K[illegible]n Doherty

From:	Daniel Bastreri <daniel@mpm-environment.london>
Sent:	Tuesday 12 September 2017 11:31
To:	Kieran Doherty
Cc:	Philip Green
Subject:	Ref PA0033 Galway Harbour compensatory measures V2.3B
Attachments:	P-APB-002 Galway Harbour compensatory measures V 2.3B.docx; P-APB-002 Galway Harbour compensatory measures V 2.3B.pdf
Follow Up Flag:	Follow up
Flag Status:	Flagged

Hello Kieran

As promised, please find attached my report on the proposed Phase 1 approach to compensatory measures for the above project.

Following your advice, this report can be read as a standalone document, without the need to read or refer to my previous report. For this, I edited and added some (brief) sections of the previous report. Also as indicated, the report is focused only on the compensatory measures presented on v 2.3B of the applicant's report. Please let me know if any part of the report is not clear, or if you would like me to expand any section - I have also attached a word version, which hopefully, you should be able to edit and/or add comments or track-changes this time, if required. I'd be happy to review or edit any part of the report if necessary.

I will also post a disc or a pen drive with the report later today.

Best regards,

Daniel

Daniel Bastreri BSc CSci CMarSci MIMarEST
Director

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On 22/08/2017 14:27, Kieran Doherty wrote:

Hello Daniel,

I hope you are well.

Following on from our latest meeting, An Bord Pleanála has now received Galway Harbour Company's proposed initial Phase 1 approach to compensatory measures. I have been asked to send you a copy of these and request you to report on whether you consider the proposals to be appropriate and adequate.

You might just confirm whether you are in a position to submit your report by 12th September 2017.

I have attached the record of the latest meeting for your information and I will send you a copy of the proposed measures on a CD to your address as per below:

82 South End,

Bassingbourn,

Cambridgeshhire,

SG8 5NL,

England, UK

Regards,

Kieran

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FÓGRA RÚIN: Tá an ríomhphost seo agus aon chomhaid atá nasctha leis faoi rún agus dírithe amháin don seolaí. Má bhfuair tú an ríomhphost seo trí earráid, déan teagmháil le bainisteoir an chórais.

Tabhair faoi deara led thoil: aon tuairimí nochtaithe san ríomhphost seo is iad tuairimí

Galway Harbour extension (Strategic Infrastructure Case 61.PA0033): Assessment of proposed compensatory measures (V 2.3B)

For An Bord Pleanála –Project P-ABP-002
September 2017

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P-APB-002	001	001	12/09/2017
Author	Signature		Position
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Executive Summary

The present report includes my review comments on the compensatory measures being proposed to address the impacts on the integrity of the Galway Bay Complex Special Area of Conservation that would arise from the extension of Galway Harbour. These are outlined in the report 'Proposed Compensatory Measures (Version 2.3B) in relation to the proposed Galway Harbour Extension, An Bord Pleanála (Ref: 61.PA 0033)' (Tobin/Aquafact, August 2017). My brief includes reporting on whether I consider the proposals to be appropriate and adequate.

The current proposals are based on ecological restoration of existing habitats within the boundaries of the SAC. Ecological restoration is a form of compensation specifically described in the EU (2007) Guidance document on Article 6 (4) of the Habitats Directive.

GHC proposes to develop a management plan for part of the Tawin area of Inner Galway Bay, within the boundary of the SAC, which includes the three List I habitats (intertidal fucoid-dominated reef and sand - mud flat, perennial vegetation on stony bank and salt marsh) affected by the proposed harbour extension and the construction of the Galway Harbour Enterprise Park in the 1990s. Parts of the habitats proposed as compensatory within the Tawin peninsula are considered as being of 'unfavourable/inadequate' status), due to current agricultural practices at the site. Specific management measures are proposed for the habitats requiring compensatory measures. These are based on a significant reduction of organic load input to the site and direct physical damage caused by livestock, vehicle circulation and extraction of materials.

For the proposed compensation to succeed, it is essential that clear objectives are set. These objectives and target values must be directly related to the conservation objectives of the site, and all management measures designed and implemented to meet the objectives and targets of the proposed compensation. The evidence for ecological restoration should be in the form of numerical data on relevant community parameters, to determine indices such as abundance, diversity, dominance, evenness,

etc. In general, the scope of the surveys proposed in the report is fit for purpose, and should provide sufficient data of adequate quality to identify the target area for implementing the management plan.

Equally important is to acquire numerical data and information on the same community parameters in the habitats that would be lost to the proposed development, in order to compare the ecological status of both areas. Data and information on the biological communities in the compensation area will be necessary to establish a valid baseline for the sites that may be subject to change – restoration and/or enhancement – before these take place. The extent of these changes – and the success of the proposed mitigation measures – can be measured by comparing the baseline with the results of successive surveys. Another important requirement for monitoring ecological restoration and measuring its success is the selection of a reference site. This is, an area with the same characteristics as the site subject to management and in the same location, which will not be managed. Comparison between the two sites would allow for an assessment of the success of the management measures, and ultimately, the success of the proposed compensation.

Based on the information provided to me by the Board and my current understanding of the proposed compensatory measures, it is my considered opinion that these are in line with EU guidance on the application of Article 6 (4) of the Habitats Directive and current practice within the EU. The proposed compensation, based on bespoke management of habitats in the Tawin Peninsula within the boundaries of the SAC, has the potential to bring ecological restoration and/or enhancement to habitats very similar to those that have been lost to the development of the Galway Harbour Enterprise Park and will be lost to the proposed harbour expansion.

Effective and targeted management of these habitats to improve their condition would lead to an improvement to the function of the SAC as an ecosystem, since it would restore any provision of habitat for biological populations, transfer of energy between different trophic levels, diversity and resilience that would have been lost due to these habitats being in a degraded condition.

