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License Application for Sustainable hand-harvesting of *Ascophyllum nodosum* at Clew Bay (SAC Site Code 1482). In accordance with National Parks & Wildlife Service conservation objectives for marine and coastal habitats and species and the EU Habitats Directive 92/43/EEC.

Appendix 5:
Impact Assessment of *A. nodosum* harvesting activities on Clew Bay SAC

Prepared by: BioAtlantis Ltd.
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Contents

Introduction

Overview: The section describes the scoring, decisions and results obtained during the hazard analysis of *A. nodosum* harvesting in Clew Bay.

Site Name: Clew Bay Complex (Site Code 1482)

Activity under assessment: Harvesting *A. nodosum* in Clew Bay. Assessor: BioAtlantis Ltd.

Scope of current assessment:

a) Marine & Coastal species & habitats (as protected under Annex I & II of EU Habitats Directive 92/43/EEC).
b) Species & habitats of general interest.
c) *Ascophyllum nodosum* biotope and species therein.
d) Continuous disturbance
e) Broad, holistic examination of the nature, extent and impact of hand harvesting.
f) Existing Operations: potential in-combination effects and interactions.
g) Planned Operations: potential in-combination effects and interactions.
h) Invasive species

NOTE:

- For a summary of the findings of this hazard analysis, please consult Section 3 and Tables 10-16 of the main text document.
- For more detailed analysis of risks associated with protected bird species, please consult Appendix 6.
- For more detailed analysis of risks associated with existing and planned operations, please consult Appendix 7.

Methodology employed:

This system outlined on the following was used in determining which hazard(s) require control measures. Identification of control measures was based on a 5x5 risk analysis matrix. Risk scores are calculated on basis of probability of hazard occurring multiplied by severity by which the respective hazard imposes on the species/habitat under assessment. High risk hazards (i.e. ≥15) automatically require a Natura Impact Statement (NIS). In the event of moderate risks being identified, it was deemed necessary to assess whether or not an NIS was required, through working with independent environmental consultants.

Note: This document has been updated following a public consultation period which took place between December 2014 and January, 2015. This analysis includes additional planned and existing activities in Clew Bay, along with additional mitigation measures where required.

Likelihood of Hazard Occurring:

1. Highly Improbable
2. Probable - annually
3. Infrequent - 2-3 times/year
4. Occasional - monthly
5. Frequent – weekly

Severity of Consequences:

1. Low
2. Low to moderate
3. Moderate
4. Moderate to high
5. High

Risk Rating = Probability x Severity

PROBABILITY	SEVERITY 5	4	3	2	1
5	25	20	15	10	5
4	20	16	12	8	4
3	15	12	9	6	3
2	10	8	6	4	2
1	5	4	3	2	1

Risk Ratings are grouped into three categories

15 – 25: High risk, requiring mitigation measure;
8 - 12: Moderate risk, establish control procedures;
1 - 6: Low risk, establish control measures if appropriate.

Figure 1: Risk Calculation

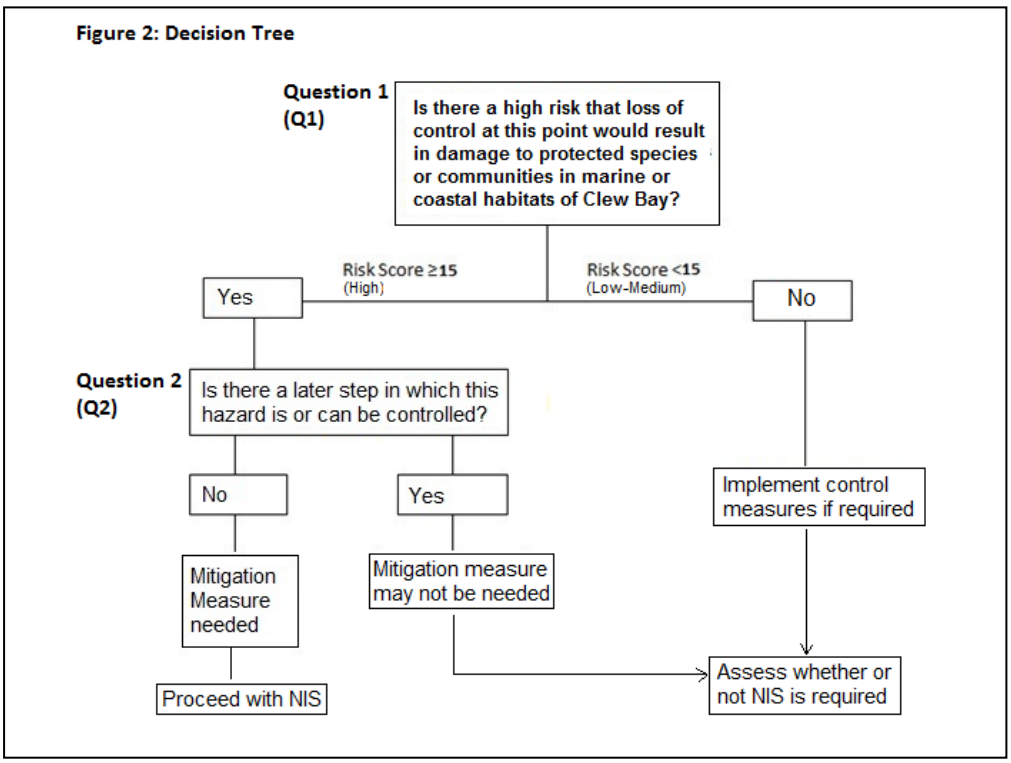

Figure 2 : Decision Tree

Results & Control measures

(a) Marine & Coastal species & habitats (as protected under Annex I & II of EU Habitats Directive 92/43/EEC).

(1) Permanent habitat area

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species	Non-conformance with harvest procedures leading to inadvertent removal of habitats, e.g. excessive removal of sand, shingle, stones, pebbles, rock, debris, holdfasts).	2	5	A	no	n/a	yes	• Harvesters are provided with training, where necessary, to ensure that no removal of permanent habitat occurs, i.e. ➢ No removal of excessive levels of sand, shingle, stone, pebbles, gravel, etc. ➢ No removal of *A. nodosum* holdfasts that could carry sand, shingle, stone, etc. • Resource Manager will inspect the harvest on collection or during the washing bagging operation on the collection boat (if deemed applicable for the area). ➢ If excessive sand, shingle or debris etc is observed, the harvester will be provided with training. • Checks will be recorded on the Goods Received Notes (GRNs, See Appendix 3). • Production Operators will also inspect incoming harvested seaweed on production logsheets. The following will apply: ➢ If excessive levels of sand, shingle or debris is present in harvested weed: -Removal by sand filter and decanter and clarifier. -Harvester provided with training, where necessary ➢ If stones or rocks are present: Harvester provided with training, where necessary. Non-conformance is reported, particularly in the serious event of *A. nodosum* holdfasts being present.	EU Dir. 92/43/ EEC & NPWS Target 1 of Objective 1, NPWS, 2011A, page 12. MSFD targets (2016)

Chemical: Synthetic and naturally occurring substances, cleaning residues, oil/grease, fuel, etc.	Fuel oil leak from harvest recovery/collection boat caused by engine malfunction, fuel line rupture, etc. Non-conformance with procedures for storing and cleaning of boat.	1	5	A	no	n/a	yes	Routine maintenance of boat engine, etc Harvesters provided with training, where necessary, to ensure cleaning takes place in a manner which does not lead to wash off of cleaning agents into the environment, e.g. use of designated washing bays where available.	
Physical: Heat, cold, noise, vibration. mechanical hazards, ionising radiation (e.g. X-rays) and non-ionising radiation (e.g. microwaves), solar radiation. Presence of foreign matter (rubber, plastic, sand, stones, glass, metal, organic material)	Debris from the boat may inadvertently be deposited into the environment	1	3	A	no	n/a	yes	Appropriate removal of rubbish, debris or other foreign matter when at port.	

Hazard	Probability	Severity	Reason for Decision
Biological	**2**		Likelihood of sand and rocks being removed along with harvested *A. nodosum* is low. Given that such materials may damage production equipment and end product, harvesters will be required to ensure such materials are not included in the bags/nets. The collection of bags/nets at high tide or as high tide approaches also reduces the likelihood of excessive levels of sand or other material being removed from the foreshore. In addition, A. nodosum will be harvested no less than 200mm above the holdfast. This reduces the likelihood of holdfasts being removed, which could otherwise, inadvertently lead to removal of attached pebbles or stones (see Appendix 4 for Code of Practise)
		5	In accordance with EU Dir. 92/43/EEC & NPWS, areas must be maintained at favourable conservation conditions to ensure stability of the permanent habitat area (Ref: Target 1 of Obj. 1, NPWS, 2011A). Removal of habitat may contravene this directive (e.g. removal of excessive levels of sand or rock).
Chemical	**1**		It is highly improbable that a chemical hazard will occur given that no chemical wills be carried on board of boats, except for standard cleaning and hygiene equipment.
		3	Severity associated with chemical hazards coming in contact with the permanent habitat of Clew Bay could be significant, particularly to marine life which are sensitive to chemical toxins and could contravene Target 1 of Objective 1, NPWS, 2011A, page 12.
Physical	**1**		It is highly improbable that debris will inadvertently be deposited into the environment, as harvesters will be provided with training, where necessary in general hygiene best practises and means of disposing of general and mechanical waste associated with boats.
		3	Severity associated with physical waste is potentially significant as it could lead to damage to the permanent habitat area.

