at the cliff base and face along the South Quay;

² Further design details over and above the masterplan submitted with the ES have resulted in the revision of the areas of some features associated with the ecological mitigation. Figures submitted in ES are below.

³ 5300m² specified in ES

⁴ 2200m² specified in ES

⁵ 7100m² specified in ES

⁶ 1000m² specified in ES

- Retention and protection of rare plant (Childing Pink) areas off site (East Quay) and translocation of species (Corky Fruited Water Dropwort and Corn Parsley if required);
- Provision of brown roofs on the District Centre in West Pond (approximately 2500 m² of habitat).
- Brownfield habitat to be provided – up to 3500m² - as part of green corridor around south-western periphery of site⁷. This provision would be at ground level with a scrub corridor/hedge border adjacent to the development.
- Translocation of reptiles from within the application boundary to a suitable offsite area
- Creation of ‘green corridor’ link between off-site railway scrub and the cliff corridor.
- Retention of the cliff top green space managed as wildlife gardens, allotments and open space.
- Up to 1:5⁸ of the approximate 600 houses in South Quay to have bird boxes.
- Up to 300m² of thicket scrub in East Quay Park⁹

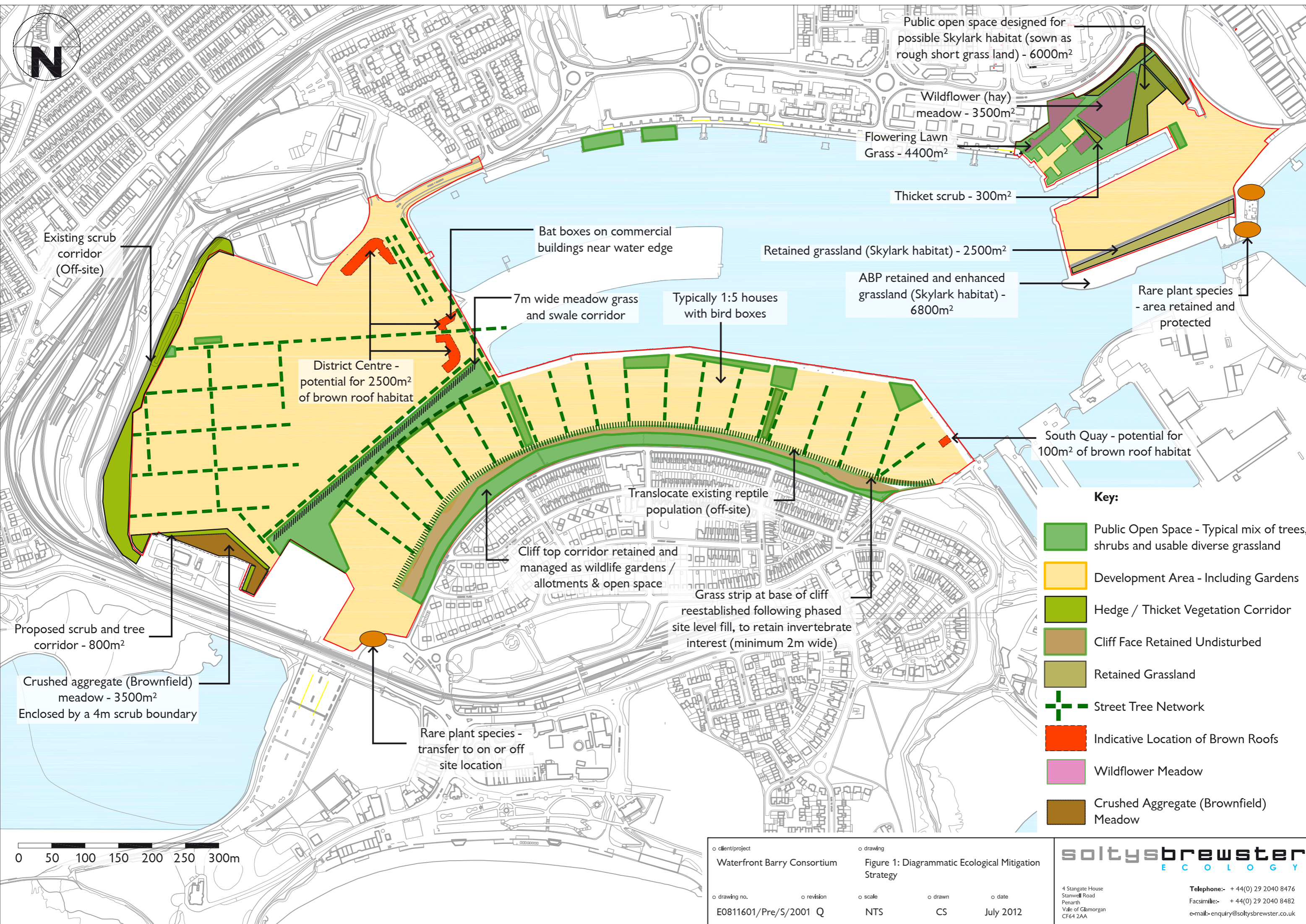
3.4 Appropriate management of these features has been identified in a separate management plan (SBE, 2012a) to assist with the discharge of Outline Planning Condition 24 (for the full list of planning conditions relating to ecology see Appendix II).

3.5 Separate mitigation strategies are being prepared for a number of species including reptiles, rare plants and invertebrates (for invertebrates see *Barry Waterfront Invertebrate Management Plan* (SBE, 2012b)). These species have not been considered in detail within this document, although recommendations relating to these species have been made where appropriate. Additional surveys for the rare plants (Corky Fruited Water Dropwort, Childing Pink and Corn Parsley) are to be undertaken in spring/ summer 2012 to inform the preparation of an appropriate mitigation strategy which will be prepared prior to the commencement of the relevant phases of development.

⁷ 2000m² specified in ES

⁸ Consultation with the Vale of Glamorgan post submission of the ES resulted in an increased provision of bird boxes – 1:10 provision was included in the submitted ES.

⁹ 500m² specified in ES. Approximate total area of shrub planting in East Quay Park is 3200m².



Public open space designed for possible Skylark habitat (sown as rough short grass land) - 6000m²

Wildflower (hay) meadow - 3500m²

Flowering Lawn Grass - 4400m²

Thicket scrub - 300m²

Retained grassland (Skylark habitat) - 2500m²

ABP retained and enhanced grassland (Skylark habitat) - 6800m²

Rare plant species - area retained and protected

Existing scrub corridor (Off-site)

Bat boxes on commercial buildings near water edge

7m wide meadow grass and swale corridor

Typically 1:5 houses with bird boxes

District Centre - potential for 2500m² of brown roof habitat

South Quay - potential for 100m² of brown roof habitat

Translocate existing reptile population (off-site)

Cliff top corridor retained and managed as wildlife gardens / allotments & open space






Grass strip at base of cliff reestablished following phased site level fill, to retain invertebrate interest (minimum 2m wide)

Proposed scrub and tree corridor - 800m²

Crushed aggregate (Brownfield) meadow - 3500m² Enclosed by a 4m scrub boundary

Rare plant species - transfer to on or off site location

Key:

-  Public Open Space - Typical mix of trees, shrubs and usable diverse grassland
-  Development Area - Including Gardens
-  Hedge / Thicket Vegetation Corridor
-  Cliff Face Retained Undisturbed
-  Retained Grassland
-  Street Tree Network
-  Indicative Location of Brown Roofs
-  Wildflower Meadow
-  Crushed Aggregate (Brownfield) Meadow



| | | | | | |
|------------------|-----------------------------|------------|---|---------|-----------|
| o client/project | Waterfront Barry Consortium | o drawing | Figure 1: Diagrammatic Ecological Mitigation Strategy | | |
| o drawing no. | E0811601/Pre/S/2001 Q | o revision | o scale | o drawn | o date |
| | | | NTS | CS | July 2012 |

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4.0 MITIGATION AND HABITAT CREATION – WEST POND (PHASE 1)

4.1 Remediation works within the area associated with Phase 1 of the development are due to commence from summer 2012. The habitat mitigation and creation associated with Phase 1 (within the area known as West Pond) is detailed below, with further detail on the specification of habitat creation provided in the following drawings and documents:

| | |
|---|-------------------|
| Ecological Mitigation: Street Tree Network | 0833103/PI/GA/065 |
| Ecological Mitigation: Brownfield Meadow and Pond | 0833103/PI/GA/066 |
| Ecological Mitigation: Linear Park and Swale | 0833103/PI/GA/067 |
| Invertebrate Management Plan | E0811601/ R08 |

Protection of offsite habitats/ existing scrub corridor

4.2 Prior to the commencement of works at the site, the boundary of the site is to be clearly demarcated using appropriate fencing (Heras or similar) to prevent encroachment onto adjacent areas and ensure protection of the off-site scrub along the western and northern boundaries.

4.3 The boundary of any other areas of the site to be used for any purpose associated with Phase 1 of the development (e.g. for the stockpiling of material, storage, vehicular access etc) should also be clearly demarcated and activities should not be undertaken outside these areas. No work should be undertaken in any area of South Quay due to the existing reptile population in this location (South Quay Parkside may be used for storage of material etc – reptiles are not associated with this location (see location plan in Appendix I)). The area which supports a population of Corky Fruited Water Dropwort (south of West Pond) should be fenced out during all works to prevent encroachment/ damage in this area. A strip at least 3m wide along the base of the cliff should also be protected from all works and should be demarcated via red and white tape (or similar).

Badgers

4.4 Site surveys (including a site walk-over undertaken in December 2011 and January 2012) found no evidence to suggest Badgers are currently using any area of the site. However, as a precautionary measure, a dedicated badger survey will be undertaken within 4 weeks of the commencement of any works at the site (survey undertaken from May 2012). The results of the survey will be submitted for approval to the local planning authority to assist with discharge of Full Condition 9 and Outline Condition 31.

Nesting birds

- 4.5 To reduce the suitability of the habitat for ground and scrub nesting bird species all existing vegetation within the boundary of Phase 1 (and any other area to be affected by works within Phase 1) should be cut to ground level in February 2012 (prior to the bird nesting season which typically runs from March to August inclusive). All arisings should be removed. Following the initial cut subsequent maintenance cutting of the vegetation should be undertaken every 2– 3 weeks between September and February to maintain vegetation height at 50– 100mm, or until the area has been surcharged.
- 4.6 No cutting should be undertaken in the area associated with the population of Corky Fruited Water Dropwort (south of West Pond), or along the base of the cliff (a strip at least 3m wide should be retained, protected and demarcated via red and white tape or similar).
- 4.7 The retained scrub around the site boundaries is likely to provide continued resource for scrub nesting species, along with additional scrub and tree planting in the proposed soft landscaping. Provision for nesting birds (bird boxes and retained areas for ground nesting species) are to be included in subsequent phases of the development (see Section 5.6 and 6.7 below).

Pond

- 4.8 Prior to the commencement of surcharging works at the site a shallow pond is to be created within the area identified for the brownfield meadow (see drawing number 0833103/PI/GA/066 - Ecological Mitigation: Brownfield Meadow and Pond). The pond is to be approximately 80m², gently sloping to a maximum water depth of 500mm. The pond should be excavated using a toothed bucket to a depth of 700mm and lined with compacted clay (approx. depth of 200mm) to ensure it retains water. Following completion of the clay lining a toothed excavator bucket should be gently raked over any remaining smooth surfaces to roughen the substrate surface and provide habitat for plant colonisation. Care should be taken not to pierce the depth of the clay ‘liner’ during this process. In order to permit surcharging/ in-filling of the existing pond from late autumn 2012, creation of the new pond in the brownfield meadow area would need to be programmed at the start of site works - i.e. from April/May 2012.
- 4.9 The pond should be allowed to fill naturally with rain water, or if filled artificially should be allowed to stand for a minimum of 14 days before introducing material from the existing pond. Material from the existing pond is to be dredged using an excavator with a straight edged (blade) bucket and immediately transferred to the newly created pond to transfer some of the existing interest and to help speed its establishment. Preferential timing for this operation would be in late summer/autumn 2012 so as to transfer eggs/larvae to

the new pond, although transfer of material would need to be undertaken prior to any surcharging works in the area associated with the existing pond.