1. Introduction

Galway Harbour Company Limited (GHC) has applied to An Bord Pleanála (the Board) for an extension of Galway Harbour (Connaught, Ireland). This extension would be adjacent to the existing Galway Harbour Enterprise Park (GHEP), approximately 500m south-east of the commercial Inner Harbour. The proposed Galway Harbour Extension (GHE) would be constructed on reclaimed land to the south of the existing GHEP, which was also partially built on land reclaimed from the sea.

After considering the Natura Impact Statement (NIS) and all other relevant submissions, including further information submitted by the applicant and further submissions made in the course of the oral hearing, the Board undertook an appropriate assessment of the implications of the proposed development for the European Sites potentially affected by the project in view of the sites' conservation objectives. The Board's Statement of Appropriate Assessment (SAA) (2015) concluded that the integrity of the Galway Bay Complex Special Area of Conservation (SAC) would be affected by the proposed development, due to the direct loss of fucoid-dominated reef habitat [Natura 2000 code 1170] and mud and sand flat habitat [Natura 2000 code 1140] within the footprint of the extension, and the potential loss of perennial vegetation on stony banks [Natura 2000 code 1220] due to the expected sheltering effect of the harbour extension.

The Board concluded that approval of the proposed development could not be considered under article 6 (3) of the Habitats Directive, given that a significant adverse impact on the integrity of the Galway Bay SAC would occur. Additionally, and on a without prejudice basis to the final determination of the application, the Board sought to invoke the derogation provisions set out in Article 6 (4) of the Habitats Directive in regard to Imperative Reasons of Overriding Public Interest (IROPI). The Board issued a letter in which it sought compensatory measures from the applicant to address the impacts on the integrity of the Galway Bay SAC.

Following the completion of the Appropriate Assessment, the Board wrote to the developer (GHC) on the 29th September 2015, to ask if they wished to have the project considered for approval under Article 6 (4) of the Habitats Directive. The Board also

advised that GHC should submit proposals for compensatory measures to address the impacts on the integrity of the Galway Bay SAC mentioned above. These compensatory measures would be addressed in two phases:

- Phase 1, in which the proposals for compensatory measures would be set out by GHC for initial consideration. GHC was advised to liaise with the National Parks and Wildlife Service (NPWS) in this regard.

- Phase 2: Pending the outcome of Phase 1, the applicant will be afforded further time to develop the compensatory measures in more detail leading to submission of a detailed proposal for consideration by the Board.

GHC submitted a response on the 25th November 2015, setting out initial approaches for compensatory measures, and a report (Aquafact, 2015) addressing the requirements set for Phase 1. The approach taken by the developers is based on the criteria and principles set out by the EU Commission's guidance on Article 6 (4) (EU, 2007/2012), as advised by the Board. The Board considered these initial measures and issued a Direction on the 29th January 2016, instructing that the applicant's submission be forwarded to the National Parks and Wildlife Service of Ireland (NPWS) for comments and to arrange a meeting between representatives of the Board and the NPWS to discuss the acceptability of the proposed measures. The NPWS responded by way of a submission dated 27th May 2016, which included comments on the applicant's proposal for compensatory measures. A meeting between representatives of NPWS and the Board (Director of Planning and Assistant Director of Planning) was held on the 28th June 2016. Following this meeting, further discussions on the approach to the proposed compensatory measures were held between the applicant and the NPWS. Legacy issues related to the previous loss of intertidal, stony bank and saltmarsh habitats due to the construction of the GHEP in the 1990s were also raised by NPWS, and these were addressed by the applicant in a further submission to the Board in October 2016. The combined extension of List I Habitats that would be lost to the development, and for which compensatory measures are required is:

- Intertidal fucoid-dominated reef [1170] – intertidal mud and sand flats [1140] complex: 14.51ha

- Stony banks [1220]: 0.63ha
- Atlantic and Mediterranean saltmarsh [1410] complex: 7.39ha

A tripartite meeting between the Board, NPWS and the applicant was held on the 13th December. Previous to this meeting, the applicant submitted a further package of information setting out their proposals for compensatory measures, which was also discussed during the tripartite meeting.

Following NPWS' comments on the initial set of compensatory measures, the applicants submitted a second report with a set of proposals for compensatory measures. This report (Aquafact, December 2016) which includes a package of measures with focus on three areas within Galway Bay SAC was also considered by the Board and NPWS. After further consultations and a meeting between the Board, the NPWS and GHC, a new set of potential compensatory measures was proposed by the applicant in August 2017. These proposals are described in version 2.3b of the report (Tobin/Aquafact, 2017b) which is intended by the applicant to be the final stage of Phase 1.

2. The Briefing

With regard to the progress made on the discussion of compensatory measures, the Board has requested my advice on the approach to compensatory measures being proposed in the applicant's submissions. My brief is to continue providing expert ecological advice to the Board as the case advances, and at this stage, having received GHC's report (V 2.3b) on the Phase 1 proposed approach to compensatory measures, report to the Board on whether I consider the proposals to be appropriate and adequate.

The following documents have been forwarded to me by the Board:

- Proposed Compensatory Measures (Version 2.3B) in relation to the proposed Galway Harbour Extension, An Bord Pleanála (Ref: 61.PA 0033) Tobin/Aquafact, August 2017

- Summary of Proposed Compensatory Measures (Version 2.3B) in relation to the proposed Galway Harbour Extension, An Bord Pleanála (Ref: 61.PA 0033) Tobin/Aquafact, August 2017.

- Record of Meeting (An Bord Pleanála, National Parks & Wildlife Service, Galway Harbour Company) held on the 27th July 2017.

In addition to the above documents, the following reports were used for the preparation of this report:

EU (2007/2012) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC

EU (2000). Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC.

European Commission (2001) Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC.

CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester.

