Appendix A.8.26

Compensatory Habitat Management Plans

A.8.26

1 Introduction

This Compensatory Habitat Management Plan (hereafter referred to as "CHMP") describes the process for the compensation[1] of the following Annex I habitats, which were identified as having a significant residual impact as a result of the proposed N6 Galway City Ring Road (hereafter referred to as the "*proposed road development*"):

- European dry heaths [4030] (Refer to **Section 2**)
- Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) [6210] (Refer to **Section 3**)
- *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410] (Refer to **Section 4**)
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae*) [*91E0] (Refer to **Section 5**)

Full details of the impact assessment and residual impacts are described in Chapter 8, Biodiversity of the Environmental Impact Assessment Report (EIA Report).

The measures outlined in this report will compensate for the significant residual effect on the above habitats by ensuring that there will be no net permanent loss of this habitat type as a consequence of the proposed road development. In the interests of clarity, the compensation proposed in this report does not represent compensation as defined by Article 6(4) of the Habitats Directive. All of the areas of the above habitats to be lost fall outside of designated areas for nature conservation.

The measures outlined in this report were developed following an extensive literature review (refer to **Section 6 References**). This literature review included peer reviewed scientific research and other grey literature sources (e.g. guidance from government agencies) for the relevant habitat types under discussion in this report; i.e. dry heath, semi-natural dry calcareous grassland, *Molinia* meadow and alluvial woodland. These include examples of best practice for habitat creation, restoration and management for these target habitat types, as well as reviews of the effectiveness of specific techniques recommended in this report. This report has only recommended the creation of habitat types where there is good scientific evidence that the habitat can be successfully created, and it therefore is based on best scientific knowledge and evidence. This report has not made recommendations for creation of habitat types for which either there is no good scientific evidence that the habitat can be successfully created, or there is significant doubt around the effectiveness of the habitat creation techniques. Careful and detailed consideration has gone into the nature of and site conditions at donor and receptor sites to ensure that the proposals are realistic and have a high chance of succeeding.

The CHMP is a working document and will be finalised by the Contractor following appointment and prior to commencing works on site, including the preparation of

[1] "*Compensation describes measures taken to make up for residual effects resulting in the loss of, or permanent damage to, ecological features despite mitigation*" (CIEEM, 2016).

site specific method statements. This CHMP will be implemented by the Contractor under the advice and supervision of the Project Ecologist (employed by the Employer) and/or the Ecological Clerk of Works (ECoW) (employed by the Contractor). The finalisation of the CHMP by the Contractor will not affect the robustness and adequacy of the information presented here and relied upon in the EIA Report and NIS.

1.1 Guidance

This CHMP has been prepared with regard to the following guidance documents, as relevant:

- *Guidelines for Ecological Impact Assessment in the UK and Ireland Terrestrial, Freshwater and Coastal, 2nd Edition* (Chartered Institute of Ecology and Environmental Management, 2016);
- *Guidelines for Ecological Report Writing* (Chartered Institute of Ecology and Environmental Management, 2017);
- *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions* (Iuell *et al.*, 2003);
- *Habitat Translocation A Best Practice Guide* (Anderson, 2003);
- *A Habitats Translocation Policy for Britain* (Joint Nature Conservation Committee, 2003);
- *Guidelines on the Information to be contained in Environmental Impact Statements* (Environmental Protection Agency, 2002)
- *Guidelines on the Information to be Contained in Environmental Impact Assessment Report* (Environmental Protection Agency, Draft August 2017)
- *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements* (Environmental Protection Agency, 2003)
- *Advice notes for Preparing Environmental Impact Statements* (Environmental Protection Agency, Draft September 2015)
- *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland Version 2.0* (Perrin *et al.*, 2014)
- *Lowland Calcareous Grassland Creation and Management in Land Regeneration* (Ashwood, 2014)
- *The Lowland Grassland Management Handbook 2nd Edition* (Crofts & Jefferson, 1999)
- *Our Trees A Guide to Growing Ireland's Native Trees in Celebration of a New Millennium* (The People's Millennium Forests, 2000)
- *Management Guidelines for Ireland's Native Woodlands* (Cross & Collins, 2017)
- *Results of a Monitoring Survey of Old Sessile Oak Woods and Alluvial Forests* (O'Neill & Barron, 2013)

- *National Survey of Native Woodlands 2003-2008* (Perrin *et al.*, 2008a and b)
- *A Guide to Landscape Treatments for National Road Schemes in Ireland* (National Roads Authority, 2006)

2 European dry heaths [4030]

2.1 Introduction

The proposed road development will result in the permanent loss of *c.* 1.85ha of the Annex I habitat European dry heaths [4030] (hereafter referred to as "*4030"*). It is proposed to compensate for this loss by re-creating c. 7.06ha of 4030 habitat. This area of habitat creation represents c. 148% of the combined losses of:

- the Annex I habitat European dry heath 4030 (*i.e. c.* 1.85ha)
- the Annex I habitat Northern Atlantic wet heaths with *Erica tetralix* [4010] (*i.e. c.* 2.06ha in total, of which c. 1.23ha is due to direct impacts, while *c.* 0.84ha are due to indirect impacts)
- lands containing a mosaic of these two habitats (*i.e.* c. 0.87ha)

Although that habitat creation proposed does not reduce the residual impact associated with the loss of 4010 or the mosaics of 4010/4030, it will provide an overall biodiversity gain for peatland habitats. The creation of 7.06ha of 4030 however, fully compensates for the loss of 1.85ha of 4030.

Separate to the areas of 4030 habitat to be created as a compensatory measure, there are areas of 4030 habitat located within the proposed development boundary that will be retained and fenced off for the duration of construction. These areas will not be directly impacted by the proposed road development. These areas are presented in Figures 8.23.1 to 8.23.14 of the EIA Report. These areas will not be available to use as donor sites for the purposes of creation of compensatory 4030 habitat.

The steps followed for the 4030 habitat compensation process are:

- Identification and selection of suitable compensatory habitat receptor sites for 4030 habitat (Refer to **Sections 2.2 to 2.5**)
- Pre-compensatory site preparation works at both the donor and receptor sites, including (Refer to **Sections 2.5.2 and 2.5.3**):
    - the provision of site specific method statements within Finalised Ecology Site Management Plans (Refer to **Section 2.5.2.1**)
    - erection of temporary fencing
    - soil analysis test
    - surface vegetation management and removal
    - topsoil stripping

  - soil acidity amelioration techniques
- Implementation of a combination of compensatory measures as dependent on the characteristics of the receptor sites (Refer to **Section 2.5.3**). These measures include:
  - the translocation of turves and suitable soil from donor to receptor sites
  - harvesting and spread of heather clippings at the donor site
- Short-term and long-term management of receptor sites following the implementation of compensatory measures (Refer to **Section 2.6**)
- Monitoring of receptor sites to be carried out pre-compensation, during and post-compensation by a suitably qualified and experienced ecologist[2] in order to ensure that any potential issues are identified at an early stage and addressed through adaptive management measures. (Refer to **Section 2.7**)

2.2 Description of Annex I habitat 4030

In Ireland the Annex I habitat 4030 usually occurs on well-drained mineral soils or shallow peats (*i.e.* typically less than *c.* 50cm deep) on sloping ground and is dominated by ericaceous dwarf shrubs such as *Calluna vulgaris*, *Erica cinerea*, *Ulex gallii* and *Vaccinium myrtillus*. There are six Dry heath vegetation communities, which correspond to 4030 habitat. Five of these six plant communities consist of only a limited cover of peat-forming species, with the exception of the plant community DH4 *Calluna vulgaris – Sphagnum capillifolium*. There is only one Dry heath vegetation community that will be affected as a consequence of the proposed road development, *i.e.* DH1. In Ireland this community is characterised by the presence of *Ulex gallii*, generally accompanied by *Erica cinerea* or *Calluna vulgaris* and is typically found in coastal areas (Perrin *et al.*, 2014). Dry heath habitat is commonly found in a mosaic of different vegetation types present on rock slopes (Perrin *et al.*, 2014). Burning of Dry heath is sometimes used as a management tool to produce a heathland with a variety of heather growth stages. However, currently in Ireland most heath fires are intentionally started to encourage grass growth for livestock (Perrin *et al.*, 2014).

[2] Throughout this document where it is clear the role of the ecologist is attached to the construction stage, the role is referred to as the "Project Ecologist and/or EcOW". However where the role for an ecologist being referred to may involve a role beyond the contractor's contract (i.e. during the operation and maintenance of the proposed road development), the role is referred to as "a suitably qualified and experienced ecologist".

2.3 Description of 4030 Donor Sites

There are 47 relatively very small, isolated polygons of Annex I habitat 4030 which will be removed to facilitate the construction of the proposed road development (see **Figure 1-6** for locations). All of these areas are located west of the River Corrib and outside of any designated areas for nature conservation. These sites were classified as Annex I habitat due to the presence of a sufficient number of positive indicator species (after Perrin *et al.*, 2014). Three of these donor sites (*i.e.* 4030.D9, 4030.D.41 and 4030.D44, see **Figures 1 and 5**) form a mosaic with 4010; however the dominant habitat present is 4030. Full descriptions of these 47 polygons (*i.e.* 4030 donor sites) of habitat to be lost are provided below and are grouped into seven geographically distinct areas.

2.3.1 An Baile Nua - Ch. 0+000 to Ch. 0+800

There are nine donor sites within this area, 4030.D1 to 4030.D9, consisting of c. 0.31ha (see **Figure 1** for locations). Botanical and other relevant environmental data (as per the 4030 structure and function condition assessment described in Perrin *et al.*, 2014) was collected at two relevés located *c.* 102m west of the nearest area of 4030 habitat to be lost and *c.* 25m south-east of the nearest area of 4030 habitat to be lost on the 10 September 2014 and 3 September 2015 respectively. Data collected at these relevés is considered to be representative of the habitat to be lost in this general location. A total of three (at one relevé) and five (in the other relevé) of the eight positive indicator species of this Annex I habitat were present (*i.e. Arctostaphylos uva-ursi*, *Calluna vulgaris*, *Daboecia cantabrica*, *Erica cinerea* and *Ulex gallii*). The percentage cover of these positive indicator species present was greater than 50%, while the percentage cover of dwarf shrub species at one relevé was greater than 50%. Only two bryophyte species were present at one relevé (*i.e. Rhytidiadelphus squarrosus* and *Hypnum cupressiforme*), while none were present in the other. No negative indicator species were present at either relevé; however *Pteridium aquilinum* was present in both. There was evidence of senescent *Calluna vulgaris* in one of the relevés; however this was less than 50% and there were no signs of burning in the local vicinity of each relevé. The depth of peat at each relevé varied from *c.* 20-50cm at one to *c.* 0-5cm at the other. The latter of which had a higher associated percentage cover of bare soil and rock compared to the former. No surface water was noted in either relevé. The median height of the field layer at each relevé differed (*i.e. c.* 60cm and 40cm), as did the dwarf shrub layer (*i.e. c.* 40cm and 35cm) and the ground layer (*i.e. c.* 5cm and 0cm). One of the relevés passed all 14 criteria of the structure and function condition assessment, while the other failed on six of the 14 criteria, *i.e.* failing on number of bryophytes or non-crustose lichen species present (≥3); percentage cover of non-native species in relevé taken and within habitat only (<1%); percentage cover of *Pteridium aquilinum* (<10%); and, cover of disturbed ground in relevé taken and within habitat

only (<10%) (Perrin *et al.*, 2014). Refer to relevé codes EC05 R1 and R336-NFMR R2 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

2.3.2 Na Foraí Maola Thiar -Ch. 0+800 to Ch. 1+150

There are three donor sites within this area, 4030.D10 to 4030.D12, consisting of c. 0.07ha (see **Figure 2** for locations). Botanical and other relevant environmental data (as per the 4030 structure and function condition assessment described in Perrin *et al.*, 2014) was collected at two relevés located within two areas of 4030 habitat to be lost on 3 September 2015 and 7 September 2015 respectively. Data collected at these relevés is considered to be representative of the habitat to be lost in this general location. Severe encroachment from *Pteridium aquilinum* was noted at one relevé. A total of four of the eight positive indicator species were within each relevé (*i.e. Erica cinerea*, *Daboecia cantabrica*, *Calluna vulgaris* and *Ulex gallii*). The percentage cover of positive indicator species present was greater than 50%, while the percentage cover of dwarf shrub species at one relevé was greater than 50%. Two bryophyte species and one lichen species were present at one relevé (*i.e. Hypnum jutlandicum*, *Scleropodium purum* and *Cladonia* sp.), while two were recorded in the other (*i.e. Hylocomium splendens* and *Hypnum jutlandicum*). No negative species were present at either relevé and non-native species were only recorded in one relevé at very low abundance level. *Pteridium aquilinum* was present in both relevés with percentage covers greater than 10%. There was evidence of senescent *Calluna vulgaris* in one of the relevés; however this was less than 50% and there were no signs of burning in the local vicinity of each relevé. The depth of peat at each relevé varied from *c.* 10cm at one to *c.* 5cm at the other. No bare soil was present at either relevé; however a very small percentage of bare rock was noted at one. No surface water was noted in either relevé. The median height of the field layer at each relevé differed (*i.e. c.* 50cm and 60cm), as did the ground layer (*i.e. c.* 8cm and 15cm), while the median height of the dwarf shrub layer was the same for both (*i.e. c.* 45cm). One of the relevés passed on 13 of the 14 criteria of the structure and function condition assessment, while the other passed on 10 of the 14 criteria (Perrin *et al.*, 2014), *i.e.* failing on percentage cover of *Pteridium aquilinum* (<10%); number of bryophytes or non-crustose lichen species present (≥3); percentage cover of dwarf shrub cover (<50%); and, cover of disturbed ground in relevé taken. Refer to relevé codes R336-NFMR R1 and R336-NFMR R2 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

2.3.3 Na Foraí Maola Thoir - Ch. 1+150 to Ch. 1+600

There are seven donor sites within this area, 4030.D13 to 4030.D19, consisting of c. 0.40ha. See **Figure 2** for locations. Botanical and other relevant environmental data (as per the 4030 structure and function condition assessment described in Perrin *et al.*, 2014) was collected at two relevés located *c.* 122m south-east of the

nearest area of 4030 habitat to be lost and within very close proximity to an area of 4030 habitat to be lost on the 8 September 2014 and the 7 September 2015 respectively. Data collected at these relevés is considered to be representative of the habitat to be lost in this general location. A total of four (at one relevé) and three (in the second relevé) of the eight positive indicator species of this Annex I habitat were present (*i.e. Calluna vulgaris*, *Ulex gallii*, *Daboecia cantabrica* and *Erica cinerea*). The percentage cover of positive indicator species was greater than 50% at both relevés, while the percentage cover of dwarf shrub species at one relevé was greater than 50%. Four bryophyte species were present at one relevé (*i.e. Hypnum jutlandicum* and *Rhytidiadelphus squarrosus*), while two were recorded in another (*i.e. Hypnum jutlandicum* and *Pseudoscleropodium purum*). No negative or non-native species were present in either relevé. *Pteridium aquilinum* was present in only one relevé with a percentage cover less than 10%. There was evidence of senescent *Calluna vulgaris* in one of the relevés; however this was less than 50% and there was no signs of burning in the local vicinity of each relevé. The depth of peat was very low at both relevés (*i.e.* 4cm and 10cm). No bare soil was present in either relevé. The percentage cover of bare rock and litter was less than 10% at both relevés. No surface water was noted in either relevé. The median height of the dwarf shrub layer at each relevé differed (*i.e. c.* 40cm and 25cm), as did the ground layer (*i.e. c.* 15cm and 5cm), while the median height of the field layer was the same for both (*i.e. c.* 30cm). One of the relevés passed on all of the 14 criteria of the structure and function condition assessment (Perrin *et al.*, 2014), while the other passed on 13 of the 14 criteria, *i.e.* failing on percentage cover of dwarf shrub cover (<50%). Refer to relevé codes EC12 R1 and EC12 R3 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

2.3.4 Troscaigh Thiar - Ch. 2+000 to Ch. 2+400

There are 12 donor sites within this area, 4030.D20 to 4030.D31, consisting of c. 0.31ha. See **Figure 3** for locations. Botanical and other relevant environmental data (as per the 4030 structure and function condition assessment described in Perrin *et al.*, 2014) was collected at one relevé located *c.* 172m west of the nearest area of 4030 habitat to be lost on the 4 September 2014. Data collected at these relevés is considered to be representative of the habitat to be lost in this general location. A total of three of the eight positive indicator species of this Annex I habitat were present (*i.e. Ulex gallii*, *Calluna vulgaris* and *Erica cinerea*). The percentage cover of these positive indicator species was greater than 50%, as was the percentage cover of dwarf shrub cover. One bryophyte species were present (*i.e. Pseudoscleropodium purum*). No negative species, non-native species, *Pteridium aquilinum* or *Juncus effusus* were present. There was evidence of senescent *Calluna vulgaris* and *Ulex gallii* and this was greater than 50%; however there were no signs of burning in the local vicinity of the relevé. The depth of peat was less than 10cm. No bare soil or rock was present. No surface water was noted. The median height

of the field layer, dwarf shrub layer and ground layer was c. 40cm, 50cm and 3cm respectively. It passed on 11 of the 14 criteria of the structure and function condition assessment, *i.e.* number of bryophytes or non-crustose lichen species present (≥3); percentage cover of dwarf shrub cover (<50%); and, percentage cover of senescent *Calluna vulgaris* cover (<50%) (Perrin *et al.*, 2014). Refer to relevé code EC13 R1 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

2.3.5 Ballard East - Ch. 3+450 to Ch. 3+900

There are eight donor sites within this area, 4030.D32 to 4030.D38, consisting of c. 0.23ha. See **Figure 4** for locations. One of these sites forms a mosaic with 4010 habitat. Botanical and other relevant environmental data (as per the 4030 structure and function condition assessment described in Perrin *et al.*, 2014) was collected at two relevés located *c.* 240m north-east of the nearest area of 4030 habitat to be lost and *c.* 21m west of the nearest area of 4030 habitat to be lost on the 4 September 2014 and the 9 September 2015 respectively. Data collected at these relevés is considered to be representative of the habitat to be lost in this general location. Both these relevés were located within a mosaic of habitats which included Acid grassland (GS3), Dry siliceous rock (ER1) and Wet grassland (GS4) (as defined in Fossitt 2000). A total of four (at one relevé) and two (in the second relevé) of the eight positive indicator species of this Annex I habitat were present (*i.e. Calluna vulgaris*, *Erica cinerea*, *Ulex gallii*, *Daboecia cantabrica* and *Arctostaphylos uva-ursi*). The percentage cover of these positive indicator species was greater than 60% at both relevés, while the percentage cover of dwarf shrubs was great than 25% at one of the relevés. Five bryophyte species were present at one relevé, while two were present at the other (*i.e. Hylocomium* sp., *Sphagnum papillosum*, *Hylocomium splendens*, *Hypnum jutlandicum*, *Dicranum scoparium* and *Pleurozia purpurea*). No negative indicator species, non-native species or *Pteridium aquilinum* were present at either relevé. There was evidence of senescent *Calluna vulgaris* at both the relevés; however at very low percentage cover. The depth of peat varied at both relevés (*i.e. c.* 5c and 10cm). There was no bare soil or rock present at either relevé. No surface water was noted. The median height of the field layer at each relevé differed (*i.e. c.* 50cm to 35cm), as did the median height of the dwarf shrub layer (*i.e. c.* 40cm and 30cm) and ground layer (*i.e. c.* 8cm and 5cm). Both relevés passed on all 14 criteria of the structure and function condition assessment (Perrin *et al.*, 2014). Refer to relevé codes EC18 R3 and EC18 R7presented in **Appendix A.8.19** of the EIA Report for an associated species list.

2.3.6 Area near the Ballymoneen Road - Ch. 4+700 to Ch. 5+250

There are six donor sites within this area, 4030.D39 to 4030.D44, consisting of c. 0.52ha. See **Figure 5** for locations. Two of these sites form a mosaic with 4010 habitat. Botanical and other relevant environmental data as per the 4030 structure and function condition assessment described in Perrin *et al.*, 2014) was collected at one relevé located *c.* 600m north-east of the nearest area of 4030 habitat to be lost on the 28 September 2014. Data collected at these relevés is considered to be representative of the habitat to be lost in this general location. A total of two of the positive indicator species were present (*i.e. Calluna vulgaris* and *Erica cinerea*). The percentage cover of these positive indicator species was less than 50% at both relevés, as was the the percentage cover of dwarf shrubs. Two bryophyte species were present at one relevé (*i.e. Hylocomium* sp., *Sphagnum papillosum*, *Hylocomium splendens*, *Hypnum jutlandicum*, *Dicranum scoparium* and *Pleurozia purpurea*). No negative indicator species or *Pteridium aquilinum* were present, however non-native species were. There was evidence of senescent *Calluna vulgaris* at both the relevés; however at very low percentage cover. Bare ground and rock were noted; however the low percentage cover of disturbed bare ground was relatively low. No surface water was noted. The median heights of the field layer and dwarf shrub layer were c. 15cm, while the mean height of the ground layer was *c.* 3cm. The relevé passed on 11 of the 14 criteria of the structure and function condition assessment (Perrin *et al.*, 2014). Refer to relevé codes EC20 R4 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

2.3.7 Knocknafroska to Knocknabrona - Ch. 7+800 to Ch. 8+000 and Ch. 0+600 on the N59 Link Road North

There are three donor sites within this area, 4030.D45 to 4030.D47, consisting of c. 0.23ha. See **Figure 6** for locations. Botanical and other relevant environmental data (as per the 4030 structure and function condition assessment described in Perrin *et al.*, 2014) was collected at one relevé located *c.* 472m west to the nearest area of 4030 to be lost on the 5 August 2014. Data collected at these relevés is considered to be representative of the habitat to be lost in this general location. Four out of the eight positive indicator species of this habitat type were present (*i.e. Daboecia cantabrica*, *Calluna vulgaris*, *Erica cinerea* and *Ulex gallii*). The percentage cover of these positive indicator species was greater than 50%, while the dwarf shrub cover was less than 50%. Two bryophyte species and one lichen species were recorded within the relevé (*i.e. Hypnum jutlandicum* and *Dicranum scoparium* and *Cladonia portentosa*). No negative indicator species, non-native species or Pteridium aquilinum were present. There was evidence of senescent *Calluna vulgaris*; however it was less than 50% and there were no signs of burning in the local vicinity of the relevé.

The depth of peat was *c.* 5cm and the percentage cover of bare soil, rock and litter was very low. No surface water was present. The median height of the field layer was *c.* 30cm, while the median height of the dwarf shrub layer was *c.* 20cm and the median height of the ground layer was *c.* 5cm. It passed on all 14 criteria of the structure and function condition assessment (Perrin *et al.*, 2014). Refer to relevé code EC25 R1 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

2.4 Description of Other Peatland Donor Sites

There are 11 isolated polygons of Annex I habitat 4010 (Northern Atlantic wet heaths with *Erica tetralix*) which will be removed to facilitate the construction of the proposed road development (see **Figures 2-5** for locations) and which contain soils/peat which will be suitable for use at 4030 receptor sites. All of these areas are located west of the River Corrib between Ch. 0+950 to Ch. 3+750 and outside of any designated areas for nature conservation. These sites were classified as Annex I habitat due to the presence of a sufficient number of positive indicator species (after Perrin *et al.*, 2014) and range in area from *c.* 0.006ha to *c.* 0.64ha.

Three of these sites form a mosaic with three other Annex I habitats (*i.e.* 4030 wet heath, 6410 Molinia meadows and blanket bog [*7130][3]); however the dominant habitat present is 4010 wet heath (see **Figure 2-3 and Figure 5** for locations). These three 4010 dominated mosaic donor sites are located: *c.* 235m south west of 4030.R6 on **Figure 2**; directly south of 4030.R11 on **Figure 3**; and, directly south of 4030.D42 on **Figure 5**.

There is one other site, a mosaic of 4010 and 4030, which will be removed to facilitate the construction of the proposed road development, comprised equally of 4030 dry heath and 4010 wet heath. This site is located between Ch. 3+650 to Ch. 3+750 (*c.* 0.11ha in total area), directly north of a 4010 donor site, and is outside of any designated areas for nature conservation (see *4030/4010 Donor Sites* on **Figure 4**).

[3] Although Blanket bog [*7130] is present within this mosaic, where it occurs it will not be affected in any way by the proposed road development.