Brownfield meadow

- 4.10 A brownfield meadow is to be created across an area of approximately 3500m² to the south of Phase 1 (see drawing number 0833103/PI/GA/066 - Ecological Mitigation: Brownfield Meadow and Pond). The substrate for the meadow should include a mixture of crushed aggregate (sourced from the site where possible) and ‘clean’, free draining subsoil (free of contaminants – i.e. sourced from off-site) and is intended to replicate existing habitat conditions found across much of the site. The pH of any imported aggregate should be neutral to slightly basic (ie pH 7-8) and the grain range of between 25mm to dust. The meadow area is to include a number of gently sloping substrate mounds (approximately 1m high) with stone and log piles to increase habitat diversity. The substrate will be sown in Autumn 2012 or Spring 2013 (timing dependent upon completion of sewer which is to run beneath the brownfield meadow) with Emorsgate EM1Basic General Purpose Meadow Mixture (a native grass and wildflower seed mix), with a variety of other species also likely to arrive by natural colonisation. The seed should not be sown onto frozen or waterlogged ground. The brownfield meadow should be surveyed by a suitably qualified in ecologist between July and September in the year following sowing. If a strong sward has failed to establish, further seed may need to be introduced. If required further seed will be collected from the species-rich grasslands at East Quay using a brush harvester (or similar method) and scattered across the brownfield meadow.
- 4.11 Log piles should be approximately 1.5m x 1m x 1m and should be constructed using timber and brash of varying sizes. Stone piles should include stones and boulders of varying sizes. The overall dimension of the stone piles should be approximately 1.5m x 1m x 1m. Timber and stones/ boulders could be sourced from the site itself if appropriate resources exist (any scrub/ trees should not be cut down in the breeding bird season which typically runs from March- August inclusive).
- 4.12 The brownfield meadow and adjacent scrub corridor (see Section 4.13) should be fenced out during all site clearance/ construction works to prevent any damage occurring during construction across the rest of the site. Vehicles should not be tracked over the area and the area should not be used for storage or for any other purpose to prevent damage to the substrate/ compaction.

Scrub and tree corridor

- 4.13 A 4m wide scrub and tree corridor is to be planted around the northern boundary of the brownfield meadow area to buffer the meadow from the residential development and provide additional scrub habitat on site (see drawing number 0833103/PI/GA/066 - Ecological Mitigation: Brownfield Meadow and Pond).

Species planted will include those found elsewhere on the site such as Hawthorn, supplemented with other native species to increase diversity such as Blackthorn *Prunus spinosa*, Dogwood *Cornus sanguinea*, Holly *Ilex aquifolium* and Hazel *Corylus avellana* with trees such as Field Maple *Acer campestre*, Alder *Alnus glutinosa*, Wild Cherry *Prunus avium* and Crab Apple *Malus sylvestris*. The tree and scrub planting will link into other tree corridors to be planted across the site.

Tree corridors

4.14 The tree corridors (street trees) are to be detailed as part of a future reserved matters application. Tree species will include native and ornamental species, (both flowering and fruiting varieties) appropriate to differing public realm locations. The trees corridors will be designed to contribute to overall biodiversity and provide a network of foraging and commuting habitats across the site for species such as birds and bats (see drawing number 0833103/PI/GA/065 - Ecological Mitigation: Street Tree Network).

Linear park

4.15 The linear park (see drawing number 0833103/PI/GA/067 - Ecological Mitigation: Linear Park and Swale), which includes a tree corridor, swale and meadow grass planting, is likely to provide shelter and foraging habitat for a variety of species such as birds, bats and invertebrates and is designed to link in to other linear habitats across the site such as the tree corridors.

4.16 The meadow grassland will form a 3m wide strip running the length of the park and will be seeded with Emorsgate EM2 Standard General Purpose Meadow Mixture, with Emorsgate EC1 Standard Cornfield Mixture as a nurse Mix. Additional bulbs and seeding will be included for landscape display purposes, including: Bluebell *Hyacinthoides non-scripta*, increased Cowslip *Primula veris*, Snakeshead Fritillary *Fritillaria meleagris* and spring and autumn crocus. The swale strip is to be 4m wide and located directly adjacent to the meadow grassland strip. The swale is to be seeded with Emorsgate EM8 Meadow Mixture for Wetlands to create a diverse, flower rich sward, with additional planting in key areas. The seed should not be sown onto frozen or waterlogged ground. The linear park should be surveyed by a suitably qualified in ecologist between July and September in the year following sowing. If a strong sward has failed to establish, further seed may need to be introduced. If required further seed will be collected from the species-rich grasslands at East Quay using a brush harvester (or similar method) and scattered across the linear park. The swale and the meadow grass strips will be managed to allow species to flower and set seed over the summer.

4.17 Emorsgate EL1 Flowering Lawn Mix will be used in amenity grassland areas within the linear park. This mix includes a variety of grasses and wildflowers that respond well to short mowing and will provide greater diversity than a standard amenity grass seed mix.

Invertebrates

- 4.18 Much of the invertebrate interest in the area to be developed during Phase 1 is associated with the existing shallow pond. A similar shallow pond is to be created in the brownfield meadow area to the south of the site (see 4.8 – 4.9). This pond is to be dug prior to the destruction of the existing pond and material from the existing pond is to be transferred to the newly created pond to help speed its establishment. It is likely this transfer of material will also include some of the invertebrate interest. Many of the species associated with the existing pond are known to be quick to colonise new water bodies and rapid colonisation of the new pond from other existing ponds in the surrounding area is considered likely.
- 4.19 The off-site scrub corridors around the western and northern boundary supported a variety of butterfly species. This existing resource is to be retained and protected during all site clearance and construction work. Additional habitat will also be provided within the brownfield meadow and scrub corridor, and the meadow and swale planting associated with the linear park.

Bat boxes

- 4.20 Bat boxes are to be incorporated into the commercial buildings along the water's edge, the full details of which are to be dealt with as part of a future reserved matters application. It is recommended that boxes should be positioned at a height of at least 5m above the ground on both the eastern and southern elevation of the commercial buildings (see Figure 1), close to the water's edge and the linear park. Appropriate boxes would include those that can be incorporated into a building itself (e.g. bat bricks <http://www.ibstock.com/sustainability-ecozone.asp>) or bat boxes which can be affixed to the external walls (e.g. Schwegler 1FF Bat Box http://www.alanaecology.com/wildlife/1FF_Bat_Box.html). These boxes are long lasting and require no maintenance and would be considered appropriate for species such as Pipistrelle which have been recorded on the site.
- 4.21 Off-site scrub along the western and northern boundary of West Pond will provide continued foraging and commuting habitat, with the linear park, street tree network and scrub corridor proposals within the site all providing additional potential commuting and foraging habitat.
- 4.22 To prevent disturbance to light sensitive species site lighting is to be restricted to maintain 'dark corridors' wherever possible along features such as the retained scrub boundaries of the site. A lighting design plan has not yet been prepared, but where standard height street lighting is required adjacent to the retained habitats, directional or cowled lanterns should be adopted that limit light spill. Lantern design should be of high-pressure sodium type. Further advice on street lighting and bats can be found in Appendix IV.

Brown roofs

- 4.23 Brown roofs are to be incorporated onto the district centre, the full details of which are to be dealt with as part of a future reserved matters application – these buildings are not within the control of the Development Consortium. It is recommended that a substrate of crushed aggregate and subsoil similar to that used to create the brownfield meadow is used. The substrate depth should vary across the roof to promote the development of habitat diversity. The substrate should be sown in spring or autumn with a native grass and wildflower seed mix such as Emorsgate EM1Basic General Purpose Meadow Mixture.

Rare Plants

- 4.24 Corky Fruited Water Dropwort was identified to the south of West Pond and no works should be undertaken in this area until a survey to confirm likely presence/absence of the plant has been undertaken (July 2012). The area should be clearly demarcated/fenced out to prevent accidental damage (tracking of vehicles, storage of materials etc.).

Reptiles

- 4.25 Reptile surveys undertaken in 2008 confirmed the likely absence of reptiles from all land which falls into Phase 1 of the development, although a medium sized population of Slow Worm was identified at the eastern end of South Quay. It is considered unlikely that the reptile population would have spread into the West Pond area due the largely unsuitable nature of the habitat in between the existing population at South Quay (predominantly bare ground and ephemeral/ short perennial vegetation), although as a precaution a reptile proof fence is to be constructed along the western boundary of South Quay (see Section 5.22).

Programme of works

- 4.26 The anticipated timing for the completion of features associated with the ecological mitigation within Phase 1 are detailed in Table 1. All timings are approximate only and may be subject to change, dependent upon progress of works on site.

Table 1. Anticipated programme of work

| Works | Anticipated timing |
|--|-------------------------------|
| Construction of temporary fence around Corky Fruited Water Dropwort and demarcation of retained strip along cliff base (minimum 3m wide) via red and white tape or similar. Erection of reptile proof fence along western boundary of South Quay. | June/ early July 2012 |
| Construction of shallow pond and transfer of material from existing pond to newly created pond. | July/ August 2012 |
| Creation of brownfield meadow substrate. | Summer/ Autumn 2012* |
| Sowing of brownfield meadow (Emorsgate EM1 Meadow Mixture). | Autumn 2012 or Spring 2013* |
| Planting of scrub corridor around brownfield meadow. | October 2012 – March 2013* |
| Sowing of meadow strip and swale within the linear park. | September 2015 – January 2016 |

* = timing dependent upon completion of sewer which is to run beneath the brownfield meadow area.

- 4.27 Following completion of the above works a site visit is to be undertaken a suitably qualified ecologist and (if required) the local authority ecologist to check the features have been completed to the required specification.

5.0 MITIGATION AND HABITAT CREATION – SOUTH QUAY

5.1 Construction at South Quay is expected to begin in 2016. The proposed habitat mitigation and creation associated development in this area is detailed below, with further detail provided in the drawings and documents listed below. Specifications are indicative only and may be subject to revision, dependent upon the final site layout.

| | |
|--|-------------------|
| Ecological Mitigation: Street Tree Network | 0833103/PI/GA/065 |
| Ecological Mitigation: Cliff Top and Base | 0833103/PI/GA/073 |
| Ecological Mitigation: Bird Box Locations | 0833103/PI/GA/071 |
| Invertebrate Management Plan | E0811601/ R08 |

Interim Management

5.2 Given the anticipated development timescale for South Quay (and East Quay – see Section 6.2), management between 2012 and 2016 would be appropriate to maintain the existing habitat mosaic and prevent the whole area being colonised by scrub – Butterfly Bush *Buddleia Davidii* would likely colonise much of the grassland/bare ground at South Quay if left unmanaged. Regular management by annual cutting/strimming of vegetation to ground level in September/October would be effective in controlling scrub encroachment. Following cutting, all arisings should be removed immediately from site (within 48h) and disposed off or composted off-site.