NPWS (2013) The Status of Protected EU Habitats and Species in Ireland. Overview Volume 1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. Editor: Deirdre Lynn.

NPWS (2012) Marine Natura Impact Statements in Irish Special Areas of Conservation.

2.1 Author's competence

I am a marine ecologist with more than 26 years of continued professional experience, and a chartered scientist and chartered marine scientist with the UK Science Council through the Institute of Marine Engineering, Science and Technology (IMarEST), and a member of IMarEST. My experience relevant to this assignment includes providing specialist evidence-based advice on anthropogenic impacts on the marine and aquatic environment to UK government organisations, government organisations in the Middle East, and the private sector in the UK, Indonesia, Ecuador and Nicaragua. Between 2007 and 2013, I was a Marine Impact Assessor and science lead on the Regulatory Assessments Team of the Centre for Environment, Fisheries an Aquaculture Science (Cefas), an agency of the UK's Department of Food and Rural Affairs (Defra), providing advice to England's marine regulator, the Marine Management Organisation (MMO) and their predecessors on the assessment of impacts of proposed developments, including nationally significant infrastructure projects. In this capacity, I provided specialist advice to the MMO on the impacts associated with harbour development works in the ports of Dover, London Gateway, Harwich, Sheerness, Ramsgate, Portland, Southampton, Portsmouth, Newhaven, Sovereign Harbour and Littlehampton. I also advised the MMO and their predecessors on other nationally significant infrastructure projects affecting the marine environment, including several offshore wind farms (London Array, Blyth, Thanet, Kentish Flats, Scroby Sands, Gunfleet, Westermost Rough, Rampion), the Thames Tideway Tunnel and the extraction of marine minerals in the English Channel and the North Sea.

I have undertaken research in the areas of plankton ecology and taxonomy, biological effects of pollutants associated to water and sediment, and the impacts of point and diffuse water discharges on coastal, estuarine and freshwater environments, including undertaking over 30 'Stage III Appropriate Assessments' of licensed water discharges to Natura 2000 (European Sites) in S and SE England (from the Thames Estuary to the North Norfolk Coast) on behalf of the Environment Agency. Other areas of research related to the application of the EU Birds and Habitats Directives and the EU Water Framework Directive in the UK include undertaking numerical analyses of benthic populations in estuarine and coastal waters in the NE of England, toxicity,

bioavailability and bioaccumulation of pollutants in marine sediments within a European Site, and long term bioaccumulation studies in coastal fish, shellfish and seaweeds. Between 1998 and 2003, I was the Environment Agency scientific lead for the UK's National Marine Monitoring Programme (NMMP) in the NE of England. My duties involved planning, managing, and executing marine surveys, for taking water, sediment, fish and macrobenthos samples on regular intervals in a series of intertidal, coastal and offshore sites, adding the data to a national database managed by Cefas, and undertaking data analyses to understand trends and drivers of environmental change at national level, and for the early implementation of the EU Habitats and Water Framework Directives. These included bioaccumulation studies involving fish, mussels and seaweeds (*Fucus spp*) and assessment of intertidal coastal habitats and macrobenthic populations in the NE and SE of England.

As a consultant over the last 4 years, I have assessed the impacts of the construction of large and small jetties in the Thames Estuary, decommissioning of an oil platform in the North Sea, undertaken several Water Framework Directive and Habitats Regulation Assessments, a study of long-term sediment chemistry and benthic populations in the Orwell and Stour Estuaries for Harwich Harbour Authority, and many other assessments regarding the impacts of navigation dredging and disposal of contaminated sediments.

3. Proposed compensatory measures (August 2017)

Following discussions with the Board and NPWS the applicant's focus on identifying suitable compensatory measures shifted from the northern shore west of Silverstrand to the eastern shore of Galway Bay towards Renville and Tawin.

The version 2.1 report was discussed at a tripartite meeting in December 2016 following which a further update (V 2.2) was issued in February 2017. In version 2.2 it was proposed that initial qualitative surveys of the Tawin area be carried out to assess the site's suitability for the proposed compensation, and to allow for the selection of areas for quantitative surveys to be undertaken. Data acquired during these surveys would be used to describe the biological communities associated to the habitats in

question. The initial set of proposals – included in the Aquafact (2016) reports version 2 and 2.2 – were discussed in my previous report to the Board (Bastreri, 2017).

V2.3 (Draft A) was discussed by the Board and NPWS on the 28th March 2017, to direct the preliminary survey work required to choose the site for the implementation of compensatory measures.

Having carried out the qualitative surveys in April 2017, Mweeloon Lagoon has been selected as the preferred location for the compensatory measures, subject to the results of the analyses data and information from the quantitative surveys to be undertaken during the following weeks.

Possible compensatory measures included in versions 2.1 and 2.2 were also discussed during a tripartite meeting including the Board, NPWS and GHC on the 27th July 2017. Version 2.3B of the report has been finalised, and GHC proposes to lodge this version of the Tobin/Aquafact report as the last element of Phase 1 of the compensatory proposals process.

The current proposals – included in version 2.3B of the report - are based on ecological restoration of existing habitats within the boundaries of the SAC. It is stated in the report that restoration is a form of compensation specifically described in the EU (2007) Guidance document on Article 6 (4) of the Habitats Directive. In section 1.4.3 (Page 14) there is a reference to 'biological improvement of substandard habitat within an existing designated site' as one of the possible options for compensatory measures.