2.5 Methodology for Compensatory Habitat Creation

2.5.1 Selection of Receptor Sites

The identification and selection of compensatory habitat receptor sites, where 4030 habitat will be created, was based on a desk study conducted in July 2017 and site visits conducted during the period of 2014 to 2017 as part of the environmental surveys undertaken to inform the Environmental Impact Assessment for the proposed road development. These sites were selected, in consultation with the design team, as suitable receptor sites based on a review of the following:

- Site data collected as part of habitat surveys undertaken in 2014, 2015 and 2017 at the locations of the 47 donor sites and at the 21 receptor sites. Detailed relevés were carried out within three donor sites and in close proximity (*i.e. c.* 472m-25m) to the other 44 donor sites within the same habitat type. Relevé information collected in these areas is considered to be representative and comparable to the sites themselves. The following information was collected:
    - the percentage cover of positive indicator plant species present
    - depth of peat (cm)
    - median vegetation height (cm)
    - presence of soil, rock, surface water features and plant litter
    - other botanical and environmental factors considered as part of condition assessment criteria for this habitat type (after Perrin *et al.* 2014)
- Hydrological and hydrogeological data collected to inform the environmental studies for the proposed road development
- Soils and Geology data collected to inform the environmental studies for the proposed road development

Other information relied upon as part of the selection process included the following information sources:

- Ordnance Survey of Ireland mapping and aerial photography available from www.osi.ie
- Online data available on European sites as held by the National Parks and Wildlife Service (NPWS) from www.npws.ie
- Online data available from the National Biodiversity Data Centre mapping service (http://maps.biodiversityireland.ie/#/Map)
- Information on land-use zoning from the online mapping of the Department of the Environment, Community and Local Government http://www.myplan.ie/en/index.html
- Information on water quality in the area available from www.epa.ie
- Information on soils, geology and hydrogeology in the area available from www.gsi.ie

- Information on the location, nature and design of the proposed scheme supplied by the applicant's design team
- Information on the status of EU protected habitats in Ireland (National Parks & Wildlife Service, 2013)

A total of 21 compensatory habitat receptor sites for the creation of 4030 were selected (see **Figure 1-6** for locations). A full description of the baseline conditions at these sites is provided below. These receptor sites are located within the proposed development boundary[4], adjacent or in close proximity to the footprint of the proposed road development. Based on a review of information collected (from the sources described above and with reference to guidance provided in **Section 1.1**), these receptor sites were considered suitable for the following reasons:

- The likely presence of suitable soil pH, structure, fertility and sub-soil type necessary for the establishment of Dry heath
- Presence of other physical characteristics at the receptor site necessary for the establishment of 4030 such as suitable geology and/or hydrological features (*i.e.* undulating micro topography with rocky outcrop features, on well-drained mineral soils or shallow peats)
- Presence of similar plant species composition within or in close proximity to the receptor site to that being compensated for at the donor site (*i.e.* at three of the receptor sites, RS.1, RS.5 and RS.7, there is 4030 and 4010 habitats located directly adjacent)
- Relatively short distance between some donor and receptor sites, where possible
- Total area of the receptor sites (*i.e.* 7.06ha) in the context of the total area to be lost of 4030 habitat (*i.e.* 1.85ha)[5], wet heath [4010] (*i.e. c.* 2.06ha); and, lands containing a mosaic of these two habitats (*i.e. c.* 0.87ha)
- Existing or future access to the site that will facilitate machinery, required for the proposed compensatory measures or management activities, entering or exiting the site

2.5.1.1 Receptor Site 4030.R1 - Ch. 0+000 to Ch. 0+050

This receptor site consisting of c. 0.09ha was surveyed on the 3 September 2015 and two habitat types (as defined by Fossitt 2000) were identified within its boundaries, *i.e.* Wet grassland (GS4) and Dense bracken (HD1). See **Figure 1** for location. The Wet grassland was described as rank with ruderals and disturbance

[4] The extents of the lands to be compulsory acquired for the construction and operation of the proposed road development is referred to as the proposed development boundary.

[5] "*Due to the uncertainty inherent in compensation, particularly in cases which require ecological restoration or habitat creation, replacement ratios greater than one-to-one may be appropriate for delivery of compensatory habitats or ecosystems… Increased replacement ratios can also help take account of the tie lag in delivering compensation and regaining the same maturity, complexity and diversity of habitats and the full complement of associated species.*" (CIEEM, 2016).

indicators. This area has also been identified as a Material Deposition Area[6] (*i.e.* DA01) (refer to Figures 7.301 to 7.302 and Chapter 7, Construction Activities, Chapter 9 Soils and Geology and Chapter 11, Hydrology of the EIA Report for further details.

2.5.1.2 Receptor Site 4030.R2 – Ch. 0+200 to Ch. 0+350

This receptor site consisting of c. 0.23ha was surveyed on the 3 September 2015 and four habitat types (as defined by Fossitt 2000) were identified within its boundaries, *i.e.* Dense bracken (HD1), Scrub (WS1), Recolonising bare ground (ED3) and a relatively small patch of Dry siliceous heath (HH1), which corresponded to the habitat 4030 and is also the donor site 4030.D6 (as described in **Section 2.3.1** above). The Dense bracken and Scrub were also found in a mosaic within the site and lands immediately adjacent. The northern boundary of the site borders an area of habitat 4030 which is located outside the proposed development boundary. See **Figure 1** for location. This site is also a Material Deposition Area (*i.e.* DA02).

2.5.1.3 Receptor Site 4030.R3 – Ch. 0+250 to Ch. 0+400

This receptor site consisting of c. 0.25ha was surveyed on the 3rd September 2015 and three habitat types (as defined by Fossitt 2000) were identified within its boundaries, *i.e.* Dense bracken (HD1), Scrub (WS1) and Exposed siliceous rock (ER1). The Dense bracken, Scrub and Exposed siliceous rock were found in a mosaic. See **Figure 1** for location. This site is also a Material Deposition Area (*i.e.* DA03).

2.5.1.4 Receptor Site 4030.R4 – Ch. 0+450 to 0+650

This receptor site consisting of c. 0.43ha was surveyed on 10 September 2014 and four habitat types (as defined by Fossitt 2000) were identified within its boundaries, *i.e.* Dense bracken (HD1), Scrub (WS1), Acid grassland (GS3) and Wet grassland (GS4). Both the dense bracken and the scrub and the Wet grassland and Acid grassland were found in mosaics. See **Figure 1** for location.

2.5.1.5 Receptor Site 4030.R5 - Ch. 0+800 to Ch. 0+900

This receptor site consisting of c. 0.12ha was surveyed on the 3 September 2015 and the 22 August 2016 and three habitat types (as defined by Fossitt 2000) were identified within its boundaries, *i.e.* Buildings and artificial surfaces (BL3), which

[6] These are areas within the proposed development boundary where excavated material suitable for reuse will be deposited, areas where lands have been severed, areas within slip road embankments, localised depressions around attenuation and infiltration ponds, and areas within Lackagh Quarry with slope stability concerns of the existing quarry walls.

consisted of a residential property, Broadleaved woodland and Spoil and bare ground (ED2). See **Figure 2** for location.

2.5.1.6 Receptor Site 4030.R6 - Ch. 1+100 to Ch. 1+150

This receptor site consisting of c. 0.10ha was surveyed in September 2015 and three habitat types (as per Fossitt 2000) were identified in a mosaic within its boundaries, *i.e.* Dense bracken (HD1), Wet grassland (GS4) and Scrub (WS1). The southern boundary of the site partially borders an area of habitat 4030, which is located outside the proposed development boundary. See **Figure 2** for location. This is also a Material Deposition Area (*i.e.* DA04).

2.5.1.7 Receptor Site 4030.R7 –Ch. 1+250 to Ch. 1+350

This receptor site consisting of c. 0.55ha was surveyed in 9 September 2014, and two habitat types (as per Fossitt 2000) were identified, *i.e.* a mosaic of Dense bracken (HD1) and Scrub (WS1). See **Figure 2** for location.

2.5.1.8 Receptor Site 4030.R8 and 4030.R9 – Ch. 1+350 to Ch. 1+550

These two receptor sites, which are separated by a proposed drain, were surveyed in September 2014, August 2015 and September 2015 and five habitat types (as per Fossitt 2000) were identified, *i.e.* Acid grassland (GS3), Wet grassland (GS4), Scrub (WS1), Treeline (WL2) and Dense bracken (HD1). Receptor 4030.R8 consists of 0.40ha and 4030.R9 consists of 0.54ha. See **Figure 2** for location. These sites are also a Material Deposition Area (*i.e.* DA05).

2.5.1.9 Receptor Site 4030.R10 – Ch. 1+650 to Ch. 1+900

This receptor site consisting of c. 0.44ha was surveyed in September 2014 and five habitat types (as per Fossitt 2000) were identified, *i.e.* Dense bracken (HD1), Scrub (WS1), Wet grassland (GS4), Acid grassland (GS3) and a very small area of wet heath (HH3), which corresponds with habitat 4010. This area of 4010 forms part of a larger 4010 (other peatland) donor site. See **Figure 2** for location. This is also a Material Deposition Area (*i.e.* DA06).

2.5.1.10 Receptor Site 4030. R11 –Ch. 2+900 to Ch. 3+050

This receptor site consisting of c. 0.66ha was surveyed in September 2014 and four habitat types (as defined in Fossitt 2000) were identified within its boundaries. See **Figure 3** for location. These included a mosaic of Acid grassland (GS3), Wet grassland (GS4), Scrub (WS1) and Dense bracken (HD1) and Wet grassland (GS4) and Scrub (WS1). The habitat 4010 was identified directly east of this site; this habitat falls within the proposed development boundary however is proposed to be retained. This site is also a Material Deposition Area (*i.e.* DA08).

2.5.1.11 Receptor Site 4030.R12 – Ch. 3+200 to Ch. 3+300

This receptor site consisting of c. 0.23ha was surveyed on the 9 September 2015 and two habitat types (as defined by Fossitt 2000) were identified within its boundaries, *i.e.* Wet grassland (GS4) and Improved agricultural grassland (GA1). See **Figure 4** for location. This site is also a Material Deposition Area (*i.e.* DA09).

2.5.1.12 Receptor Site 4030.R13 – Ch. 3+300 to Ch. 3+400

This receptor site consisting of c. 0.11ha was surveyed on the 9 September 2015 and three habitat types (as defined by Fossitt 2000) were identified within its boundaries, *i.e.* Wet grassland (GS4), Acid grassland (GS3) and spoil and bare ground (ED2). See **Figure 4** for location.

2.5.1.13 Receptor Site 4030.R14 – Ch. 3+300 to Ch. 3+400

This receptor site consisting of c. 15ha was surveyed on the 9 September 2015 and three habitat types (as defined by Fossitt 2000) were identified within its boundaries, *i.e.* Scrub (WS1), Wet grassland (GS4) and tall-herb swamp (FS2). See **Figure 4** for location. This site is also a Material Deposition Area (*i.e.* DA10).

2.5.1.14 Receptor Site 4030.R15 and 4030.R16 – Ch. 3+900 to Ch. 4+100

These receptor sites, separated by a tributary of the Bearna Stream, were surveyed in September 2015 and two habitat types (as defined by Fossitt 2000) were identified within its boundaries, *i.e.* Wet grassland (GS4) and Acid grassland (GS3). Receptor 4030.R15 consists of 0.35ha and 4030.R16 consists of 0.47ha. See **Figure 4** for locations. Both these sites are Material Deposition Areas (*i.e.* DA11 and DA12).

2.5.1.15 Receptor Site 4030.R17 –Ch. 4+800 to Ch. 4+900

This receptor site consisting of c. 0.12ha was surveyed in August 2016 and one habitat type (as defined by Fossitt 2000) was identified within its boundaries, *i.e.* Wet grassland (GS4). See **Figure 5** for location. This site is also a Material Deposition Area (*i.e.* DA13).

2.5.1.16 Receptor Site 4030.R18 –Ch. 5+200 to Ch. 5+350

This receptor site consisting of c. 0.81ha was surveyed both in August 2014 and September 2015 and five habitat types (as defined in Fossitt 2000) were identified within its boundaries. These included a mosaic of Scrub (WS1) and Dense bracken (HD1), Improved agricultural grassland (GA1), Dry meadows and grassy verges (GS2), Dense bracken (HD1), Scrub (WS1) and Dry siliceous heath (HH1). The area of Dry siliceous heath corresponds to 4030 habitat and is 4030.D43 to be lost

(see **Section 2.3.6** for more details). See **Figure 5** for location. This site is also a Material Deposition Area (*i.e.* DA14).

2.5.1.17 Receptor Site 4030.R19 –Ch. 5+850 to Ch. 6+000

This receptor site consisting of c. 0.35ha was surveyed in August 2014 and four habitat types (as defined in Fossitt 2000) were identified within its boundaries, *i.e.* Scrub (WS1), Acid grassland (GS3), Wet grassland (GS4) and Improved agricultural grassland (GA1). See **Figure 5** for location. This site is also a Material Deposition Area (*i.e.* DA15).

2.5.1.18 Receptor Site 4030.R20 –N59 Link Road North at Ch. 0+250 to Ch. 0+150

This receptor site consisting of c. 0.40ha was surveyed in 2015 and two habitat types (as defined in Fossitt 2000) were identified within its boundaries, *i.e.* Improved agricultural grassland (GA1) and Scrub (WS1). See **Figure 6** for location This site is also a Material Deposition Area (*i.e.* DA19).

2.5.1.19 Receptor Site 4030.R21 –N59 Link Road North at Ch. 0+150 to Ch. 0+000

This receptor site consisting of c. 0.39ha was surveyed in 2015 and one habitat type (as defined in Fossitt 2000) was identified within its boundaries, *i.e.* Improved agricultural grassland (GA1). See **Figure 6** for location. This site is also a Material Deposition Area (*i.e.* DA18).

2.5.2 Pre-Compensatory Site Preparation Works

2.5.2.1 Ecology Site Management Plans

Prior to compensatory works commencing, Ecology Site Management Plans will be finalised by the Contractor in combination with the Project Ecologist and/or ECoW with reference to the construction programme, which may influence the timing and co-ordination of these works and the requirement for storage of soils and/or turves, and issued to the team involved in the compensatory works. The finalised plans will include site specific method statements outlining step-by-step actions (as per the pre-compensatory measures described in **Section 2.5.2** and compensatory measures described in **Section 2.5.3)** for the Contractor to implement within a specified timescale, under the supervision and advice of the Project Ecologist and/or ECoW. It will also include a check-list of conditions (as per the monitoring criteria set out in Perrin *et al.*, 2014, as described in **Section 2.7**) to be assessed by a suitably qualified and experienced ecologist at the receptor sites during the pre-compensation, during and post-compensation monitoring. The finalisation of the Ecology Site Management Plans by the Contractor will not affect

the robustness and adequacy of the information presented here and relied upon in the EIA Report and NIS, as these plans are merely providing more site specific detail and methodological steps to the principles and proposals already outlined in this CHMP.

2.5.2.2 Non-native Invasive Plant Species and Biosecurity

As set out in the Construction Environmental Management Plan (CEMP) in **Appendix A.7.5** of the EIA Report, a non-native invasive plant species survey will be undertaken immediately in advance of works commencing to inform the finalisation of CEMP. The biosecurity measures outlined in the CEMP will be implemented at both the donor and receptor sites, where applicable, in order to avoid the accidental spread of potentially harmful plant or animal species between sites. The CEMP also includes: measures that the Contractor will implement in order to avoid spreading invasive species during soil movement; measures to treat invasive plant species prior to construction/compensation works commencing; and, site hygiene measures to be implemented to prevent further spread of non-native invasive plant species.

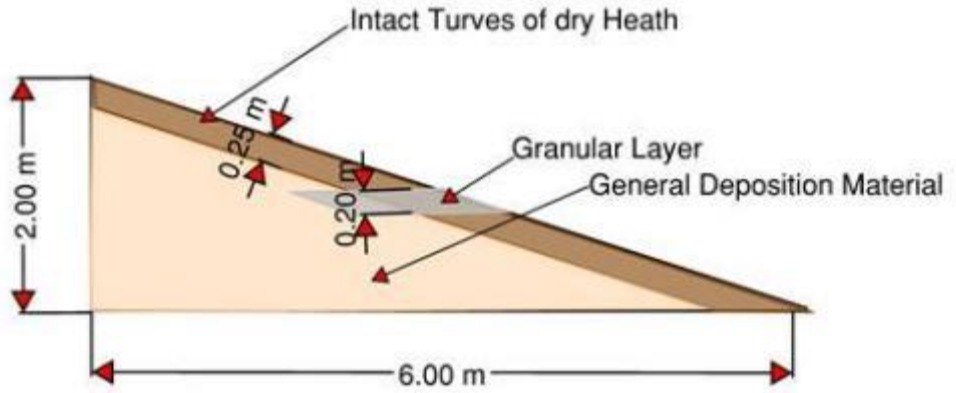
2.5.2.3 Temporary Fencing

Where applicable, temporary fencing and associated signage will be erected at both the donor and receptor sites for the duration of the construction. This will minimise any potential disturbance to adjacent sensitive habitats and/or hydrological features within both the donor and receptor sites from either encroachment into the habitat or damage. Sensitive habitats identified include: Annex I wet heath [4010]; and, a mosaic of 4030 and 4010 Annex I habitats (see **Figure 8.15.1-8.15.15** and **Figure 8.23.1-8.23.15** of the EIA Report for location maps of these sensitive habitats).

2.5.2.4 Material Deposition Areas

In the case of the receptor sites that are also Material Deposition Areas (MDA), the following measures will also be implemented to ensure the successful creation of 4030. The placement of a compatible layer of material, such as a granular material with a high permeability, on the slopes of the MDA, to allow water to freely drain and to provide slope and surface stability. On top of the granular layer, intact habitat turves may be placed (as described in **Section 2.4.3**). See **Plate 1** below for an example illustration of granular layer of the side slope of a MDA in the context of where the intact turves would be placed.

Plate 1 Example illustration of MDA side slope



2.5.2.5 Soil Preparation at the Receptor Site

The soil preparation technique(s) outlined below will be implemented at the receptor sites either alone or in-combination, as decided upon on a site-by-site basis by the Contractor under the supervision and advice of the Project Ecologist and/or ECoW. In most cases, it may be recommended that these techniques are implemented in-combination in order to increase the likelihood of success of 4030 habitat creation (Hawley *et al.*, 2008). Soil analysis tests to assess the pH and nutrient status of a receptor site will need to be carried out prior to the implementation of the site specific method statements as these factors are essential in determining which technique(s) should be employed at a site (Hawley *et al.*, 2008 and Farrell, 2008).

Surface Vegetation Management and Removal Techniques

At some receptor sites, certain undesirable herbaceous species present (such as *Pteridium aquilinum*, *Molinia caerulea* and *Deschampsia* species) may outcompete and therefore hinder the growth and establishment of the target ericaceous vegetation (Hawley *et al.*, 2008). At such receptor sites, it will be necessary to cut and remove these undesirable species, in-combination with the soil stripping method described below, in order to prepare the site prior to implementation of the compensatory measures. It is important that all cut material is removed from the receptor site and not left on the ground as failure to do so may result in the accumulation of nutrients at the site, which would provide suitable conditions for more competitive species to grow rather than the desired ericaceous species. Failure to remove cut material may also result in the shading of the desirable seedlings (Hawley *et al.*, 2008). The methods employed to remove cut material will vary per site, as dependent on its size and topography. With regards to *Pteridium aquilinum*, it may be controlled by cutting and/or crushing the growing fronds, resulting in the gradual starvation of the rhizomes and death of the plant. Bracken cutting should be targeted at mature fronds, which should be cut twice a year, *i.e.* in mid-June and

again six weeks later (Scottish Natural Heritage, 2018). At some receptor sites, it may be deemed necessary to use herbicides (*e.g.* Asulox) to control and/or eliminate the presence of *Pteridium aquilinum*, especially in areas severely infested with this species. Following treatment, the accumulated litter will need to be removed from the site (Hawley *et al.*, 2008).

Soil Acidity Amelioration Techniques

At receptor sites where the past land use was agricultural in nature, it is important that measures to manipulate the soil's acidity (*i.e.* adding sulphur to the soil to lower pH) and nutrient status (*i.e.* soil stripping to remove nutrients) are employed in-combination in order to create suitable soil conditions. This is essential for the success of the re-creation of 4030 at these particular receptor sites where low pH and low nutrient soils are required (Hawley *et al.*, 2008 and Diaz *et al.*, 2008). At sites were the soil pH is high (as identified from the results of the soil analysis test), elemental sulphur may be added to the soil following initial vegetation clearance and topsoil removal to reduce the pH to suitable acidic conditions for 4030 re-creation (Hawley *et al.*, 2008). Considering the existing habitats at the receptor sites (as described in section 3.1), it is considered unlikely that this will be required as the soil conditions at the vast majority of these sites are more than likely nutrient-poor.

Soil Stripping

Topsoil will need to be removed from receptor sites where the soil fertility has been identified as being unsuitably high for the re-creation of 4030 (*i.e.* at sites where the past land use was agricultural in nature). This action will reduce the presence of nutrients (in particular phosphate) that result in high soil fertility and will in turn result in a reduction in competitive grasses, which may be present in the existing seed bank at the receptor site and would thrive in such high soil fertility.

The removal involves stripping the topsoil from the site up to a maximum depth of *c.* 25cm (Diaz *et al.*, 2008 and Farrell, 2008). These works must be undertaken during dry weather conditions under the supervision of the Project Ecologist and/or EcoW. Ground compaction of the sub-soil by machinery will be avoided as it may impede the rates of establishment of desired species following implementation of the compensatory measures. Prior to translocation of turves and soil, it may be necessary to lightly cultivate the subsoil at the receptor site using a rotovator machine to relieve any compaction or surface capping (Pywell *et al.*, 1995). An uneven, non-compacted bed is desired for a higher rate of heathland vegetation establishment (Hawley *et al.*, 2008).

Surface and below-ground vegetation (trees and shrubs) removal techniques

At receptor sites where there are undesirable woody species, it may be necessary to cut them down to ground-level and spot-treat the remaining stumps with suitable

herbicide (Hawley *et al.*, 2008). All associated vegetation will need to be removed from the receptor site.

2.5.3 Compensatory Measures

The three different compensatory measures described below outline how to re-create 4030 habitat within the 21 compensatory habitat receptor sites. More than likely these measures will be implemented in-combination with one another, as to be determined on a site-by-site basis by the Contractor under the supervision and advice of the Project Ecologist and/or EcoW. The timing and duration of these works will depend on the progress of the construction of the proposed road development, requirements for access and weather conditions. It should be noted that the process of habitat creation can take several years (Morris *et al.*, 2006 and Farrell, 2008) and that appropriate adaptive management of these sites (as outlined in **Sections 2.6** and **2.7**) may be required to ensure success.

2.5.3.1 Translocation of Turves

Translocation of the heath habitat is considered to be the most successful restoration and re-creation treatment in the long-term as it results in the desired plant communities of the targeted habitat becoming quickly established (Pywell *et al.*, 2011). Translocation involves the removal of intact turves (*i.e.* the vegetated sod-peat), soil and/or plant species from the impacted donor site to the new receptor or compensation site (Iuell *et al.*, 2003). Following site preparation, intact turves of existing 4030 habitat (*i.e.* c. 10-25cm in depth, depending on the depth of peat at the individual donor sites) will be carefully removed from the donor sites using a suitable excavator (*i.e.* with adequate capacity to carefully remove and translocate the intact turves) during dry weather conditions and moved to the receptor site. Each turve will be placed at a distance from one another, as determined by the size of the receptor site. These gaps will be subsequently filled in with suitable soils from the donor sites. The turves will need to be laid out at the receptor site in such a manner as to avoid excessive movement of the excavator, which could cause damage. This may be achieved by arranging the turves in such a manner as to avoid excessive movement on the turves and/or subsoil, which could result in soil compaction, in turn impeding the rates and/or success of establishment of desired species.

Following site preparation, which may include the stripping of topsoil, the turves will be incorporated into the bare substrate at the receptor site. This process will need to be undertaken slowly and carefully in order maintain the integrity of the intact turves, which will contain desirable species of this habitat type such as those outlined in **Section 2.2**. Where translocation direct from the donor site to the receptor site cannot take place (e.g. due to construction programme constraints and/or other project commitments), it will be necessary to store turves from the donor sites for later translocation to the receptor site at the appropriate time of year.