(2) Zostera Seagrass (and associated communities).

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required. .
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Regulatory Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species (i.e. Zostera Seagrass and associated communities).	Unauthorized harvest in these protected areas.	1	5	A	no	n/a	yes	• Harvest of *A. nodosum* in these areas will not take place.	EU Dir. 92/43/ EEC & NPWS Targets 2-4 of Obj.1, NPWS, 2011A, pg:12,13
Chemical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**1**		It is highly improbable that the distribution, abundance, diversity or area occupied by Zostera Seagrass (and associated communities) will be altered due to harvesting of *A. nodosum* given that: (a) these areas and communities exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) the sandy substrate supporting Zostera growth are insufficient to support *A. nodosum* and thus, will not be affected by harvest activities.
		5	EU Dir. 92/43/EEC & NPWS, requires the maintenance of the natural extent of Zostera Seagrass and associated communities (Ref: Targets 2-4 of Objective 1, NPWS, 2011A, pages 12, 13). Harvest activities in these areas could significantly damage these areas.
Chemical /Physical			n/a
			n/a

(3) Maerl Dominated communities

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species (i.e. Maerl Dominated communities)	Unauthorized harvest in these protected areas.	1	5	A	no	n/a	yes	• Harvest of *A. nodosum* in these areas will not take place.	EU Dir. 92/43/ EEC & NPWS Targets 2-4 of Obj.1, NPWS, 2011A, pg:12,13
Chemical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**1**		It is highly improbable that the distribution, abundance, diversity or area occupied by maerl and associated communities will be altered due to harvesting of *A. nodosum* given that: (a) these areas and communities exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) the coarse, mixed, sandy mud and muddy sand sediment substrates which support maerl growth are insufficient to support *A. nodosum* and thus, will not be targeted for harvest activities.
		5	EU Dir. 92/43/EEC & NPWS, requires the maintenance of the natural extent of maerl and associated communities (Ref: Targets 2-4 of Objective 1, NPWS, 2011A, pages 12, 13). Harvest activities in these areas could significantly damage maerl and associated communities
Chemical /Physical			n/a
			n/a

(4) Polychaetes & bivalves community complex (Intertidal and sub-tidal Sandy mud areas)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species (i.e. Sandy mud with polychaetes & bivalves community complex)	Unauthorized harvest in mudflat/sandflat areas during low tide.	2	5	A	no	n/a	yes	• Ensure implementation of code of practice to ensure that harvesters do not attempt to navigate at low tide to rocky shorelines located beyond mudflats and sandflats (see Appendix 4)	EU Dir. 92/43/ EEC & NPWS Maintain polychaete & bivalve community complex in Sandy mud areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14).
Chemical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**2**		It is unlikely that the distribution, abundance, diversity or area of sandy mud occupied by polychaete & bivalve community complex will be altered due to harvesting of *A. nodosum* given that: (a) the intertidal sandy mud areas containing these communities exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) sandy and muddy areas are insufficient to support growth of *A. nodosum* and thus, will not be targeted for harvest activities. (c) accessing rocky shorelines that lie beyond mudflat/sandflat areas at low tide in particular, is very difficult and would be avoided by harvesters by default.
		5	EU Dir. 92/43/EEC & NPWS, requires the maintenance of the natural extent of polychaete & bivalve community complex in Sandy mud areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14).). Harvest activities in these areas could significantly damage these community complexes.
Chemical /Physical			n/a
			n/a

(5) *Nephtys cirrosa* community (clean, fine sand areas)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species (i.e. Fine sand dominated by *Nephtys cirrosa* community)	Unauthorized harvest in these protected areas during low tide.	2	5	A	no	n/a	yes	• Ensure implementation of Code of Practice to ensure that harvesters do not attempt to navigate at low tide to rocky shorelines located beyond clean, fine sand areas in the south west of the complex (see Appendix 4)	EU Dir. 92/43/ EEC & NPWS Maintain *Nephtys cirrosa* community in fine sand areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14).
Chemical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**2**		The probability of *Nephtys cirrosa* communities and their habitat (clean, fine sand area) being altered due to harvest activities in Clew Bay is relatively low given that: (a) the fine sand areas containing this community exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) fine sand areas are insufficient to support growth of *A. nodosum* and thus, will not be targeted for harvest activities. (c) accessing rocky shorelines that lie beyond clean, fine sand areas at low tide in particular, is very difficult and would be avoided by harvesters by default.
		5	EU Dir. 92/43/EEC & NPWS, requires the maintenance of the natural extent of the *Nephtys cirrosa* community in fine sand areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14). Harvest activities in these areas could significantly damage these community complexes.
Chemical /Physical			n/a
			n/a

(6) *Tubificoides benedii* and *Pygospio elegans* community complex (Intertidal sandy mud areas)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Damage to or removal of habitat required by *Tubificoides benedii* and *Pygospio elegans* communities (i.e. Intertidal sandy mud)	Use of boats to access rocky shorelines which lie beyond mudflats at low tide.	2	5	A	no	n/a	yes	• Ensure implementation of code of practice to ensure that harvesters do not attempt to navigate at low tide to rocky shorelines located beyond mudflat/sandflat areas, within which *Tubificoides benedii* and *Pygospio elegans* reside (see Appendix 4)	EU Dir. 92/43/ EEC & NPWS Maintain *Tubificoides benedii* and *Pygospio elegans* community complex in intertidal sandy mud areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14).
Chemical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		The probability of *Tubificoides benedii* & *Pygospio elegans* species and their habitat (intertidal sandy mud) being altered due to harvest activities in Clew Bay is relatively low given that: (a) *A. nodosum* does not grow on intertidal sandy mud substrate, and therefore will not be subjected to harvest activities. (b) in most areas, intertidal sandy mud areas exhibit little overlap with the rocky shorelines. (c) accessing rocky shorelines that lie beyond intertidal sandy mud areas at low tide in particular, is very difficult and would be avoided by harvesters by default.
		5	EU Dir. 92/43/EEC & NPWS, requires maintenance of *Tubificoides benedii* and *Pygospio elegans* community complex in intertidal sandy mud areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14). Harvest activities in these areas could significantly damage these community complexes and/or their habitat.
Chemical : none identified			n/a
			n/a
Physical:			n/a
			n/a

(7) Shingle (pebbles and gravel)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species (i.e. Shingle (pebbles and gravel)	• Potential removal of small quantities of stones, rocks, etc. • Small, stony, friable substrate occurs frequently in Clew Bay.	2	5	A	no	n/a	yes	A system is in place which ensures that: • Hand harvest techniques employed along shingle areas will ensure that *A. nodosum* is severed above point of contact with underlying substrate. See "Code of Practise" for details (Appendix 4). • Levels of disturbance or displacement that could give rise to presence of shingle, friable substrate and/or associated holdfast material, will be monitored and recorded via 'Goods received Notes' (GRN) and also at production facilities. • Site Inspection Forms will be used to • Sites will be inspected post harvest to check the sustainability of the methods employed and the harvest locations (Site Inspection Form, SIF, Appendix 3).	EU Dir. 92/43/ EEC & NPWS Maintenance of shingle habitats and species therein (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).
Chemical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: Disruption or disturbance of shingle.	• Impact by boats • Disturbance or displacement may occur with inappropriate technique, lack of training or oversight	2	5	A	no	n/a	yes	• A code of practice will be implemented to ensure that harvesters employ good boating practices, particularly when landing on shores (See Appendix 4). • Training provided to harvesters, where necessary, to ensure that reef or shingle is not disturbed or displaced. • Levels of disturbance or displacement that could give rise to presence of such material in the harvested seaweed, will be monitored and recorded via 'Goods received Notes' (GRN) and also at production facilities.	