GHC proposes to develop a management plan for part of the Tawin area of Inner Galway Bay, within the boundary of the SAC, which includes the three List I habitats (intertidal fucoid-dominated reef, sand and mud flat, perennial vegetation on stony bank and salt marsh). Parts of these habitats were considered as being of 'unfavourable/inadequate' status in a report commissioned by NPWS (2006). This is due to current agricultural practices at the site, including grazing, poaching by cattle, dumping of waste and extraction of stone and gravel. Specific management measures are proposed for each one of habitats requiring compensatory measures. These are listed below:

3.1 Specific management measures for salt marsh and stony bank habitats

Based on the results of the initial desk studies, the report states that potential areas of approximately 25ha of perennial vegetation on stony bank and approximately 136ha of salt marsh 'may exist in the Tawin Peninsula within which appropriate areas may be found to compensate for the losses of 0.63 ha of stony bank and 7.39 ha of salt marsh' (Tobin/Aquafact, 2017 V 2.3B) lost to the development of the GHEP and the proposed Galway Harbour extension.

The proposal includes the management of salt marsh and stony habitats that can be purchased or long term management agreed with their current owners. The proposed management measures include control and curtail of grazing by livestock, stop the spread of fertilisers and slurry, dunging, use of herbicides, access of livestock, shooting, access of vehicles, and the use of supplementary feeding for livestock. Other management measures include ceasing the extraction of cobbles and the construction of drainage channels, ceasing the maintenance of sea defences and regular removal of litter. The proposal includes undertaking annual biological surveys 'to document any changes in their extent and any changes in their characteristic species'. Surveys would also be carried out following 'extreme events' such as storms. The results of these surveys would be used to adjust or modify the management plan, together with the results of annual independent audits (to be commissioned). The proposal also includes the display of signage with information on the habitat management project and the biological communities present at the site.

3.2 Specific management measures for intertidal habitats

The proposed management measures for the fucoid-dominated reef and sandflat-mudflat complex include the same measures proposed for saltmarsh and stony bank habitats (listed in the previous section), plus stopping current aquaculture practices and the eradication of an invasive non-native species, a tunicate of the Genus *Didemnum* ('sea-squirt').

3.3 Proposed extent of compensation

A generic table including each one of the three habitats for which compensation is required is included in Appendix 7 of the report. In this table, the management proposals for each habitat are presented under two main headings, ownership and management. The Management heading is further broken down into five sub headings:

1. Damaging Impacts e.g. grazing, slurry spreading, use of weed killers etc.
2. Damaging works e.g. drainage, machinery tracking over the habitat etc.
3. Constraining works e.g. no construction works on the habitats
4. Removal of litter on an on-going basis
5. Monitoring.

Each one of these headings and subheadings can be then assessed in terms of its effectiveness and scored against the seven topics listed in the EU Article 6(4) Guidance document: Targeted Compensation, Effective Compensation, Technical Feasibility, Extent of Compensation, Location of Compensatory Measures, Timing of Compensation and Long Term Implementation. Following the completion of the surveys at both locations, the generic compensatory Management Assessment Tables in Appendix 7 would be populated.

The scores would be used as a basis to 'arrive at' (define?) an equivalent compensatory area for each habitat. Subject to agreement of this assessment methodology, the detailed qualitative and quantitative study results would be presented in this format to show the extent and effectiveness of the compensation to be proposed.

3.3 Preferred area for the establishment of management measures

A series of qualitative surveys to identify the most appropriate areas for the establishment of the proposed management measures was undertaken at three areas within the Tawin peninsula during April 2017: Mweeloon Lagoon, Glasheen Island and Tawin West. The surveys included walk over surveys, qualitative sampling of relevant habitats, rocky shore transects to record macrophytes and macrofauna and aerial photographic surveys of each location using a drone. Significant areas of intertidal, stony bank and saltmarsh habitats were found in each one of the three areas. Based

on the results of the surveys and the available information acquired so far, it is proposed to undertake the quantitative surveys for compensatory habitats at Mweeloon Lagoon and its immediate surrounds. This is considered to be the most similar to the area where the expansion of the Galway Harbour extension is proposed. The rationale behind this decision is based on the relatively sheltered location of Mweeloon Lagoon, which results in low levels of energy being transmitted to the shore and in consequence, less coastal erosion and more fine sediment deposition taking place here than in the other two areas. The initial survey results also indicate that the three target habitats are well represented in this area.

The proposal is thus to concentrate the sampling efforts for the target habitats at Mweeloon Lagoon and its immediate surroundings. Quantitative surveys will be undertaken over the next few weeks (at the time of the report being written) both at Renmore and in and around Mweeloon Lagoon, which will cover intertidal fucoid-dominated reef, sand and mud flats complex, stony bank and saltmarsh complex habitats. Additionally, a preliminary survey and a report on *Didemnum sp.* in the vicinity of Mweeloon Lagoon will be carried out by Aquafact.

4. Discussion

As explained in Section 1 (p. 7) of this report, the Board advised GHC that they should submit proposals for compensatory measures to address the impacts on the integrity of the Galway Bay Complex SAC for approval under Article 6 (4) of the Habitats Directive. During Phase 1 proposals for compensatory measures would be set out by GHC for initial consideration. Further time will be afforded to the applicant to develop the compensatory measures in more detail during Phase 2, in which a detailed proposal will be written and submitted to the Board for consideration. In consequence, I will discuss the current proposal based on the expectation that most of the details will be addressed and agreed at a later stage.

4.1 The option of compensatory measures

As it was correctly pointed out in the report (Tobin/Aquafact 2017, V 2.3b), the improvement of existing habitats, the restoration or enhancement in existing sites, restoring the habitat to ensure the maintenance of its conservation value and compliance with the conservation objectives of the site or improving the remaining habitat in proportion to the loss due to the plan or project on a Natura 2000 site are all considered as appropriate in the EU Guidance document on Article 6 (4) *(Op. cit.)*. This document also states that species reintroduction, species recovery and enforcement, land purchase and acquisition, incentives for certain activities and reduction of threats are within the range of compensatory measures found in current practice within the EU in the frame of the Habitats Directive.