5.3 Due to the elapsed time between the baseline surveys (SBE, 2008 and SBE, 2009) and the anticipated commencement of works at South Quay (2016) it is recommended that an update botanical and site walkover survey is undertaken in the year prior to commencement of works in this area. The full scope of the surveys should be agreed with the local authority before being undertaken.

Protection of off-site habitats

5.4 Prior to the commencement of works at South Quay, the boundary of the appropriate development phase is to be clearly demarcated using appropriate fencing (Heras or similar) to prevent encroachment onto adjacent areas and ensure protection of off-site habitats - in particular the base of the cliff and retained corridor. The boundary of any other areas to be used for any purpose associated with the development (e.g. for the stockpiling of material, storage, vehicular access etc) should also be clearly demarcated and activities should not be undertaken outside these areas.

Badgers

- 5.5 Site surveys including a site walk-over undertaken in January 2012 found no evidence to suggest Badgers are currently using the South Quay area of the site. However as a precautionary measure a dedicated Badger survey should be undertaken within 4 weeks of the commencement of any works in the South Quay area of the site. The results of the survey will be submitted for approval to the local planning authority to assist with discharge of Outline Condition 31.

Nesting birds

- 5.6 To reduce the suitability of the habitat for ground and scrub nesting bird species all existing vegetation within the boundary of the South Quay development should be cut to ground level over the winter prior to the commencement of development. All vegetation management would need to be undertaken outside the breeding bird season (which typically runs from March to August inclusive) and would also need to co-incide with the timing of vegetation clearance for the reptile mitigation strategy. All arisings should be removed and disposed of/ composted off site as appropriate. Following the initial cut, subsequent maintenance cutting of the vegetation should be undertaken every 2– 3 weeks between March 2016 and the commencement of construction works (anticipated from summer 2016) to maintain vegetation height at 50– 100mm, or until the area has been surcharged.
- 5.7 Bird boxes are to be included on 1:5 of the houses within the South Quay area. Although the site layout has yet to be finalised indicative locations for bird boxes have been included in drawing number 0833103/PI/GA/071 - Ecological Mitigation: Bird Box Locations. Appropriate bird boxes include the Schwegler variety (available from www.alanaecology.com or similar) which are known to be long lasting (25 years or more) and require little or no maintenance. The successful occupation of these boxes will be dependent upon a combination of factors including the presence of the target species in the local area, box location, availability of food, and local scarcity of natural nesting sites.
- 5.8 Suitable boxes include those that can be incorporated into the building itself or affixed to the external walls. Appropriate boxes and optimal positioning for each type of box is detailed in Table 1. Where possible the box entrance hole should face between north and east, out of the prevailing wind and direct sunlight. Boxes should be affixed using galvanized or stainless steel screws or nails that will not rust. Where possible boxes should not be affixed directly above windows to prevent droppings falling onto them. It may be necessary to affix a droppings board below House Martin nests boxes in certain locations to avoid problems with a build-up of bird droppings on building walls (suitable designs include the Schwegler Droppings Board).
- 5.9 Boxes for species which nest in colonies such as Swift, House Martin and House Sparrow should be positioned in appropriately sized groups to encourage their use. House Sparrows tend to nest in loose

colonies of 10- 20 pairs, with House Martins nesting in colonies of around 5- 10 pairs. Swift colony size is determined largely by the availability of suitable nesting sites.

Table 1. Bird boxes appropriate for use in South Quay

| Box Type | Species | Position | Height above the ground | Percentage of boxes |
|---|---|--|-------------------------|---------------------|
| Schwegler No 11 House Martin Nest | House Martin | On unobstructed walls directly beneath the eaves, or on walls without eaves. | 2m or above | 15 |
| Schwegler No 17 Triple Cavity Swift Box | Swift | Near the roof of the building. | 6- 7m | 30 |
| Schwegler 1SP Sparrow Terrace | House Sparrow | Incorporated into the building or affixed to walls | 2m or above | 20 |
| Schwegler 2H Open Fronted Robin Box | Robins, Pied Wagtails, Wrens etc | Hung from building walls or fences, with the entrance to the side. | 1.5- 2.5m | 20 |
| Schwegler 1N Deep Nest Box | Robins, Pied Wagtails, Tits and Sparrows. | Hung from building walls or fences. | 2- 3m | 15 |

5.10 Provision for ground nesting species (retained grassland) is to be included at East Quay and is detailed further below (see Section 6.8). The retained scrub along the cliff top is likely to provide continued resource for scrub nesting species, along with additional scrub and tree planting in the proposed soft landscaping.

Tree corridors

5.11 The tree corridors will be dependent upon the final layout. Tree species will include native and ornamental species, (both flowering and fruiting varieties) appropriate to differing public realm locations. The trees corridors will be designed to contribute to overall biodiversity and provide a network of foraging and commuting habitats across the site for species such as birds and bats (see drawing number 0833103/PI/GA/065 - Ecological Mitigation: Street Tree Network).

Cliff Top

5.12 The cliff top is currently dominated by dense scrub with smaller areas of grassland, as well as a number of existing allotments and a garden associated with Barry Island Primary School. Although proposals for much of the cliff top have yet to be finalised it is likely to include a number of allotments and wildlife gardens, as well as areas of retained scrub and grassland to be managed primarily for the benefit of biodiversity (see drawing number 0833103/PI/GA/073 - Ecological Mitigation: Cliff Top and Base). Clearance of a small area of the cliff top for allotments is to begin in February 2012, with further clearance for allotments/ gardens to be undertaken at a later date. The cliff top scrub and grassland habitats are considered suitable to support

breeding birds and common reptiles (Slow Worms have been identified along the cliff top). To avoid conflict with these species sensitive working methodology and timings and should be adopted as detailed below.

- 5.13 In the areas proposed for allotments/ gardens all scrub should be cleared to ground level between December and late February. Clearance between December and February would coincide with the period of reptile hibernation and would avoid the need for successive, gradual cuts of the vegetation that would be required for vegetation clearance works later in the year, as well as avoiding the breeding bird season. Vegetation to be cleared by hand to ground level (c.50mm) using stimmers, chainsaws, brush cutters or similar. All arisings are to be removed and disposed of/ composted off-site as appropriate. To ensure the area remains unsuitable for reptiles vegetation maintenance/ management may be required to maintain the vegetation height at or below 50mm until works to construct the allotments/ gardens have commenced. Works to construct the allotments/ gardens should be undertaken during the period when reptiles are active (typically from April to September, dependent upon weather conditions). No works (including storage of material, tracking of vehicles etc) should be undertaken in any area except that cleared for allotments.
- 5.14 The retained habitat is to include a strip approximately 4- 5m wide along the length of the cliff top, as well as larger areas of retained habitat at the western and eastern ends. The areas of retained habitat are to be fenced out to prevent the allotments/ gardens encroaching upon the habitat and to limit disturbance. To benefit species such as invertebrates, areas of existing dense scrub are to be cleared and these areas managed via a cutting regime to maintain the grassland habitat and promote species diversity. Scrub cover should be cut back until approximately 20% cover remains in patches across the retained areas at the eastern and western ends of the cliff top – the 4-5m strip along the cliff top should remain in-situ with only minimal management to prevent encroachment into the allotment areas. Clearance of all scrub/ trees should be undertaken outside of the breeding bird season and all vegetation clearance should be undertaken by hand using stimmers, chainsaws, brush cutters or similar. All arisings should be removed and disposed of/ composted off-site as appropriate. Clearance of scrub from the retained habitats could be programmed in from winter 2013. Woody scrub could be stump treated with herbicide to kill off the root and prevent re-growth, or alternatively, roots could be ‘grubbed out’ later in the year from late spring to summer, during the period when reptiles are active. Grubbing out should not be undertaken over winter to avoid the risk of affecting hibernating reptiles that may be present.
- 5.15 Cleared areas should be allowed to naturally colonise with grassland species from the surrounding area or, to help speed establishment, could be sown with an appropriate native seed mix (such as Emorsgate EM10 Tussock Mixture) or seed sourced from a grassland site in the local area.

- 5.16 To benefit species such as reptiles and invertebrates a number of log-piles should be constructed in the retained areas of habitat at the eastern and western ends of the cliff-top. It is recommended that 4 log-piles are constructed in the larger areas of retained habitat at either end of the cliff (2 log-piles at each end). Log piles should be approximately 1.5m x 1m x 1m and should be constructed using timber and brash of varying sizes. Timber for the log-piles could be sourced from the site itself if appropriate resources exist (any scrub/trees should not be cut down in the breeding bird season which typically runs from March- August inclusive), or sourced externally if required.

Cliff Base

- 5.17 The grassland and scree at the base of the cliff in South Quay was identified as a key habitat for invertebrates within the Quays site. A strip at least 2m wide along the cliff base is to be re-established following surcharging to provide continued habitat for invertebrates in this area (see drawing number 0833103/PI/GA/073 - Ecological Mitigation: Cliff Top and Base).
- 5.18 Prior to surcharging scree and large boulders are to be excavated from along the cliff base and stored in an appropriate location. The substrate at the foot of the cliff is also to be excavated to a depth of 400mm and stored in an appropriate location (to prevent damage the substrate should be moved no more than twice i.e. once to an appropriate storage location and once to return it to the cliff base). Following surcharging the cliff base habitat is to be recreated using the stored substrate material, scree and boulders along the length of the cliff. The substrate excavated from the cliff based should be replaced along the surcharged areas at the base of the cliff, with the scree placed on top of the substrate to recreate the cliff base habitat. Selected large boulders should be replaced along the length of the cliff base (any surplus boulders could be used elsewhere on the site, e.g. at the edge of the brownfield meadow and pond, or in the swale corridor. Vegetation should be allowed to naturally colonise the cliff base, or seed collected from species-rich grasslands in other areas of the site (e.g retained grassland at East Quay) using a brush harvester and scattered along the recreated cliff-foot substrates.

Bats

- 5.19 To prevent disturbance to light sensitive species site lighting is to be restricted to maintain 'dark corridors' wherever possible along features such as the cliff base and cliff top. Where standard height street lighting is required adjacent to the retained habitats, directional or cowled lanterns should be adopted that limit light spill. Lantern design should be of high-pressure sodium type. Further advice on street lighting and bats can be found in Appendix IV.

Invertebrates

5.20 Most of the invertebrate interest in the area to be developed at South Quay is associated with the scree habitats along the base of the cliff. The mitigation measures for the cliff base described in section 5.17 have been developed as part of the mitigation strategy for terrestrial invertebrates (see *Barry Waterfront Invertebrate Management Plant* (SBE, 2012b) for further detail). Other habitats such as the retained habitat along the cliff top and the tree, shrub and garden planting to be implemented across the South Quay area are also likely to provide habitat for a variety of invertebrate species.

Brown roofs

5.21 As well as within the district centre at West Pond there is potential for up to 100m² of brown roof habitat to be included on a building at the eastern end of South Quay. The full details of the building are yet to be finalised but it is recommended that a substrate of crushed aggregate and subsoil similar to that used to create the brownfield meadow and brown roofs at West Pond is used. The substrate depth should be varied across the roof to promote the development of habitat diversity in the roof top habitat. The substrate should be sown in spring or autumn with a native grass and wildflower seed mix such as Emorsgate EM1Basic General Purpose Meadow Mixture, with other species likely to arrive by natural colonisation.