During storage, turves must not be placed on top of each other in order to avoid any compaction of soil, as this would reduce the quality of the soil and would negatively impact on the success of the translocation. The duration of storage must be as minimal as possible. Depending on the duration of storage and prevailing weather conditions, the intact turves may require periodic watering at an appropriate levels in order to ensure that the plants and seeds present do not dry out and die. Careful consideration will need to be given to how often and how much watering should be applied to the turves.

2.5.3.2 Translocation of Suitable Soils/Peat

Following site preparation, the heathland soils/peat (including the topsoils with or without various associated suitable vegetative matter) of the donor sites of existing 4030 habitat may be scraped up and transferred together to the receptor sites in a suitable excavator. The translocation of the topsoil in-combination with the translocation of intact turves should contain a sufficient seed bank of desirable plant species to encourage the establishment of the desired ericaceous species and allow the receptor site to re-vegetate, creating the habitat type (Hawley *et al.*, 2008). In some cases it may be necessary (e.g. due to construction programme constraints and/or other project commitments), to store the soil/peat from the donor sites for later translocation to the receptor site at the appropriate time of year. The duration of storage must be as minimal as possible. Topsoil and subsoil must be stored separately and separate to any other topsoil or soil present on-site. In order to avoid soil compaction and soil smearing, it is recommended that: soil is handled during dry conditions and not when saturated; and, after placement the soil is decompacted by ripping, which will improve drainage, aeration and rooting establishment. It should be noted that stripping and disturbance of soils may encourage the release of nutrients and in turn alter the soil fertility and promote undesirable weed species (National Roads Authority, 2006); therefore measures outlined above under the heading of surface vegetation management and removal techniques may be required.

In additional to heathland soils/peat taken from the 4030 donor sites, any additional soils/peat required at the receptor sites may be sourced from the other peatland donor sites located within the proposed development boundary (see **Section 2.4** for more details). The requirement for these soils at the receptor sites will be determined on a site-by-site basis by the Contractor under the supervision and advice of the Project Ecologist and/or EcoW. The existing habitats at these donor sites are comprised of 4010 and mosaics of 4010/4030; therefore they will contain suitable soils (*i.e.* peat) for the re-creation of 4030.

The total area of 4030 donor sites is *c.* 1.85ha, while the total area of all other peatland donor sites is *c.* 2.1ha; therefore the overall area of peatland donor sites with suitable available soils for 4030 re-creation is *c.* 3.95ha. Following a review of the depths of peat at sites located within or near to donor sites as recorded as part

of ground investigation works, depths of peat recorded at relevés surveyed as part of habitat surveys, and knowledge regarding the habitat types of Dry heath and Wet heath, it is considered that sufficient soils for the creation of *c.* 7.06ha of 4030 may be sourced from within the proposed landtake for the proposed road development.

2.5.3.3 Harvesting and Spread of Heather Clippings

Clippings with seed capsules of the desired ericaceous species *Calluna vulgaris* and *Erica cinerea* may be harvested from within the 4030 donor sites and the other potential peatland donor sites located within the proposed development boundary in autumn and winter time (Pywell *et al.*, 1995). These clippings must be spread on bare peat translocated from the donor sites (and not on the areas where intact turves have been translocated to). The amount of clippings spread is recommended to be twice the area they must cover (Diaz *et al.*, 2008). The depth of the harvested shoots applied to the substrate was found to have a critical effect on heather seedling germination and recruitment at the small scale (Pywell *et al.*, 1995).

2.6 Management

Site specific details (*i.e.* with regards to whether or not the physical and/or chemical control of encroaching *Pteridium aquilinum* is required) on both the short-term and long-term management of the newly created habitat will be outlined in the finalised Ecology Site Management Plan, as determined by the Project Ecologist and/or EcoW. Management of the newly created habitat is necessary for its success, as it will prevent the domination of the sward by undesirable species (*e.g. Pteridium aquilinum*), which have the ability to outcompete the desired heath species.

Following the implementation of the chosen compensatory measure(s), a stock-proof protective fence will be erected to protect the receptor site from disturbance such as unwanted grazing and/or trampling. At sites where *Pteridium aquilinum* is encroaching on the newly created habitat, it may be necessary to cut it back two to three times a year (Hawley *et al.*, 2008), as determined by a suitably qualified and experienced ecologist on a site by site basis. All cuttings will need to be removed from the site to avoid alterations to the existing soil conditions. It may be deemed necessary to use selective herbicides (*e.g.* Asulox) to eliminate the presence and potential spread of *Pteridium aquilinum*, especially in areas severely infested with this species (Hawley *et al.*, 2008).

2.7 Monitoring

Monitoring of receptor sites will be carried out by a suitably qualified and experienced ecologist pre-compensation, during and post-compensation in order to:

- firstly, ensure that potential issues that may deter the success of the compensation are identified and addressed through adaptive management measures; and
- secondly, to determine the overall success of the habitat compensation process

Adaptive management measures will be targeted to address the specific issues identified by the monitoring and may be varied. For example they could include, translocation of additional turves and/or heather clippings to replace those that have failed. Adaptive management measures, implemented in response to monitoring results, will not affect the robustness and adequacy of the information presented here and relied upon in the EIA Report and NIS, providing these measures either fall within the scope of proposals already provided for in this CHMP, or involve impacts of equal of lesser significance to those provided for in this CHMP and assessed in the EIA Report and NIS.

The finalised Ecology Site Management Plans, which will be prepared on a site-by-site basis, will include a check-list of conditions to be assessed by a suitably qualified and experienced ecologist at the receptor sites during pre-compensation, during the compensation works, and as part of the post-compensation monitoring. Conditions assessed in both the short and long-term will be in reference to the monitoring criteria set out in Perrin *et al.*, 2014 for this Annex I habitat and will be used to determine the extent of successful 4030 establishment. These conditions include the following as a minimum:

- Information on vegetation composition, *i.e.* number of positive indicator species and bryophyte species present, proportions of shrub cover, cover of negative indicator species, non-native invasive plant species, scattered native trees and scrub, *Pteridium aquilinum* and *Juncus effusus*;
- Information on vegetation structure, *i.e.* senescent proportion of *Calluna vulgaris*, level of grazing, signs of burning and growth of *Calluna vulgaris* across the receptor site; and,
- Information on physical structure, *i.e.* cover of disturbed ground.

The intervals and duration for the pre- and during compensation works monitoring programme, will be decided upon by the Project Ecologist and/or ECoW and is likely to depend upon the speed of habitat establishment and stabilisation.

The post-construction monitoring programme will require annual monitoring, commencing on the year of habitat creation, for a minimum period of five years, with a review by a suitably qualified and experienced ecologist at the end of that period undertaken to determine whether the monitoring period needs to be extended further, if for example it is viewed that the habitat has not stabilised or become fully

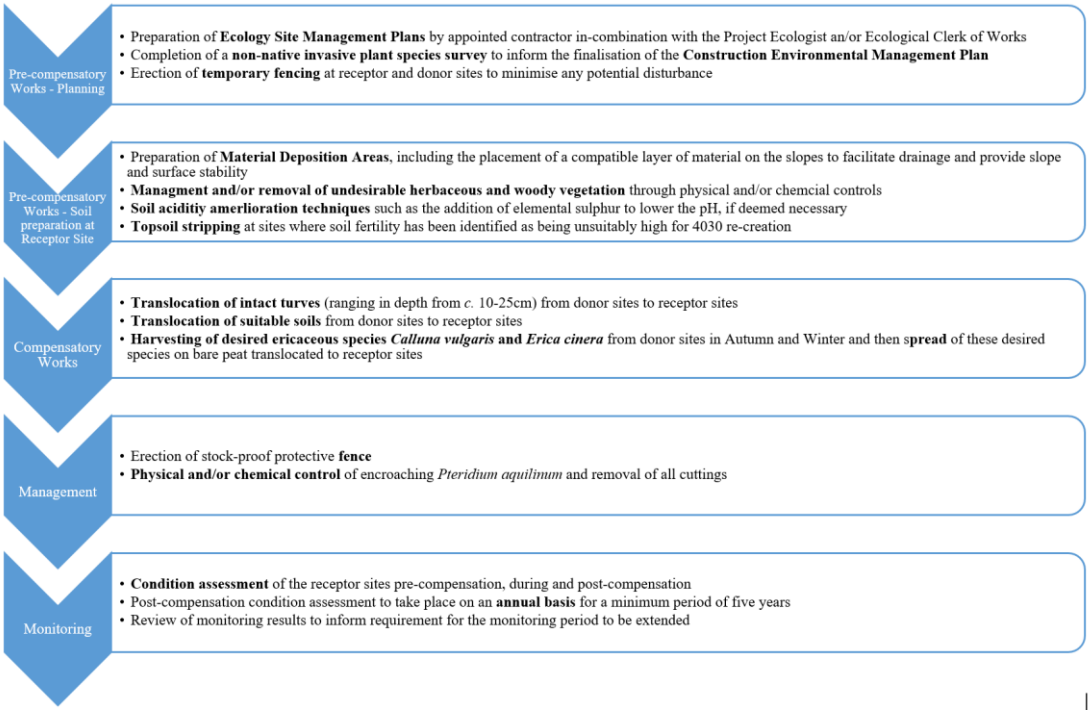
established by that time. Any extension to the monitoring period will need to consider whether on-going monitoring should be at annual or longer intervals e.g. +3 years post-creation, +6 years post-creation etc.

The results of all monitoring will be made available to the NPWS.

2.8 Conclusions

The measures outlined in this section will compensate for the significant residual effect on 4030 habitat by ensuring that there will be no net permanent loss of this habitat type as a consequence of the proposed road development and a biodiversity gain for peatland habitats. A total area of *c.* 7.06ha (*c.* 148% of the combined losses of: 4030, 4010 and a mosaic of these habitats) will be created as part of the proposed compensatory works. The steps outlined in this section are presented below as a flow chart.

Plate 2 Flow chart of steps involved in the creation of 4030



3 Semi-natural dry grasslands and scrubland facies on calcareous substrates [6210]

3.1 Introduction

The proposed road development will result in the permanent loss of *c.* 0.7ha of Annex I habitat Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) [6210] (hereafter referred to as 6210). It is proposed to compensate for this loss by re-creating c. 7.14ha.

Separate to the areas of 6210 habitat to be created as a compensatory measure, there are areas of 6210 habitat located within the proposed development boundary that will be retained and fenced off for the duration of construction. These areas will not be directly impacted by the proposed road development. These areas are presented in **Figures 8.23.1** to **8.23.15** of the EIA Report. These areas will not be available to use as donor sites for the purposes of creation of compensatory 6210 habitat.

The steps followed for the 6210 habitat compensation process are:

- Identification and selection of suitable compensatory habitat receptor sites for 6210 habitat (Refer to **Sections 3.2 to 3.5**)
- Pre-compensatory works site preparation at both the donor sites and receptor sites, including: the provision of site specific method statements within the Finalised Ecology Site Management Plans; erection of temporary fencing; topsoil stripping; and, weed control (Refer to **Section 3.5.2**)
- Implementation of compensatory measures at the receptor sites, either alone or in-combination as dependent on the characteristics of the receptor sites. These measures include: the translocation of turves and soil from donor sites to the receptor sites; seeding from either seed collected at donor sites or bought native Irish seed mix; green-hay strewing; and/or, natural colonisation (Refer to **Section 3.5.3**)
- Short-term and long-term management of the receptor sites following the implementation of compensatory measures (Refer to **Section 3.6**)
- Monitoring of the receptor sites to be carried out pre-compensation, during and post-compensation by a suitably qualified and experienced ecologist in order to ensure that potential issues are identified at an early stage and addressed through adaptive management measures. (Refer to **Section 3.7**)

3.2 Description of Annex I habitat 6210

The vegetation community associated with the Annex I habitat Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) [6210] to be lost is *Briza media – Thymus polytrichus*. This is a species-rich sub-community of the grassland vegetation community *Cynosurus*

cristatus – Plantago lanceolata. It contains a large number of constants, such as the graminoid species *Carex flacca, Briza media, Anthoxanthum odoratum* and *Sesleria caerulea* with *Carex caryophyllea, Festuca* spp. and *Koeleria macrantha* and forb species *Thymus polytrichus, Linum catharticum, Galium verum, Lotus corniculatus, Campanula rotundifolia, Polygala vulgaris, Leucanthemum vulgare* and *Pilosella officinarum*. It is comprised of swards of calcareous grassland on shallow, well-drained soils of poor fertility (*i.e.* a mean organic content of 26.6%). In Ireland it is typically found in association with limestone pavement and eskers, occurring at middling altitudes often on sloping ground which improves drainage. The management of these swards usually involves light grazing regimes by cattle or horses (O'Neill *et al.*, 2013). The diversity of this habitat type is a result of a combination of mineral nutrient stress and grazing/cutting management conditions, which prevents a few rank species dominating the grassland (Ashwood, 2014).

3.3 Description of 6210 Donor Sites

There are five sites of Annex I habitat 6210 which will be removed to facilitate the construction of the proposed road development (see **Figure 8, 9 and 11** for locations). All of these sites are located east of the River Corrib. These sites were classified as Annex I habitat due to the presence of a sufficient number of high quality positive/positive indicator species (after O'Neill *et al.*, 2013). Full descriptions of the five donor sites of habitat to be lost are provided below.

3.3.1 Donor Site 6210.D1 - Ch. 11+750

Donor site 6210.D1 consists of c. 0.09ha. See **Figure 8** for location. Botanical and other relevant environmental data (as per the 6210 structure and function condition assessment described in O'Neill *et al.*, 2013) was collected at a relevé within this area of 6210 habitat to be lost on the 27th July 2016. Data collected within this relevé was considered to be representative of the habitat to be lost. On the day of the survey, it was noted that the habitat was being moderately grazed by horses. A total of four of the 18 high quality indicator species of this Annex I habitat (*i.e. Anthyllis vulneraria, Linum catharticum, Briza media* and *Blackstonia perfoliata*) and three of the 17 positive indicator species were present (*i.e. Lotus corniculatus, Leontodon hispidus* and *Carex flacca*). No non-native species, negative indicator species or scrub species (or *Pteridium aquilinum*) were noted. The percentage cover of bare ground was *c.* 15% with some bare soil, rock and litter present. No surface water was present. The median vegetation height for grass species was *c.* 10cm, while the median vegetation height for forb species present was *c.* 20cm. The area failed on three of the 11 criteria of the structure and function condition assessment, *i.e.* the presence of positive indicator species (≥7); the percentage cover of bare ground (<10%); and, signs of serious grazing or disturbance (<20m^3) (O'Neill *et al.*, 2013). Refer to relevé code LQ-N84 R1 presented in **Appendix A.8.19** of the EIA report for an associated species list.

3.3.2 Donor Site 6210.D2 - Ch. 12+000 *c.* 205m east of Lackagh Quarry

Donor site 6210.D2 consists of c. 0.003ha. See **Figure 8** for location. Botanical and other relevant environmental data (as per the 6210 structure and function condition assessment described in O'Neill *et al.*, 2013) was collected at a relevé on the 3rd September 2015 located *c.* 14m south of this area of 6210 habitat to be lost. Data collected at this relevé was considered to be representative of the habitat to be lost. Most likely due to high level of grazing and disturbance at the site, only one of the 18 high quality indicator species of this Annex I habitat (*i.e. Koeleria macrantha*) and one of the 17 positive indicator species (*i.e. Leontodon hispidus*) were present. No non-native or scrub species were present. The total percentage cover of negative indicator species present was less than 20%. There was no bare soil or rock present and the percentage cover of litter was very low at *c.* 1%. No surface water was present. The median height of grass species present was *c.* 25cm, while the median vegetation height of forb species was *c.* 35cm. The area failed on three of the 11 criteria of the structure and function condition assessment, *i.e.* the presence of positive indicator species (≥7); the presence of high quality indicator species (≥2); and, signs of serious grazing or disturbance (<20m^3) (O'Neill *et al.*, 2013). Refer to relevé code EC37 R8 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

3.3.3 Donor Site 6210.D3 – Ch. 12+100 *c.* 282m east of Lackagh Quarry

Donor site 6210.D3 consists of c. 0.1ha. See **Figure 9** for location. Botanical and other relevant environmental data (as per the 6210 structure and function condition assessment described in O'Neill *et al.*, 2013) was collected at a relevé on the 14th August 2014 located within this area of 6210 to be lost. Data collected at this relevé was considered to be representative of the habitat to be lost. It was described as an area of disturbed ground recolonised by 6210 vegetation. Only one of the 18 high quality indicator species (*i.e. Knautia arvensis*) and five of the 17 positive indicator species were present (*i.e. Daucus carota*, *Carex flacca*, *Ctenidium molluscum*, *Helictotrichon pubescens* and *Lotus corniculatus*). Non-native species were noted with a percentage cover greater than 1%. No negative species were noted. The percentage cover of bare soil, rock and litter was noted to be *c.* 3%. No surface water features were present; however it was noted that the drainage of the site appeared to be impeded with damp patches present. The median height of grass species present was *c.* 35cm, while them median height of forb species was *c.* 30cm. The area failed on three of the 11 criteria of the structure and function condition assessment, *i.e.* the presence of positive indicator species (≥7); the presence of high quality indicator species (≥2); and, cover of non-native species (<1%) (O'Neill *et al.*, 2013). Refer to relevé code LQ-N84 R2 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

3.3.4 Donor Site 6210.D4 - Ch. 12+150 *c.* 52m east of N84 Headford Road

Donor site 6210.D4 consists of c. 0.02ha. See **Figure 9** for location. Botanical and other relevant environmental data (as per the 6210 structure and function condition assessment described in O'Neill *et al.*, 2013) was collected at a relevé on the 27th August 2014 located *c.* 16.5m south of the area of 6210 to be lost. Data collected at this relevé was considered to be representative of the habitat to be lost. It was described as a slightly damp area of disturbed ground with localised Exposed calcareous rock with species-rich grassland. A total of three of the 18 high quality indicator species of this Annex I habitat (*i.e.* Briza media, *Anthyllis vulneraria* and *Linum catharticum*) and seven of the 17 positive indicator species (*i.e. Sesleria caerulea*, *Helictotrichon pubescens*, *Carex flacca*, *Daucus carota*, *Lotus corniculatus*, *Pilosella officinarum* and *Ctenidium molluscum*) were present. No non-native species were present and the total percentage cover of negative indicator species present was less than 20%. There was no litter present and the percentage cover of bare soil was less than 10%. No surface water features were present. The median height of grass species present was *c.* 25cm, while the median height of forb species was *c.* 25cm. The area passed on all 11 criteria of the structure and function condition assessment (O'Neill *et al.*, 2013). Refer to relevé code EC39 R11 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

3.3.5 Donor Site 6210.D5 - Ch. 16+250 *c.* 126m north-east of the existing N6

Donor site 6210.D5 consists of c. 0.48ha. See **Figure 11** for location. Botanical and other relevant environmental data (as per the 6210 structure and function condition assessment described in O'Neill *et al.*, 2013) was collected at a relevé on the 17th June 2014 located *c.* 11m south-west of the area to be lost. Data collected at this relevé was considered to be representative of the habitat to be lost. It was described as a species-rich grassland with outcrops of rock and evidence of very light grazing. There was *Pteridium aquifolium* and scrub encroaching. A total of two of the 18 high quality indicator species of this Annex I habitat (*i.e. Briza media* and *Carex caryophyllea*) and four of the 17 positive indicator species were present (*i.e. Ranunculus bulbosus*, *Pilosella officinarum*, *Lotus corniculatus* and *Helictotrichon pubescens*). No non-native species were present and the total percentage cover of negative indicator species present was less than 20%. There was no bare soil present and the percentage cover of bare rock was noted to be between 11-25%, while the percentage cover of litter present was less than 3%. No surface water was present. The area failed on two of the 11 criteria of the structure and function condition assessment, *i.e.* the presence of positive indicator species (≥7); and, cover of scrub, bracken and heath cover (≤5%) (O'Neill *et al.*, 2013). Refer to relevé code EC56 R4 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

3.4 Description of Other Dry Calcareous and Neutral Grassland Donor Sites

There are 37 polygons of the habitat type Dry calcareous and neutral grassland (GS1) classified as being of local importance higher value, which will be removed to facilitate the construction of the proposed road development (see **Figures 7-11** for locations) and which contain soils which will be suitable for use at 6210 receptor sites. Five of these polygons also overlap partially or entirely with receptor sites; 6210.R1 and 6210.R2 (**Figure 7**), 6210.R3, 6210.R4 and 6210.R5 (**Figure 8**). Of these 6210.R1 is located partially within the boundaries of the Lough Corrib candidate Special Area of Conservation (cSAC). All other sites lie outside of any designated areas for nature conservation. All of these areas are located east of the River Corrib between Ch. 9+400 to Ch. 17+100 and range in area from *c.* 0.00023ha to *c.* 1.54ha. See Chapter 8, Biodiversity of the EIA Report for further details on this habitat type.

3.5 Methodology for Compensatory Habitat Creation

3.5.1 Selection of Receptor Site

The identification and selection of the compensatory habitat receptor sites, where 6210 habitat will be created, was based on a desk study conducted in June 2017 and March 2018 and site visits conducted on various dates from 27 July 2015 to 10 October 2017 as part of the surveys undertaken to inform the environmental studies for the proposed road development. These sites were selected, in consultation with the design team, as suitable receptor sites based on a review of the following:

- Site data collected as part of habitat surveys undertaken between 2014 and 2016 at the location of five donor sites and in 2015, 2016 and 2017 at the location of receptor sites.

  Detailed relevés were carried out within two donor sites and in close proximity (*i.e. c.* 11m-16.5m) to the other three donor sites within the same habitat type and the following information was collected:

  - the percentage cover of high quality, positive and/or negative indicator plant species present
  - presence of soil, rock and surface water
  - other botanical and environmental factors considered as part of condition assessment criteria for this habitat type (after O'Neill *et al.* 2013)
- Hydrological data collected to inform the environmental studies for the proposed road development
- Soils and Geology data collected to inform the environmental studies for the proposed road development

- Information on current and past land-use activities undertaken at the receptor sites, which may have influenced the condition of the topsoil

Other information relied upon as part of the selection process included the following information sources:

- Ordnance Survey of Ireland mapping and aerial photography available from www.osi.ie
- Online data available on European sites as held by the National Parks and Wildlife Service (NPWS) from www.npws.ie
- Online data available from the National Biodiversity Data Centre mapping service (http://maps.biodiversityireland.ie/#/Map)
- Information on land-use zoning from the online mapping of the Department of the Environment, Community and Local Government http://www.myplan.ie/en/index.html
- Information on water quality in the area available from www.epa.ie
- Information on soils, geology and hydrogeology in the area available from www.gsi.ie
- Information on the location, nature and design of the proposed road development supplied by the applicant's design team
- Information on the status of EU protected habitats in Ireland (National Parks & Wildlife Service, 2013)

Seven compensatory habitat receptor sites for the creation of 6210 were selected (see **Figure 7-8** for locations). A full description of the baseline conditions at these sites is provided below. These receptor sites are located within the proposed development boundary, adjacent or in close proximity to the footprint of the proposed road development. Based on a review of information collected (from the sources described above and with reference to guidance provided in **Section 1.1**), these receptor sites were considered suitable for the following reasons:

- Presence of physical characteristics at the receptor site necessary for the establishment of calcareous grassland such as suitable topography and geology
- Presence of similar plant species composition within or in close proximity to the receptor site to that being compensated for at the donor site (*i.e.* the nearest area of 6210 habitat is located *c.* 20m north of one of the receptor site)
- Relatively short distance between donor and receptor sites (*i.e.* the shortest distance between a donor site to a receptor site is between 6210.D3, which is located *c.* 103m to the south-east of 6210R.7) (See **Figures 8-9** for locations)

- Total combined area of the receptor sites (*i.e. c.* 7.14ha) in the context of the total area of 6210 to be lost (*i.e. c.* 0.7ha) (*i.e. c.* 1,020% of the area of 6210 lost will be compensated for)[7]
- Existing or future access to the site that will facilitate machinery, required for the proposed compensatory measures or management activities, entering or exiting the site

3.5.1.1 Receptor Site 6210.R1 – Ch. 9+400 to Ch. 9+550

This receptor site consisting of c. 0.83ha was surveyed on the 10 September 2015 and 1 June 2016 and two habitat types (as defined by Fossitt 2000) were identified within its boundaries. The site was dominated by Dry calcareous and neutral grassland (GS1). There was also a small area of Exposed calcareous rock (ER2), located in the north-eastern corner of the eastern field. It is partially located within Lough Corrib cSAC and is also partially located within a GS1 donor site. See **Figure 7** for location.