Thus, the proposal of restoring, improving or enhancing habitats that may not currently be in favourable condition within the SAC would in my opinion meet the requirements of Article 6 (4) and the available EU guidance document on Article 6 (4). It must be clear however that the compensatory measure is to bring about the improvement, and not the management measures implemented to achieve this outcome. This seems at times somewhat lost in the report, and it would appear that both the management plan and the monitoring plan are referred to as compensation in parts of it. At this stage, the detailed methodology does not need to be addressed, but there must be clarity on the objectives. Furthermore, the EU guidance document on Article 6 (4) is very clear about the fact that compensatory measures should be additional to the actions that are normal practice under the Habitats and Birds Directives or obligations laid down in EU law. More specifically, it states (in page 10) that *'the implementation of a management plan, or the proposal/designation of a new area, already inventoried as of Community importance, constitute "normal" measures for a Member State'.*

Ecological restoration can be defined as the process of repairing damage caused by human activity to the diversity and dynamics of indigenous ecosystems (Jackson *et al.,* 1995), an attempt to recover a natural range of ecosystem composition, structure, and dynamics (Falk 1990; Allen *et al.* 2002; Palmer *et al.* 2005). This is a process of change to a functional ecosystem, to increase its balance, resilience, biodiversity, and its potential to deliver ecosystem services. This increase in the delivery of ecosystem

services - from the processes of energy transfer to biological regulation and nutrient recycling – would compensate for those lost to the proposed harbour extension.

For compensatory measures to be feasible and operational in reinstating the ecological conditions to ensure the overall coherence of the Natura 2000 Network – the structure and functions lost, and the habitats and species affected – their objectives and methods must be clear. In this respect, it is essential to ascertain the need for improvement of substandard areas of these habitats which in places have been described as being of 'unfavourable/inadequate' status. This objective would be achieved during Phase 2, once the required data and information have been acquired through the proposed ecological surveys.

Clear objectives and target values must also be directly related to the conservation objectives of the site, and all management measures designed and implemented to meet the objectives and targets of the proposed compensation. Some examples are given in the EU Guidance document, and these include identifying the number of species affected, the principal functions of the habitats that will be adversely affected, and the measures needed to offset the damage to the habitat functions and species affected so that they are restored to a state that reflects the favourable conservation status of the area. These are all relevant to the compensatory measures proposed by GHC in the report, since they will need to provide evidence that the habitats selected for implementing the management plan are effectively in a 'unfavourable/inadequate status' if the objective of the management plan is to achieve an improvement, or, that the habitats would be improved or enhanced by the management plan if they are not in 'unfavourable/inadequate status'.

The evidence should be in the form of numerical data on relevant community parameters, to determine indices such as abundance, diversity, dominance, evenness, etc. These are discussed in more detail in the methods section, but in general, the scope of the surveys proposed in the report is fit for purpose, and should provide sufficient data of adequate quality to identify the target area for implementing the management plan.

Equally important is to acquire numerical data and information on the same community parameters in the habitats that would be lost to the proposed development, in order to compare the ecological status of both areas. Data and information on the biological communities in the compensation area will be necessary to establish a valid baseline for the sites that may be subject to change – restoration and/or enhancement – before these take place. The extent of these changes – and the success of the proposed mitigation measures – can be measured by comparing the baseline with the results of successive surveys, as the monitoring programme advances. I note that the scope of the surveys includes Renmore, so this requirement would be met, as long as data is acquired for all three relevant habitats.

The final requirement for monitoring ecological restoration and measuring its success is the selection of a reference site, this is, an area with the same characteristics as the site subject to management and in the same location, which will not be managed. Comparison between the two sites would allow for an assessment of the success of the management measures, and ultimately, the success of the proposed compensation.

Since the compensatory measures relate to three different Annex I habitats, I will address these separately in sections 4.4.1 to 4.1.3.

4.1.1 Intertidal habitats

The reef and sand/mud flats are not considered individually in the proposed compensatory measures, and NPWS consider that it would not be appropriate to delineate the individual contribution of each Annex I habitat to the area to be lost. The 5.93ha of intertidal habitats to be lost to the proposed development, and the areas lost to the development of the GHEP in the past include intertidal fucoid- dominated reef interspersed with sand and mud flats. As both habitats (reef and sand/mudflats) can be found together in the areas proposed for compensatory measures, I will discuss these in relation to both habitat types.

Intertidal fucoid-dominated reef communities are common and widespread around the coasts of Ireland and the British Isles. They are characterised by the dominance of brown seaweeds including bladder wrack (*Fucus vesiculosus*), serrated wrack (*Fucus*

serratus), spiral wrack (*Fucus spiralis*), brown seaweed (*Fucus distichus*), knotted wrack (*Ascophyllum nodosum*) and channelled wrack (*Pelvetia canaliculata)* with their associated flora and fauna. Other seaweeds commonly associated to this habitat are *Codium* spp. and the red algae *Vertebrata lanosa* and *Hildebrandia rubra*. The epifauna associated to this habitat includes the common limpet (*Patella vulgata*), common mussel (*Mytilus edulis*), the flat top shell *Gibbula umbilicalis* and the grey top shell *Gibulla cineraria*, periwinkles (*Littorina spp.*), and crustaceans such as barnacles (*Balanus spp.* and *Semibalanus spp.*). The seaweeds provide substratum and shelter for the tube worm *Spirorbis spirorbis*, herbivorous isopods, such as *Idotea*, and surface grazing snails, such as the flat common periwinkle *Littorina obtusata*. During high tide, the fronds provide substratum and shelter to an assemblage of planktonic and epibenthic invertebrates, which in turn are used as food resources by coastal fish larvae and juveniles.