Reptiles

5.22 Reptile surveys undertaken in 2008 confirmed the presence of a medium sized population of Slow Worm at the eastern end of South Quay. It is considered unlikely that the reptile population would have spread far into adjoining habitats due the largely unsuitable nature of the habitat in-between the existing population and areas to the west (predominantly bare ground and ephemeral/ short perennial vegetation). Prior to the commencement of any works at South Quay a detailed reptile translocation strategy will be prepared and agreed with the Local Authority. The translocation strategy will include an assessment of any proposed receptor site and appropriate measures to enhance the habitat for reptiles at the site.

5.23 To prevent the spread of reptiles to other areas of the site where they could be at risk of killing or injury a suitable fence is to be erected along the western boundary of South Quay in 2012, prior to the commencement of development at West Pond. A concrete fence (dug into the ground) currently exists along much of the western boundary of South Quay but does not extend the full length of the boundary, with open metal fencing at both ends. A reptile-proof fence should be constructed from the concrete fence to meet the cliff face along the southern boundary and the existing tarmac along the northern boundary. The fence should be constructed using timber board securely fixed to upright posts or to the existing metal fence. The board should extend at least 600mm above the ground and should be dug a minimum of 300mm into the ground. After being dug into the ground material should be backfilled into the hole and compacted as far as possible to ensure that no fissures or gaps are left in the backfill or against the board. No gaps should be

present along or underneath the fence, or where the board abuts the existing concrete fence. The fence should be regularly checked to ensure it remains intact, with any damaged sections immediately replaced or repaired (within 24- 48hrs).

6.0 MITIGATION AND HABITAT CREATION - EAST QUAY

6.1 Construction at East Quay is expected to begin in 2020. The proposed habitat mitigation and creation associated development in this area is detailed below, with further detail on the specification of habitat creation provided in the drawings and documents listed below. Specifications are indicative only and may be subject to revision, dependent upon the final site layout.

| | |
|--|-------------------|
| Ecological Mitigation: East Quay Park | 0833103/PI/GA/068 |
| Ecological Mitigation: Street Tree Network | 0833103/PI/GA/065 |
| Ecological Mitigation: Retained Grassland at East Quay | 0833103/PI/GA/072 |
| Invertebrate Management Plan | E0811601/ R08 |

Interim Management

6.2 Given the anticipated development timescale for East Quay, management between 2012 and 2020 would be appropriate to maintain the existing habitat mosaic and prevent the whole area being colonised by scrub – Butterfly Bush *Buddleia Davidii* would likely colonise much of the grassland/bare ground if left unmanaged. Regular management by annual cutting/strimming of vegetation to ground level in September/October would be effective in controlling scrub encroachment (see drawing number 0833103/PI/GA/072 - Ecological Mitigation: Retained Grassland at East Quay). Following cutting, all arisings should be removed immediately from site (within 48h) and disposed off or composted off-site.

6.3 Due to the elapsed time between the baseline surveys (SBE, 2008 and SBE, 2009) and the anticipated commencement of works at East Quay (2020) it is recommended that an update surveys are undertaken in the year prior to commencement of works in this area. Recommended surveys would include a botanical survey, reptile survey and invertebrate survey. The full scope of the surveys should be agreed with the local authority before being undertaken

Protection of off-site habitats

6.4 Prior to the commencement of works at the site, the boundary of the site is to be clearly demarcated using appropriate fencing (Heras or similar) to prevent encroachment onto adjacent areas and ensure protection of habitats retained as part of the development – in particular the retained grassland at the southern edge of East Quay (Figure 1).

Badgers

6.5 Surveys undertaken in 2008 identified some evidence of the possible presence of Badgers in parts of East Quay. However subsequent inspection found that the excavations present on site were unlikely to be

suitable for use by Badgers, although it is possible that badgers may have foraged in the area in the past leaving some evidence of their presence. No evidence of badgers has been recorded during any of the subsequent site surveys, including a site walkover undertaken in December 2011. However, as a precautionary measure, a dedicated badger survey will be undertaken within 4 weeks of the commencement of any works in this area of the site. The results of the survey will be submitted for approval to the local planning authority to assist with discharge of Outline Condition 31.

Nesting birds

- 6.6 To reduce the suitability of the habitat for ground and scrub nesting bird species all existing vegetation within the boundary of the East Quay development - i.e. East Quay Park and the residential development south of the basin - should be cut to ground level in the winter prior to the commencement of development (winter 2019). All vegetation management will need to be undertaken outside the breeding bird season (which typically runs from March to August inclusive). All arisings should be removed. Following the initial cut subsequent maintenance cutting of the vegetation should be undertaken every 2– 3 weeks between September and February to maintain vegetation height at 50– 100mm, or until the area has been surcharged.
- 6.7 The retained grassland to the south of East Quay is designed to provide continued nesting habitat for ground nesting species such as Skylark (see Section 6.8), with scrub and tree planting in the proposed soft landscaping at East Quay Park likely to provide a resource for scrub nesting species.

Retained Grassland at East Quay

- 6.8 Grassland to the south of East Quay is to be retained and managed with the aim of maintaining a resource for ground nesting bird species such as Skylark and Meadow Pipit (see drawing number 0833103/PI/GA/072 - Ecological Mitigation: Retained Grassland at East Quay). The retained grassland should be fenced out during all site clearance/ construction works to prevent any damage occurring during construction across the rest of the site. Vehicles should not be tracked over the area and the area should not be used for storage or for any other purpose to prevent damage to the habitats or disturbance of nesting birds. Following completion of construction the area a permanent fence is to be erected along the boundary of the land owned by the Consortium to prevent access by members of the public, both to limit disturbance to nesting birds and on health and safety grounds associated with the dock edge along the southern boundary. Any fence is to have bird deterrent devices (e.g. bird spiking) fitted onto all potential perching posts to prevent predatory birds (which could predate ground nesting birds and their eggs) from using the fence.
- 6.9 A narrow strip adjacent to the residential development may require re-grading as a result of surcharging works, although this will not be confirmed until the final layout has been approved. Should re-grading be

required a grass sward should be re-established over the disturbed area using Emorsgate EM10 Tussock Mixture, sown in spring or autumn.

East Quay Park

- 6.10 East Quay Park (see drawing number 0833103/PI/GA/068 – Ecological Mitigation: East Quay Park) includes tree and shrub planting, with areas of wildflower meadow and rough grassland. The park is likely to provide shelter and foraging habitat for a variety of species such as birds, bats and invertebrates.
- 6.11 The meadow grassland (approximately 3500m²) and will be seeded with Emorsgate EM3 Special General Purpose Meadow Mixture, with a nurse mix of EC1 Standard Cornfield Mixture. These mixes include a diverse range of wildflowers and grasses. Additional native species will be added to this to increase its visual interest as a focal area within the park, including an increased percentage of Oxeye Daisy *Leucanthemum vulgare*, Bluebell *Hyacinthoides non-scripta*, Snakeshead Fritillary *Fritillaria meleagris* and spring and autumn bulbs. The rough grassland (approximately 6000m²) is located directly adjacent to the meadow grassland and is to be seeded with Emorsgate EM10 Tussock Mixture to create a tussocky, flower rich sward. The meadow and rough grass areas will be managed to allow species to flower and set seed over the summer, with some rough grassland retained over the winter to provide shelter for species such as invertebrates.
- 6.12 Emorsgate EL1 Flowering Lawn Mix will be used in many of the amenity grassland areas within East Quay Park. This mix includes a variety of grasses and wildflowers that respond well to short mowing and will provide greater diversity than a standard amenity grass seed mix.

Tree corridors

- 6.13 The tree corridors will be dependent upon the final layout. Tree species will include native and ornamental species, (both flowering and fruiting varieties) appropriate to differing public realm locations. The trees corridors will be designed to contribute to overall biodiversity and provide a network of foraging and commuting habitats across the site for species such as birds and bats (see drawing number 0833103/PI/GA/065 - Ecological Mitigation: Street Tree Network).

Invertebrates

- 6.14 Most of the invertebrate interest in the area to be developed at East Quay is associated with the existing grassland habitats. To maintain the existing grassland resource in the interim prior to development (i.e. between 2012 and 2020) it is recommended that the grassland is cut each year in September/ October, with all arisings removed (see 6.2). No vegetation management should be undertaken during the breeding bird season which typically runs from March to August inclusive. The retained grassland habitat to the south of

East Quay, the wildflower grasslands in East Quay Park and the tree, shrub and garden planting to be implemented across the East Quay area are also likely to provide habitat for a variety of invertebrate species.

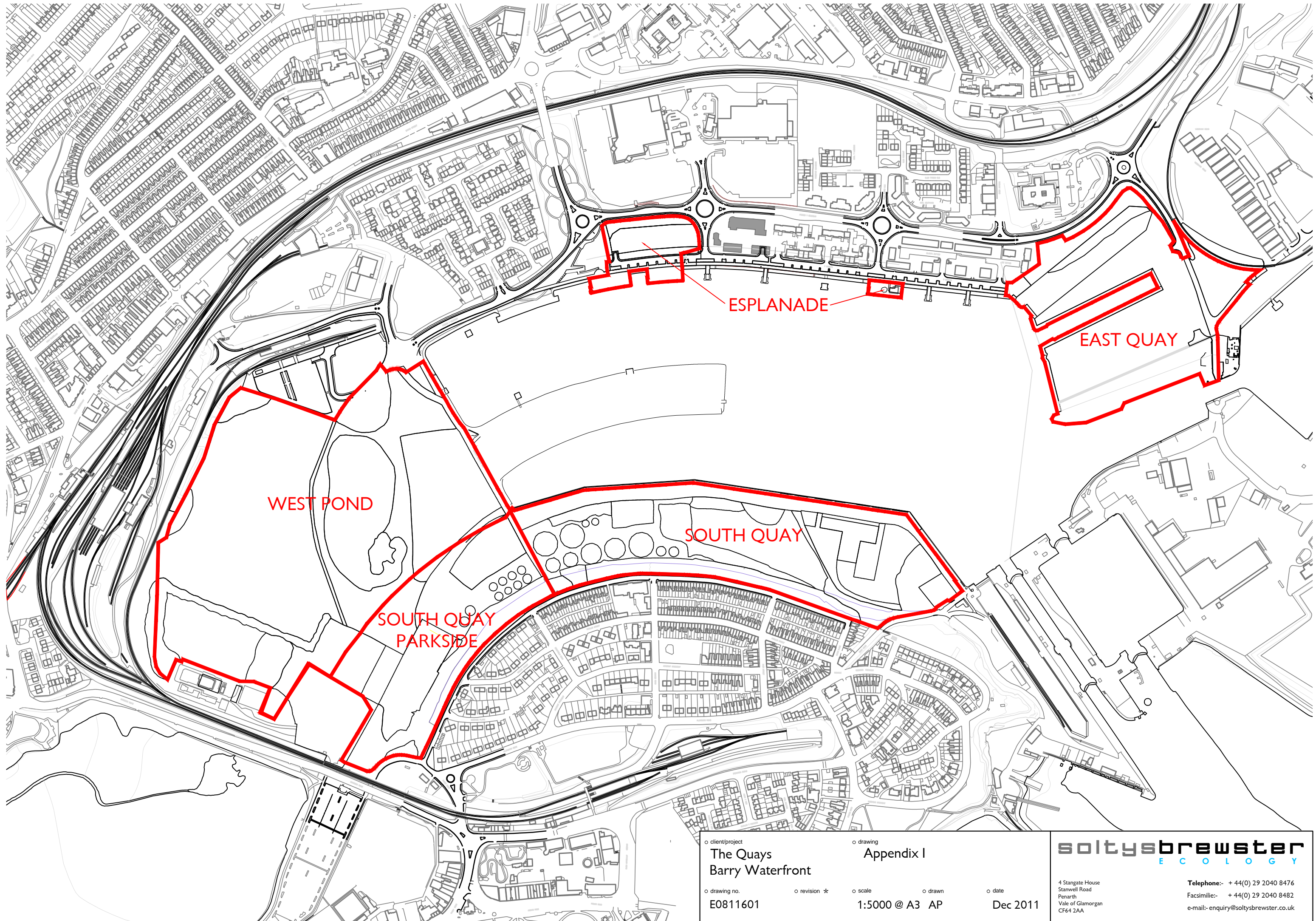
Rare plants

- 6.15 Corn Parsley was identified growing on a road verge to the northeast of East Quay, with the population of Childling Pink located off-site to the Southeast. Additional surveys for these plants are to be undertaken in summer 2012 to inform the mitigation/ translocation strategy which will be prepared prior to the commencement of the relevant phases of development.