Hazard	Probability	Severity	Reason for Decision
Biological	**2**		It is unlikely that distribution, abundance, diversity or area of shingle will be altered due to harvesting of *A. nodosum* given that shingle is considered contaminant material and will not be removed during harvest.
		5	EU Dir. 92/43/EEC & NPWS, requires the maintenance of shingle habitats and species therein (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13). Harvest activities in these areas could significantly damage these community complexes.
Chemical /Physical	**2**		It is unlikely that shingle areas will be damaged due to harvesting of *A. nodosum* given that: (a) harvesters will be using small boats to land on islands and coastal areas. Care will be taken in order to ensure that contact with shingle and reef is minimal, therefore avoiding any damage being inflicted on boats. It is unlikely that significant levels of disturbance or displacement of shingle will occur. This is due to the fact that the hand harvest methodology involves working at low tide and harvesters have full view of the cutting process, allowing them to take care not to disturb the substrate.
		5	EU Dir. 92/43/EEC & NPWS, requires the maintenance of shingle habitats and species therein (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13). Harvest activities in these areas could significantly damage these community complexes.

(8) Reef

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).
NOTE: The *A. nodosum* biotope has been assessed in Section C of this Appendix.

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
• Removal of habitat (i.e. reef) • Removal with or without holdfast material	• Potential removal of small quantities of stones, rocks, etc. • Small, stony, friable substrate occurs frequently in Clew Bay.	2	5	A	no	n/a	yes	A system is in place which ensures that: • Hand harvest techniques employed along rocky shores will ensure that *A. nodosum* is severed above point of contact with underlying substrate. See "Code of Practise" for details (Appendix 4). • Levels of disturbance or displacement that could give rise to presence of reef and/or associated holdfast material, will be monitored and recorded via 'Goods received Notes' (GRN) and also at production facilities. • Sites will be inspected post harvest to check the sustainability of the methods employed and the harvest locations (Site Inspection Form, SIF, Appendix 3).	EU Dir. 92/43/ EEC & NPWS Maintenance of reef habitats and species therein (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: Disruption or disturbance of reef.	• Impact by boats • Disturbance or displacement may occur with inappropriate technique, lack of training or oversight	2	5	A	no	n/a	yes	• A code of practice will be implemented to ensure that harvesters employ good boating practices, particularly when landing on shores (See Appendix 4). • Harvesters provided with training, where necessary, to ensure that reef is not disturbed or displaced. • Levels of disturbance or displacement that could give rise to presence of such material in the harvested seaweed, will be monitored and recorded via 'Goods received Notes' (GRN) and also at production facilities.	

Hazard	Probability	Severity	Reason for Decision
Biological	**2**		It is unlikely that distribution, abundance, diversity or area of reef will be altered due to harvesting of *A. nodosum*. While *Ascophyllum nodosum* may be harvested in from rocky shores which contain reef as underlying substrate, the hand harvesting technique used ensures that *A. nodosum* vegetative growth is severed well above the point of contact with reef. Contact with reef would also lead to damage to the harvesters sickle/blade, thus, reef will always be avoided. It is unlikely that significant levels of disturbance or displacement would occur, to levels which would lead to co-removal of reef with or without holdfast material. This is due to the fact that the hand harvest methodology involves working at low tide and harvesters have full view of the cutting process, allowing them to take care not to disturb the substrate.
		5	EU Dir. 92/43/EEC & NPWS, requires the maintenance of reef in a natural condition (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).
Chemical:			
			n/a
Physical:	**2**		It is unlikely that reef will be damaged due to harvesting of *A. nodosum* given that: (a) harvesters will be using small boats to land on islands and coastal areas. Care will be taken in order to ensure that contact with reef is minimal, therefore avoiding any damage being inflicted on boats. (b) The harvest collection boat (if deemed applicable to the area) will be fitted with a depth can device to ensure that contact with the reef is avoided as it will damage both the reef and the boat. It is unlikely that significant levels of disturbance or displacement of reef will occur. This is due to the fact that the hand harvest methodology involves working at low tide and harvesters have full view of the cutting process, allowing them to take care not to disturb the substrate.
		5	EU Dir. 92/43/EEC & NPWS, requires the maintenance of reef in a natural condition (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).

(9) Mudflats and sandflats not covered by seawater at low tide.

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	EU Dir. 92/43/ EEC & NPWS The permanent habitat area is stable or increasing, subject to natural processes (Ref: Target 1 of Objective 2, NPWS, 2011A, page 14).
Chemical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: disruption of intertidal sandy mud.	Use of boat during low tide to access rocky shorelines which lie beyond mudflat or sandflats.	2	5	A	no	n/a	yes	• Ensure implementation of Code of Practice to ensure that harvesters do not attempt to navigate at low tide to rocky shorelines located beyond mudflat/sandflat areas (see Appendix 4)	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological: none identified			n/a
			n/a
Chemical: none identified			n/a
			n/a
Physical: Disruption of intertidal sandy mud.	**2**		The probability of mudflats and sandflats being altered due to harvest activities in Clew Bay is relatively low given that: (a) this substrate is not suitable for *A. nodosum* growth will not be targeted for harvest activities and (b) in most areas, mudflats and sandflats exhibit little overlap with the rocky shorelines. (c) accessing rocky shorelines lie beyond mudflats and sandflats at low tide in particular, is very difficult and would be avoided by harvesters.
		5	EU Dir. 92/43/EEC & NPWS, requires maintenance of *Tubificoides benedii* and *Pygospio elegans* community complex in intertidal sandy mud areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14). Harvest activities in these areas could significantly damage these community complexes and/or their habitat.

(10) Harbour seals: General population.

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Human activities Presence of humans and/or their activities can alter the behaviour of harbour seals (e.g. 'flushing out' and entering the water, man-made energy (Ariel or underwater noise), deterioration of resources such as water quality or food source	Unauthorized presence of harvesters at haul out sites or activities known to cause seals to 'flush out' and enter the water.	2	5	A	no	n/a	yes	BioAtlantis will issue the "Code of Practice" for the Protection of the Harbour Seal (Appendix 4), to ensure that harvesters: • Have full knowledge of the sites in Clew Bay known to be relevant the harbour seal. • Full knowledge of harbour seal sites which have been excluded from this application. • Understand the steps required to ensure that all contact with seals is prevented from day to day. • Understand best practises for dealing with contact with seals should it occur and methods of reporting such incidents should they arise. • In rare cases where contact occurs, harvesting will cease immediately and harvesters will move to new location. • Harvesters follow clearly defined routes according to pre-planned schedules. • Engines will run at a constant rate in areas important to the harbour seal during sensitive times of the year, e.g. haul out sites and not enter within 100m of these sites at sensitive times of the season. • Avoid stalling or slowing down unnecessarily en route to harvest locations or pick up points (pier, etc). See Appendix4 for details of the "BioAtlantis Code of Practice" for the Protection of the Harbour Seal along with site-specific measures and general measures. For details on action limits, analytical procedures monitoring and corrective actions, see Table 10 of main text.	EU Dir. 92/43/ EEC & NPWS Human activities should occur at levels that do not adversely affect the harbour seal population at the site (Ref: Target 5 of Objective 3, NPWS, 2011A, page 16)

Hazard	**Probability**	**Severity**	**Reason for Decision**
Human Activities	**2**		Contact with harbour seals at haul out sites will be minimal as harvest cannot take place at haul out sites during sensitive times of year. Boats will also operate in a manner known to least affect seal behaviour (see Appendix 4 for details).
		5	EU Dir. 92/43/EEC & NPWS, requires that human activities should occur at levels that do not adversely affect the harbour seal population at the Clew Bay site (Ref: Target 5 of Objective 3, NPWS, 2011A, page 16). Seals are very sensitive to the presence of humans and activities in boats, which can lead to alterations in important behavioural activities such as 'flushing out' into water or leaving haul out sites.

(11) Harbour seals: species range

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	EU Dir. 92/43/ EEC & NPWS Species range should not be restricted by artificial barriers to site use (Ref: Target 1 of Objective 3, NPWS, 2011A, page 15).
Chemical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: Restriction of the harbour seal species range.	Presence of artificial barriers.	n/a	5	n/a	n/a	n/a	n/a	Physical barriers which could block access to harbour seals and site of importance to their species will not be installed in Clew Bay.	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:			n/a
			n/a
Chemical:			n/a
			n/a
Physical:	**n/a**		It is highly improbable that hand harvest of *A. nodosum* will restrict or affect the species range of harbour seals in Clew Bay due to the use of artificial physical barriers and no such barriers will be used in operations.
		5	EU Dir. 92/43/EEC & NPWS, requires that human activities should not involve the use of artificial barriers to site use, which could affect the range of the harbour seal species (Ref: Target 1 of Objective 3, NPWS, 2011A, page 15). Restrictions on the range of harbour seals could have significantly negative effects on this protected species which would contravene EU Law.