3.5.1.2 Receptor Site 6210.R2 –Ch. 9+600 to Ch. 9+700

This receptor site consisting of c. 0.98ha was surveyed on the 10 September 2015 and one habitat type (as defined by Fossitt 2000) was identified within its boundaries, *i.e.* Dry calcareous and neutral grassland (GS1). On the day of the survey, it was noted that this field, and surrounding fields, were heavily grazed by horses. It is located *c.* 25m east of Lough Corrib cSAC and is within a GS1 donor site. See **Figure 7** for location.

3.5.1.3 Receptor Site 6210.R3 –Lackagh Quarry between Ch. 10+800 to Ch. 11+100

This receptor site consisting of c. 1.38ha was surveyed on the 3 September 2015, 27 July 2016 and 10 October 2017 and seven habitat types (as defined by Fossitt 2000) were identified within and directly adjacent to its boundaries. These included: a mosaic of Dry meadows and grassy verges (GS2) and Dry calcareous and neutral grasslands (GS1); a mosaic of Dry meadows and grassy verges (GS2) and Scrub (WS1); Hedgerows (WL1); Treelines (WL2); Spoil and bare ground (ED2); and, Buildings and artificial surfaces (BL3). This site is also a Material Deposition Area and part of it is a GS1 donor site (*i.e.* DA23). See **Figure 8** for location.

[7] "*Due to the uncertainty inherent in compensation, particularly in cases which require ecological restoration or habitat creation, replacement ratios greater than one-to-one may be appropriate for delivery of compensatory habitats or ecosystems… Increased replacement ratios can also help take account of the time lag in delivering compensation and regaining the same maturity, complexity and diversity of habitats and the full complement of associated species*." (CIEEM, 2016).

3.5.1.4 Receptor Site 6210.R4 –Lackagh Quarry between Ch. 11+100 to Ch. 11+200

This receptor site consisting of c. 0.51ha was surveyed on the 3 September 2015, 27 July 2016 and 10 October 2017 and one habitat type (as defined by Fossitt 2000) was identified within its boundaries, *i.e.* Spoil and bare ground (ED2). See **Figure 8** for location.

3.5.1.5 Receptor Site 6210.R5 –Lackagh Quarry between Ch. 11+200 to Ch. 11+450

This receptor site consisting of c. 2.14ha was surveyed on 3 September 2015, 27 July 2016 and 10 October 2017 and five habitat types (as defined by Fossitt 2000) were identified within its boundaries. These included: other artificial lakes and ponds (FL8); Dry calcareous and neutral grassland (GS1); Dry meadows and grassy verges (GS2); Spoil and bare ground (ED2); and, Buildings and artificial surfaces (BL3). It partially overlaps with a GS1 donor site. This site is also a Material Deposition Area (*i.e.* DA24). See **Figure 8** for location.

3.5.1.6 6210.R6 –Lackagh Quarry between Ch. 11+450 to Ch. 11+600

This receptor site consisting of c. 0.82ha was surveyed on 3 September 2015, 27 July 2016 and 10 October 2017 and three habitat types (as defined by Fossitt 2000) were identified within its boundaries. These included: Recolonising bare ground (ED3); Spoil and bare ground (ED2); and, Dry calcareous and neutral grassland (GS1). It partially overlaps with a GS1 donor site. See **Figure 8** for location.

3.5.1.7 6210.R7 –Lackagh Quarry between Ch. 11+850 to Ch. 12+000

This receptor site consisting of c. 0.48ha was surveyed on the 3 September 2015 and one habitat type (as defined by Fossitt 2000) was identified within its boundaries, *i.e.* Dry calcareous and neutral grassland (GS1). See **Figure 8** for location.

3.5.2 Pre-Compensatory Works Site Preparation

3.5.2.1 Ecology Site Management Plans

Prior to compensatory works commencing, Ecology Site Management Plans specific will be finalised by the Contractor in combination with the Project Ecologist and/or ECoW with reference to the construction programme, which may influence the timing and co-ordination of these works and the requirement for storage of soils and/or turves, and issued to the team involved in the compensatory works. The finalised plans will include a site specific method statement outlining

step-by-step actions (as per the pre-compensatory measures described in **Section 3.5.2** and compensatory measures described in **Section 3.5.3**) for the Contractor to implement within a specified timescale, under the supervision and advice of the Project Ecologist and/or ECoW. It will also include a check-list of conditions (as per the monitoring criteria set out in O'Neill *et al.* 2013 and condition assessments set out in Ashwood 2014, as described in **Section 3.7**) to be assessed by the Project Ecologist and/or ECoW at the receptor site during the pre-compensation, during and post-compensation monitoring. The finalisation of the Ecology Site Management Plans by the Contractor will not affect the robustness and adequacy of the information presented here and relied upon in the EIA Report and NIS, as these plans are merely providing more site specific detail and methodological steps to the principles and proposals already outlined in this CHMP

3.5.2.2 Non-native Invasive Plant Species and Biosecurity

As set out in the Construction Environmental Management Plan (CEMP) in Appendix A.7.5 of the EIA Report, a non-native invasive plant species survey will be undertaken immediately in advance of works commencing to inform the finalisation of CEMP. The biosecurity measures outlined in the CEMP will be implemented at both the donor and receptor sites, where applicable, in order to avoid the accidental spread of potentially harmful plant or animal species between sites. The CEMP also includes: measures that the Contractor will implement in order to avoid spreading invasive species during soil movement; measures to treat non-native invasive plant species prior to construction/compensation works commencing; and, site hygiene measures to be implemented to prevent further spread of non-native invasive plant species.

3.5.2.3 Temporary Fencing

Where applicable, temporary fencing and associated signage will be erected at both the donor and receptor sites for the duration of the construction. This will minimise any potential disturbance to adjacent sensitive habitats and/or hydrological features within both the donor and receptor sites from either encroachment into the habitat or damage.

3.5.2.4 Material Deposition Areas

In the case of the receptor sites that are also Material Deposition Areas (MDA), the following measures will also be implemented to ensure the successful creation of 6210. This will include the placement of suitable soils on top of the MDA to allow water to freely drain and to provide a suitable substrate for the habitat to establish upon (via measures described in **Section 3.4.3**). Due to the proposed management requirements of 6210 (outlined in **Section 3.5** below), the side-slopes of the MDAs will not be used to create this habitat type.

3.5.2.5 Stripping of Unsuitable Topsoil

Soil fertility, in particular the presence of major plant nutrients nitrogen, potassium and phosphorus, is one of the main factors in determining the likely establishment and success of a newly created semi-natural grassland. It is recommended that at receptor sites where the previous land-use was agricultural in nature and as such soil fertility is likely to be high, the topsoil is removed (Crofts & Jefferson, 1994). This involves stripping the topsoil of the site to a maximum depth of *c.* 30cm . This topsoil may contain a seed bank of highly competitive plant species that are undesirable in the context of Dry calcareous grasslands creation or other existing surrounding semi-natural habitats. These works should be undertaken during dry weather conditions under the supervision of the Project Ecologist and/or ECoW. Prior to translocation of turves and soil from the donor sites, it may be necessary to lightly cultivate the subsoil at the receptor site using a rotovator machine to relieve any compaction or surface capping.

3.5.2.6 Weed Control

It is possible that undesirable plant species, dormant in the soil of the receptor site, may become disturbed during the site preparation process and as a result start to germinate and establish as seedlings. Appropriate measures (e.g. sowing a pioneer/nurse crop; spot treatments with herbicides and/or, cutting or pulling undesirable plants prior to flowering; see also **Section 3.5.2.6** below) will need to be undertaken to control such species, which could potentially outcompete and inhibit the germination and establishment of the desired species required for the creation of 6210. If there is a significant time period between site clearance at the receptor site and when the compensatory habitat will be created, these appropriate measures may include at the receptor site: sowing a pioneer/nurse crop; spot treatments with herbicides and, cutting or pulling undesirable plants in June before flowering (Crofts & Jefferson, 1994).

3.5.3 Compensatory Measures

The five different compensatory measures described below outline how 6210 habitat will be created within the compensatory habitat receptor site. These measures will be implemented either in-combination or alone, as determined by the Contractor under the supervision and advice of the Project Ecologist and/or ECoW. The timing and duration of these works will depend on the progress of the construction of the proposed road development, requirements for access and weather conditions. It should be noted that for whichever compensatory measure or combination of measures adopted, the process of grassland establishment and the development of stable vegetative communities can take several years and that appropriate management of these sites (as outlined in **Section 3.6**) is essential to ensure success (Ashwood, 2014 and Crofts & Jefferson, 1999).

3.5.3.1 Translocation of Turves

Translocation involves the removal of turves, soil and/or plant species from the impacted donor site to the new receptor or compensation site (Iuell *et al.*, 2003). Following site preparation, intact turves of existing 6210 habitat (*i.e. c.* 25cm-30cm in depth as dependent on conditions at donor site) will be carefully removed from the chosen donor site using a suitable excavator (*i.e.* with adequate capacity to carefully remove and translocate the intact turves) during dry weather conditions and moved to the receptor site. Following site preparation, which will include the stripping of topsoil to a maximum depth of *c.* 10cm, the turves will be incorporated into the bare substrate at the receptor site. This process will need to be undertaken slowly and carefully in order maintain the integrity of the intact turves, which will contain desirable species of this habitat type such as those outlined in O'Neill *et al* (2013). The turves will need to be laid out at the receptor site in such as manner as to avoid excessive movement of the excavator, which could cause damage. Small "*plugs*" of impacted turves from the donor sites may also be translocated and incorporated into the receptor site. The general close proximity of the donor sites to the receptor site will help facilitate this translocation method.

Where translocation direct from the donor site to the receptor site cannot take place, it will be necessary to store turves from the donor sites for later translocation to the receptor site at the appropriate time of year. During storage, turves must not be placed on top of each other in order to avoid any compaction of soil, as this would reduce the quality of the soil and would negatively impact on the success of the translocation. The duration of storage must be as minimal as possible. Depending on the duration of storage and prevailing weather conditions, the intact turves may require periodic watering at an appropriate level in order to ensure that the plants and seeds present do not dry out and die. Careful consideration must be given to how often and how much watering will need to be applied to the turves. Where there will be a time delay between removing turves from donor sites, site preparation works at the receptor sites and placing turves at receptor sites, it is recommended that a pioneer/nurse seed mix is planted at the receptor site, if site clearance has taken place in the receptor site, in order to stabilise the soil substrate (Ashwood, 2014).

3.5.3.2 Translocation of Suitable Soils

Following site preparation, both the soils (including the topsoil) and the vegetation of the donor sites of existing 6210 habitat may be scraped up and transferred together to the receptor site in a suitable excavator. The topsoil of the donor sites should contain a sufficient seed bank of desirable plant species to allow the receptor site to re-vegetate naturally, creating the habitat type. In some cases it may be necessary (*e.g.* due to the project schedule and/or other project commitments), to

store the soil from the donor sites for later translocation to the receptor site at the appropriate time of year.

The duration of storage must be as minimal as possible. Topsoil and subsoil must be stored separately and separate to any other topsoil or soil present on-site. In order to avoid soil compaction and soil smearing, it is recommended that: soil is handled during dry conditions and not when saturated; and, after placement the soil is decompacted by ripping, which will improve drainage, aeration and rooting establishment. It should be noted that stripping and disturbance of soils may encourage the release of nutrients and in turn alter the soil fertility and promote undesirable weed species (National Roads Authority, 2006); therefore weed control measures outlined in Section 3.2.4 may be required.

In addition to soils taken from the 6210 donor sites, any additional soils required at the receptor sites may be sourced from the other Dry calcareous and neutral grasslands (GS1) donor sites located within the proposed development boundary (see **Section 3.4** for more details). The requirement for these soils at the receptor sites will be determined on a site-by-site basis by the Contractor, the Project Ecologist and/or ECoW. The existing habitats at these donor sites are comprised of Dry calcareous and neutral grassland (GS1) classified as being of local importance higher value; therefore they will contain suitable neutral to calcareous soils for the re-creation of 6210.

The total area of 6210 donor sites is *c.* 0.7ha, while the total area of all other Dry calcareous and neutral grassland donor sites is *c.* 12.6ha; therefore the overall area of donor sites with suitable available soils for 6210 re-creation is *c.* 13.28ha.

Following a review of the depths of topsoil at sites located within or near to donor sites as recorded as part of ground investigation works and knowledge regarding this habitat type, it is considered that sufficient soils for the creation of *c.* 7.14ha of 6210 may be sourced from within the proposed landtake for the proposed road development.

3.5.3.3 Seeding

It is recommended that seeds of desirable plant species from the local donor sites are collected directly from plants once mature (*i.e.* from August/September onwards) during warm, dry conditions, stored in suitable conditions to ensure their survival and then planted as seed mix at the compensatory receptor site. This is the preferred method of seeding as it will ensure that no foreign seeds are present in the planted seed mix and will in turn help to protect the integrity of the local genetic population of plants of this habitat type (Ashwood, 2014 and Crofts & Jefferson, 1999). It may be carried out by hand or by seed collection machines as dependent on the size of the donor site (National Roads Authority, 2006). To determine first whether or not it is an appropriate time to harvest the seeds at a particular donor site and secondly that the seeds themselves have developed properly, it may be necessary to check a sample selection first. This will involve: assessing the seed's

colour, which typically may be brown when mature; examining whether or not they crack under pressure; and/or, determining whether or not the cotyledon is present. During collection, seeds may be stored in paper or cloth bags or open tubs to avoid exposure to direct sunlight (NBDC, 2016). In some cases it may be necessary (*e.g.* due to the project schedule and/or other project commitments), to store seeds from the donor sites for planting later at the appropriate time of year. Prior to storage and sowing, seeds must be air dried (at *c.* 18°C) and then cleaned using a sieve to remove any dust and the chaff of the seed. The dry seeds can be placed into an air-tight container with dry silica sachets and placed in a refrigerator at a low temperature (NBDC, 2016). If it is necessary to store seeds for a longer period of time, then they may be frozen (at a recommended temperature of *c.* -20°C). This can only occur when seeds have underground the drying process[8] (Kew).

Where seed collection from the donor sites is not possible, local native seed mixes may be bought at "*Irish Wildflower Showcase*"[9] (or similar supplier of native seed stock), which is a reputable supplier of local native seed mixes. Specific seed mixes, containing only the desirable plant species indicative of 6210 habitat and suited to the climate and main soil conditions of the receptor site, can be made up to order to help ensure the successful creation of this habitat type.

To yield best results, it is recommended that seeds are sown in August or September time (*i.e.* late summer to early autumn) as it will allow the plants sufficient time to become established during the winter ready for vigorous growth the following spring (National Roads Authority, 2006). Seed sowing can be undertaken either by hand or using agricultural machinery such as slot, seeders and seed drills where applicable (Crofts & Jefferson, 1999). Where possible, the soil should be rolled following seeding as this will improve the likelihood of germination taking place by maximising the seed surface contact with the soil (National Roads Authority, 2006).

3.5.3.4 Hay-strewing

Hay-strewing is an alternative method to translocation and/or natural colonisation. It involves, following site preparation of the receptor site, spreading freshly cut hay, which contains seeds from the donor sites, over the receptor site to be colonised (Ashwood, 2014 and Crofts & Jefferson, 1999). In order to yield best results, it is necessary for the hay to be cut at the donor site after the target plant species have flowered and while the seeds are still attached (*i.e.* August/September), but at the point of dispersal (National Roads Authority, 2006). Once cut and collected, the hay will need to be spread loosely and quickly (*i.e.* within 24 hours) to prevent any spoiling or loss of the seeds (National Roads Authority, 2006). It is then left for a period of three weeks until seeds have fallen. It will need to be turned once if

[8] As described by Royal Botanic Gardens, Kew website: https://www.kew.org/blogs/archived-blogs/seed-drying-long-term-storage. Accessed on the 29th March 2018.
[9] Irish Wildflower Showcase website: http://www.wildflowers.ie/

possible during this period. The hay will then need to be removed to prevent smothering of seedlings and to shake out any remaining attached seeds (Crofts & Jefferson, 1999).

3.5.3.5 Natural Colonisation

During surveys undertaken in July 2014, an area of 6210 Annex I habitat was identified *c.* 20m north of one of the receptor sites and as such it is possible that natural colonisation of the receptor site would occur if colonisation gaps are provided for. This process may however take a number of years before establishment of desired species occurs (Crofts & Jefferson, 1999). This measure should only be implemented in-combination with a selection of or all of the compensatory measures outlined above.

3.6 Management

Site specific details on both the short-term and long-term management of the newly created habitat will be outlined in the finalised Ecology Site Management Plan, as determined by the Project Ecologist and/or ECoW. Management of the newly created habitat is necessary for its success, as it will prevent the domination of the sward by undesirable rank species (e.g. *Rubus fruticosus* L.), which have the ability to outcompete the desired species, and will help to maintain a high species richness.

Following the implementation of the chosen compensatory measure(s), a stock-proof protective fence will be erected to protect the receptor site from disturbance such as unwanted grazing and/or trampling. This will give the newly created habitat sufficient time to establish and stabilise, which typically takes between three to five years (Ashwood, 2014). Established grasslands develop "*rootmats*" which allow the grassland to withstand trampling by animals (Crofts & Jefferson, 1994). Mowing will be required at a newly created grassland site; however depending on the compensatory measure implemented, mowing may or may not be required in the first year of the created habitat, *e.g.* in cases where turves have been translocated on to bare substrate cutting will not be required (Ashwood, 2014).

While mowing dates and frequency of cutting will be assessed on an on-site basis, as it will be influenced by the rate of plant species growth, it will more than likely take place once a year from mid-June to July after the grasses have set seed. Mowing must consider the potential for ground nesting birds to be present (Ashwood, 2014 and Croft & Jefferson, 1994). All cuttings will need to be removed from the site to avoid nutrient enrichment of the sward and the shading of young seedlings (Ashwood, 2014 and Croft & Jefferson, 1994). The cut must be set high (*i.e.* above 4cm from ground level) to avoid scalping the turves, which could potentially result in the exposure of bare ground and in turn the encouragement of weed invasion. Mowing will need to ideally be undertaken during dry conditions to

avoid compacting and potentially damaging the soil structure (National Roads Authority, 2006).

The potential for significant impacts to arise from the creation of a small area of 6210 within the Lough Corrib cSAC (*i.e.* at receptor site 6210.R1) has been considered and assessed as part of the Natura Impact Statement (NIS) produced for the proposed road development. The mitigation measures outlined in the NIS and detailed in the CEMP will ensure no adverse effects on European site integrity will arrive from the implementation of the proposed road development, including the proposal for creation of 6210.R1.

3.7 Monitoring

Monitoring of receptor sites will be carried out by a suitably qualified and experienced ecologist pre-compensation, during and post-compensation in order to

- Firstly, ensure that potential issues that may deter the success of the compensation are identified at an early stage and addressed through adaptive management measures; and
- secondly to determine the overall success of the habitat compensation process.

Adaptive management measures will be targeted to address the specific issues identified by the monitoring and may be varied. For example they could include, translocation of additional turves to replace those that have failed, and/or additional seeding where this is deemed necessary to improve vegetation cover/presence. Adaptive management measures, implemented in response to monitoring results, will not affect the robustness and adequacy of the information presented here and relied upon in the EIA Report and NIS, providing these measures either fall within the scope of proposals already provided for in this CHMP, or involve impacts of equal of lesser significance to those provided for in this CHMP and assessed in the EIA Report and NIS.

The finalised Ecology Site Management Plans, which will be prepared on an on-site basis, will include a check-list of conditions to be assessed by a suitably qualified and experienced ecologist at the receptor site during the pre-compensation, during, and post-compensation monitoring. Conditions assessed in both the short and long-term will include as a minimum (after O'Neill *et al.*, 2013 and Ashwood, 2014):

- Information on vegetation composition, *i.e.* number of (high quality) positive indicator species, cover of negative indicator species and non-native invasive plant species, cover of scrub, bracken and heath.
- Information on vegetation structure, *i.e.* height of vegetation, ratio of forb to graminoid species and level of grazing and disturbance.

- Information on physical structure and extent of 6210 establishment, *i.e.* cover of bare ground and litter and presence of bald patches.

The intervals and duration for the pre- and during compensation monitoring programme, will be decided upon by the Project Ecologist and/or ECoW and is likely to depend upon the speed of habitat establishment and stabilisation.

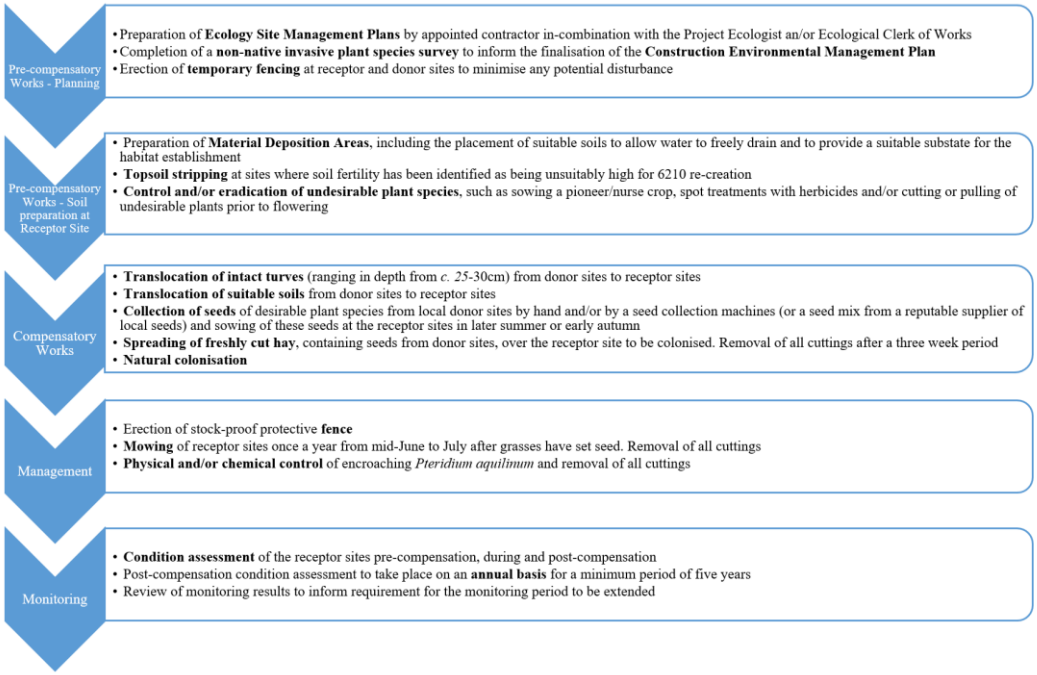
6210 may take between three to five years after initial habitat creation to become established (Ashwood, 2014). The post-construction monitoring programme will require annual monitoring, commencing on the year of habitat creation, for a minimum period of five years, with a review by a suitably qualified and experienced ecologist at the end of that period undertaken to determine whether the monitoring period needs to be extended further, if for example it is viewed that the habitat has not stabilised or become fully established by that time. Any extension to the monitoring period will need to consider whether on-going monitoring should be at annual or longer intervals e.g. +3 years post-creation, +6 years post-creation etc.

The results of all monitoring will be made available to the NPWS.

3.8 Conclusions

The measures outlined in this section will compensate for the significant residual effect on 6210 habitat by ensuring that there will be no net permanent loss of this habitat type as a consequence of the proposed road development. A total area of *c.* 7.14ha (*i.e. c.* 1,020% of the area of 6210 lost) will be created as part of the proposed compensatory works. The steps outlined in this section are presented below as a flow chart. The steps outlined in this section are presented below as a flow chart.

Plate 3: Flow cart of steps involved in the creation of 6210



4 Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [6410]

4.1 Introduction

The proposed road development will result in the permanent loss of *c.* 0.28ha of the Annex I habitat *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410] (hereafter referred to as 6410). It is proposed to compensate for this loss by re-creating *c.* 0.49ha. This is *c.* 175% of the loss of 6410 (*i.e.* 0.28ha).

Separate to the areas of 6410 habitat to be created as a compensatory measure, there are areas of 6410 habitat located within the proposed development boundary that will be retained and fenced off for the duration of construction. These areas will not be directly impacted by the proposed road development. These areas are presented in **Figures 8.23.1** to **8.23.15** of the EIA Report. These areas will not be available to use as donor sites for the purposes of creation of compensatory 6410 habitat.