The overall status for these habitats in Galway Bay Complex SAC is bad (NPWS, 2013). The dominant species in this habitat - seaweeds of the Genus *Fucus* and *Ascophyllum* - are highly fecund, and each fully developed plant may produce over one million eggs, which adhere to rocks and almost any substrate within hours of settlement. The germling may be visible to the naked eye within two weeks (Knight & Parke, 1950), and the life cycle lasts between 2 and 5 years. Whilst the timing of reproduction of *Fucus spp.* is to a certain extent conditioned by wave exposure and local hydrodynamic patterns, what is known of the biology of these species suggests that colonisation of any new habitats (reefs) by *Fucus spp.* and their associated flora and fauna would take place within 2 to 5 years. These communities tend to be unstable, due to the combined effects of physical disturbance, competition, grazing, predation and recruitment variation. They are often dominated by a small number of species, which occupy the majority of available space (Hill et al., 1998). Their sensitivity to impacts is low, and their recoverability high[1].

Whilst intertidal rock habitats provide food resources and substratum for many commercially important species of fish during high water, there is little evidence of dependence on littoral communities (*Ibid.*). These habitats also provide food for

[1] (http://www.marlin.ac.uk/species/detail/1330;http://www.marlin.ac.uk/species/sensitivity_rationale)

aquatic birds and opportunistic terrestrial mammals (Feare and Summers, 1985) during low water.

The benthic communities characteristic of the sand and mudflats present in the areas to be lost are generally described in the 'Galway Bay Complex SAC Conservation objectives supporting document' (NPWS 2013). These are:

Intertidal sandy mud community complex

The fauna of this complex includes the thin tellin *Tellina tenuis*, the Baltic tellin *Macoma balthica*, the common cockle *Cerastoderma edule* and the polychaetes *Glycera tridactyla* and *Nephtys hombergii*. Other species, such as the brown shrimp *Crangon crangon*, the lugworm (polychaete) *Arenicola marina* and the peppery furrow shell *Scrobicularia plana* are present in moderate abundance, and their distribution is patchy in this habitat type.

Intertidal sand community complex

In this community complex, species such as the polychaetes *Spio martinensis* and *Scoloplos armiger* and the bivalve common cockle *Cerastoderma edule* are generally associated to a sandy substrate, whilst the polychaetes *Exogone (Parexogone) hebes, Pomatoceros lamarcki, Travisia forbesii* and the chiton *Lepidochitona cinerea* are found associated to coarser material.

Both habitats and community types in mudflats and sandflats are common in coastal areas of northern Europe. They are important in providing structure to coastal ecosystems, and in the processes of energy production and transfer within the ecosystem and beyond. In this respect, their role in providing food resources for marine birds and coastal fish and shellfish is widely acknowledged as important. The overall status for these habitats in Galway Bay SAC is inadequate (NPWS, 2013).

The sandflats at the affected site are similar to other intertidal sand and mudflats around the coasts of Ireland, the British Isles and Northern Europe. The flats are covered by casts on the sand, made by lugworms, (*Arenicola marina*), which is an indicative species of the intertidal sandy mud community complex.

The total area of intertidal habitats that would be lost to the development and require addressing by compensatory measures is 5.93ha. In addition to this, 8.58ha of intertidal habitats were also lost during the construction of the existing GHEP. These combined intertidal areas amount to 14.51ha. Considering the intertidal habitats as a complex including both reef and sandflat/mudflat habitats, the loss of these 14.51ha represents approximately 0.17% of the total, according to the combined extension of these two habitat types (1140 and 1170) in the Natura 2000 Standard Data Form for the site (3,516ha). Following the guidance in the 'Managing Natura 2000 Sites (EU, 2011) document, the connotation or meaning of 'integrity' should be considered as a quality or condition of being whole or complete. In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation. The decision as to whether it is adversely affected has been correctly based on the site's conservation objectives, regardless of the extension of the affected habitats. However, it is necessary to consider the extent of structure and function that would be lost to the proposed development to establish the extent of compensation that will be required. Due to the resilience and low sensitivity of these specific intertidal habitats and their communities, their potential to evolve in ways that are favourable to conservation is generally high. In consequence, the loss of 0.17% of their structure and function could be offset by an increase on those provided by the ecological restoration of a significant area of similar habitats. The proposal of managing these habitats to improve their condition would lead to an improvement in the function of the ecosystem, as it would restore any provision of habitat for biological populations, transfer of energy between different trophic levels, etc. that could have been lost due to these habitats being in a degraded condition.

For these reasons, it is my opinion that the proposed compensation is feasible from an ecology perspective. Overall, the proposed approach for compensatory measures, consisting in habitat restoration and/or enhancement is appropriate in general, and meets the requirements of Article 6(4) and the available EU guidance document on Article 6(4) (*Ibid.*).

4.1.2 Perennial vegetation on stony banks

The 0.35ha of stony bank habitat that would be lost to the development includes a narrow fringe of perennial vegetation between the strand line and terrestrial vegetation. The site was being used by dog walkers and other members of the public during our inspection of February 2017, as it was during my first visit, in December 2014. A significant amount of litter could be seen on this site, possibly most of it is from waste thrown to the sea or the River Corrib and deposited on the site by the action of tides and waves. This is not uncommon for densely populated areas and harbours, and suggests that the site is subject to a significant level of disturbance. This is clearly shown in the photographs shown in my previous report (*Op. cit.*), which demonstrate that this is far from being a pristine site, and that the site would benefit from basic management, such as litter picking and the presence of signs describing the rare plant species that could be found there, and exhortations to maintain the site clean and not to trample over the plants. Another observation made during our visit is that the particle size distribution of the site is more towards sand than larger particles, at least on the surface. This would appear to be a 'sandy bank' with a stony fringe in parts, rather than a 'stony bank'.