(12) Harbour seals (Breeding sites)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Presence of humans and/or their activities can alter the behaviour of harbour seals (e.g. 'flushing out' and entering the water).	Unauthorized presence of harvesters in areas important to the harbour seal during breeding (between May-July)	2	5	A	no	n/a	yes	• No harvest at breeding sites between May-July. • Boats operated using methods which have least effects on harbour seals. See "BioAtlantis Code of Practice" for protection of the harbour sea" for details (Appendix 4)	EU Dir. 92/43/ EEC & NPWS Breeding sites should be maintained in a natural condition (Ref: Target 2 of Objective 3, NPWS, 2011A, page 15)
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: Noise	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		As above in table A10 (i.e. Harbour seals: General population.)
		5	EU Dir. 92/43/EEC & NPWS, requires that breeding sites should be maintained in a natural condition (Ref: Target 2 of Objective 3, NPWS, 2011A, page 15). Human contact is a known risk factor which can negatively impact upon harbour seal breeding and activities which take place on thereafter.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(13) Harbour seals (Moulting sites)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Presence of humans and/or their activities can alter the behaviour of harbour seals (e.g. 'flushing out' and enter the water).	Unauthorized presence of harvesters in areas important to the harbour seal during moulting (between Aug-Sept)	2	5	A	no	n/a	yes	• No harvest at moulting sites between Aug-Sept. • Boats operated using methods which have least effects on harbour seals. See "BioAtlantis Code of Practise" for protection of the harbour seal for details (Appendix 4).	EU Dir. 92/43/ EEC & NPWS Moult out sites should be maintained in a natural condition (Ref: Target 3 of Objective 3, NPWS, 2011A, page 15)
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		As above in table A10 (i.e. Harbour seals: General population.)
		5	EU Dir. 92/43/EEC & NPWS, requires that Moult-out sites should be maintained in a natural condition (Ref: Target 3 of Objective 3, NPWS, 2011A, page 15). Human contact is a known risk factor which can negatively impact upon harbour seal behaviour during times of moult.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(14) Harbour seals (Resting sites)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Presence of humans and/or their activities can alter the behaviour of harbour seals (e.g. 'flushing out' and enter the water).	Unauthorized presence of harvesters in areas important to the harbour seal during resting (between Nov-April)	2	5	A	no	n/a	yes	• No harvest at resting sites between Oct-April. • Boats operated using methods which have least effects on harbour seals. See "BioAtlantis Code of Practise" for protection of the harbour seal for details (Appendix 4).	EU Dir. 92/43/ EEC & NPWS Resting Haul-out sites should be maintained in a natural condition (Ref: Target 4 of Objective 3, NPWS, 2011A, page 15)
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		As above in table A10 (i.e. Harbour seals: General population.)
		5	EU Dir. 92/43/EEC & NPWS, requires that Resting Haul-out sites should be maintained in a natural condition (Ref: Target 4 of Objective 3, NPWS, 2011A, page 15). Harbour seal spend much of their time scanning their surrounding area during times of rest. Human contact can have negative impacts upon harbour seal resting behaviour, and can lead to seals leaving the area.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(15) Perennial vegetation of stony banks

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species (i.e. Perennial veg. of stony banks).	Removal of habitat due to harvest and/or storage of material in these areas.	1	5	A	no	n/a	yes	Harvest, storage and transport activities will not take place in these locations. Harvest must occur along rocky shorelines followed by immediate collection and transfer from nets/bags to the boat or towing of nets/bags from harvest sites for pick up via existing pier and road networks. In some cases, certain individuals with existing seaweed harvesting rights may prefer to land seaweed at pick up points.	EU Dir. 92/43/ EEC & NPWS To maintain the favorable conservation condition (ref: Objective 1, NPWS, 2011B, pg. 6).
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: Disruption and damage to vegetation found at or above the mean high water spring tide mark on shingle beaches.	Unauthorized transport in these areas.	1	5	A	no	n/a	yes	• Training: Harvesters provided with training, where necessary, to ensure that all transport activities take place using existing piers and roadways. • Location of harvest and pick-up points will be recorded on GRNs (See Appendix 3). • Inspection of GRNs and Site Inspection Forms (SIFs) by QC at BioAtlantis.	

Hazard	**Prob-ability**	**Severity**	**Reason for Decision**
Biological	**1**		It is highly improbable that Perennial vegetation of stony banks in Clew Bay will be affected due to harvesting of *A. nodosum* given that: (a) piers will be required for upload/pick-up - use of banks for this purpose will not occur, (b) *A. nodosum* does not grow in these locations, and therefore will not be subject to harvest activities, (c) contamination with other materials may result in damage production equipment and end product and (d) harvested weed will not be stored in these locations. This ensures no inadvertent co-removal of protected species such as perennial vegetation.
		5	EU Dir. 92/43/EEC & NPWS, requires that Perennial vegetation of stony banks are maintained in favourable condition (ref: Obj. 1, NPWS, 2011B, pg. 6). Any activities which would lead to removal of biological material could significantly damage these areas and would contravene this directive.
Chemical:			n/a
			n/a
Physical:	**1**		The probability of physically impacting upon Perennial vegetation of stony banks is exceptionally low given that: (a) *A. nodosum* does not grow in these environs and thus will not be subjected to harvest activities and (b) Harvesters provided with training, where necessary, to ensure that all transport activities will take place using established piers and roadways. Transport cannot occur in these areas.
		5	Severity associated with disruption and damage to this environment is potentially significant as it could lead to damage to the permanent habitat area.

(16) Atlantic salt meadows

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species (i.e. Atlantic salt meadows)	Removal of habitat due to harvest and/or storage of material in these areas.	1	5	A	no	n/a	yes	Harvest, storage and transport activities will not occur in these locations. Harvest must occur along rocky shorelines rather than in the areas of mud or sand substrate which is required for Atlantic salt meadow environs & associated species.	EU Dir. 92/43/ EEC & NPWS To restore the favourable conservation condition (ref: Objective 2, NPWS, 2011B, pg. 9)
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: Disruption and damage to stands of vegetation which occur along sheltered coasts.	Unauthorized transport in these areas.	1	5	A	no	n/a	yes	• Training: Harvesters provided with training, where necessary, to ensure that all transport activities take place using existing piers and roadways. • Locations of harvest and pick-up points will recorded on GRNs (See Appendix 3). • Inspection of GRNs by QC personnel at BioAtlantis HQ	

Hazard	**Prob-ability**	**Sever-ity**	**Reason for Decision**
Biological:	**1**		It is highly improbable that Atlantic salt meadows in Clew Bay will be affected due to harvesting of *A. nodosum* given that: (a) established piers will be required for upload/pick-up - use of Atlantic salt meadow areas for this purpose will not occur, (b) *Ascophyllum nodosum* does not grow at high density in these locations, and therefore will not be subject to harvest activities, (c) contamination will other material may result in damage production equipment and end product and (d) harvested weed will not be stored in these locations. This ensures no inadvertent co-removal of protected species characteristic of Atlantic salt meadows.
		5	EU Dir. 92/43/EEC & NPWS, requires that the favourable conservation condition of Atlantic salt meadows be restored (ref: Objective 2, NPWS, 2011B, pg. 9). Any activities which would lead to removal of biological material could significantly damage these areas and would contravene this objective.
Chemical:			n/a
			n/a
Physical:	**1**		It is highly improbable that Atlantic salt meadows in Clew Bay will be altered due harvesting of *A. nodosum* given that: (a) *A. nodosum* does not grow at high density on intertidal sandy mud substrate in these environs and thus will not be subjected to harvest activities and (b) Harvesters provided with training, where necessary, to ensure that all transport activities will take place using established piers and roadways. Transport cannot occur in these areas.
		5	Severity associated with disruption and damage Atlantic Salt meadows is potentially significant as it could lead to damage to the permanent habitat area.