The steps followed for the 6410 habitat compensation process are:

- Identification and selection of a suitable compensatory habitat receptor site for 6410 habitat (Refer to **Section 4.2 – 4.4**)
- Pre-compensatory works site preparation at both the donor sites and receptor site, including (Refer to **Section 4.4.2**):
    - the provision of site specific method statements within Finalised Ecology Site Management Plans
    - erection of temporary fencing; topsoil stripping
    - weed control
- Implementation of compensatory measures, either alone or in-combination as dependent on the characteristics of the receptor site. These measures include: the translocation of turves and soil from donor sites to the receptor site; seeding from either seed collected at donor sites or bought native Irish seed mix; application of freshly cut material; and/or, natural colonisation (Refer to **Section 4.4.3**)
- Short-term and long-term management of the receptor site following the implementation of compensatory measures (Refer to **Section 4.5**)
- Monitoring of the receptor site to be carried out pre-compensation, during and post-compensation by a suitably qualified and experienced ecologist in order to ensure that potential issues are identified at an early stage and addressed through adaptive management measures (Refer to **Section 4.6**)

4.2 Description of Annex I habitat 6410

The 6410 habitat area to be lost corresponds with the *Molinia caerulea – Potentilla erecta* vegetation community (after O'Neill *et al.*, 2013). In Ireland, this vegetation community is relatively species-poor and is usually found on wet, very infertile and acidic basin peats and peaty gleys. It is dominated by *Molinia caerulea*, which is typically found growing in large tussocks. *Potentilla erecta* is also abundant. Other frequent species present include *Juncus acutiflorus*, *Agrostis stolonifera*, *Anthoxanthum odoratum* and *Holcus lanatus*, which form a fairly tall, rank sward, and *Succisa pratensis* and *Filipendula ulmaria*. The management of these swards usually involves grazing by cattle at a low intensity. The main threats are considered to be improvement, abandonment and afforestation (O'Neill *et al.*, 2013).

4.3 Description of Potential 6410 Donor Site

There is one site of the Annex I habitat 6410 which will be removed to facilitate the construction of the proposed road development (see **Figure 9** for location). This site is located *c.* 300m south-west of Ballindooley Lough and lies outside of any designated areas for nature conservation. This donor site was classified as Annex I habitat due to the presence of a sufficient number of high quality positive/positive indicator species (after O'Neill *et al.*, 2013). Full description of this donor site of habitat to be lost is provided below.

4.3.1.1 Donor Site 6410.D1 – Ch. 12+250 to Ch. 12+400

Donor site 6410.D1 consists of c. 0.28ha. See **Figure 9** for location. Botanical and other relevant environmental data (as per the 6410 structure and function condition assessment described in O'Neill *et al.*, 2013) was collected at six relevés, two of which were located within the site and the other four between *c.* 200m to 825m north-east of the area of 6410 habitat to be lost in July 2014 and November 2017. Data collected within these relevé was considered to be representative of the habitat to be lost. At three of these relevés one high quality indicator species of this Annex I habitat was present (*i.e. Juncus conglomeratus* and *Cirsium dissectum*). A total of five (at two relevés), six (at the second relevé), seven (at third) and eight (at the fourth and fifth relevés) positive indicator species were present (*i.e. Molinia caerulea, Filipendula ulmaria, Potentilla erecta, Carex panacea, Carex flacca, Carex nigra, Juncus articulatus, Mentha aquatica, Ranunculus flammula, Succisa pratensis* and *Galium palustre*). No non-native species, negative indicator species or *Polytrichum* species (or *Pteridium aquilinum*) were noted in any of the relevés. At four of the six relevés the following additional condition information was recorded. Scrub cover greater than 5% was only noted in one relevé. No bare soil or rock was present in three of the four relevés, while peat was present in one of the relevés at a low percentage cover. The percentage cover of bare ground was *c.* 15% with some bare soil, rock and litter present. No surface water was present. The

median vegetation height for grass species at three of the relevés differed (*i.e. c.* 40cm at two relevés and *c.* 5cm and 20cm at the other two respectively). Each of the four relevés where condition information was recorded passed a varying number of the 12 criteria of the structure and function condition assessment (O'Neill *et al.*, 2013), *i.e.* nine out of 12 for two relevés and 10 out of 12 for other two relevés, *i.e.* failing on presence of positive indicator species (≥7); presence of high quality indicator species (≥1); percentage cover of scrub, bracken and heath cover (≤5%) forb to graminoid ration (40-90% forb); and, percentage cover of sward between 10-80cm in height (≥30%). Refer to relevé codes EC39 R6, EC39 R7, EC39 R8, EC39 R10, EC39 R14 and EC39 R15 presented in **Appendix A.8.19** of the EIA Report for an associated species list.

4.4 Methodology for Compensatory Habitat Creation

4.4.1 Selection of Receptor Site

The identification and selection of the compensatory habitat receptor site, where 6410 habitat will be created, was based on a desk study conducted in September 2017 and a site visit conducted in September 2014 and November 2017 as part of the surveys undertaken to inform the environmental studies for the proposed road development. This site was selected, in consultation with the design team, as a suitable receptor site based on a review of the following:

- Site data collected as part of habitat surveys undertaken in July 2014 at the donor site and in September 2014 and November 2017 at the receptor site. Detailed relevés were carried out within and in close proximity (*i.e. c.* 200m-825m) to the donor site within the same habitat type. Relevé information collected in these areas is considered to be representative and comparable to the sites themselves. The following information was collected:
    - the percentage cover of high quality, positive and/or negative indicator plant species present
    - presence of soil, rock and surface water
    - other botanical and environmental factors considered as part of condition assessment criteria for this habitat type (after O'Neill *et al.* 2013)
- Hydrological and hydrogeological data collected to inform the environmental studies for the proposed road development
- Soils and Geology data collected to inform the environmental studies for the proposed road development

Other information relied upon as part of the selection process included the following information sources:

- Ordnance Survey of Ireland mapping and aerial photography available from www.osi.ie

- Online data available on European sites as held by the National Parks and Wildlife Service (NPWS) from www.npws.ie
- Online data available from the National Biodiversity Data Centre mapping service (http://maps.biodiversityireland.ie/#/Map)
- Information on land-use zoning from the online mapping of the Department of the Environment, Community and Local Government http://www.myplan.ie/en/index.html
- Information on water quality in the area available from www.epa.ie
- Information on soils and geology in the area available from www.gsi.ie
- Information on the location, nature and design of the proposed scheme supplied by the applicant's design team
- Information on the status of EU protected habitats in Ireland (National Parks & Wildlife Service, 2013)

Based on a review of information collected (from the sources described above and with reference to guidance provided in **Section 1.1**), one compensatory habitat receptor site for the creation of 6410 was selected. It is located in Na Foraí Maola Thoir at Ch. 0+800 to Ch. 0+950 within the proposed development boundary, adjacent or in close proximity to the footprint of the proposed road development (see **Figure 2** for location). This receptor site was surveyed on the 9 September 2014 and 3 November 2017 and five habitat types (as defined in Fossitt, 2000) were identified within and directly adjacent to its boundaries. These included: a mosaic of Dense bracken (HD1), Scrub (WS1), Acid grassland (GS3) and Wet grassland (GS4) and Wet grassland, Broadleaved woodland (WD1) and Building and artificial surfaces (BL3) alone. It was located directly adjacent to an area of 6410 habitat; this habitat falls within the proposed development boundary however is proposed to be retained.

This site was considered to be a suitable receptor site for 6410 habitat compensation for the following reasons:

- Presence of physical characteristics at the receptor site necessary for the establishment of *Molinia* meadow habitat such as suitable topography, geology and/or hydrological features (*i.e.* an undulating topography on granite bedrock and peaty soils within a poorly productive groundwater body)
- Presence of similar plant species composition within or in close proximity to the receptor site to that being compensated for at the donor site (*i.e.* the nearest area of 6410 habitat is located directly adjacent to the receptor site)
- Total area of the receptor site (*i.e. c.* 0.49ha) in the context of the total area of 6410 to be lost (*i.e. c.* 0.28ha) (*i.e. c.* 175% of the area of 6410 lost will be compensated for)[10]

[10] "*Due to the uncertainty inherent in compensation, particularly in cases which require ecological restoration or habitat creation, replacement ratios greater than one-to-one may be appropriate for delivery of compensatory habitats or ecosystems… Increased replacement ratios can also help take*

- Existing or future access to the site that will facilitate machinery, required for the proposed compensatory measures or management activities, entering or exiting the site

4.4.2 Pre-Compensatory Works Site Preparation

4.4.2.1 Ecology Site Management Plans

Prior to compensatory works commencing, Ecology Site Management Plans specific to the contract programme will be finalised by the Contractor in combination with the Project Ecologist and/or ECoW, with reference to the construction programme, which may influence the timing and co-orinrdation of these works and the requirement for storage of soils and/or turves, and issued to the team involved in the compensatory works. The finalised plans will include site specific method statements outlining step-by-step actions (as per the pre-compensatory measures described in **Section 4.4.2** and compensatory measures described in **Section 4.4.3**) for the Contractor to implement within a specified timescale, under the supervision and advice of the Project Ecologist and/or ECoW. It will also include a check-list of conditions (as per the monitoring criteria set out in O'Neill *et al.* 2013 and as described in **Section 4.6**) to be assessed by a suitably qualified and experienced ecologist at the receptor site during the pre-compensation, during and post-compensation monitoring. The finalisation of the Ecology Site Management Plans by the Contractor will not affect the robustness and adequacy of the information presented here and relied upon in the EIA Report and NIS, as these plans are merely providing more site specific detail and methodological steps to the principles and proposals already outlined in this CHMP.

4.4.2.2 Non-native Invasive Plant Species and Biosecurity

As set out in the Construction Environmental Management Plan (CEMP) in Appendix A.7.5 of the EIA Report, a non-native invasive plant species survey will be undertaken immediately in advance of works commencing to inform the finalisation of CEMP. The biosecurity measures outlined in the CEMP will be implemented at both the donor and receptor sites, where applicable, in order to avoid the accidental spread of potentially harmful plant or animal species between sites. The CEMP also includes: measures that the Contractor will implement in order to avoid spreading invasive species during soil movement; measures to treat invasive plant species prior to construction/compensation works commencing; and, site hygiene measures to be implemented to prevent further spread of non-native invasive plant species.

account of the tie lag in delivering compensation and regaining the same maturity, complexity and diversity of habitats and the full complement of associated species." (CIEEM, 2016).

4.4.2.3 Temporary Fencing

Where applicable, temporary fencing and associated signage will be erected at both the donor and receptor sites for the duration of the construction. This will minimise any potential disturbance to adjacent sensitive habitats and/or hydrological features within both the donor and receptor sites from either encroachment into the habitat or damage.

4.4.2.4 Soil Preparation at the Receptor Site

The soil preparation technique(s) outlined below will be implemented at the receptor site either alone or in-combination, as decided upon on an on-site by the Contractor in combination with the Project Ecologist and/or ECoW. It is recommended that the soil fertility at the receptor site is determined prior to the implementation of the site specific method statements as this will influence which technique(s) are employed at a site. It is recommended that a combination of these measures are implemented in order to increase the likelihood of success of 6410 habitat creation (Klimkowska *et al.*, 2007). A reduction in soil fertility (*i.e.* in particular reduced levels of phosphorus) is an essential part in the restoration and creation of semi-natural wet grasslands of high nature value (Tallowin & Smith, 2001).

Surface Vegetation Management and Removal Techniques

At the receptor site, it may be necessary to cut and remove certain undesirable species (such as *Pteridium aquilinum* and *Rubus fruticosus* L.), in-combination with the soil stripping method described in Section 3.2.3.2 below, in order to prepare the site prior to implementation of the compensatory measures. It may be deemed necessary to use herbicides (*e.g.* Asulox) to control and/or eliminate the presence of *Pteridium aquilinum*, especially in areas severely infested with this species. Following treatment, the accumulated litter should be removed from the receptor site.

Stripping of Unsuitable Topsoil

The stripping of unsuitable topsoil is one of the most effective techniques to reduce the soil fertility of a receptor site and to remove highly competitive undesirable species that may be present in the seed bank (Tallowin & Smith, 2001 and Klimkowska *et al.*, 2007). Studies have shown that the greater the depth of topsoil removal (*i.e. c.* 15-20cm) at the receptor the increased likelihood of success due to a reduction in soil fertility and in some cases prolonged water stagnation and associated anoxic conditions, which would be detrimental to undesirable species (Klimkowska *et al.*, 2007).

The topsoil removal will involve stripping the topsoil of the site to a maximum depth of *c.* 25cm. These works must be undertaken during dry weather conditions under the supervision of the Project Ecologist and/or ECoW. Ground compaction of the sub-soil by machinery will be avoided as it may impede the rates of

establishment of desired species following implementation of the compensatory measures.

4.4.3 Compensatory Measures

The five different compensatory measures described below outline how 6410 habitat will be created within the compensatory habitat receptor site. More than likely these measures will be implemented in-combination with one another, as to be determined by the Contractor under the supervision and advice of the Project Ecologist and/or ECoW. The timing and duration of these works will depend on the progress of the proposed road development's construction, requirements for access and weather conditions. It should be noted that the process of habitat restoration and creation can take several years and that appropriate management of these sites is essential to ensure success (Crofts & Jefferson, 1999). However suitable hydrological/hydrogeological conditions necessary for the creation of 6410 (*i.e.* wet, waterlogged soil conditions) were identified at the receptor site during surveys undertaken in September 2014 and October 2017, as reflected by the existing habitats of wet grassland, located within the receptor site, and 6410 located directly adjacent to the receptor site. This should ensure that the proposals have a high chance of succeeding.

4.4.3.1 Translocation of Turves

Translocation involves the removal of turves, soil and/or plant species from the impacted donor site to the new receptor or compensation site (Iuell *et al.*, 2003). Following site preparation, intact turves of existing 6410 habitat (*i.e. c.* 25cm-30cm in depth as dependent on conditions at donor site) will be carefully removed from the chosen donor site using a suitable excavator (*i.e.* with adequate capacity to carefully remove and translocate the intact turves) during dry weather conditions and moved to the receptor site (located in Na Foraí Maola Thiar). Following site preparation, which will include the stripping of topsoil to a maximum depth of *c.* 25-30cm, as dependent on the conditions at the donor site, the turves will be incorporated into the bare substrate at the receptor site. This process must be undertaken slowly and carefully in order maintain the integrity of the intact turves, which will contain desirable species of this habitat type such as those outlined in **Section 2.2** and **Section 2.3** (after O'Neill *et al* (2013). The turves must be laid out at the receptor site in such as manner as to avoid excessive movement of the excavator, which could cause damage. Ground compaction of the soil must be avoided as it may impede the rates of establishment of desired species following implementation of the compensatory measures. Small "*plugs*" of impacted turves from the donor site may also be translocated and incorporated into the receptor site. Due to the wetness of soils associated with 6410 habitat, it is recommended that, where possible, they are translocated immediately from the donor site to the receptor site as failure to do so may reduce the likelihood of successful 6410

creation. In the event of this not being possible, the duration of storage must be as minimal as possible. During storage, turves must not be placed on top of each other in order to avoid any compaction of soil, as this would reduce the quality of the soil and would negatively impact on the success of the translocation.

4.4.3.2 Translocation of Suitable Soils

Following site preparation, both the soils (including the topsoil) and the vegetation of the donor site of existing 6410 habitat may be scraped up and transferred together to the receptor site in a suitable excavator. The topsoil of the donor site is likely to contain a sufficient seed bank of desirable plant species to allow the receptor site to re-vegetate naturally, creating the habitat type. Likewise, any intact vegetation present is likely to be comprised of a number of 6410 target species. Due to the wetness of soils associated with 6410 habitat, it is recommended that, where possible, they are translocated immediately from the donor site to the receptor site as failure to do so may reduce the likelihood of successful 6410 creation. In the event of this not being possible, the duration of storage should be as minimal as possible. It is anticipated that all soils required for the creation of 6410 will be sourced from the 6410 donor site.

4.4.3.3 Seeding

It is recommended that seeds of desirable plant species from the local donor site, and any other available site comprised of 6410 habitat, are collected directly from the plant once mature (*i.e.* from August/September onwards) during warm, dry conditions, stored in suitable conditions to ensure their survival and then planted as seed mix at the compensatory receptor site. The timing of seed collection will need to be considered as part of the construction programme. This is the preferred method of seeding as it will ensure that no foreign seeds are present in the planted seed mix and will in turn help to protect the integrity of the local genetic population of plants of this habitat type (Crofts & Jefferson, 1999). It may be carried out by hand or by seed collection machines as dependent on the size of the donor site (National Roads Authority, 2006). To determine first of whether or not it is an appropriate time to harvest the seeds at a particular donor site and secondly that the seeds themselves have developed properly, it may be necessary to check a sample selection first. This will involve: assessing the seed's colour, which typically may be brown when mature; examining whether or not they crack under pressure; and/or, determining whether or not the cotyledon is present. During collection, seeds may be stored in paper or cloth bags or open tubs to avoid exposure to direct sunlight (NBDC, 2016). In some cases it may be necessary (*e.g.* due to the project schedule and/or other project commitments), to store seeds from the donor sites for planting later at the appropriate time of year. Prior to storage and sowing, seeds should be air dried (at *c.* 18°C) and then cleaned using a sieve to remove any dust and the chaff of the seed. The dry seeds can be placed into an air-tight container with dry silica sachets

and placed in a refrigerator at a low temperature (NBDC, 2016). If it is necessary to store seeds for a longer period of time, then they may be frozen (at a recommended temperature of *c.* -20°C). This can only occur when seeds have underground the drying process[11] (Kew).

Where seed collection from the donor sites is not possible, local native seed mixes may be bought at "*Irish Wildflower Showcase*"[12] (or similar supplier of native seed stock), which is a reputable supplier of local native seed mixes. Specific seed mixes, containing only the desirable plant species indicative of 6410 habitat and suited to the climate and main soil conditions of the receptor site, can be made up to order to help ensure the successful creation of this habitat type.

To yield best results, it is recommended that seeds are sown in late summer to early autumn as it will allow the plants sufficient time to become established during the winter ready for vigorous growth the following spring (National Roads Authority, 2006). Seed sowing can be undertaken either by hand or using agricultural machinery such as slot, seeders and seed drills where applicable (Crofts & Jefferson, 1999). Where possible, the soil should be rolled following seeding as this will improve the likelihood of germination taking place by maximising the seed surface contact with the soil (National Roads Authority, 2006).

4.4.3.4 Application of Freshly Cut Plant Material

Following site preparation of the receptor site, freshly cut plant material, which contains seeds from desirable species present at the donor site, may be spread over the receptor site to be colonised (Crofts & Jefferson, 1999). In order to yield best results, it is necessary for the material to be cut at the donor site after the target plant species have flowered and while the seeds are still attached (*i.e.* August/September), but at the point of dispersal (National Roads Authority, 2006). Once cut and collected, the material will be spread loosely and quickly (*i.e.* within 24 hours) to prevent any spoiling or loss of the seeds (National Roads Authority, 2006). It is then left for a period of three weeks until seeds have fallen. It should be turned once if possible during this period. The hay will then be removed to prevent smothering of seedlings and to shake out any remaining attached seeds (Crofts & Jefferson, 1999).

4.4.3.5 Natural Colonisation

During the survey undertaken in September 2014, an area of 6410 Annex I habitat was identified directly adjacent to the receptor site and as such it is possible that natural colonisation of the receptor site may occur where colonisation gaps are provided for. This process may however take a number of years before

[11] As described by Royal Botanic Gardens, Kew website: https://www.kew.org/blogs/archived-blogs/seed-drying-long-term-storage. Accessed on the 29th March 2018.
[12] Irish Wildflower Showcase website: http://www.wildflowers.ie/

establishment of desired species occurs (Crofts & Jefferson, 1999). This measure should only be implemented in-combination with a selection of, or all of, the compensatory measures outlined above.

4.5 Management

Site specific details on both the short-term and long-term management of the newly created habitat will be outlined in the finalised Ecology Site Management Plans, as determined by the Project Ecologist and/or ECoW. Management of the newly created habitat is necessary for its success, as it will prevent the domination of the sward by undesirable rank species (e.g. *Pteridium aquilinum* and *Rubus fruticosus* L.), which have the ability to outcompete the desired species, and will help to maintain a high species richness.

Following the implementation of the chosen compensatory measure(s), a stock-proof protective fence will be erected to protect the receptor site from disturbance such as unwanted grazing and/or trampling. This will give the newly created habitat sufficient time to establish and stabilise. Regular mowing will be required at a newly created grassland site (Klimkowska *et al.*, 2007).

While mowing dates and frequency of cutting will be assessed on an on-site basis, as it will be influenced by the rate of plant species growth, it will more than likely take place once a year from mid-June to July after the grasses have set seed. Timing of mowing should consider the potential for ground nesting birds to be present (Croft & Jefferson, 1994). All cuttings should be removed from the site to avoid nutrient enrichment of the sward and the shading of young seedlings (Croft & Jefferson, 1994). The cut should be set high (*i.e.* above 4cm from ground level) to avoid scalping the turves, which could potentially result in the exposure of bare ground and in turn the encouragement of weed invasion. Mowing should ideally be undertaken during dry conditions to avoid compacting and potentially damaging the soil structure (National Roads Authority, 2006).

4.6 Monitoring

Monitoring of the receptor site will be carried out by a suitably qualified and experienced ecologist pre-compensation, during and post-compensation in order to:

- firstly, ensure that potential issues that may deter the success of the compensation are identified at an early stage and addressed through adaptive management measures; and
- secondly, to determine the overall success of the habitat compensation.

Adaptive management measures will be targeted to address the specific issues identified by the monitoring and may be varied, For example they could include, translocation of additional turves to replace those that have failed, and/or additional seeding where this is deemed necessary to improve vegetation cover/presence.

Adaptive management measures, implemented in response to monitoring results, will not affect the robustness and adequacy of the information presented here and relied upon in the EIA Report and NIS, providing these measures either fall within the scope of proposals already provided for in this CHMP, or involve impacts of equal of lesser significance to those provided for in this CHMP and assessed in the EIA Report and NIS.

The finalised Ecology Site Management Plans, which will be prepared on an on-site basis, will include a check-list of conditions to be assessed by a suitably qualified and experienced ecologist at the receptor site pre-compensation, during the compensation works, and as part of the post-compensation monitoring. Conditions assessed in both the short and long-term will be in reference to the monitoring criteria set out in O'Neill *et al.*, 2013 for this Annex I habitat and will be used to determine the extent of successful 6410 establishment. These conditions include the following as a minimum:

- Information on vegetation composition, *i.e.* number of high quality and positive indicator species present; percentage cover of negative indicator species, non-native, scrub species and *Pteridium aquilinum* present;
- Information on vegetation structure, *i.e.* height of vegetation and forb to graminoid ration;
- Information on physical structure, *i.e.* cover of bare ground and litter and evidence of grazing and/or disturbed ground.

The intervals and duration for the pre- and during compensation monitoring programme, will be decided upon by the Project Ecologist and/or ECoW and is likely to depend upon the speed of habitat establishment and stabilisation.