REFERENCES

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- Nathaniel Lichfield and Partners (NLP) (2009) *Barry Waterfront – Environmental Statement Chapter F – Ecology*.
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- Soltys Brewster Ecology (SBE) (2012) *Ecological Mitigation Strategy – Development Phase 1*.
- Soltys Brewster Ecology (SBE) (2012a) *The Quays – Ecological Management Plan*
- Soltys Brewster Ecology (2012b) *The Quays - Invertebrate Management Plan*.

APPENDIX I SITE LOCATION AND EXTENT OF PHASE 1 OF DEVELOPMENT



client/project The Quays
Barry Waterfront

drawing Appendix I

drawing no. E0811601

revision *

scale 1:5000 @ A3 AP

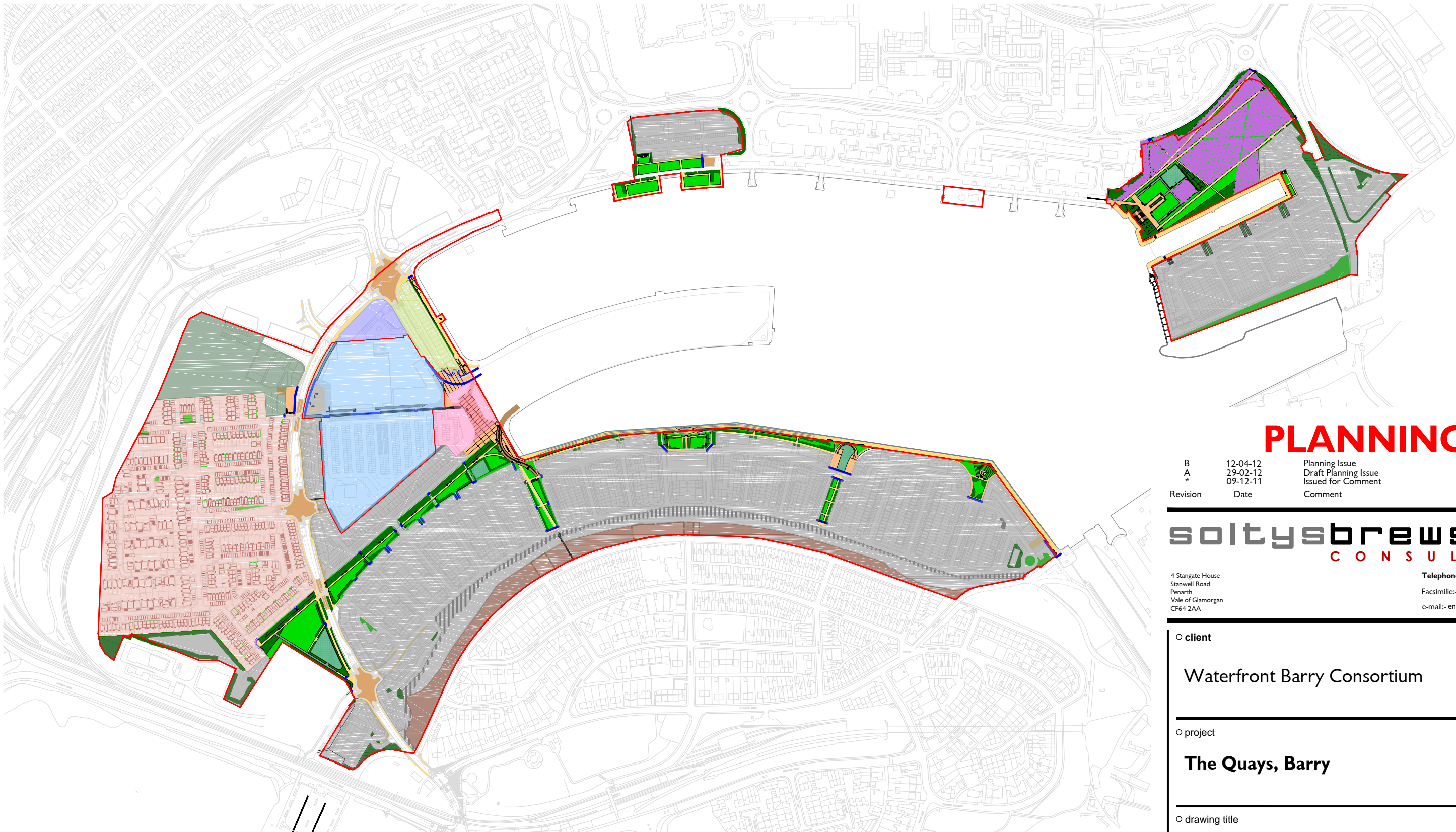
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PLANNING

| Revision | Date | Comment |
|----------|----------|----------------------|
| B | 12-04-12 | Planning Issue |
| A | 29-02-12 | Draft Planning Issue |
| * | 09-12-11 | Issued for Comment |

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| ○ client | | | |
| Waterfront Barry Consortium | | | |
| ○ project | | | |
| The Quays, Barry | | | |
| ○ drawing title | | | |
| Public Realm Extent | | | |
| ○ scale | ○ drawn | ○ approved | ○ date |
| 1:5000 @ A3 | CS | SB | April 2012 |
| ○ drawing no. | | | ○ revision |
| 0833103/PI/GA/064 | | | B |

General Key:

| | | | |
|--|------------------------------------|--|---|
| | Public Realm (Including Link Road) | | School Site |
| | Phase 1 Residential (West Pond) | | Apartment Site (West Pond) |
| | Retail Site | | Cliff Top Strip |
| | Waterside Retail and Commercial | | Future, Principally Residential Development Phases (Arno Quay, South Quay, Park Side, East Quay) |
| | Hotel Site | | |

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APPENDIX II PLANNING CONDITIONS RELATING TO SITE ECOLOGY

Full Conditions

- 7 *No development shall commence until such time as a detailed scheme for the provision of the proposed habitat mitigation / creation shall be submitted to and approved in writing with the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme.*
- 8 *Before the commencement of development a detailed mitigation statement and translocation methodology (including assessment of any proposed receptor site and measures to increase carrying capacity) shall be submitted to and approved in writing with the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme, unless any variations are agreed in writing with the Local Planning Authority.*
- 9 *No development shall commence until a survey of the site for badgers has been undertaken and prepared by competent persons with suitable qualifications, licenses and experience, and a report submitted to and approved in writing with the Local Planning Authority. The timing of the survey shall be appropriate to confirm the absence of badgers from the site immediately prior to work commencing and to ensure that it is undertaken using nationally recognised survey guidelines / methods where available and working to best practice standards.*
- 10 *Any vegetation clearance across the site shall be undertaken outside the nesting season, which is generally recognised to be from March to August inclusive, unless it can be demonstrated through submission to the Local Planning Authority of an appropriate survey immediately prior to works commencing that nesting birds are absent or a method statement for works is agreed in writing with the local planning authority and fully implemented prior to works commencing.*

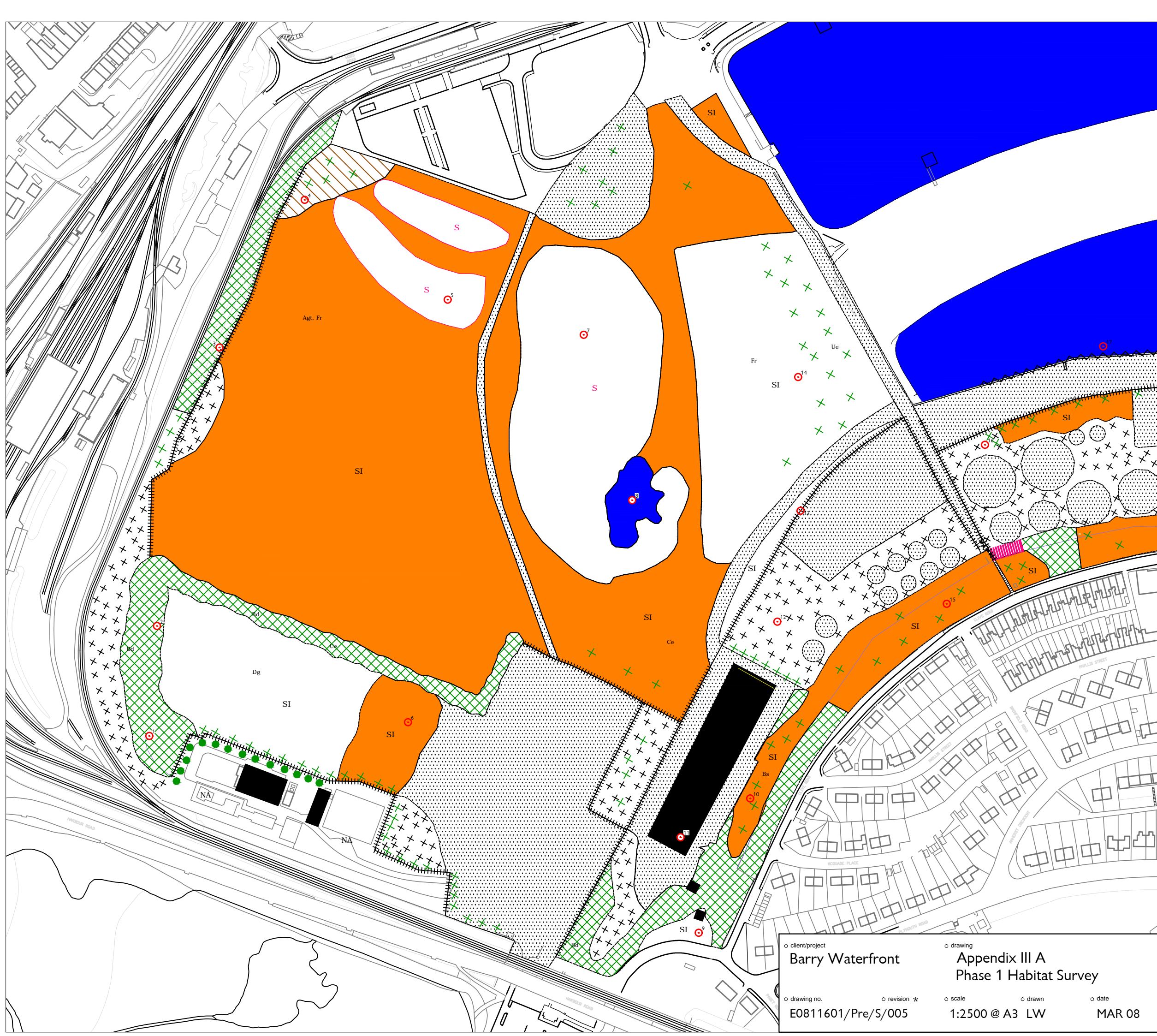
Outline conditions

- 24 *Before the commencement of development a detailed and costed wholosite management plan and monitoring scheme for the biodiversity interests across the site, shall be submitted to and agreed in writing with the Local Planning Authority and this strategy shall be followed by a detailed and costed management plan for each phase of the development, prior to the commencement of any work on that phase. These phased plans shall provide for management responsibilities for a 20 year period and a monitoring scheme to include submission of a monitoring report and management review to the Local Planning Authority in years 2, 5, 10 and 20, and the agreed plan shall be implemented thereafter unless any variations are agreed in writing with the Local Planning Authority.*