(17) Sand dune habitats

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species (i.e. Sand dune habitats)	Removal of habitat due to harvest and/or storage of material in these areas.	1	5	A	no	n/a	yes	Harvest , storage and transport activities will not occur in these locations. Harvest must occur along rocky followed by immediate collection and transfer from nets/bags to boat or towing of nets/bags from harvest sites to pick up points. In some cases, certain individuals with existing seaweed harvesting rights may prefer to land seaweed at pick up points.	EU Dir. 92/43/ EEC & NPWS To restore the favourable conservation condition. (ref: Objective 3, NPWS, 2011B, pg. 15).
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: Disruption and damage to: Annual vegetation of drift lines along the high tidal mark of Clew Bay. Embryonic shifting dunes above the strandline. Shifting dunes.	Unauthorized transport in these areas.	1	5	A	no	n/a	yes	• Training: Harvesters provided with training, where necessary, to ensure that all transport activities take place using existing piers and roadways. • Location of harvest and pick-up points will be recorded on GRNS (See Appendix 3). • Inspection of GRNs by QC at BioAtlantis.	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**1**		It is highly improbable that sand dune habitats or species therein will be affected due to harvesting of *A. nodosum* given that: (a) Loading and transport activities will occur exclusively using established piers and road networks, (b)*Ascophyllum nodosum* does not grow in these locations, and therefore will not be subject to harvest activities, (c) contamination with other material may result in damage to production equipment/end product and (d) harvested weed will not be stored in these locations. This ensures no inadvertent co-removal of protected species in sand dune habitats.
		5	EU Dir. 92/43/EEC & NPWS, requires the favourable conservation condition of sand dune habitats be restored (ref: Objective 3, NPWS, 2011B, pg. 15). Any activities which would lead to removal of biological material could significantly damage these areas, thus contravening these objectives.
Chemical:			n/a
			n/a
Physical:	**1**		It is highly improbable that sand will be physically damaged due to harvesting of *A. nodosum* given that: (a) *A. nodosum* does not grow on in these environs and thus will not be subjected to harvest activities and (b) harvesters will be provided with training, where necessary, to ensure that all transport activities will take place using established piers and roadways. Transport cannot occur in these areas.
		5	Severity associated with disruption and damage to sand dune habitats is potentially significant as it could lead to damage to the permanent habitat area.

(18) Otter *(Lutra lutra)*

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Negative impacts: • Distribution of positive survey sites • Extent of terrestrial habitat • Extent of marine habitat • Extent of freshwater (river) habitat. • Extent of freshwater (lake/lagoon) habitat. • Number of couching sites and holts • Decline in fish biomass • Increase in barriers to connectivity	• Damage to freshwater habitats • Damage to marine habitats. • Damage to fish resources. • Blocking access to sites	1	5	A	no	n/a	yes	It is highly unlikely that otters will be affected by sustainable *A. nodosum* harvesting. Taking a pre-cautionary approach however, the following measures have added to the Code of Practice and will be implemented to ensure that impacts do not occur, either directly or indirectly. • Always follow pre-planned harvest schedules provided by BioAtlantis. Harvest areas are defined by BioAtlantis. • To avoid or prevent disturbance or interactions with otters, ensure the following: ➢ All activities are maintained within the intertidal *A. nodosum* zone. Avoid all linear habitats located beyond the intertidal zone. ➢ Avoid marine riparian areas beyond the foreshore. Only use existing routes. ➢ Never interfere with couching sites, holts, access paths/routes, that may be present near coastal areas, agricultural fencing, roads, slipways, access points or other areas. ➢ Avoid large trees near coastal areas as they can represent important otter breeding and resting sites. ➢ Avoid undisturbed areas (e.g. impenetrable scrub/reeds) which are refuges for otters. ➢ Do not behave in an obtrusive or noisy manner around otters. ➢ Never interfere with, deliberately approach or disturb otters or their cubs that are resting, sleeping, hunting, feeding or foraging in water or on the shore during the daytime, dawn or dusk. Ensure caution during the periods of breeding, rearing and hibernation. ➢ If migrating/commuting otters are encountered in water, do not obstruct their movement. Slow down the boat and give sufficient space to pass without "boxing" them in, blocking narrow channels or acting as a barrier to commuting or connectivity. ➢ If encountered on the shore, allow otters free access and ample opportunity to escape to the water or land. Do not behave in manner that results in them moving away or fleeing human disturbance. ➢ To prevent in combination effects, adhere to the above measures at all times, particularly when working in areas known to exhibit signs of otter activity. • To prevent impacts on the dietary requirements of otter, the following mitigation measures will apply: ➢ Harvesting must be limited to 20% of the total available *A. nodosum* biomass per site per annum, in order to allow for sufficient regrowth. ➢ Harvesting must not take place in areas outside the *A. nodosum* zone, as these habitats	EU Dir. 92/43/ EEC The Wildlife Acts, 1976 and 2000 (Rep. of Ireland)

Hazard *(What can go wrong)*	Cause *(Why did it go wrong?)*	Risk assessment *P**	*S**	*A/UA*	Decision Tree Q1	Q2	Control Measures? Yes / No	Control Measure *(What can I do about it?)*	Compliance Requirements
								represent the broader habitat range of the otter's prey during adult and early life stages, including: flowing and static freshwater areas (rivers, streams, canals, lakes, reservoirs, ponds), deep water subtidal areas (>30m), shallow subtidal areas (<30m), exposed areas, estuarine mud areas, brackish waters, subtidal gravel/coarse bottom substratum, intertidal soft bottom (sand or mud), lagoons, maerl, rock pools, saltmarsh habitats, seagrass, subtidal soft bottom (sand or mud) and exposed waters in the vicinity of rocky cliffs. ➢ Avoid exposed and non-sheltered areas that represent the otter's broader habitat range, hunting ground and foraging area. ➢ Harvesting cannot occur at the mouth of Lough Furnace or the Burishoole Catchment to ensure that potential impacts on salmon, trout and European Eel. ➢ All freshwater aquatic linear habitat and riparian environments must be avoided at all times including lakes and rivers and other areas (e.g. east side of InishGowla South). ➢ Avoid co-harvesting non-*A. nodosum* material near coastal habitats, near the shoreline or on the shore. Ensure that inadvertent by-catch of other algae, dead/senescing algae, amphipods, isopods or other *Animalia* or material is prevented and minimized. ➢ Do not remove the *A. nodosum* holdfast and take care not to disturb rocky or crevice substratum. See "BioAtlantis Code of Practise" for details (Appendix 4).	
Chemical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none identified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	Probability	Severity	Reason for Decision
Biological:	**1**		Otters are associated with a wide variety of habitats including land habitats, flowing freshwater (i.e. rivers, streams and canals), static freshwater (lakes, reservoirs, ponds), brackish water habitats, estuarine areas, exposed shores, semi-exposed shores, sheltered shores, rocky areas, boggy areas, tidal mudflats, sandflats, lagoons, saltmarsh habitats and sand dune habitats. The distribution of the otter has previously been examined in Clew Bay and surrounding areas. The species is identified as occurring in a range of habitats within the complex. This includes freshwater, marine, aquatic and terrestrial areas, and within both sheltered and exposed coastal locations that extend towards the outer reaches of the bay. In coastal areas of the west of Ireland and Mayo, the otter's diet is highly variable, consisting of a range of fish species, crustaceans and molluscs, amphibians, invertebrates and birds. Given the variable nature of the otter's prey species, the potential impact of sustainable hand harvesting of *A. nodosum* on the otter's dietary requirements is very low. While some components of the otter's prey species can occur within the intertidal zone, they are also known to be associated with a wide range of non- *A. nodosum* habitats during adult and early life stages, including: freshwater areas (rivers, streams, canals, lakes, reservoirs, ponds), deep water marine areas (>30m), shallow subtidal water marine areas (<30m), exposed areas, estuarine mud areas, brackish waters, subtidal gravel/coarse bottom substratum, intertidal soft bottom, lagoons, maerl, rock pools, saltmarsh, seagrass, subtidal soft bottom and exposed waters in the vicinity of rocky cliffs. The spatial overlap between these habitats and *A. nodosum* harvesting is extremely low and in many cases is absent. Therefore, it is highly unlikely that the dietary requirements of otter will be affected by

			sustainable *A. nodosum* harvesting. Kelly et al., (2001), indicate that hand harvesting is not associated with reductions in fish numbers within the *A. nodosum* biotope. In terms of potential direct effects on otters, recent assessments indicate that there are no significant relationships between the percentage occurrence of otters and human disturbance in SACs in Ireland (Bailey and Rochford 2006). Moreover, there are no differences in the occurrence of otters between sites within and outside of SACs. Hand harvesting of *A. nodosum* will occur in the intertidal zone with no activities in freshwater habitats. Hand harvesters will not engage in activities which would block sites of relevance to otters, including holt sites. There will be no barriers to block access to otters to and from and between sites. Based on the information above, it is concluded that it is highly unlikely that the otter's food supply will be affected due to sustainable *A. nodosum* harvesting activities.
		5	Otters are listed as a protected species under EU directives. Any activities which would negatively impact and contribute to the decline of this species would be severe. Otters are deemed to be in decline in many parts of Europe with risks including roads, fishing nets and lobster pots (NPWS 2007). Organochlorine pesticides are widely accepted as having severely reduced otter population sizes in the UK (Jones and Jones, 2002).
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(19) Birds