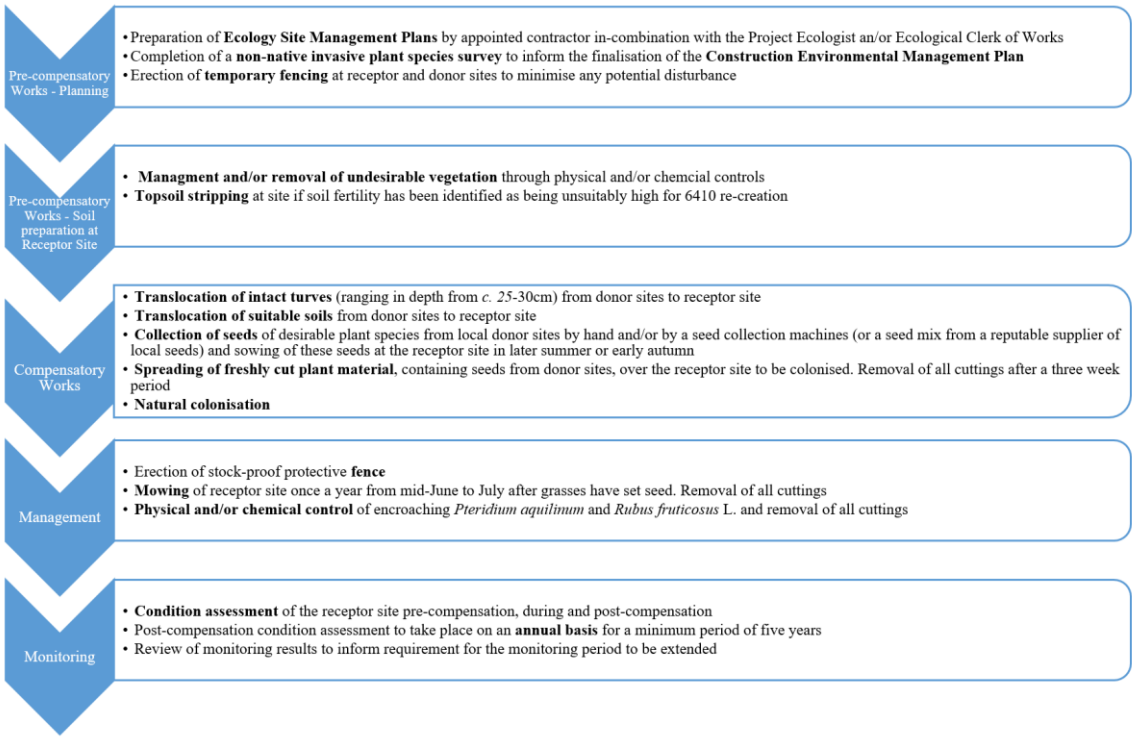
The post-construction monitoring programme will require annual monitoring, commencing on the year of habitat creation, for a minimum period of five years, with a review by a suitably qualified and experienced ecologist at the end of that period undertaken to determine whether the monitoring period needs to be extended further, if for example it is viewed that the habitat has not stabilised or become fully established by that time. Any extension to the monitoring period will need to consider whether on-going monitoring should be at annual or longer intervals e.g. +3 years post-creation, +6 years post-creation etc.

The results of all monitoring will be made available to the NPWS.

4.7 Conclusions

The measures outlined in this section will compensate for the significant residual effect on 6410 habitat by ensuring that there will be no net permanent loss of this habitat type as a consequence of the proposed road development. A total area of *c.* 0.49ha (*i.e. c.* 175% of the area of 6410 lost) will be created as part of the proposed compensatory works. The steps outlined in this section are presented below as a flow chart.

Plate 4 Flow chart of steps involved in the creation of 6410



5 Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae) [*91E0]

5.1 Introduction

The proposed road development will result in the permanent loss of *c.* 0.11ha of the priority Annex I habitat Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*) [*91E0] (hereafter referred to as *91E0). This habitat does not fall within the Lough Corrib cSAC. It is proposed to compensate for this loss by re-creating c. 0.18ha. This is c. 164% of the loss of *91E0 (*i.e.* 0.11ha).

The steps followed for the *91E0 habitat compensation process are:

- Identification and selection of a suitable compensatory habitat receptor site for *91E0 habitat (Refer to **Section 5.2 to 5.4**)
- Pre-compensatory works site preparation at both the donor site and receptor site, including: the provision of site specific method statements within Finalised Ecology Site Management Plans; erection of temporary fencing; topsoil stripping; and, weed control (Refer to **Section 5.4.2**)
- Implementation of compensatory measures, either alone or in-combination with one another, as dependent on the characteristics of the receptor site. These measures include (Refer to **Section 5.4.3**):
    - the translocation of soil from the donor site to the receptor site
    - seed collection and sowing
    - tree planting
    - growing trees from cuttings
- Short-term and long-term management of the receptor site following the implementation of compensatory measures (Refer to **Section 5.5**)
- Monitoring of the receptor site to be carried out pre-compensation, during and post-compensation by a suitably qualified and experienced ecologist in order to ensure that potential issues are identified at an early stage and addressed through adaptive management measures (Refer to **Section 5.6**)

5.2 Description of Annex I Habitat *91E0

The vegetation type with the priority Annex I habitat Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*) [*91E0] to be lost is *Salix cinerea – Equisetum fluviatile*. In Ireland this vegetation type is comprised of willow-dominated wet woodland stands of waterlogged, regularly inundated or permanently submerged ground. Soils present are typically base-rich, organic and

highly fertile. The stands are strongly dominated by *Salix cinerea*. *Fraxinus excelsior* and *Alnus glutinosa* are frequent, but typically provide little cover. The field layer is dominated by *Rubus fruticosus, Hedera helix* and *Filipendula ulmaria*. Other frequent species include *Carex remota, Dryopteris dilatata, Agrostis stolonifera, Mentha aquatica, Phalaris arundinacea, Galium palustre* and *Angelica sylvestris*. *Equisetum fluviatile* and *Cardamine pratensis* are occasionally present. Bryophyte cover is typically low, with most frequent species being *Calliergonella cuspidata, Kindbergia praelonga, Isothecium myosuroides* and *Brachythecium rutabulum*. *Calliergon cordifolium* occurs occasionally around small pools (Perrin *et al.*, 2008a & Perrin *et al.*, 2008b). Threats to this vegetation type include changes to hydrological regimes, overgrazing by livestock, woodland clearance and invasion by non-native species.

5.3 Description of Potential *91E0 Donor Sites

There are three sites of Annex I habitat *91E0 subject to permanent habitat loss as a consequence of the proposed road development (see **Figure 7** for locations). These donor sites of *91E0 habitat were considered to be Annex I habitat due to the presence of a sufficient number of high quality positive/positive indicator species (after Perrin *et al.*, 2008a & Perrin *et al.*, 2008b. Full descriptions of the donor sites of habitat to be lost is provided below.

5.3.1 Donor Site *91E0.D1 and *91E0.D2 –NUIG between Ch. 9+100 to Ch. 9+250 (*c.* 35.46m^2 and 3.59m^2 in total area, respectively)

Donor sites *91E0.D1 and *91E0.D2 consists of c. 35.46m^2 and 3.59m^2 respectively. See **Figure 7** for locations. These two relatively small sites are part of two larger areas of *91E0 habitat. These sites overlap very slightly with the south-eastern edge of the proposed development boundary. Botanical data was collected within this site in 2014. These areas are described as WN6-3c *Alnus glutinosa – Filipendula ulmaria* group, *Salix cinerea – Equisetum fluviatile* vegetation type, which corresponded with the Residual alluvial forest [*91E0] priority Annex I habitat type.

5.3.2 Donor Site *91E0.D3 - Ch. 9+850 to Ch. 9+900

Donor site *91E0.D3 consists of c. 0.12ha. See **Figure 7** for location. This donor site lies outside of but adjacent to Lough Corrib cSAC. Botanical data was collected within this site on the 1 June 2016. It was described as a small patch of *Salix cinerea* wet woodland (WN6-3c *Alnus glutinosa – Filipendula ulmaria* group, *Salix cinerea – Equisetum fluviatile* vegetation type), which corresponded with the Residual alluvial forest [*91E0] priority Annex I habitat type. The woodland was dominated by *Salix cinerea* subsp. *oleifolia*, with *Fraxinus excelsior*, *Agrostis stolonifera*,

Rubus fruticosus agg., *Filipendula ulmaria* and *Eurhynchium striatum* recorded frequently. Other species present included: *Juncus effusus*, *Hedera helix*, *Lythrum salicaria*, *Galium palustre*, *Geranium robertianum*, *Crataegus monogyna*, *Prunus spinosa*, *Galium aparine*, *Rumex sanguineus*, *Equisetum fluviatile*, *Epilobium hirsutum*, *Corylus avellana*, *Ranunculus repens* and the moss species *Calliergonella cuspidatum*, *Eurhynchium striatum*, *Kindbergia praelongum* and *Thamnobryum alopecurum*.

5.4 Methodology Compensatory Habitat Creation

5.4.1 Selection of Receptor Site

The identification and selection of the compensatory habitat receptor site, where *91E0 habitat will be created, was based on a desk study conducted in June 2017 and site visits conducted in 2014 to 2017 as part of the surveys undertaken to inform the environmental studies for the proposed road development. This site was selected, in consultation with the design team, as a suitable receptor site based on a review of the following:

- Site data collected as part of habitat surveys undertaken in 2016 at the donor site and in 2015 at the receptor site. The following information was collected: the percentage cover of high quality, positive and/or negative indicator plant species present; presence of soil, rock and surface water; and, other botanical and environmental factors considered as part of condition assessment criteria for this habitat type (after Perrin *et al.*, 2008a & Perrin *et al.*, 2008b)
- Hydrological data collected to inform the environmental studies for the proposed road development
- Soils and Geology data collected to inform the environmental studies for the proposed road development

Other information relied upon as part of the selection process included the following information sources:

- Ordnance Survey of Ireland mapping and aerial photography available from www.osi.ie
- Online data available on European sites as held by the National Parks and Wildlife Service (NPWS) from www.npws.ie
- Online data available from the National Biodiversity Data Centre mapping service (http://maps.biodiversityireland.ie/#/Map)
- Information on land-use zoning from the online mapping of the Department of the Environment, Community and Local Government http://www.myplan.ie/en/index.html
- Information on water quality in the area available from www.epa.ie
- Information on soils and geology in the area available from www.gsi.ie

- Information on the location, nature and design of the proposed scheme supplied by the applicant's design team
- Information on the status of EU protected habitats in Ireland (National Parks & Wildlife Service, 2013)

Based on a review of information collected (from the sources described above and with reference to guidance provided in **Section 1.1**), one compensatory habitat receptor site for the creation of *91E0 was selected. It is located directly south-east of the donor site *91E0.D3 within the proposed development boundary, adjacent or in close proximity to the footprint of the proposed road development (see **Figure 7** for location). This receptor site lies outside of but adjacent to Lough Corrib cSAC.

This receptor site was surveyed on the 10 September 2015 and October 2017 only one habitat type (as defined in Fossitt, 2000) was identified within and directly adjacent to its boundaries, *i.e.* Wet grassland (GS4). It was considered to be a suitable receptor site for *91E0 habitat compensation for the following reasons:

- Presence of physical characteristics at the receptor site necessary for the establishment of Residual alluvial forest such as suitable topography, geology and/or hydrological features (*i.e.* waterlogged, base-rich, organic and highly fertile soils which are regularly inundated or permanently submerged by water)
- Presence of similar plant species composition within or in close proximity to the receptor site to that being compensated for at the donor site (*i.e.* the nearest area of *91E0 habitat is located immediately north of the receptor site)
- Short distance between donor and receptor sites (*i.e.* the donor site is located directly adjacent to the receptor site)
- Total area of the receptor site (*i.e. c.* 0.18ha) in the context of the total area of Residual alluvial forest to be lost (*i.e. c.* 0.11ha) (*i.e. c.* 181% of the area of *91E0 lost will be compensated for)[13]
- Existing or future access to the site that will facilitate machinery, required for the proposed compensatory measures or management activities, entering or exiting the site

This site is located within the same flooding regime as the adjacent donor site *91E0.D3 (*i.e.* Flood Zone A and Flood Zone B, see **Figure 11.4.107** of the EIA Report for location of this flooding zone). The geographical location of the receptor site within this flood regime is important for the establishment of ground conditions suitable for the creation of *91E0 at the site (*i.e.* waterlogged soils that are regularly inundated or permanently submerged). This flooding regime will not be impacted by the proposed road development.

[13] "*Due to the uncertainty inherent in compensation, particularly in cases which require ecological restoration or habitat creation, replacement ratios greater than one-to-one may be appropriate for delivery of compensatory habitats or ecosystems… Increased replacement ratios can also help take account of the tie lag in delivering compensation and regaining the same maturity, complexity and diversity of habitats and the full complement of associated species.*" (CIEEM, 2016).

The vegetation type with the priority Annex I habitat Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae*) [*91E0] to be lost is *Salix cinerea – Equisetum fluviatile*. In Ireland this vegetation type is comprised of willow-dominated wet woodland stands of waterlogged, regularly inundated or permanently submerged ground. Soils present are typically base-rich, organic and highly fertile. The stands are strongly dominated by *Salix cinerea*. *Fraxinus excelsior* and *Alnus glutinosa* are frequent, but typically provide little cover. The field layer is dominated by *Rubus fruticosus, Hedera helix* and *Filipendula ulmaria*. Other frequent species include *Carex remota*, *Dryopteris dilatata*, *Agrostis stolonifera*, *Mentha aquatica*, *Phalaris arundinacea*, *Galium palustre* and *Angelica sylvestris*. *Equisetum fluviatile* and *Cardamine pratensis* are occasionally present. Bryophyte cover is typically low, with most frequent species being *Calliergonella cuspidata*, *Kindbergia praelonga*, *Isothecium myosuroides* and *Brachythecium rutabulum*. *Calliergon cordifolium* occurs occasionally around small pools (Perrin *et al.*, 2008a & Perrin *et al.*, 2008b). Threats to this vegetation type include changes to hydrological regimes, overgrazing by livestock, woodland clearance and invasion by non-native species.

5.4.2 Pre-Compensatory Works Site Preparation

5.4.2.1 Ecology Site Management Plans

Prior to compensatory works commencing, Ecology Site Management Plans will be finalised by the Contractor in combination with the Project Ecologist and ECoW with reference to the construction programme, which may influence the timing and co-ordination of these works and the requirement for storage of soils, and issued to the team involved in the compensatory works. The finalised plans will include site specific method statements outlining step-by-step actions (as per the pre-compensatory measures described in **Section 5.4.2** and compensatory measures described in **Section 5.4.3)** for the Contractor to implement within a specified timescale, under the supervision and advice of the Project Ecologist and/or ECoW. It will also include a check-list of conditions (as per the monitoring criteria set out in Perrin *et al.*, 2008a & Perrin *et al.*, 2008b and as described in **Section 5.6**) to be assessed by a suitably qualified and experienced ecologist at the receptor site during the pre-compensation, during and post-compensation monitoring. The finalisation of the Ecology Site Management Plans by the Contractor will not affect the robustness and adequacy of the information presented here and relied upon in the EIA Report and NIS, as these plans are merely providing more site specific detail and methodological steps to the principles and proposals already outlined in this CHMP.

5.4.2.2 Non-native Invasive Plant Species and Biosecurity

As set out in the Construction Environmental Management Plan (CEMP) in Appendix A.7.5 of the EIA Report, a non-native invasive plant species survey will be undertaken immediately in advance of works commencing to inform the finalisation of CEMP. The biosecurity measures outlined in the CEMP will be implemented at both the donor and receptor sites, where applicable, in order to avoid the accidental spread of potentially harmful plant or animal species between sites. The CEMP also includes: measures that the Contractor will implement in order to avoid spreading invasive species during soil movement; measures to treat invasive plant species prior to construction/compensation works commencing; and, site hygiene measures to be implemented to prevent further spread of non-native invasive plant species.

5.4.2.3 Temporary Fencing

Where applicable, temporary fencing and associated signage will be erected at both the donor and receptor sites for the duration of the construction. This will minimise any potential disturbance to adjacent sensitive habitats within both the donor and receptor sites from either encroachment into the habitat or damage. Both the receptor and donor site lie outside of but adjacent to the Lough Corrib cSAC and therefore any temporary fencing will need to be installed in a manner that is sensitive to and does not impact on the adjacent Lough Corrib cSAC.

5.4.2.4 Stripping of Topsoil

Depending on the condition of the receptor site during construction, it may be necessary to remove its topsoil in the event that the site has been improved considerably and as a consequence contains a seed bank of highly competitive plant species that are undesirable in context of *91E0 creation or other existing surrounding semi-natural habitats. This would involve stripping the topsoil of the site to a maximum depth of *c.* 5-10cm. These works must be undertaken during dry weather conditions under the supervision of the Project Ecologist and/or ECoW. Considering the current condition of the receptor site, it is not anticipated that this measure will be required.

5.4.2.5 Weed Control

It is possible that undesirable plant species, dormant in the soil of the receptor site, may become disturbed during the site preparation process and as a result start to germinate and establish as seedlings. Appropriate measures should be undertaken to control such species, which could potentially outcompete and inhibit the germination and establishment of the desired species required for the creation of *91E0. If there is a significant time period between site clearance at the receptor site and when the compensatory habitat will be created, measures may include at

the receptor site: sowing a pioneer/nurse crop; spot treatments with herbicides and, cutting or pulling undesirable plants in June before flowering.

5.4.3 Compensatory Measures

The five different compensatory measures described below outline how *91E0 habitat will be created within the compensatory habitat receptor site. These measures will be implemented either in-combination with one another or alone, as determined by the Contractor under the supervision and advice of the Project Ecologist and/or ECoW. The timing and duration of these works will depend on the progress of the proposed road development's construction, requirements for access and weather conditions. It should be noted that for whichever compensatory measure or combination of measures adopted, the process of woodland creation, and the establishment of a typical structural diversity of a woodland, can take several years before it reaches a natural state (Forestry Commission, 1999). It is recommended that a combination of measures are implemented in order to ensure the successful establishment of *91E0. The compensatory measure of translocating trees from the donor site to the receptor site may be considered by the Project Ecologist and/or ECoW prior to works commencing; however considering current ground conditions and the composition and structure of the donor site, it is likely that this measure would not be feasible.

5.4.3.1 Translocation of Suitable Soils

Following site preparation, both the soils (including the topsoil) and the herbaceous vegetation of the donor site (where practical) of existing *91E0 habitat may be scraped up and transferred together to the receptor site in a suitable excavator. The topsoil of the donor sites should contain a sufficient seed bank of desirable plant species to allow the receptor site to re-vegetate naturally, creating the habitat type. In some cases it may be necessary (*e.g.* due to the project schedule and/or other project commitments), to store the soil from the donor sites for later translocation to the receptor site at the appropriate time of year.

The duration of storage must be as minimal as possible. Topsoil and subsoil must be stored separately and separate to any other topsoil or soil present on-site. In order to avoid soil compaction and soil smearing, it is recommended that: soil is handled during dry conditions and not when saturated; and, after placement the soil is decompacted by ripping, which will improve drainage, aeration and rooting establishment (National Roads Authority, 2006).

Considering the condition of the receptor site (*i.e.* an unimproved, wet grassland field), it is not anticipated that the translocation of suitable soils will be required; however in the event that this is required, suitable soils for the creation of *91E0 may be sourced from within the proposed road development boundary.

5.4.3.2 Site Preparation of Suitable Soil for Seed Sowing and Tree Planting

The soil at the receptor site will have to be prepared accordingly to make it suitable for seed sowing and tree planting. This will involve: digging over the soil to a minimum depth of *c.* 25cm, removing larger stones and any roots of undesirable species; and creating growing beds (*c.* 1m wide and flat-topped) by raising the soil slightly (no more than *c.* 10cm) above the ground level. The surface of the bed should be firm and fine. Any weeds must be removed prior to the sowing of seeds or planting of trees (The People's Millennium Forest, 2000).

5.4.3.3 Tree Seed Collection and Sowing

It is recommended that seeds of desirable tree species from the local donor site are collected directly from the plant once mature during warm, dry conditions, stored in suitable conditions to ensure their survival and then planted at the compensatory receptor site. This is the preferred method of seeding as it will ensure that no foreign seeds are present in the planted seed mix and will in turn help to protect the integrity of the local genetic population of plants of this habitat type (DAFM, 2015). The construction programme will need to factor in this requirement to ensure that seed is collected prior to site clearance.

Tree seeds will need to be: collected from a group of nearby trees (*i.e.* where cross-pollination and fertilisation are likely to have occurred); placed in Hessian or mesh bags; and, stored in suitable containers in a cool, dark place on a temporary basis. Specifics details on how seeds from different tree species, indicative of the *91E0 habitat, should be collected and sown are available in *Our Trees A Guide to Growing Ireland's Native Trees in Celebration of a New Millennium* (The People's Millennium Forest, 2000), *e.g.* seeds from *Alnus glutinosa* (present in their cones) should be shaken out immediately prior to sowing. Seeds may be sown in different ways, depending on the species (*i.e.* seed dibbing or broadcasting, followed by rolling).

Ideally, seeds should be sown directly into the ground immediately after collection; however this may not be possible (*e.g.* due to the project schedule and/or other project commitments) and as such they may have to be stored on a long-term basis (*i.e.* for more than a few weeks). It is important that the seeds are stored appropriately in order to ensure they still remain viable. This process will involve: extracting the seeds; cleaning and drying them; placing them in a polythene bag; and, sealing firmly to ensure no air is present. They should then be stored in a refrigerator at a temperature of *c.* 2-3°C. They may be stored for several years and still remain viable. Prior to sowing, these seeds will have to be first stratified (*i.e.* undergo a process of pre-treatment to simulate natural conditions that a seed must go through before germinating) prior to sowing. The methods involved in stratification will vary depending on the species. Stratified seeds should then be

sown in February. Prior to sowing seeds, they should be checked for signs of germination (*i.e.* the seeds will appear swollen and the tip of the radicle will be evident). If germination has commenced, the seeds should be sown within a day or two. Seeds sown straight-away will stratify naturally in the ground (The People's Millennium Forest, 2000). A small mesh wire netting or fabric may be placed over the seeds to provide protection from birds.

Where seed collection from the donor sites is not possible, local native seeds may be bought at "*Irish Wildflower Showcase*"[14] (or similar supplier of native seed stock), which is a reputable supplier of local native seed mixes. Specific seed mixes, containing only the desirable plant species indicative of *91E0 habitat and suited to the climate and main soil conditions of the receptor site, can be made up to order to help ensure the successful creation of this habitat type.

5.4.3.4 Tree Planting

As an alternative to (or in-combination with) sowing seeds at the receptor site, collected seeds may be first grown at a nursery and then at a later stage planted at the receptor site. This will involve sowing a few seeds into compost filled pots. The depth seeds are sown at will depend on the species. The pots should be kept sheltered, at a suitable temperature and watered regularly. Once the seeds have germinated, they should be kept watered and weeded carefully. Following a period of growth of a few months, it may be necessary to move the seedling/tree to a new larger pot or prepared bed, as they'll require more space and depth for their roots. Seedlings should be planted at an appropriate planting depth, which is indicated by the colour difference present at the base of a seedling. Seedlings should be checked for mildew and aphid infestation regularly (Forestry Commission, 1999). Alternatively young local native trees of the desirable species for *91E0 creation may be bought and planted at the receptor site.

When planting the young trees, it is important to make sure the tiny root hairs are not damaged and/or do not dry out. Trees are planted between October to March; however not during heavy frost. The tree should be placed in the prepared soil at the appropriate depth. Roots should be carefully spread out when planting to ensure they are not damaged. For older trees that have been growing in pots, they may be move carefully into the ground with their roots and soil intact. Trees should be transplanted before the age of four as after this period the likelihood of their success decreases significantly. Following planting all young trees should be watered immediately. Mulch may be placed around the base of a planted tree in order to deter the growth of other competitive species and to conserve moisture (The People's Millennium Forest, 2000).

[14] Irish Wildflower Showcase website: http://www.wildflowers.ie/

5.4.3.5 Growing Trees from Cuttings

In the case of some tree species, such as *Salix spp.*, the easiest way to propagate large numbers is to grow them from cuttings. These cuttings will need to be taken in autumn or winter from a young branch with one or two years growth. A cutting is taken with a straight cut just below a bud at its base and will need to be between *c.* 15-24cm in length with at least three buds on it, while a slanted cut is made at the top of the branch. The flat end of the cutting is then placed in the soil to a depth of *c.* half or two thirds of the branch and immediately watered (The People's Millennium Forest, 2000). They should be taken ideally from the donor site, or alternatively from another area of suitable tree species located in close proximity to the receptor site. If necessary, the cuttings may be stored or "*heeled in*" damp coarse sand before "*pegging them out*" at the receptor site (Coillte, 2009).

5.5 Management

Site specific details on both the short-term and long-term management of the newly created habitat will be outlined in the finalised Ecology Site Management Plans, as determined by the Project Ecologist and/or ECoW. Management of the newly created habitat is necessary for its success, as it will prevent the invasion of undesirable rank species (such as non-native invasive species *Cornus sericea* and *Impatiens glandulifera*), which have the ability to outcompete the desired species, and will help to maintain a high species richness (Cross & Collins, 2017). If it is identified, during the monitoring of the receptor site, that the desired ground flora for *91E0 is not establishing, then it may be necessary to plant seedlings of these desirable species within the receptor site.