- 25 *Before the commencement of any construction works on the first of any building approved in each phase of the development site a detailed scheme for the provision of the proposed habitat mitigation / creation relating to that phase, shall be submitted to and approved in writing with the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme.*
- 26 *Before the commencement of works on site full details of a scheme for the provision of artificial bird nesting sites, which shall equate to a minimum of one fifth of the total number of residential units to be developed across South Quay, shall be submitted to and approved in writing with the Local Planning Authority, and the development shall be implemented thereafter in accordance with the approved scheme, unless any variations are agreed in writing with the Local Planning Authority.*
- 27 *No development shall commence until full details of a clearance methodology and mitigation strategy for terrestrial invertebrates shall be submitted to and approved in writing with the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme, unless any variations are agreed in writing with the Local Planning Authority.*
- 28 *No development shall commence, on the relevant phases of development, until full details of a translocation method and management and monitoring scheme for *Oenanthe pimpinelloides* and *Petroselinum segetum* and protection of *Petrorhagia nanteuilim* shall be submitted to and approved in writing with the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme, unless any variations are agreed in writing with the Local Planning Authority.*
- 29 *No development shall commence until a detailed mitigation statement and translocation methodology for protected species of reptiles (including assessment of any proposed receptor site and measures to increase carrying capacity) shall be submitted to and approved in writing with the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme, unless any variations are agreed in writing with the Local Planning Authority.*
- 30 *Prior to the construction of any buildings on site, full details of a scheme to provide bat roosting locations across the site shall be submitted to and approved in writing with the by the Local Planning Authority and the development shall be implemented thereafter in accordance with the approved scheme, unless any variations are agreed in writing with the Local Planning Authority.*

- 31 *Before the commencement of each phase of the development as agreed in regard of Condition No. 8 above, a survey of the site for badgers shall be undertaken and prepared by competent persons with suitable qualifications, licenses and experience, and a report submitted to and approved in writing with the Local Planning Authority. The timing of the survey shall be appropriate to confirm the absence of badgers from the site immediately prior to work commencing and to ensure that it is undertaken using nationally recognised survey guidelines / methods where available and working to best practice standards.*
- 32 *Any vegetation clearance across the site shall be undertaken outside the nesting season, which is generally recognised to be from March to August inclusive, unless it can be demonstrated through submission to the Local Planning Authority of an appropriate survey immediately prior to works commencing that nesting birds are absent or a method statement for works is agreed in writing with the Local Planning Authority and fully implemented prior to works commencing.*

APPENDIX III PHASE 1 HABITAT SURVEY PLANS AND TARGET NOTES



- Habitats**
- A Amenity grassland
 - SI Grassland
 - SI Grassland: semi-improved neutral
 - Bare ground
 - Ephemeral/short perennial
 - Tall ruderal
 - Dense / continuous scrub
 - Scattered scrub
 - Scattered broad-leaved trees
 - Coniferous trees
 - Introduced shrub
 - Buildings
 - Spoil
 - Maritime cliff-hard rock
 - Sea wall
 - Standing fresh water
 - S Sea water
 - Fence
 - NA Not accessible
 - Target note
 - Habitat boundary

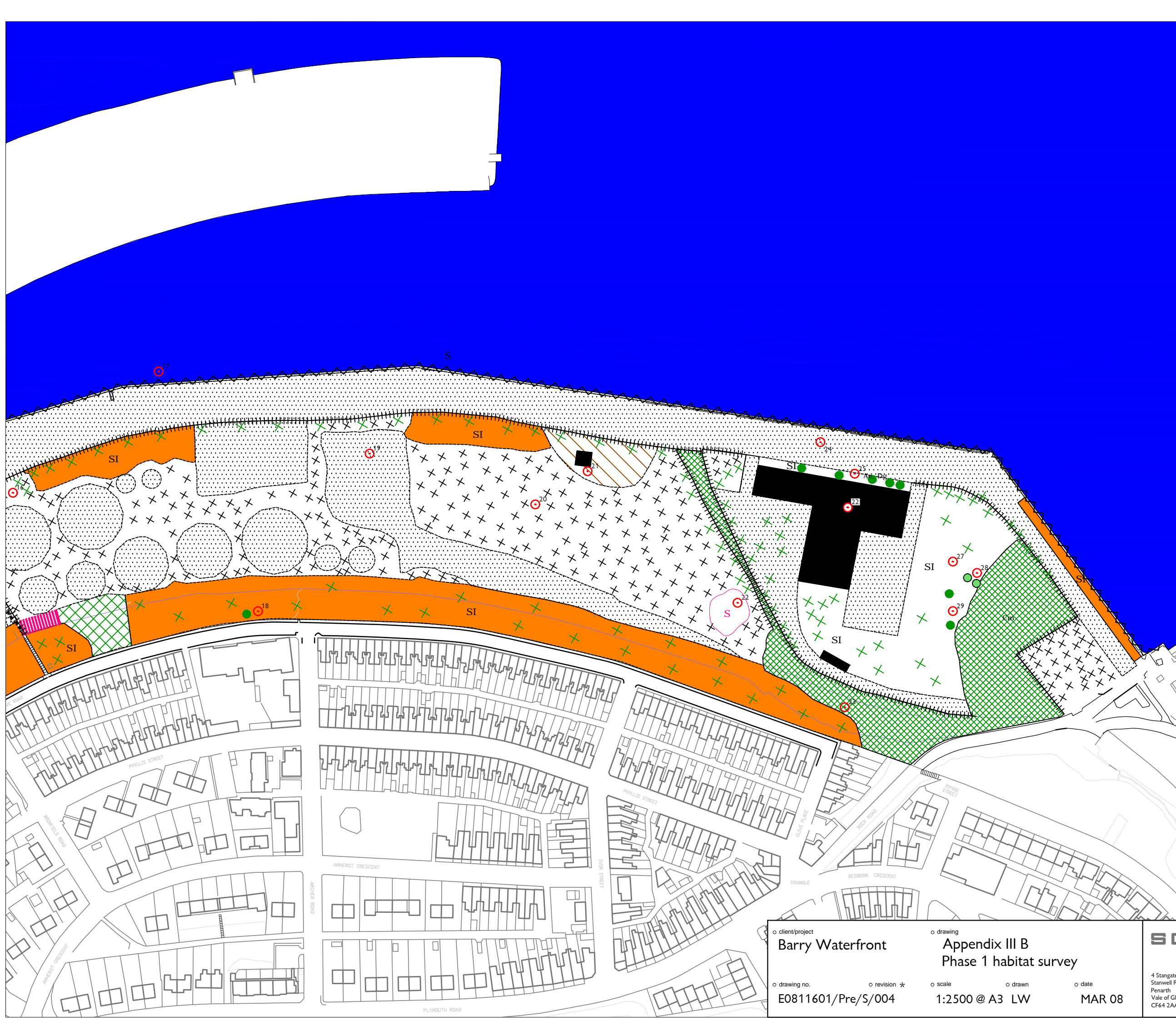
- Dominant Species Codes**
- Ae - False Oat-grass
 - Agt - Creeping Bent
 - Bd - Butterfly-bush
 - Bs - False Brome
 - Ce - Wood Small-reed
 - Cm - Hawthorn
 - Dg - Cock's-foot
 - Fr - Red Fescue
 - Je - Soft-rush
 - Rf - Bramble

| | |
|---|---|
| <p>o client/project Barry Waterfront</p> <p>o drawing no. o revision * E0811601/Pre/S/005</p> | <p>o drawing Appendix III A Phase 1 Habitat Survey</p> <p>o scale o drawn o date 1:2500 @ A3 LW MAR 08</p> |
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- Habitats**
- A Amenity grassland
 - SI Grassland
Poor semi-improved
 - SI Grassland: semi-improved neutral
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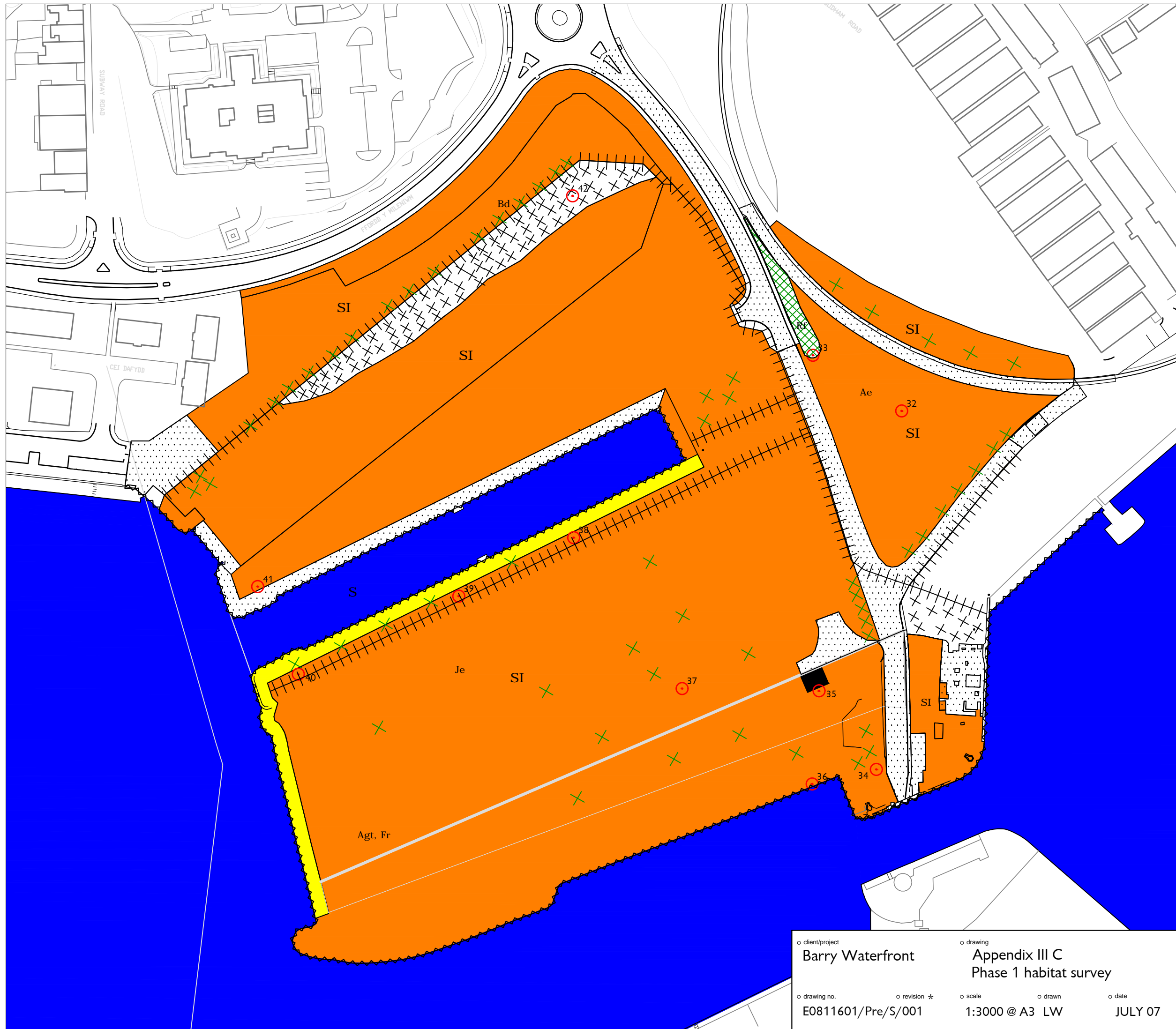
o client/project **Barry Waterfront** o drawing **Appendix III B**
Phase 1 habitat survey

o drawing no. **E0811601/Pre/S/004** o revision * o scale **1:2500 @ A3 LW** o drawn o date **MAR 08**