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Y/N		
Biological: Negative impacts on habitats relevant to species of bird and their behaviour	This may occur due to: • Excess removal of *A. nodosum* habitat, which constitutes part of the wider feeding, requirements of some bird species in Clew Bay. • Potential impact on algae as secondary food source (ref: NPWS 2013). • Human disturbance at nesting colonies can lead to abandonment of nest or chicks. • Human presence may lead to trampling of nests. • Disturbance leading to flight events.	1	5	A	no	n/a	yes	BioAtlantis will manage harvesting in a sustainable manner to ensure that excessive removal of *A. nodosum* does not occur and is limited to 20% of the total available biomass per site per annum (see Table C1a, "*A. nodosum*", for details). Harvest at sites established by NPWS as important to important wintering and breeding species (data obtained from NPWS, pers. comm. 03/12/2013) will not be harvested at sensitive times of year (see Appendix 6). See "BioAtlantis Code of Practise" for protection of bird species for more details (Appendix 4).	Annex I of the E.U Birds Directive
Chemical:none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**1**		Contact with breeding and wintering birds at sites specified by NPWS (pers. comm. 03/12/2013) will be minimal. Harvest cannot take place at these sites during sensitive times of year. See Appendix 6 for detailed description of the distribution, requirements and control measures for avian species of interest in Clew Bay. See Appendix 4 for Code of Practice. There is no evidence for strong bottom-up forcing of *A. nodosum* harvesting on birds' site visitation (Johnston, Elliot M., *et al.* 2024. Estuarine, Coastal and Shelf Science).
		5	Protected species listed on Annex I of the E.U Birds Dir. include: Common Tern, Arctic Tern, Little Tern, Barnacle Goose, Great Northern Diver, Bar tailed Godwit. Activities which would negatively impact on these species would be severe and contravene EU regulations. Other species reaching important numbers in Clew Bay: Red-breasted Merganser, Ringed Plover, Barnacle Geese (present on islands in winter), Great Northern Diver, Brent Goose, Shelduck, Wigeon, Teal, Mallard, Oystercatcher, Cormorant, Dunlin, Bar-tailed Godwit, Curlew, Redshank, Greenshank and Turnstone.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(b) Species & habitats of general interest.

(1) Fish

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of zones important for feeding, reproduction and/or sheltering of fish species such as trout and salmon.	Excess removal of habitat in the form of *A. nodosum* due to mismanagement and overharvesting of resources.	1	2	A	no	n/a	yes	• BioAtlantis Ltd. will manage harvesting activities in a sustainable manner to ensure that excessive removal of *A. nodosum* does not occur and is limited to 20% of the total available biomass per site per annum (see Table C1a, "*A. nodosum*", in the next section for details). In addition, no activities will take place in important areas of the Burrishoole catchment such as Lough Feeagh & Lough Furnace, thus preventing any impact during important life-cycle stages. • Ensure that the space of recreational/shore anglers is respected at all times, particularly when competitions and festivals are taking place, particularly during summer in areas including the following: Mallaranny Strand, Curraun, Lough Furnace Newport pier, Newport Quay, Rossnakilly, Rossnakilly, Ross, Rossanrubble, Altapheebera and Whiteheather. • Ensure that the space of fishermen and sea anglers is respected at all times. • Keep distance and do not interfere with licensed salmon draft fishermen who may cut back seaweed when using their nets. • Ensure that seaweed harvesting only takes place in the intertidal *A. nodosum* zone and not in subtidal areas of relevance to fisheries activities such as potting (Lobster, crab, shrimp, whelk and nephrops), dredging (e.g. scallop, native oyster, cockle), trammel net fishing for bait, otter trawl, tangle net (crayfish), gillnet, Mid-water trawl. Activities in subtidal waters that are permitted include site visits, collection of harvested seaweed, transport and transfer to pick up points. • Avoid interactions with non-*A. nodosum* habitats which represent the broader habitat range of fish, shellfish, invertebrates and fisheries species during adult and early-life stages, including: deep water areas, seagrass, estuarine mud areas, saltmarsh, lagoons, maerl, subtidal gravel/coarse bottom, subtidal soft bottom areas, intertidal soft bottom areas & exposed shores. • Avoid soft substratum areas where bait digging for ragworm and lugworm is observed to be taking place.	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Prob-ability**	**Severity**	**Reason for Decision**

<table>
<tr><td>Biological</td><td>1</td><td></td><td>In the absence of appropriate systems of management, monitoring and verification, there is increased likelihood of excess removal of A. nodosum which in turn, may impact upon species of fish who use these zones for feeding, reproduction and/or sheltering. However, it is highly improbable that fish numbers will be affected by harvest activities in Clew Bay given that:
(a) Harvest of A. nodosum will be undertaken sustainably and will not exceed 20% of the total available biomass per site per annum thus ensuring maintenance of the A. nodosum habitat.
(b) Important catchment areas such as Burrishoole will be excluded from all harvest-related activities.
(c) Studies indicate that hand harvest of A. nodosum does not significantly effect fish and large mobile epifauna (Kelly et al., 2001).
It is highly improbable that fish numbers will be affected by harvest activities in Clew Bay given that the spatial overlap between A. nodosum harvesting and fisheries activities is relatively low and absent in many cases (see below):
<table>
<tr><th>Type</th><th>Description/extent/location of fisheries activity</th></tr>
<tr><td>Potting for shrimp</td><td>Mainly located along the outer reaches of the complex (overlap with BioAtlantis’ proposed license area is low).</td></tr>
<tr><td>Potting for prawns</td><td>Mainly located along the outer reaches of the complex (overlap with BioAtlantis’ proposed license area is low).</td></tr>
<tr><td>Potting (crab, lobster)</td><td>Mainly located along the outer reaches of the complex (overlap with BioAtlantis’ proposed license area is low).</td></tr>
<tr><td>Potting for whelk</td><td>In 2013, a new pot fishery for whelk began (2 vessels; 400 pots each) in an area from Newport River Estuary to deeper waters and on subtidal habitats. It is unclear if this fishery is still in operation.</td></tr>
<tr><td>Tangle netting for crayfish</td><td>Mainly located along the outer reaches of the complex (overlap with BioAtlantis’ proposed license area is low).</td></tr>
<tr><td>Gill netting (pollack) and other netting</td><td>Mainly located along the outer reaches of the complex (overlap with BioAtlantis’ proposed license area is low).</td></tr>
<tr><td>Dredging for scallop</td><td>Scallop occurs in subtidal waters of 10-20m in depth on gravel/cobble substrates, within the inner reaches of the complex and beyond the SAC.</td></tr>
<tr><td>Dredging for oyster</td><td>Oysters are fished from <10m vessels using fixed toothed dredges.</td></tr>
<tr><td>Bottom trawling for mixed demersal fish</td><td>Outside license area (no overlap with BioAtlantis’ proposed license area).</td></tr>
<tr><td>Mid-water trawling for pelagic fish</td><td>Outside license area (no overlap with BioAtlantis’ proposed license area).</td></tr>
<tr><td>Hook and line fishing (mackerel, pollack)</td><td>This fishery uses trolling and bottom set lines operated in a mechanized and manual manner (approx. 16 vessels use trolling/jigging gears).</td></tr>
<tr><td>Draft net fishing for salmon</td><td>Newport river estuary and Bunowen River.</td></tr>
<tr><td>Trammel net fishing for bait</td><td>Mainly located along the outer reaches of the complex (overlap with BioAtlantis’ proposed license area is low).</td></tr>
<tr><td>Hand gathering of periwinkle and cockle</td><td>Periwinkle fishing takes place in the inner reaches of Clew Bay on semi exposed shores on the mainland and on islands. Cockles are abundant east of Mullranny on intertidal muddy sand shores and are hand gathered.</td></tr>
</table>
Sustainable harvesting is unlikely to impact on commercial fisheries species (fish, crustaceans and shellfish), their distribution, spawning areas, nursery areas and food sources (See Appendix 9 & 10).</td></tr>
<tr><td></td><td></td><td>2</td><td>While there are no conservation requirements for fish or fisheries species in the Clew Bay complex, the Burrishoole Catchment area of Clew Bay represents an important habitat for migratory fish species such as trout and salmon, and is regarded as a major European and world index site. Post</td></tr>
</table>

			smolt and adult sea trout feed within the Clew bay area and along with some other fish species, may use *A. nodosum* zones to a certain extent for purposes which include feeding, reproduction or sheltering (Kelly et al., 2001 and references therein).
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(2) Lough Furnace

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Damage to a rare example of a permanently stratified lake environment.	Human activities in this area may damage this environment.	1	4	A	no	n/a	yes	Not applicable, as this area and its associated lakes will be completely excluded from all harvest activities.	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**1**		It is highly improbable that this environment and it's associated species will be affected by activities due to hand harvesting, as these areas are excluded from the current application.
		4	Lough Furnace represents a rare deep, permanently stratified saline lake lagoon, located at the north-eastern corner of Clew Bay. Species on its exterior include: Common Reed *(Phragmites australis)*, Common Club-rush *(Scirpuslacustris)*, small patches of Great Fen-sedge *(Cladium mariscus)* and Bottle Sedge *(Carex rostrata)*. Other important flora and fauna within this environment includes: two rare amphipods *(Lembos longipes* and *Leptocheirus pilosus)*, *Neomysis integer*, *Jaera albifrons*, *J.ischiosetosa* and *J. nordmanni*, Irish species of tasselweed *(Ruppia maritima* and *R. cirrhosa)*, eel, flounder, mullet, mallard nest and black-headed Gull. As this habitat is so rare, the potential impact of human activities on these environs and associated species are given a severity score of 4.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(3) The Rossmurrevagh area