Following the implementation of the chosen compensatory measure(s), fencing may have to be erected around the periphery of the site to exclude unwanted grazers (*i.e.* deer, rabbit and /or hares) from entering the site and causing direct damage to the emerging trees and shrubs. Uncontrolled grazing at this site may negatively impact on the establishment of trees. The type of fencing erected will depend on the species of grazer to be excluded from the site. If any fences become damaged, it should be replaced accordingly. Depending on the type of fencing erected, it may be decided that tree guards and/or mulch mats are used to protect the planted trees from grazing and/or other competing plant species (The People's Millennium Forest, 2000). If non-native trees are present, which are considered to be of no ecological benefit, it may be necessary to remove them manually using a chainsaw to avoid any damage to the site.

The donor site lies outside of but adjacent to the Lough Corrib cSAC and therefore any fencing will need to be installed in a manner that is sensitive to and does not impact on the adjacent Lough Corrib cSAC. The potential for significant impacts to arise from the creation of a small area of *91E0 adjacent to Lough Corrib cSAC (*i.e.* works at donor site *91E0.D3 and receptor site *91E0.R1) has been considered

and assessed as part of the Natura Impact Statement (NIS) produced for the proposed road development. The mitigation measures outlined in the NIS and detailed in the CEMP will ensure no adverse effects on European site integrity will arrive from the implementation of the proposed road development, including the proposal for creation of *91E0.R1.

5.6 Monitoring

Monitoring of the receptor site will be carried out by a suitably qualified and experienced ecologist pre-compensation, during and post-compensation in order to:

- firstly, ensure that potential issues that may deter the success of the compensation are identified at an early stage and addressed through adaptive management measures; and
- secondly, to determine the overall success of the habitat compensation process.

Adaptive management measures will be targeted to address the specific issues identified by the monitoring and may be varied. For example they could include, additional seeding and/or planting, either from seed or cuttings, where this is deemed necessary to improve vegetation cover/presence. Adaptive management measures, implemented in response to monitoring results, will not affect the robustness and adequacy of the information presented here and relied upon in the EIA Report and NIS, providing these measures either fall within the scope of proposals already provided for in this CHMP, or involve impacts of equal of lesser significance to those provided for in this CHMP and assessed in the EIA Report and NIS.

The finalised Ecology Site Management Plans, which will be prepared on an on-site basis, will include a check-list of conditions to be assessed by suitably qualified and experienced ecologist at the receptor site pre-compensation, during the compensation works, and as part of the post-compensation monitoring. Conditions assessed in both the short and long-term will be in reference to the monitoring criteria set out in Perrin *et al.*, 2008a & Perrin *et al.*, 2008b for this Annex I habitat and will be used to determine the extent of successful *91E0 establishment. These conditions include the following as a minimum:

- Information on vegetation community, *i.e.* percentage cover of positive indicator species (including target tree species and other woody species, herbs and ferns and mosses and liverworts), percentage cover of bryophytes, percentage cover of negative indicator species;
- Information on vegetation/woodland structure, *i.e.* evidence of regeneration, grazing pressure, number of saplings present, presence of dead wood and evidence of impacting activities; and,

- In the very unlikely event that there is a change in hydrology at the receptor site (*i.e.* a change in the flooding regime), it may be necessary to block manmade drains within the receptor site and monitor water table levels within the site, as the condition of *91E0 habitat at the site will be intrinsically linked to the site's hydrology (Coillte, 2009).

The intervals and duration for the pre- and during compensation monitoring programme, will be decided upon by the Project Ecologist and/or ECoW and is likely to depend upon the speed of habitat establishment and stabilisation.

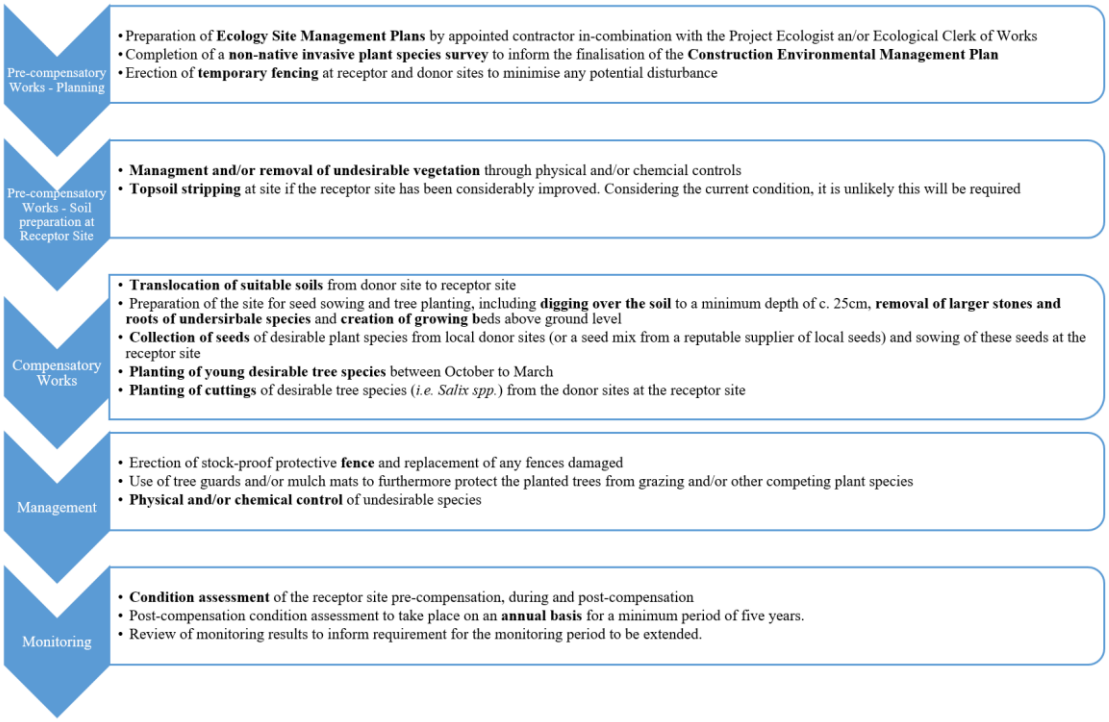
The post-construction monitoring programme will require annual monitoring, commencing on the year of habitat creation, for a minimum period of five years, with a review by a suitably qualified and experienced ecologist at the end of that period undertaken to determine whether the monitoring period needs to be extended further, if for example it is viewed that the habitat has not stabilised or become fully established by that time. Any extension to the monitoring period will need to consider whether on-going monitoring should be at annual or longer intervals e.g. +3 years post-creation, +6 years post-creation etc.

The results of all monitoring will be made available to the NPWS.

5.7 Conclusions

The measures outlined in this section will compensate for the significant residual effect on *91E0 habitat by ensuring that there will be no net permanent loss of this habitat type as a consequence of the proposed road development. A total area of *c.* 0.18ha (*i.e. c.* 181% of the area of *91E0 lost will be compensated for) will be created as part of the proposed compensatory works. The steps outlined in this section are presented below as a flow chart.

Plate 5 Flow chart of steps involved in the creation of *91E0



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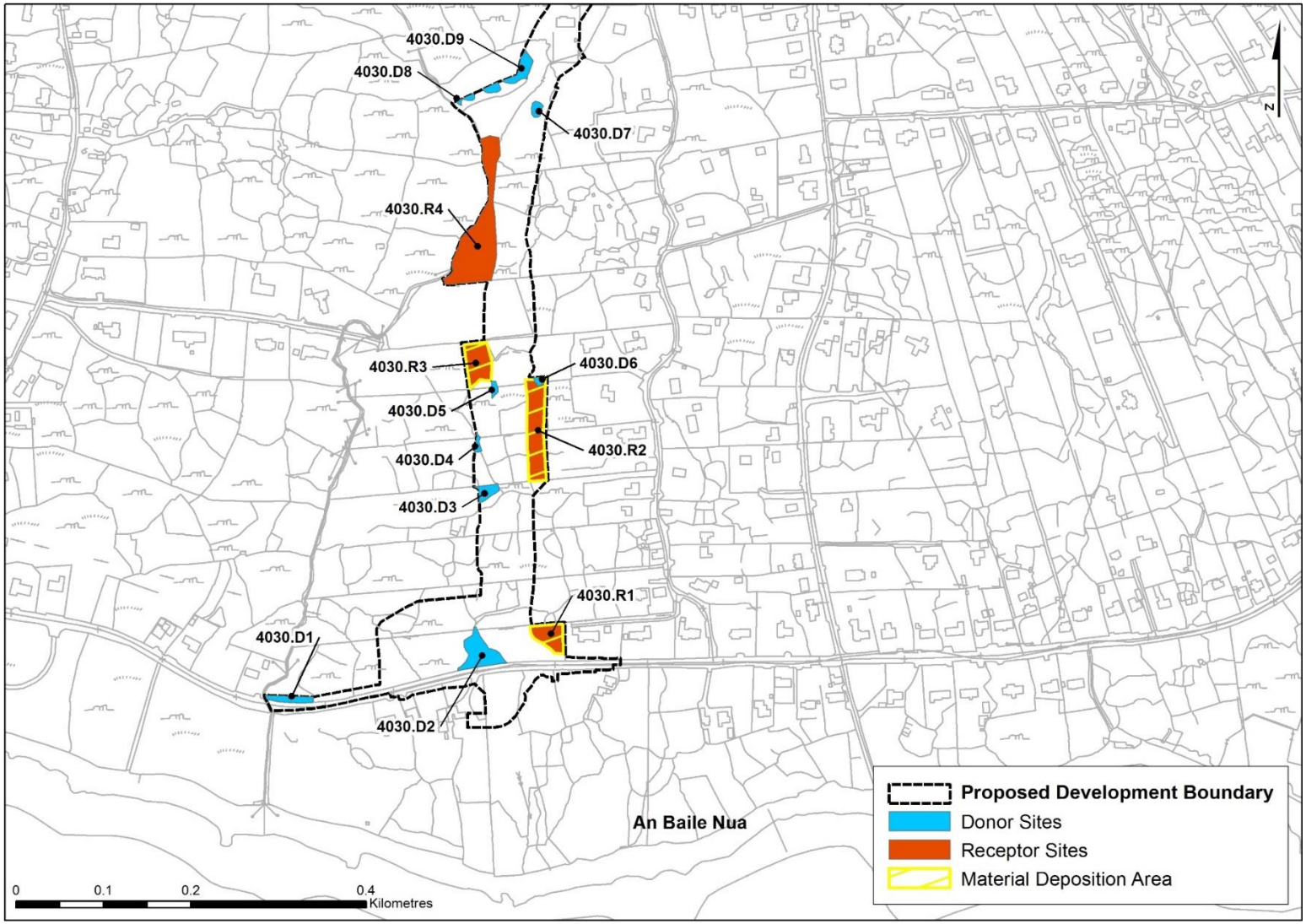
Figures 1 to 11

Figure 1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Donor Sites
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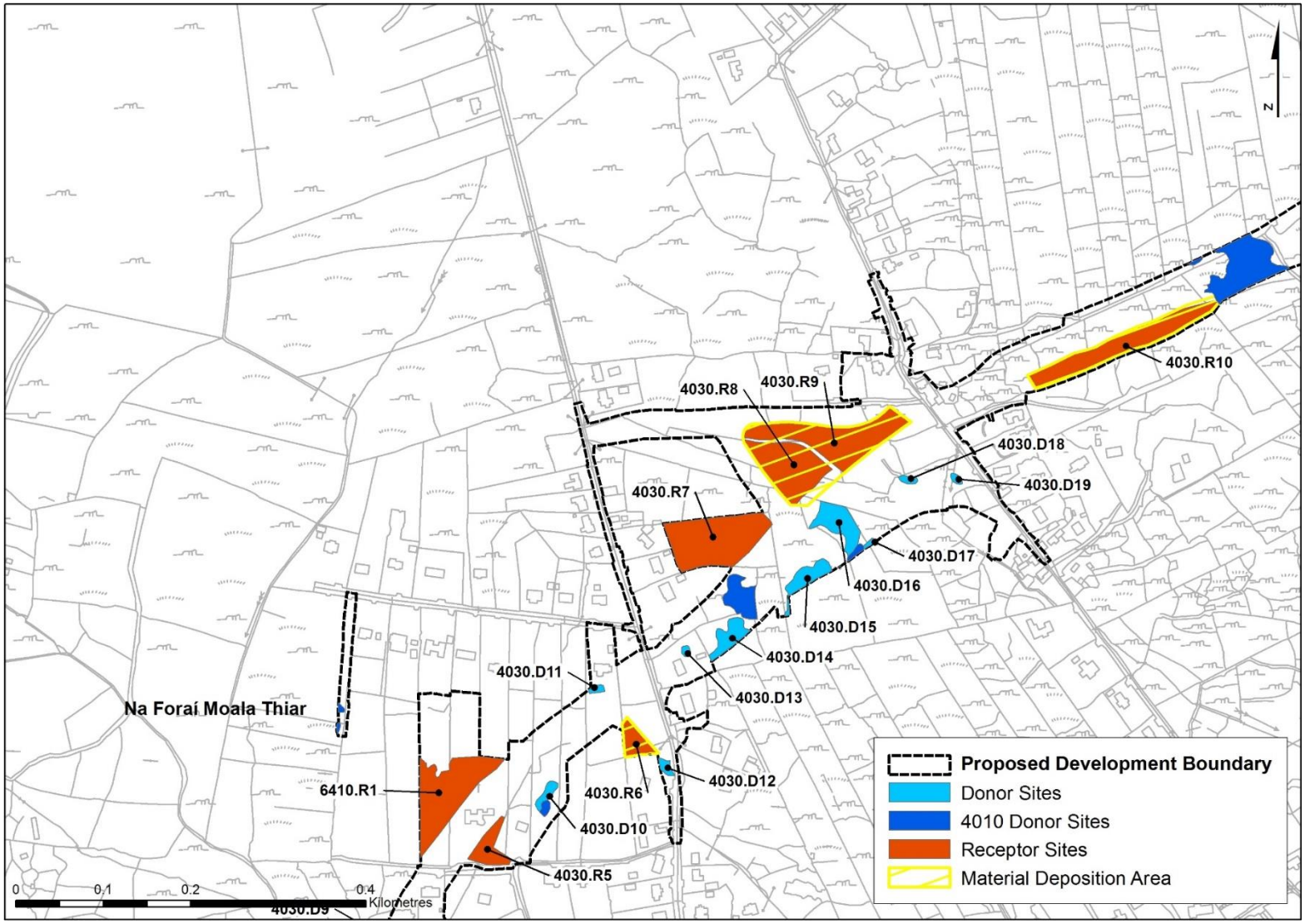
Material Deposition Area

Figure 2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Material Deposition Area

Figure 3

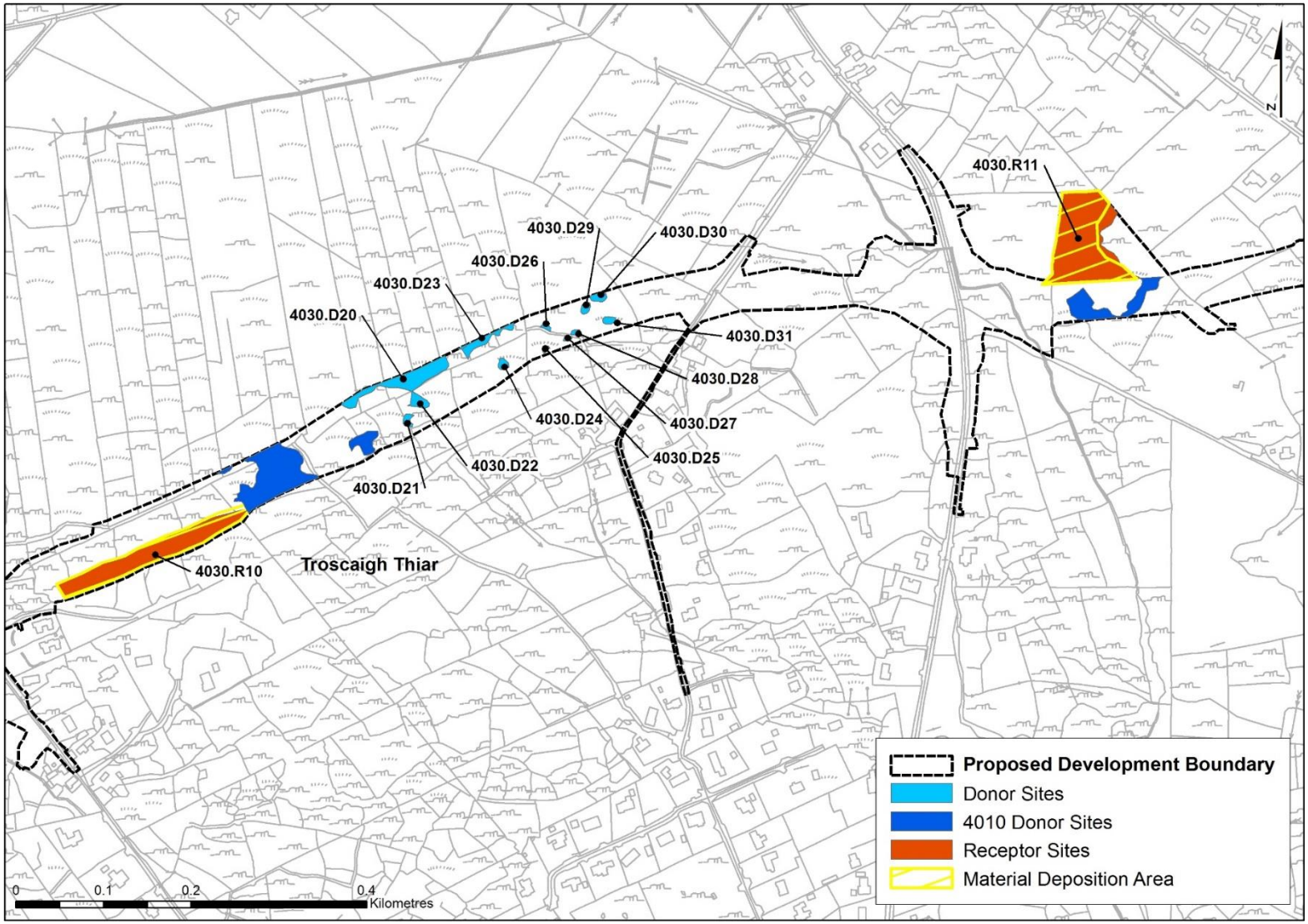
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Figure 4

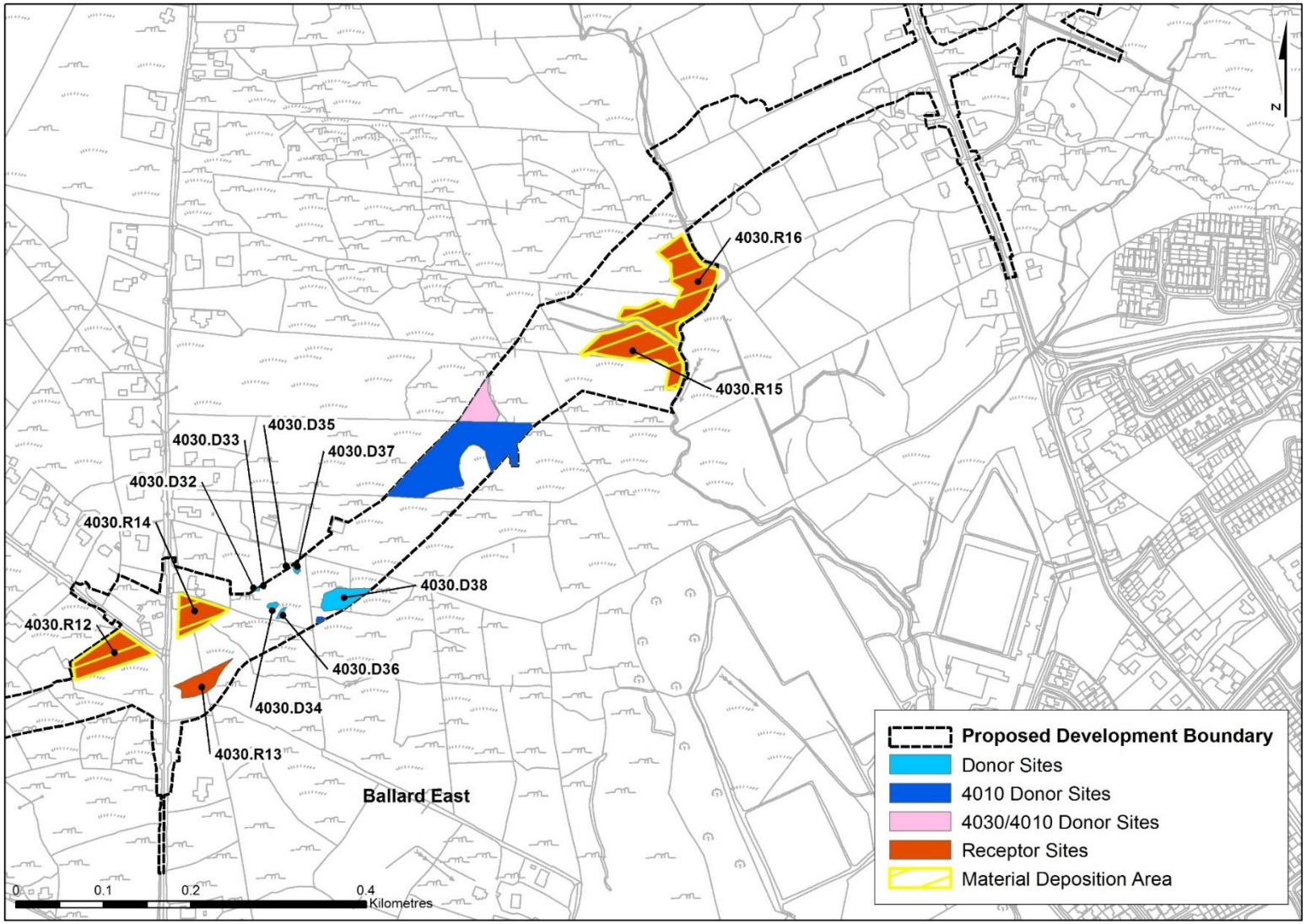
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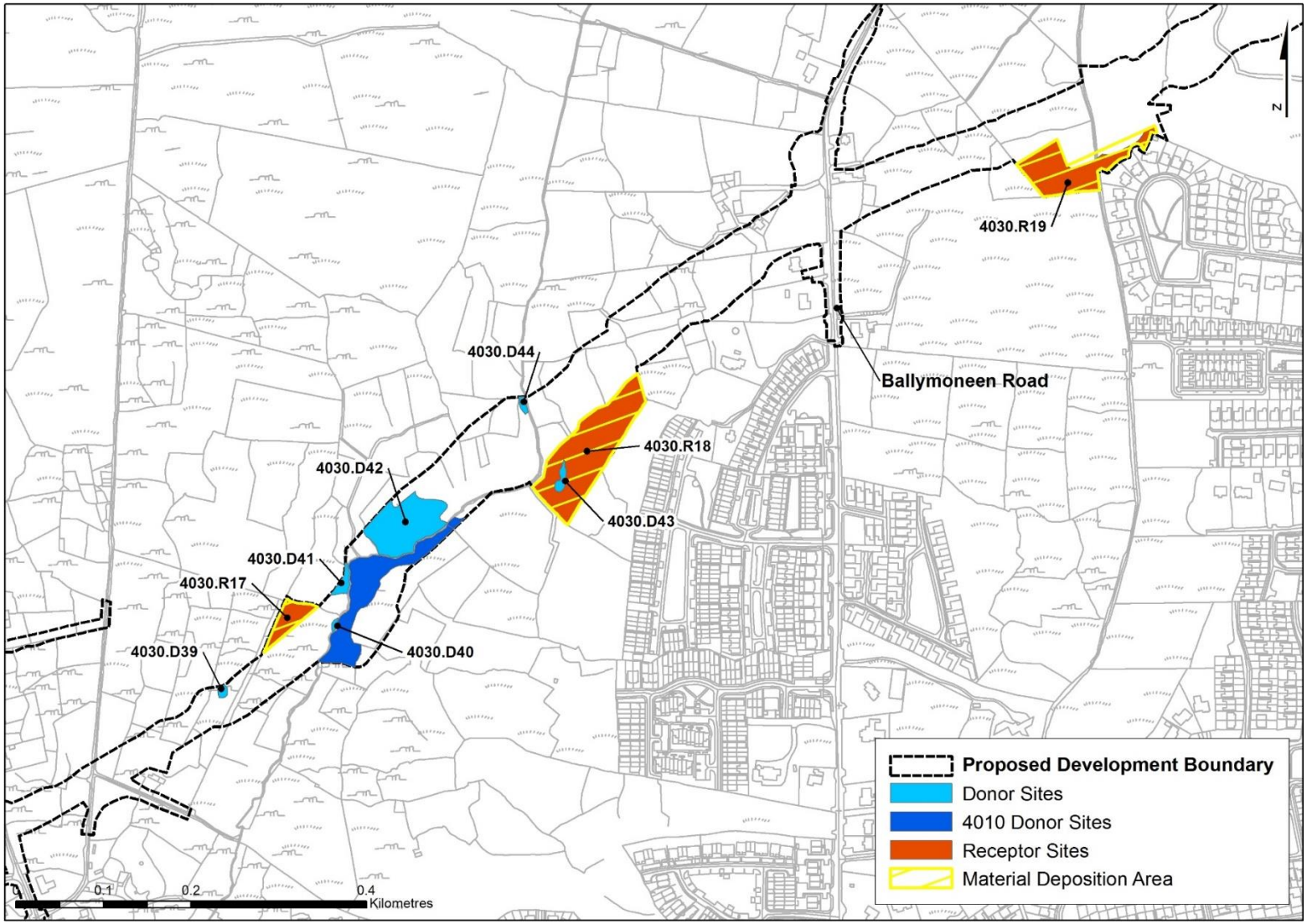
Figure 5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Proposed Development Boundary
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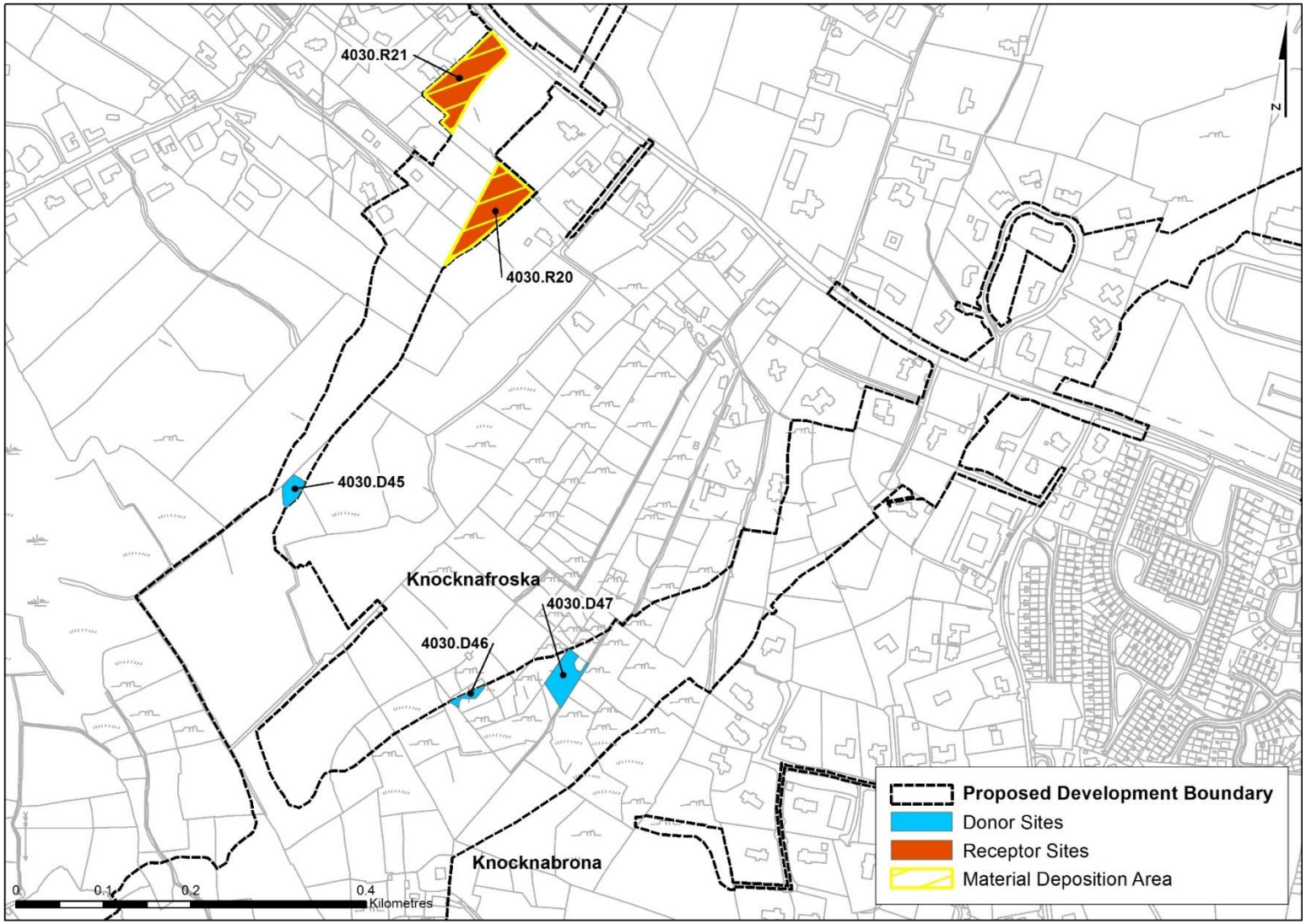
Receptor Sites
Material Deposition Area