In addition to the 0.35ha that would be lost to the proposed extension of the harbour, an extension of 0.28ha lost during the construction of the GHEP must be considered for the compensation. This is for a total of 0.63ha of this habitat, which is more sensitive, rare and less widespread than the intertidal habitats discussed above. There is less certainty regarding the extension and status of this habitat within the SAC, but it is expected that the proposed quantitative surveys will provide sufficient data to ascertain these and their ecological function. Subject to the results of the surveys, the proposed ecological restoration and/or enhancement of existing habitats with perennial vegetation in the Tawin peninsula would be an appropriate compensation for the loss of those lost to the proposed harbour expansion and to the GHEP in the past.

4.1.3 Salt marsh

There are 136.33ha of saltmarsh mosaic which have been mapped in Tawin peninsula, and some of these habitats ('in places') have been described as being of "unfavourable/inadequate" status in a report commissioned by NPWS (2006).

In relation to these habitats, the recovery of areas currently in unfavourable status, which are currently in unfavourable status due to pressures associated with agriculture practices, would be an appropriate compensatory measure for the loss of 7.39ha associated with the construction of the GHEP in the past. As mentioned previously, these would be dependent on selecting and applying adequate management measures. The removal of direct adverse pressures should result in noticeable improvements, and a reduction in organic loads discharged to the site and the reduction in grazing and disturbance that the proposed measures would bring will result in measurable improvements in the condition of these saltmarsh habitats. Periodical tidal flooding once part of the sea defenced are breached would restore the effects of sediment transport and deposition, which will in turn result in further enhancement of these habitats.

4.2 The management plan

The proposal for the restoration or enhancement of the target habitats is based on the development and application of a management plan for part of the Tawin area of Inner Galway Bay within the boundary of the SAC, which includes significant areas of intertidal fucoid-dominated reef and sand/mud flats complex, perennial vegetation on stony bank habitats and saltmarsh complex habitats. Some of these habitats have been described as being of 'unfavourable/inadequate' status in a report commissioned by NPWS (2006), mainly due to the impacts of physical damage and organic enrichment caused by agriculture and extraction of rock and gravel. This seems to be supported by the information and data gathered by the applicant's consultants, and by my own observations of the site during my survey with Senior Inspector Paul Caprani in February 2017, as described in my previous report (*Op. cit.*).

The proposed management plan would lead to stopping and reversing the physical damage caused by livestock, circulation of vehicles, extraction of materials and littering. It would also significantly reduce the input of organic matter and fertilisers to the terrestrial habitats, and in consequence, the input of these to the adjacent intertidal habitats by run-off. The intertidal areas will also be improved, by the proposed ceasing of aquaculture and the eradication of the non-native invasive tunicate of the genus

Didemnum. These measures should be effective in reducing the input of organic matter to the target habitats, and ceasing the physical damage caused to them by livestock and vehicles.

The management plan would also involve breaching some of the sea defences, to allow access of sea water to some areas. While this may lead to improvements to the saltmarsh habitats, careful consideration must be taken of the flood defence management implications of this specific measure, and its regulatory requirements – impact assessments and an 'appropriate assessment' under the Habitats and Birds Directives may be required.

Monitoring and audits or monitoring to be conducted by independent contractors are also described as part of the management plan, and it is proposed that the management plan would be adjusted or modified in the light of the monitoring results. Whilst this approach is correct in my view, it is important to consider that the scope for changes in the management plan or measures may be limited. The details of indicators of restoration or ecological change, ecological status and triggers for reviewing and changing the management measures or the management plan must be addressed during Phase 2 of the IROPI process under Article 6 (4) of the Directive.

The use of the generic table included in Appendix 7 to present the studies once it has been populated must be discussed in detail during Phase 2. At its present stage, it is unclear how the scores will be assigned, and how these scores will weight against ecological indices determined by numerical analyses of the quantitative data.

One important consideration on the management plan and measures is that one of its key components will be, potentially, a significant reduction of organic input to the relevant habitats within the Natura 2000 site. However, measuring this reduction and modelling its results is not considered in the management plan or the monitoring plan. A relatively simple calculation of nutrient loads discharged to the target habitats over time would provide valuable evidence of ecological change, when compared with the reduced loads that would be a result of the management measures. There are many standard methods based in the extension and use of land, type of livestock, etc. that could be used for this, and which would not require acquiring new data. I would suggest

discussing this option as a potential method to inform future assessments of ecological restoration in the compensatory habitats.

For the reasons outlined above, and subject to the results of the surveys and the above considerations, my opinion is that the proposed management plan is in principle appropriate to achieve its expected outcome, namely, to restore ecological structure and function to the three target habitats in the Natura 2000 Site, in order to compensate for those that would be lost to the proposed development.

4.3 The location for compensatory measures

There are extensive areas of intertidal fucoid-dominated reef and sand/mud flats complex, perennial vegetation on stony bank habitats and saltmarsh complex habitats in the location initially selected to undertake quantitative surveys and, depending on the results of the surveys, to implement the management plan to deliver the proposed compensatory measures. As it is described in the report, the target habitats are well represented in the Tawin peninsula in general, and especially in its north coast, where Mweeloon Lagoon is located. Additionally, the hydrodynamic conditions in this area are, as described in the report, more similar to those in Renmore, where the habitats to be lost are located, than the west and south coasts of the Tawin peninsula. This preliminary information is consistent with my own observations of the site, as described in my previous report *(Op. cit.)*.

For these reasons, it is my opinion that the location selected to undertake quantitative surveys is – pending on the result of the initial survey – appropriate to develop the compensation measures.

4.4 Survey methodology

The sampling of intertidal Annex I habitats (Mud and sand flats complex and fucoid-dominated reefs) is based on the use of 0.25m^2 quadrats to determine the species of macroalgae, macrofauna and coverage in each of the three intertidal zones (HW, MW and LW) on the outer north shore. Macrofauna (benthic, bottom dwelling organisms that are retained in a 0.5mm sieve) would be sampled 'when possible' using 1m^2 quadrats and a hand corer with a diameter of 15cm.