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Removal of habitat of rare & endangered species	Removal of habitat due to harvest and storage of material.	1	5	A	no	n/a	yes	Harvest and storage activities will not occur in these locations. Harvest must occur along rocky shorelines followed by immediate collection and transfer from nets/bags to boat or towing of nets/bags from harvest sites to pick up points. In some cases, certain individuals with existing seaweed harvesting rights may prefer to land seaweed at pick up points.	none
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: Disruption and damage to diverse environs.	Unauthorized transport in these areas.	1	5	A	no	n/a	yes	• Training: Harvesters provided with training, where necessary, to ensure that all transport activities take place using existing piers and roadways. • Location of harvest and pick-up points will recorded on GRNs (see Appendix 3). • Inspection of GRNs by QC personnel at BioAtlantis HQ	

Hazard	**Prob-ability**	**Severity**	**Reason for Decision**
Biological	**1**		It is highly improbable that the Rossmurrevagh area and it's associated species will be affected by activities due to hand harvesting given that: (a) *A. nodosum* does not grow in these locations, and therefore will not be subject to harvest activities, (b) Contamination with other material may damage production equipment and end product, (c) Harvested weed will not be stored in these locations. This ensures no inadvertent co-removal of protected species in the Rosmurrevagh area.
		5	The Rossmurrevagh area includes a diverse range of habitats along the seashore, dunes, coastal grassland, saltmarsh, bog and fen. This includes: • Bog/fen type vegetation: Bog Asphodel and Cuckooflower *(Cardamine pratensis)*, Bog Mosses, sedges, Bog-myrtle *(Myrica gale)*, Irish Heath, Soft Rush *(Juncus effusus)*, Water Mint *(Mentha aquatica)* andYellow Iris *(Iris pseudacorus)*. • Coastal grassland species: Common Ragwort *(Senecio jacobaea)*, Daisy *(Bellis perennis)*, Dandelion *(Taraxacum officinale)*, Heath Wood-rush *(Luzula multiflora)*, Ribwort Plantain *(Plantago lanceolata)* and Yarrow *(Achillea millefolium)*. • Saltmarsh vegetation (5 m wide): Common Saltmarsh-grass *(Puccinellia maritima)*, Common Scurvygrass, Thrift & 'turf fucoids'. A number of species and locations within Rossmurrevagh are protected (e.g. dunes) and therefore, a severity score of 5 has been assigned.
Chemical:			n/a
			n/a
Physical:	**1**		Low probability of physical damage as harvesters will be provided with training, where necessary, to ensure that all transport activities will take place using established piers and roadways. Transport cannot occur in these areas.
		5	Disruption and damage to the physical environs of this region may negatively impact upon biodiversity in the area. As certain aspects to this are protected under EU Law (e.g. dunes), a severity score of 5 has been assigned to potential hazards to the biology of this area.

(c) Ascophyllum nodosum biotope and species therein.

(1a) *A. nodosum* seaweed.

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*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Y/N		
Biological: Excess removal of *A. nodosum* habitat. • Removal of holdfast material and potential *A. nodosum* mortality. • Canopy is cut too short	Mismanagement and/or lack of oversight of activities relating to hand harvest of *A. nodosum*. • Inappropriate technique • Lack of training • Lack of oversight	2	5	A	no	n/a	yes	BioAtlantis will manage harvesting in a sustainable manner to ensure that excessive removal of *A. nodosum* does not occur and is limited to 20% of the total available biomass/site/annum. The technique will involve cutting no less than 200mm above the holdfast. Important components of the management system include: • **A system is in place which ensures:** ➢ Training harvesters to cut between 200-300mm (8-12 inches) above the holdfast, this ensuring sufficient canopy coverage. Sites will be inspected post harvest to check the sustainability of the methods employed and the harvest locations (SIF, Appendix 3). ➢ Training of harvesters to ensure holdfast is not removed. ➢ Check for the presence of holdfast via GRN and quality checks in production facilities. ➢ Sites are inspected post harvest to check the sustainability of the methods employed and the harvest locations (Site Inspection Form, SIF, Appendix 3). • **Training:** Harvesters will be provided with training, where necessary, to ensure competence in skills required to harvest *A. nodosum* in an environmentally friendly and sustainable manner. • **Protocols and schedules:** Activities carried out according to clearly defined protocols to ensure that (a) no damage to the environment or underlying growth substrate, and (b) re-growth and re-generation of the vegetation post-harvest is sufficiently facilitated. Standard protocols and methods will include: ➢ Site determination: identification of areas suitable for harvest, e.g. areas predominated by short *A. nodosum* fronds will not be harvested. ➢ Harvest Methods: Use of sickle/knife to cut 200-300mm above frond base, without damaging holdfast or underlying substrate. ➢ Method for bagging of cut weed, communicating with HQ, Incident reporting **Responsibility:** Oversight, planning and teaching provided by BioAtlantis staff along with regularly auditing to assess for compliance with procedures and for potential areas of improvement.	None specified by NPWS or EU regulations. However, *A. nodosum* grows intertidally on reef substrate.

Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	Probability	Severity	Reason for Decision
Biological:	**2**		In the absence of oversight, the probability of excessive removal of *A. nodosum* habitat may occur. This was particularly evident in a recent survey of Clew Bay during which an area previously characterised as having high density levels of *A. nodosum*, was found to have less cover than expected (see Appendix 1). The sites were characterised by an abundance of *A. nodosum* 'stumps', and evidence of two different types of harvest recent activities in the area was present. Moreover, *Fucus* sp. levels were notably dense within the *A. nodosum* zone, which may be consistent with studies by Kelly et al., (2001) and others which show that *Fucus* sp. coverage can increase as a result of hand harvesting of *A. nodosum*. To ensure that excessive removal of *A. nodosum* does not occur in Clew Bay, BioAtlantis will put a system in place which ensures that harvest activities are monitored, recorded, controlled and limited to 20% of the total available biomass per site per annum. This level of regulation is in keeping with the GMP+ Certification status of BioAtlantis, Ltd. and thus will ensure that the probability of over-harvesting of *A. nodosum* resources in Clew Bay is lowered. It is unlikely that significant levels of *A. nodosum* mortality will arise as harvesters will work when the tide is out, thereby having full view of the harvesting process and actively working to ensure that holdfast removal does not occur. This process also requires harvesters to target cutting between 200-300mm (8-12 inches) above the holdfast.
		5	Unregulated over-harvesting and inappropriate harvest methodologies could increase *A. nodosum* mortality to levels beyond background levels. Significant levels of *A. nodosum* mortality are unlikely to acceptable in an SAC such as Clew Bay.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(1b) *Fucus* (*Fucus vesiculosis Linnaeus* and *Fucus serratus Linneaus*)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of *Fucus*	Overharvesting of *A. nodosum* and/or inadvertent harvest of nearby species of *Fucus*.	2	3	A	no	n/a	yes	As above in Section C1a (*A. nodosum*).	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		Increases in the density of *Fucus* species may occur due to hand harvesting of *A. nodosum* (Kelly et al., 2001). Indeed, a recent survey of Clew Bay found substantial evidence for high *Fucus* densities in areas found to have been subjected to recent harvest activities (See Appendix 1). However, the probability of inadvertent harvest of these fucoid species is low, given that: Harvest will be limited to larger vegetative growth of *A. nodosum* fronds, approx. 200-300mm above the base. *Fucus* is considered a contaminant and will be recorded as such in the GRN.
		3	As these species are not protected under EU regulations the severity associated overharvesting of *A. nodosum* or inadvertent harvest of these species is reduced to reside within the range of 1-4. However, a severity score of 3 was assigned given the important role of these species within the *A. nodosum* canopy and their presence in the Clew Bay complex (Kelly et al., 2001). A higher score of 4-5 is unjustified. This is due to the fact that overharvesting of *A. nodosum* is not detrimental to these species. In fact, harvest of *A. nodosum* has been found to be associated with increased cover of *Fucus vesiculosis* in the Clew Bay region (Kelly et al., 2001).
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(2a): Red algae *(e.g. Polysiphonia lanosa (Linnaeus) Tandy)*