Figure 6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Proposed Development Boundary
Donor Sites
Receptor Sites
Material Deposition Area

Figure 7

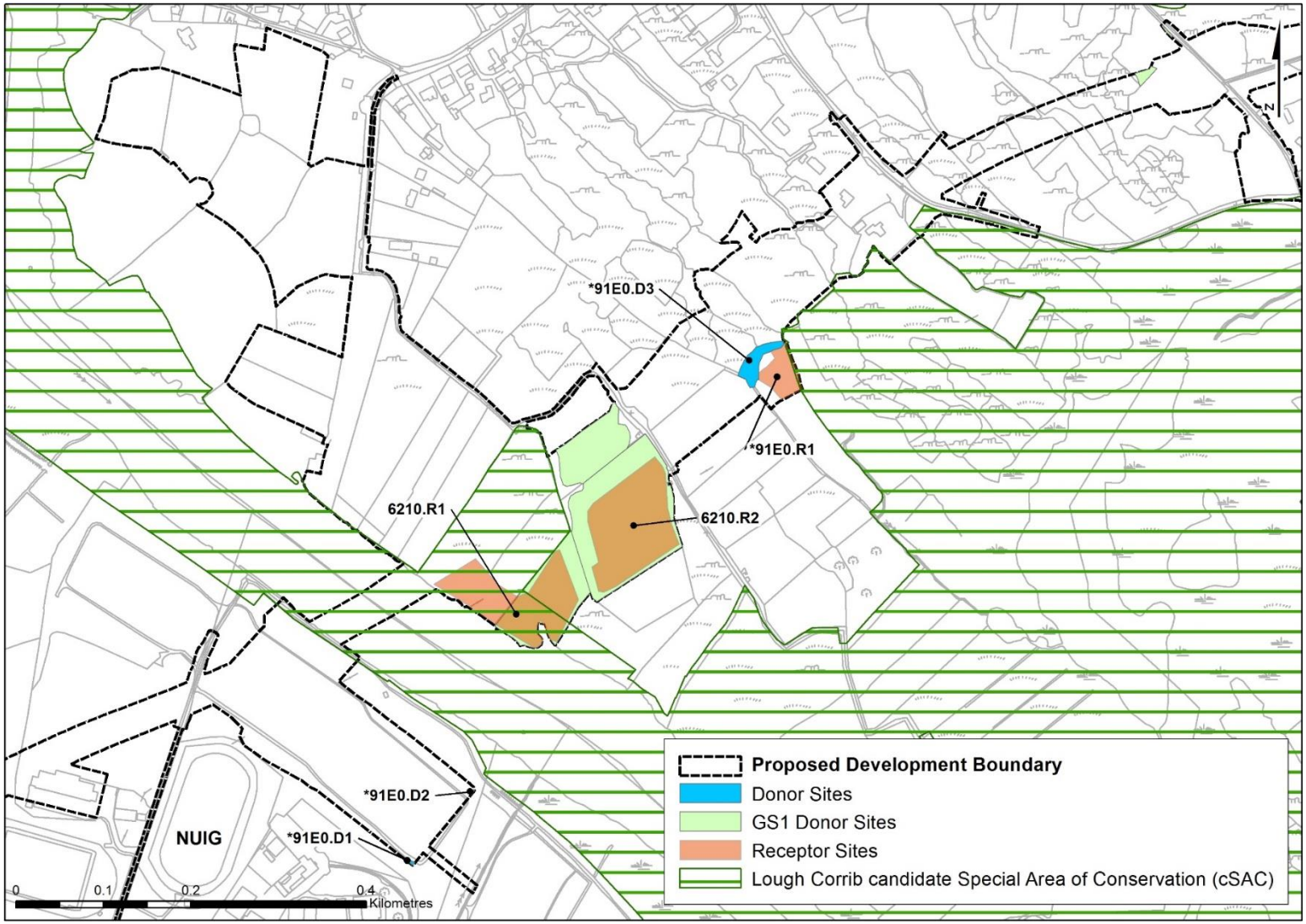
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Figure 8

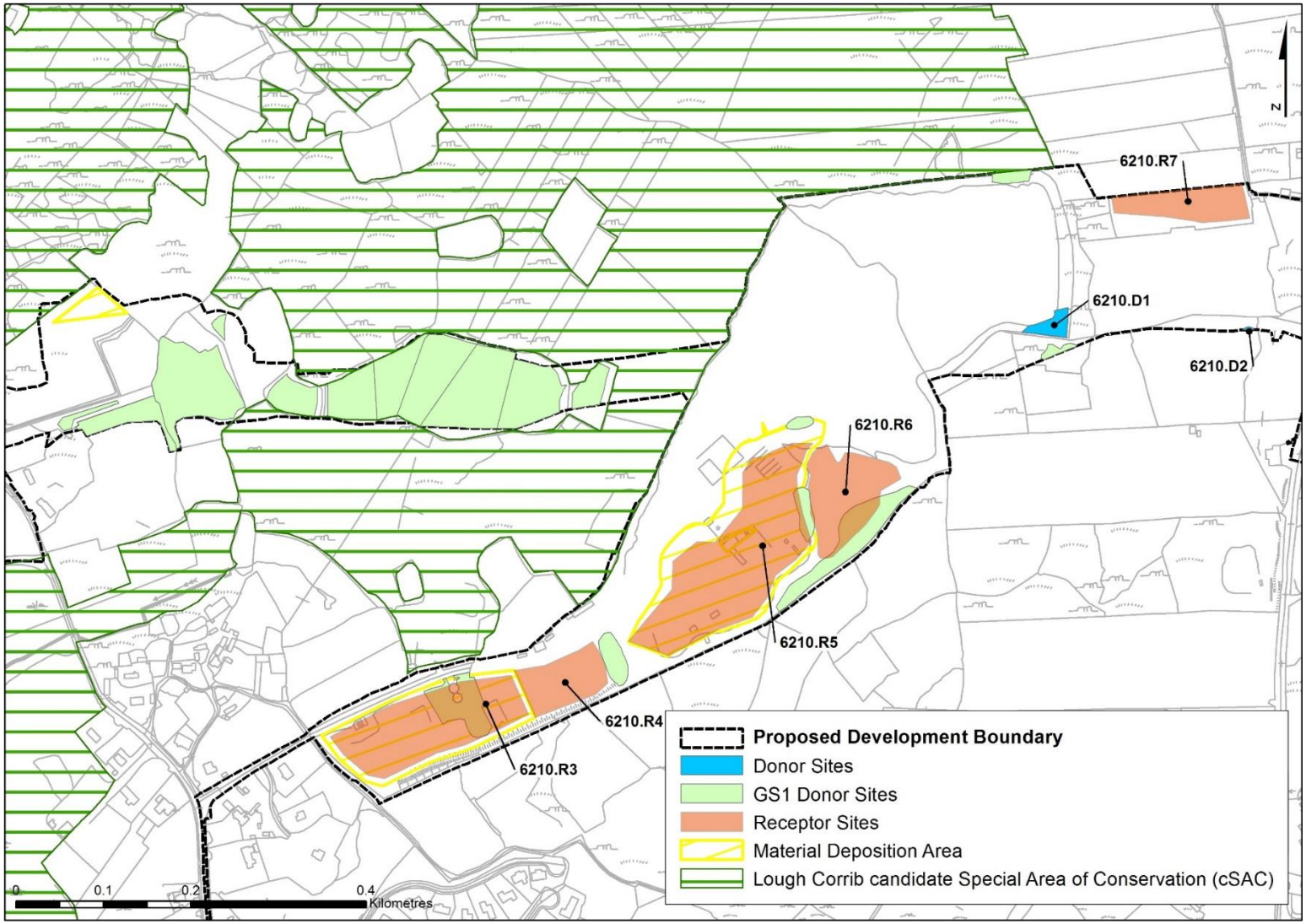
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Figure 9

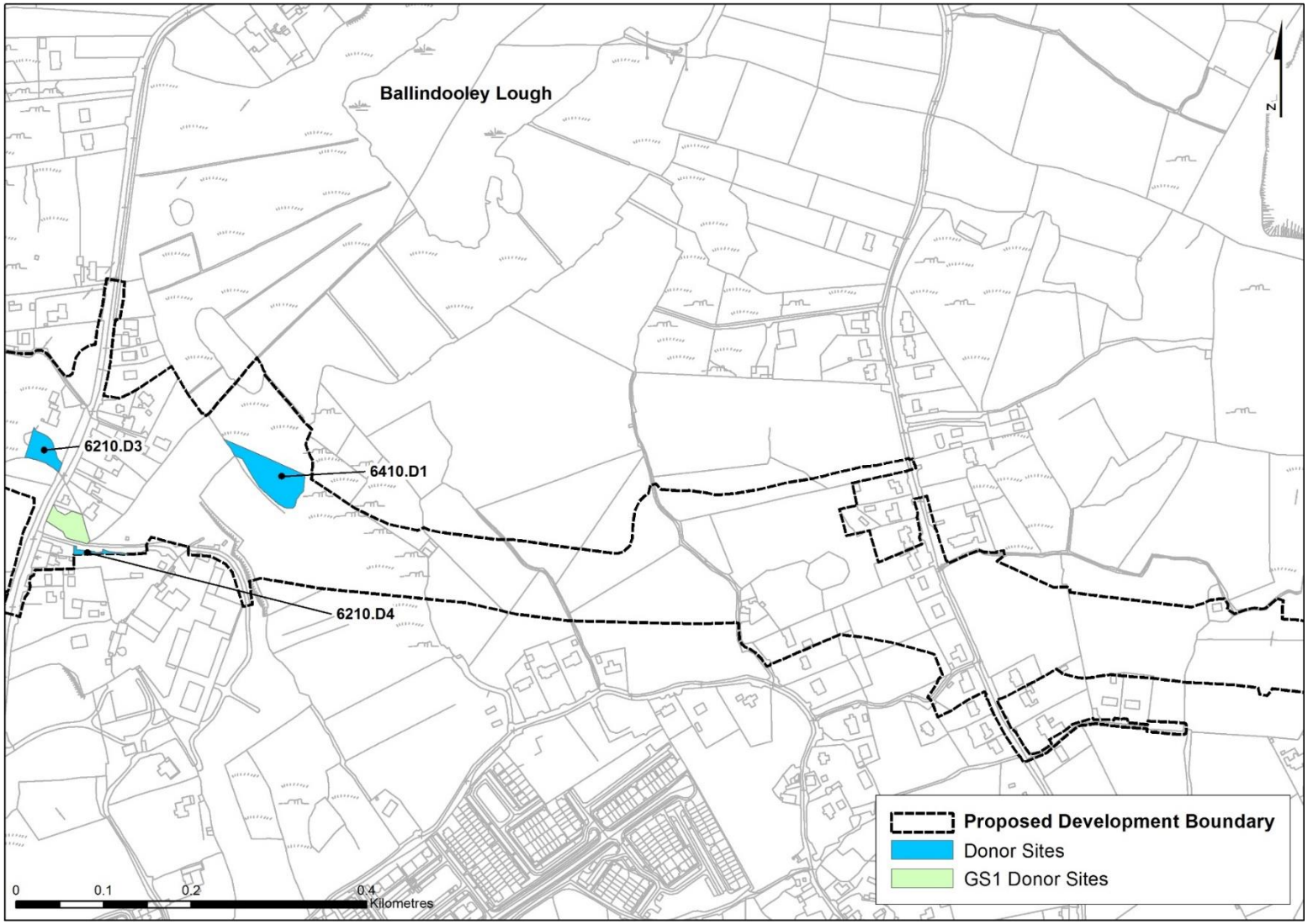
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Figure 10

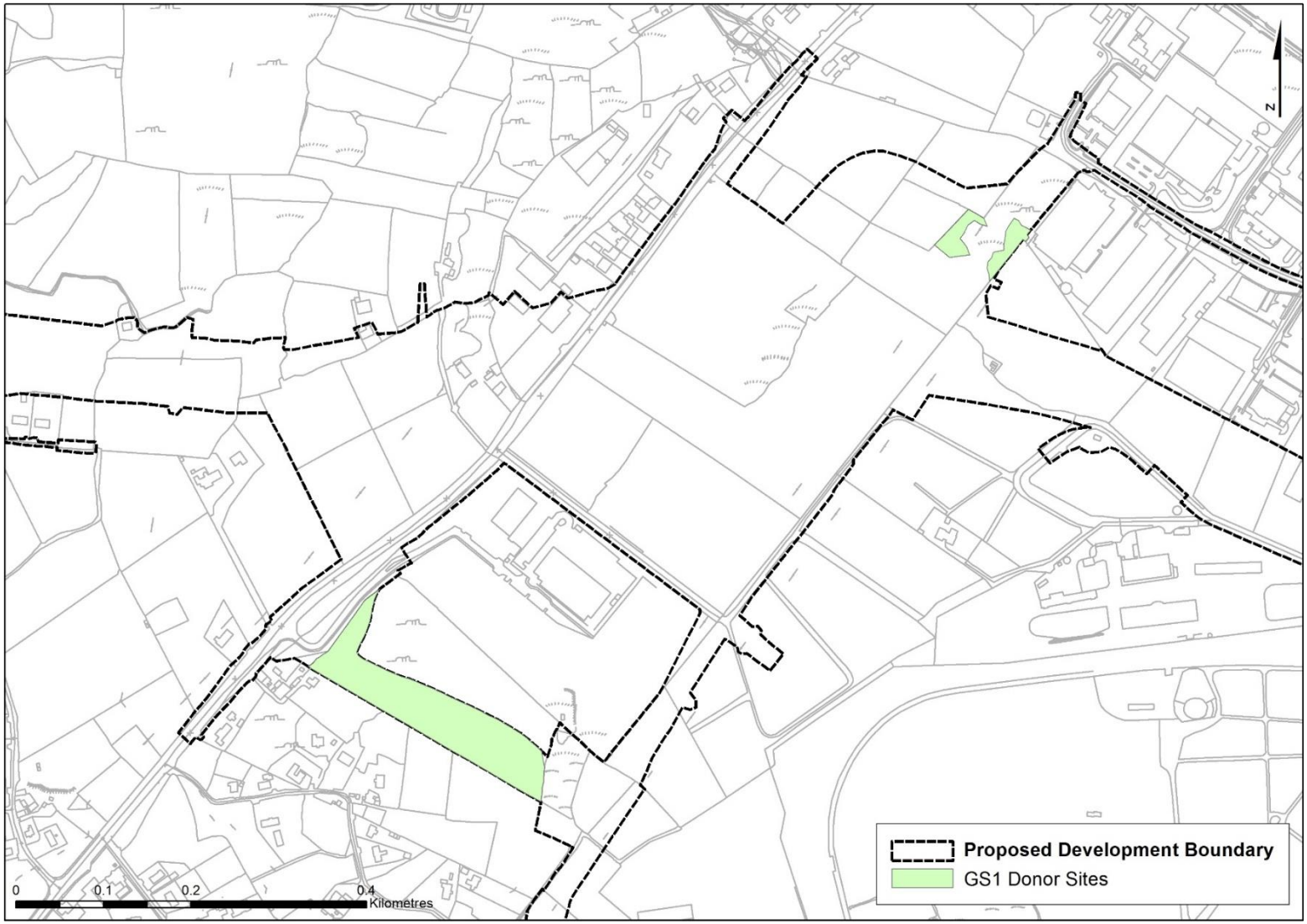
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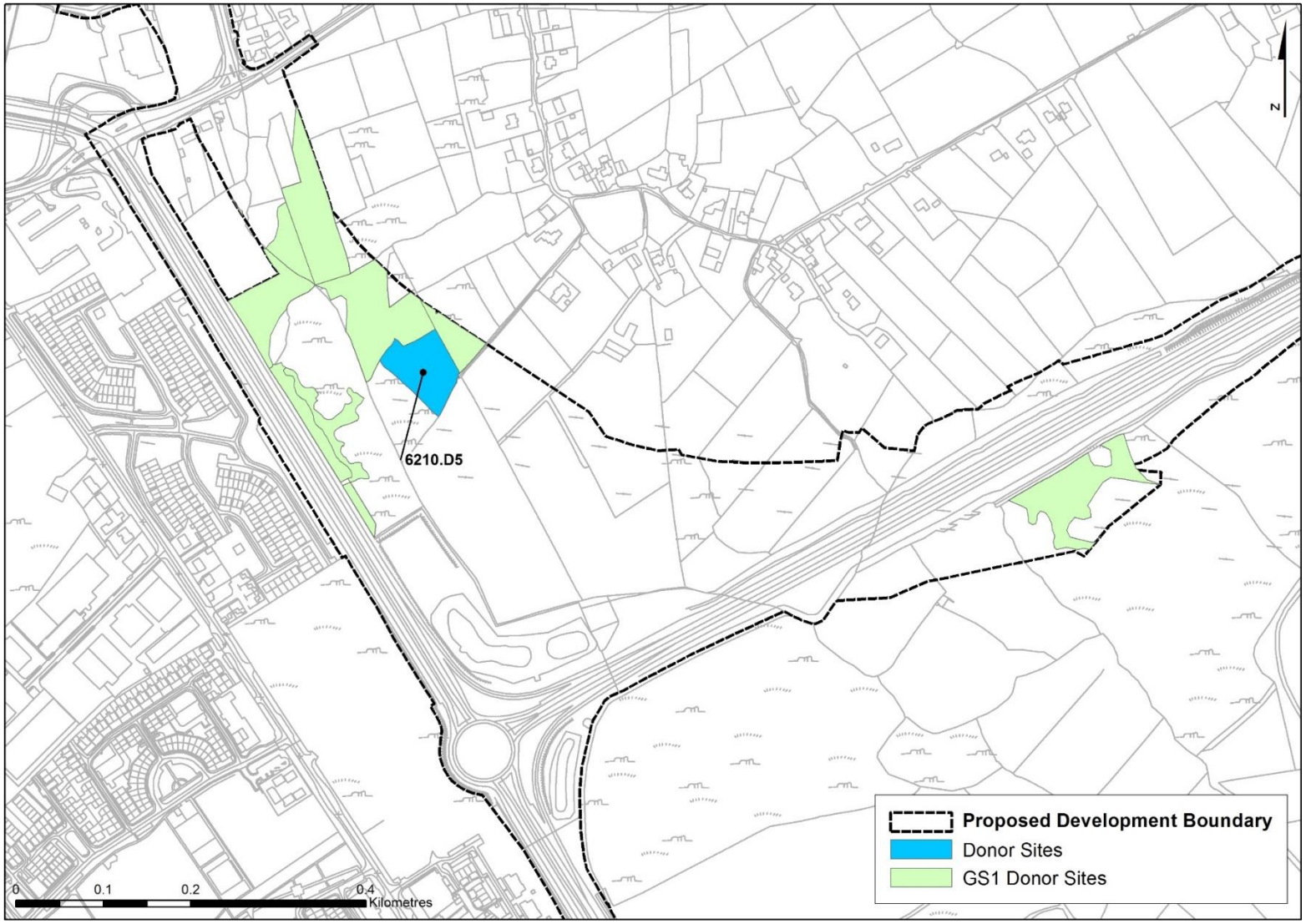
Figure 11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