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 - — — — Habitat boundary

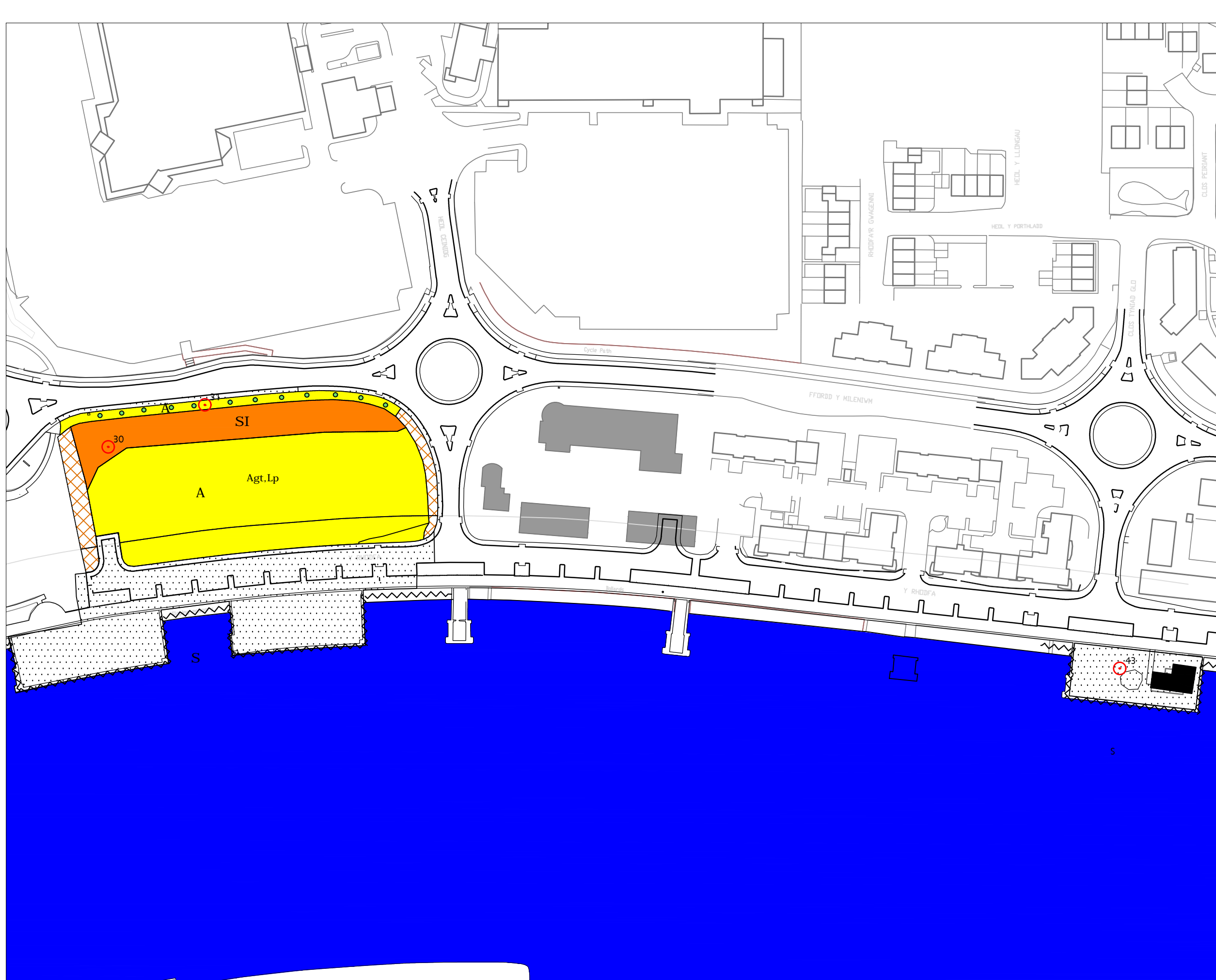
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 - Rf - Bramble

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| <p>o client/project Barry Waterfront</p> <p>o drawing no. E0811601/Pre/S/001</p> | <p>o drawing Appendix III C Phase 1 habitat survey</p> <p>o scale 1:3000 @ A3 LW</p> <p>o date JULY 07</p> |
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 - ||||| Fence
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Dominant Species Codes

- Ae - False Oat-grass
- Agt - Creeping Bent
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- Bs - False Brome
- Ce - Wood Small-reed
- Cm - Hawthorn
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|------------------|-------------------------|-----------|--|---------|----|
| o client/project | Barry Waterfront | o drawing | Appendix III D Phase 1 habitat survey | | |
| o drawing no. | E0811601/Pre/S/003 | o scale | 1:1500 @ A3 | o drawn | LW |
| o revision * | | o date | MAR 08 | | |

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| Target Note | Description/Comment |
|-------------------|---|
| Birds Seen/Heard: | Skylark, Meadow Pipit, Stonechat, Goldfinch, Robin, Dunnock, Bullfinch, Pied Wagtail, Blackbird, Great Tit, Blue Tit, Wren, Song Thrush, Kestrel, Carrion Crow, Herring Gull, Black Headed Gull, Lesser Black-backed Gull, Wood Pigeon, Magpie, Great Crested Grebe, Cormorant |
| 1 | One well-established and probably untreated colony of Japanese Knotweed straddling the site boundary fence in Butterfly-bush scrub. Dimensions of colony estimated to be 8m x 10m. |
| 2 | Very dense Butterfly bush and Gorse scrub along bank associated with railway - bushes have retained leaves throughout the winter and so may conceal small stands of Japanese Knotweed. The scrub is several metres high. Many mammal paths leading into scrub indicative of rabbit/fox (Fox hair found). High bird nesting potential. |
| 3 | Small clumps of Japanese Knotweed on railway embankment (outside survey area but within a few metres of the boundary). Railway track inclines on an earth bank towards the west providing opportunities for Badgers along the length of the bank. Boundary fence backs onto an unmanaged railway track fully colonised by broadleaved shrubs and scrubs over gravel and early successional vegetation. Railway track is likely to function as a suitable wildlife corridor for mammals, reptiles and birds. Fence line has a sizable gap underneath along its entire length, which provides ample opportunities for mammals to enter the site. Evidence of rabbits along identified mammal paths. Dense Gorse scrub and Butterfly Bush encroaches onto the site along the fence line. |
| 4 | Several small colonies of Japanese Knotweed close to the fence (within survey area). Scrub along fence line has high potential for nesting birds. Long grassland, tall herbs and dense scrub adjacent to a railway corridor provide a suitable foraging and nesting habitat for birds. Large banks of colonised rubble to the south also provide good shelter from wind/weather. Large flock of goldfinches foraging around Teasel stands. |
| 5 | Spoil pile comprising large irregular blocks of concrete rubble, with the top parts colonised by Butterfly bush but little other vegetation. |
| 6 | Very closely rabbit-grazed grassland community which appears to be moderately diverse with small annual mouse-ears, Buck's-horn Plantain and the mosses <i>Homalothecium lutescens</i> , <i>Brachythecium albicans</i> and <i>Barbula unguiculata</i> . Less suitable for reptiles or nesting skylark. |
| 7 | These spoil heaps are typically 3-4 metres high with an underlying substrate of gravel-stone-soil or rubble and soil, deposited in a series of steps/terraces with steep sides. They are mostly fully vegetated with neutral grassland likely to be of low diversity. In many places Creeping Bent and Hairy Sedge are abundant, with Gorse and Butterfly bush on the slopes. Vigorous herbs are also present, especially Bristly Ox-tongue, docks, Wild Parsnip and Creeping Thistle. Some areas support significant stands of Great Horsetail. The heaps have been used for informal recreation e.g. biking and there are some areas of erosion. |
| 8 | Area of standing water (ca. 30m across) at foot of spoil heaps. Up to 30cm of water but may be seasonal. Vegetation suggests that the ground stays damp all year at least. Species present include small stands of Sea Club-rush, Bulrush, Hard Rush and an unidentified sweet-grass. There are also extensive carpets of the moss <i>Warnstorffii aduncus</i> . Potentially suitable for common amphibians and will require amphibian survey. Water frequently used by crows and gulls. |
| 9 | Rank neutral grassland dominated by False Oat-grass considered to have low intrinsic botanical |

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| | interest but supporting a small population of Corky-fruited Water-dropwort, a species of considerable local rarity value. |
| 10 | Very steep cliff/bank supporting inaccessible neutral to slightly calcareous grassland with scattered saplings and scrub (mostly Hawthorn). False Brome is the dominant grass on the bank - the vegetation community appears to be relatively species-poor. Bramble and Traveller's-joy are encroaching. Steep cliff largely colonised by grass and scrub with few areas of exposed rock- Not likely to be suitable for nesting birds-of-prey although scrub has some potential for passerines despite heavy shading. |
| 11 | Large industrial Warehouse. Building is corrugated steel throughout with corrugated sheeting on the roof. The inside of the building consists of a large void extending up to metal rafters, which backs onto single corrugated roof sheets which is intact throughout. The western elevation is largely exposed – allowing wind and rain in. The building appears wholly unsuitable for bats although it was not closely inspected due to H & S issues. Nearby small brick-built flat-roofed hut to southwest with front access exposed. Whole building is covered in dense ivy covering. No value to roosting bats |
| 12 | Brownfield vegetation developed across an area of demolished structures. Substrate appears to be crushed brick and concrete. Appears to be at least moderately botanically diverse and could support notable species. Species that could be identified in the community at the time of survey included Tall Melilot, Hoary Mustard, Bristly Ox-tongue and Colt's-foot. Bare ground in between foundations colonised by rank grassland and ephemeral vegetation potentially suitable to support common reptiles particularly lizards. Some poorly drained areas holding water may need checking later in the season. |
| 13 | Brick built sub station with flat concrete roof and few opportunities for access. Of little if any value to roosting bats. Fascia boards lifting and split in places although the building is isolated and exposed to weather. |
| 14 | Very species-poor neutral grassland dominated by Red Fescue, along with frequent Creeping Thistle and Cock's-foot. Of very low intrinsic botanical interest. Grassland seems to be frequently used by dog walkers. Likely to support common reptiles, small mammals and grassland nesting bird species such as Skylark, Meadow Pipit and Wheatear. Area is relatively undisturbed and likely to be rich in invertebrates- providing foraging habitat for bats. Kestrel noted hunting over all grassland areas. Crow assemblage noted in numbers exceeding 50. The grassland contains areas of scrub and tall herbs such as teasel, which are valuable to foraging birds. Some areas with sporadic stands of pampas grass, which may provide suitable shelter for reptiles. Reptile mats were noted across the site. Further surveys recommended for birds, bats, reptiles and invertebrates. Many areas are poorly drained and large pools of standing water have formed in many areas proving potential breeding habitat for common amphibians. Further survey required. Area of gorse lining the trackway over grassland of high value to nesting birds. Likely to support a diversity of finches and warblers. |
| 15 | Horizontally inter-bedded cliff exposure. Appears to be limestone interbedded with mudstone or shale. Supports patchy False Brome grassland and scrub species, which suggest that soils are likely to be near neutral to slightly calcareous in reaction. |
| 16 | Species-rich early successional vegetation supporting a variety of different herbs, grasses and mosses. Herbaceous species include Lesser Trefoil, Common Vetch, Field Madder, Perforate St. John's-wort and frequent Canadian Fleabane. Vegetation and substrate likely to support common Lizard. Prominent mosses include <i>Barbula unguiculata</i> , <i>Bryum capillare</i> , <i>Bryum bicolor</i> and <i>Funaria hygrometrica</i> . |