Sampling will be carried out at low tide during a Spring tide, at ten transects, where samples will be taken at intervals of 100m. In the lagoon, samples will be taken also at intervals of 100m, in 35 transects. Samples of sediment to determine particle size distribution and organic carbon will also be taken – presumably at the same location of the biological samples – and the depth of the REDOX layer will be measured. Samples will be photographed in situ, and macrofauna within each quadrat will be identified and abundance scored using the SACFOR scale, a unified system for recording the abundance of marine benthic flora and fauna in biological surveys

The proposed methodology for sampling intertidal benthic communities is fit for purpose, and in line with research and regulatory assessments in the EU and worldwide, and should provide sufficient quantitative data for the selection of the compensation site. However, there is lack of clarity regarding the total number of samples to be taken at each transect, and uncertainty on whether the quadrat and hand core samples for macrofauna will be taken, as this would be done 'if possible'. It should be always possible to take hand cores in sand or mud flats. The use of quadrats to excavate for macrofauna is not standard, and I would recommend the use of hand corers instead. Another potential concern is the use of quadrats of 0.25m^2 for sampling macroalgae and macrofauna, instead of quadrats of 1m^2. The 0.25m^2 quadrats may be too small to take representative samples, and that is why quadrats of 1m^2 are commonly used. This is of course subject to the characteristics of the communities to be sampled, and presumably, the details will be discussed during Phase 2, in the light of the results of the quantitative surveys undertaken to select the site. It is of paramount importance that the number of samples and replicates is sufficient to undertake statistical analyses of the data with the necessary level of confidence. This applies to all data for all three habitats, and must be discussed and agreed at the very early stages of Phase 2, since the data should be comparable, and a baseline established for the compensatory habitats and the reference site.

Finally, it is essential that the objectives of all monitoring work are clearly defined before sampling starts. This is, it must be clear which hypotheses will be tested, and which 'questions' is the monitoring work intended to 'answer'. At this stage, the monitoring results will be used to inform the decision on which site to choose for the

implementation of ecological restoration as compensation, but it must be noted that in the next stage, the data will be used to assess the effectiveness and/or success of the mitigation in place.

I note that subtidal benthic populations and sediment particle size distribution within the lagoon will also be sampled, and that a bathymetric survey of the lagoon will be undertaken. Whilst the methods proposed for both surveys are in general appropriate, there is no direct reference to the purpose of these surveys in the report. I understand from the meeting held at the Board's office on the 27th July 2017 (as recorded in the minutes) that the GHC consider that the protection of marine waters within Tawin, which can be defined as a lagoon and therefore qualify as a priority habitat at a later stage, would be considered as an additional benefit.

The survey methods and equipment proposed in the report for subtidal sediment and benthic sampling and bathymetry are explained with good level of detail. These are fit for purpose and of standard use for similar studies. They are also consistent with the available guidance in the EU and common practice for regulatory assessments and monitoring in Ireland and other EU countries, including the UK.

An outline of the surveys to be undertaken on perennial vegetation on stony bank and saltmarsh habitats is presented in Appendix 8. The proposed methodology for these surveys should be appropriate to provide a sufficient amount of quantitative data to detect ecological change, in order to measure the success of the management plan and ultimately, of the compensatory measures.

4.5 Laboratory methodology

Appendix 8 also includes a detailed protocol for the analyses of sediment and benthic samples in the laboratory. This follows standard EU guidance and best practice in benthic laboratories across Europe, and will adhere to the guidance and standards of the Biological Effects Quality Assurance in Monitoring Programmes (BEQUALM)[2] and

[2] http://www.bequalm.org/about.htm

NE Marine Biological Analytical Quality Control Scheme (NMBAQC)[3]. This would ensure the use of the best available standards for excellency in marine biology laboratories.

4.6 Data analyses methodology and proposed table (Annex 7)

A very detailed method for data analysis is provided in Appendix 8. This is based on the calculation of standard ecological indices, such as abundance, number of individuals, number of taxa, and four different indices: Margalef's species richness, Pielou's evenness and Shannon-Wiener's and Simpson's diversity indices. However, they are proposed for the subtidal benthic data only. These are generic and commonly used indices (rarely others are used for regulatory ecological assessments) and I would recommend that they are also used (or some of them, since it's not essential to use them all) for the analyses of all the biological data gathered to support the management programme and measure the success of the compensation scheme.

The use of PRIMER (a software application for undertaking multivariate analyses of numerical data) is also common practice in this type of studies, as the methods proposed in the Annex 8. Ordination (MDS) and hierarchical cluster techniques are also standard for multivariate analyses, though I note that it is proposed to use a specific transformation (in this case fourth root) to normalise the raw data. In general, the transformation required to 'buffer' the weight of the most abundant species in the raw data matrix should be selected only once the data has been obtained, and a good understanding of the magnitude of difference of the more abundant and less abundant taxa achieved. In some cases, a stronger transformation may be required, and in some others, none should be used. These details must also be agreed during Phase 2, to ensure that the results allow for interpretation of ecological change.

5. Conclusions

Based on the information provided to me by the Board and my current understanding of the proposed compensatory measures, it is my considered opinion that these are in line with EU guidance on the application of Article 6 (4) of the Habitats Directive and

[3] http://www.nmbaqcs.org/about/

current practice within the EU. The proposed compensation, based on the ecological restoration of habitats in the Tawin Peninsula, within the boundaries of the SAC has the potential to bring ecological restoration and/or enhancement to habitats very similar to those that have been lost to the development of the GHEP and will be lost to the proposed harbour expansion.

Effective and targeted management of these habitats to improve their condition would lead to an improvement to the function of the SAC as an ecosystem, since it would restore any provision of habitat for biological populations, transfer of energy between different trophic levels, diversity and resilience that would have been lost due to these habitats being in a degraded condition.

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