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| 17 | Sea-water dock. Deep water retained by vertical stone walls with negligible maritime vegetation. |
| 18 | Exposed cliff face with well defined stratified layers of limestone and scree. Fallen/eroded rocks at base of cliffs have ammonite fossils. Potential geological importance. Mature Willow on cliff with few splits and cracks and fallen limbs. Generally considered of low potential for bats. Well used mammal path up cliff face to around base of tree- no setts or burrows. A Goat Willow or Goat Willow-Grey Willow hybrid at the top of a low cliff. Has two main trunks, each c. 30cm diameter. The tree is c. 6-7 metres high and is apparently in good health. Cliff is steep and heavily vegetated with dense bramble and grass with occasional tree and shrub. There are no suitable ledges for nesting birds of prey such as kestrel or Peregrine although the trees may serve as perches. Dense bramble may have value for breeding passerines. |
| 19 | Area where there is a complex mosaic of bare ground (concrete footings) surrounded by early successional vegetation, scattered Butterfly-bush scrub and small patches of neutral grassland dominated by Creeping Bent. |
| 20 | This is an area where there were previously many silos/storage tanks, now removed and leaving patches of bare and broken ground. An irregular mosaic of Brownfield vegetation and small patches of species-poor neutral grassland has subsequently developed across the area. |
| 21 | Sub station similar to others. Brick built with flat roof of low potential to bats. Fascia boards are cracked and lifted but building is fairly isolated and exposed to the weather. |
| 22 | Excavated area with spoil and dumped material including masonry and household waste. Appears to have impeded drainage, as there are a few small puddles of standing water. Dipped area of ground with some pools of standing water some with algae. Very little if any opportunities for breeding amphibians and likely to be seasonally dry. Pigeon kill suggestive of fox. |
| 23 | Two trees on cliff face with ivy covering and visible splits. Generally low potential to bats. Dense scrub below colonised over a disused railway track- good connectivity/corridor into nearby habitats. Scrub is very dense and may require a through search for badger sett if affected by development |
| 24 | Interesting short-herb vegetation growing over stone chippings and in tarmac cracks. Species recorded here included the mosses <i>Didymodon fallax</i> , <i>Barbula unguiculata</i> and <i>Ceratodon purpureus</i> , Biting Stonecrop, Common Whitlowgrass, Oxford Ragwort, Weld, Hoary Mustard, Rue-leaved Saxifrage, Field Mouse-ear and Wild Carrot. There is also a small population of the locally rare Lesser Chickweed. |
| 25 | Planted standard maples (not possible to identify to species without leaves) in front of derelict building, growing in what is now rank MG1 grassland. The trees are young, not more than 6 metres high, with a trunk diameter of 20-30cm. They are not in good condition, as some are leaning, with dead branches and cracked bark. |
| 26 | NERC Vessel Research Services. Flat roofed, brick built office block with most windows boarded up. Spaces under boards and smashed windows provide adequate means of entrance. Buildings are of medium potential for bats and require further investigation. The west side of the warehouse provides a well-used pigeon roost. |
| 27 | Species-poor rank False Oat-grass (MG1) neutral grassland, probably former amenity grassland, long unmanaged suitable for reptiles. Many Hawthorn bushes are encroaching into the grassland. Large bank to the east colonised by a dense stand of hawthorn blackthorn scrub with some gorse. Likely to be a hot spot for nesting birds. Fox seen. No signs of badger seen. |
| 28 | Two sub-mature planted willows, likely to be either White Willow or Crack Willow cultivars. |

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| | Both trees appear to be healthy, with a canopy height of about 10m and Ivy growth on the trunks. |
| 29 | Two 10m tall Leyland Cypress at the edge of an encroaching scrub belt. Bare at the base, but upper parts are dense and apparently healthy. |
| 30 | Bank appears to be relatively nutrient-poor and supports a patchy but moderately diverse vegetation cover, which includes Common Centaury. |
| 31 | Young ornamental pine saplings (no cones present). 2-3 metres high, planted at intervals beside pavement. |
| 32 | Rank sward suitable for reptiles. Nearby railway track provides connectivity to nearby habitats for reptiles and mammals. Sward is rabbit grazed and is used by gulls as a roost site- mussel shells and feathers around- wings feathers also found (suggestive of fox kill). |
| 33 | Earth Bank along access road with areas of dense scrub. Numerous rabbit burrows-with rabbit fur on nibbled bramble around entrance holes. No signs of badger. Dense scrub along railway track of high value to breeding birds. The whole area is fairly undisturbed other than a low speed train passing nearby once or twice a day |
| 34 | Rabbit burrows in earth bank. Larger holes near to harbour edge although the hole tapers off into small hole- not badger. |
| 35 | Substation. Brick built with flat roof and limited access into the internal void. Largely unsuitable for bats. Wooden fascias are loose and there are gaps in the soffit but unlikely to be suitable on account of exposed and isolated nature of building. |
| 36 | Dock wall 6-8 metres above water level is lined with stone setts with a gradient estimated to be c. 45°. |
| 37 | Dense cluster of gorse likely to be of value to nesting birds and used for shelter by rabbits. Evidence of rabbit 'forms' and grazing around base. Grassland of value to reptiles, gulls and grassland nesting species such as skylark and meadow pipit. Few areas of standing water but likely to be seasonally dry- unsuitable for breeding amphibians. No evidence of badger foraging or dung pits. |
| 38 | Bank along fence has numerous rabbit holes and burrows. The bank also contains a hole characteristic of badger with guard hair on the ceiling of the entrance |
| 39 | Another series of badger holes with guard hair at entrance. Clear current use by rabbits |
| 40 | Underground compartment associated with swing bridge. Low potential for bats. |
| 41 | Culvert over earth partially covered by a large steel plate. Large hole in earth with hole characteristic of badger. Entrance to culvert has a lot of fry grass bedding and badger guard hairs. Likely to be an outlier sett. |
| 42 | An extensive area of Brownfield vegetation over calcareous stone chippings. Appears to be at least moderately diverse and may support notable plant species. Identifiable species include Common Bird's-foot-trefoil, Ribwort Plantain and the moss <i>Cratoneuron filicinum</i> . |
| 43 | Landscaped gravel garden based on minimalistic planting of e.g. phormium and cordyline species over a substrate of marine gravel and slate chippings. Unoccupied modern building with boarded window on southern elevation where window has been smashed. Of no value to bats. |

APPENDIX IV ADVICE NOTE ON BATS AND LIGHTING

The following advice in relation to residential lighting where bats may be an on-site or influencing factor is based up on information contained within an article by Emery (2008) and available via Urbis lighting (<http://www.urbislighting.co.uk/>).

Firstly in terms of light source, the use of **Low Pressure Sodium (SOX) is recommended**, as these lamps emit light at a single wavelength with a very low amount of UV meaning that very few insects are attracted to this light source. This light also has a minimal effect on the bats. However, the use of these light sources is currently being phased out.

Next best would be High Pressure Sodium (SON) as these lamps emit light over a slightly broader wavelength spectrum attracting more insects but as these are a more intense light source they have a greater effect on bats. There are ranges of metal halide lamps available and they are classed as white light sources, these emit light at wavelengths across the colour spectrum but can also emit high levels of UV. These can attract large numbers of insects and are also a closer match daylight meaning these have an even greater impact on bats (avoid these types).

The lighting types recommended would be **8m Column heights** (rather than 10m - however, see notes below) using (in order of preference) **external rear louvres**, or internal rear louvres, or 120mm rear shields. **Either flat or curved glass protectors** may be used with the former being preferred, as light spillage is marginally less than curved. However, there may be conflicts with using some louvres (plus, spacing will be reduced and so more lighting columns may be required, therefore increasing costs).

Units may be obtained from numerous suppliers, as the above-mentioned items are standard items. However, talking to Matt Emery from Urbis Lighting with regards to bats is recommended. He is a lighting engineer firstly with an interest in bats and how light influences their behaviour and this information is also recommended by the Institute of Lighting Engineers (ILE) <http://www.ile.org.uk/>.

FURTHER NOTES

Lower Mounting Height

This option is easily implemented and would generally result in a reduced column cost.

In comparison studies between 10m and 8m column heights, the overall spread of light has been reduced by lowering the column height, however due to the lower mounting height the intensity of the light on the road has been increased with the higher illuminance values spreading further. This option reduces the column spacing by 20% resulting in more columns being required thereby neutralising the benefit of the lower unit costs.

Louvres - External

External louvres are used with a flat protector so there is no spacing constraint from the optic. As with the shields mentioned below, these are externally mounted so there are increased stresses on the supporting columns and brackets from additional wind loading. As with the internal louvres (see below) an additional unit cost will incur.

In comparative studies, the external louvre almost completely blocks all the light emitted behind the units. However, this does have a greater effect on the column spacing achievable as large amounts of light are being blocked. Excellent for light sensitive species of bats (i.e. *Myotis sp.*). Urbis therefore recommends the use of its ZX2 and ZX3 product designs that have been proven to reduce light on a road scheme in the Sirhowey Valley, Caerphilly.

Louvres - Internal

Internal louvres are not available with a flat protector due to the limited space available inside the optic. Louvres are a specially designed accessory with each one requiring testing resulting in higher additional costs per unit than any of the other options described here.

In comparative studies, the internal rear louvre greatly reduces the spread of light behind the units. However it does reduce the column spacing achievable, this is because the louvre is blocking the light emitted from the optic making the luminaire less efficient.

Rear Shield

Shields are becoming more widely available on a range of luminaires but as they are an accessory they incur an extra cost per luminaire. The longer the length of the shield the more effective it is, however the increased surface area causes greater stresses on the supporting column and bracket due to wind loading.

In comparative studies, the shield has helped reduce the spread of light behind the lighting column by almost 40%. However, the column spacing is reduced by 20% resulting in the possibility of more columns being required and also there is an increased unit cost for the accessory.

Using Flat Glass Protectors

The majority of Traffic Route luminaires are available with a flat glass protector option, so this method of limiting light emitted at high angles is easily available at little or no extra cost on unit prices. However the range of protectors typically used on traffic route lighting include curved bowls due to their less restrictive light distribution.

In comparison studies results show that there is little effect on the spread of light when a flat protector is used to light roads. This is due to the decreased column spacing required to still achieve the required lighting specification on the road increasing the intensity of the light in the area. The decrease in column spacing will also mean that extra columns could be required on longer stretches of road increasing costs.

REFERENCES

Bat Conservation Trust. (2008). *Bats and Lighting in the UK; Version 2, January 2008*. <http://www.bats.org.uk/>

Emery, M. (2008). *Effect of Street Lighting on Bats*. Urbis Lighting Ltd., 2 January 2008. <http://www.urbislighting.com/>