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Role of *Polysiphonia lanosa (Linnaeus)* Tandy within the *A. nodosum* canopy:
In brief, *Polysiphonia lanosa (Linnaeus)* Tandy is a hemiparasitic species, predominantly using *Ascophyllum nodosum* as a host and more rarely, *Fucus vesiculosis* (Guiry, M.D. & Guiry, G.M. 2013). This species is present throughout the north Atlantic in areas occupied by *A. nodosum* including Clew Bay SAC (Kelly et al., 2001).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of habitat important to epiphytes of *A. nodosum*, e.g. red algae, *Polysiphonia lanosa (Linnaeus) Tandy*	Overharvesting of *A. nodosum*	2	2	A	no	n/a	yes	As above in Table C1a (*A. nodosum*).	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		As above in Section C1a (*A. nodosum*).
		2	As these species are not protected under EU regulations the severity associated overharvesting of *A. nodosum* is reduced to reside within the range of 1-4. However, a low-moderate severity score of 2 was assigned given the role of these species within the *A. nodosum* canopy and their presence in the Clew Bay complex (Kelly et al., 2001; see below for details). A higher score of 3-5 is unjustified. This is due to the fact that spores from these species are highly successful in colonizing *A. nodosum*, and given the sustainable nature of the harvest system, effects are unlikely to be detrimental to the population. In addition, a recent survey of Clew Bay found this species to be relatively well represented in the *A. nodosum* biotope, occurring in 5 out of 8 $1m^2$ quadrants which were assessed (See Appendix 1). As spores from this species will continue to be released from unharvested areas, the settlement and survival of *P. lanosa* on *A. nodosum* will continue.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(2b): Red algae *(e.g. Mastocarpus stellatus (Stackhouse) Guiry)*

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of Red algae *Mastocarpus stellatus (Stackhouse) Guiry*, *Chondrus crispus Stackhouse* and *Corallinaceae*	Overharvesting of *A. nodosum*	1	2	A	no	n/a	yes	As above in Section C1a (*A. nodosum*).	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**1**		It is highly improbable that Red algae, *Mastocarpus stellatus (Stackhouse) Guiry*, *Chondrus crispus Stackhouse* will be altered due harvesting of *A. nodosum* given that: (a) The rare occurrence of these species within the *A. nodosum* canopy. (b) Harvest of *A. nodosum* will be limited to larger vegetative growth of *A. nodosum* fronds, approx. 200-300mm above the base, generally above the contact level with these species.
		2	As these species are not protected under EU regulations the severity associated overharvesting of *A. nodosum* is reduced to reside within the range of 1-4. A low severity score of 2 was assigned in the scenario of over-harvesting of *A. nodosum*. A higher score of 3-5 is unjustified as Red algae *Mastocarpus stellatus (Stackhouse) Guiry, Chondrus crispus Stackhouse* and *Corallinaceae* growth are not known to be affected by *A. nodosum* harvesting.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(2c): Ephemeral green algae

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of Ephemeral green algae (e.g. *Cladophora rupestris (Linnaeus) Kützing*, *Ulva sp. Linnaeus* and *Enteromorpha sp. Link;*	Overharvesting of *A. nodosum*	1	3	A	no	n/a	yes	As above in Section C1a (*A. nodosum*).	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**1**		It is highly improbable that ephemeral green algae will be altered due harvesting of *A. nodosum* given the findings of Kelly et al., 2001, in which hand harvesting has no significant impact on ephemeral green algae over time. Also, species besides *A. nodosum* are considered as contaminants and will be recorded as such in the GRN.
		3	As these species are not protected under EU regulations the severity associated with overharvesting of *A. nodosum* is reduced to reside within the range of 1-4. A moderate severity score of 3 was assigned given the important role of Ephemeral green algae in this zone. While occurring at low densities in *A. nodosum* biotope, alterations to ephemeral algae may lead to further alterations in herbivorous littorinid fauna (Kelly et al., 2011 and references therein). In turn, this has potential to decrease re-establishment of the fucoid canopies at the germling stage. However, vegetative reproduction rather than sexual reproduction is considered the most important mechanism in which the density of the *A. nodosum* population is maintained, most notably by generating shoot growth and subsequent increases in biomass for years thereafter.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(2d): Other seaweed species

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).
Role of *Lomentaria articulata (Hudson) Lyngbye* and *Membranoptera alata (Hudson) Stackhouse*, within the *A. nodosum* biotope:
Can occur on rocks and stones in pools, lower intertidal and subtidal (Guiry, M.D. & Guiry, G.M. 2013).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of other seaweed species: *Lomentaria articulata (Hudson) Lyngbye* and *Membranoptera alata (Hudson) Stackhouse*,	Overharvesting of *A. nodosum* and/or inadvertent harvest of nearby species of *Lomentaria articulata (Hudson) Lyngbye* and *Membranoptera alata (Hudson) Stackhouse*,	1	2	A	no	n/a	yes	As above in Section C1a (*A. nodosum*).	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**1**		It is highly improbable that these species of seaweed will be altered due harvesting of *A. nodosum* given that: (a) Kelly et al., 2001, demonstrates an absence of *Lomentaria articulata (Hudson) Lyngbye* and *Membranoptera alata (Hudson) Stackhouse* in Clew Bay despite being present at low numbers on Connemara. (b) The frond length of these species generally does not exceed 200 mm and harvest will be limited to larger vegetative growth of *A. nodosum* fronds, approx. 200-300mm above the base. (c) Species besides *A. nodosum* are considered as contaminants and will be recorded as such in the GRN.
		2	As these species are not protected under EU regulations the severity associated overharvesting of *A. nodosum* or inadvertent harvest of these species, is reduced to reside within the range of 1-4.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(3a): Periwinkles

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of winkles or removal of habitat important to periwinkles.	• Overharvesting of *A. nodosum* • Inappropriate technique • Lack of training	3	3	A	no	n/a	yes	• **As above in Section C1a (*A. nodosum*).** • **Additionally:** ➢ Reproduction: Harvesters will be provided with training, where necessary, to identify and avoid *A. nodosum* plants or fronds which contain visible *L. obtusata* eggs masses. ➢ Canopy damage: Harvesters will learn to avoid periwinkle disturbance by (a) cutting at low tide, (b) aiming to leave between 200-300mm (8-12 inches) of material behind, (c) under no circumstances cutting less than 200mm above the holdfast, (d) avoiding holdfast removal. ➢ Other habitats: Harvesters provided with training, where necessary, to avoid *Fucus vesiculosis* and *F. serratus*, which are additional habitats for periwinkles. ➢ By-catch: any *Animalia* by-catch observed post-harvest must be returned to the water, where possible.	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**3**		**Removal of habitat:** As outlined in Section C1a above, there is low risk of excess removal of *A. nodosum* through hand harvesting. In addition, while Kelly et al (2001) show that reductions in number were observed in winter months, harvesting did not have an impact on the size distribution of *Littorina obtusata* at Clew Bay. However, positive correlations between *A. nodosum* density and winkles numbers were identified in the survey prepared in this application Clew Bay (Appendix 1). Therefore, there is potential for alterations in winkle numbers should overharvesting occur. The risk however, is reduced as the harvesting system does not allow for overharvesting.

			Non-targeted removal: *Littorina obtusata* tends to feed at high tide. At low tide, *L. obtusata* crawls into the algae canopy and remains dormant unless conditions are favourable, such as dampness, etc. *Littorina littorea* actively feeds at high tide, seeking shelter within the canopy at low tide. The technique employed by BioAtlantis ensure that harvest takes place at low tide when periwinkles are more likely to be dormant or covered by *A. nodosum* fronds. Harvest will not take place during the feeding stage at high tide when periwinkles are out of their shells. Hence, the probability of removal of periwinkles as non-target species is reduced considerably. **Reproduction:** *L. obtusata* lays white, oval eggs masses contain a large number of eggs, on Ascophyllum, *Fucus vesiculosis* and *F. serratus*. The eggs masses are clearly visible to the naked eye. Hand harvesting could lead to reductions in eggs numbers by removing frond containing egg masses. In the case of *L. Littorina*, eggs are released with the tide. Following development from a free-living form, *L. Littorina* settles at the base of the *A. nodosum* canopy. Severe reductions in canopy could affect settlement of free-living form, *L. Littorina*. The risk for negatively affecting reproductive requirements is reduced as the harvesting system requires avoidance of egg masses and ensure that overharvesting of the canopy does not occur.
		3	As these species are not specifically protected under EU regulations the severity associated overharvesting of *A. nodosum* is reduced to reside within the range of 1-4. However, a moderate severity score of 3 was assigned given the important position of winkles in the *A. nodosum* biotope and the apparent seasonal reductions of *Littorina obtusata* observed by Kelly et al., 2001. A higher severity score of 4-5 would be unjustified. This is due to the fact that that winkles also reside within other fucoid biotopes such as *Fucus vesiculosis*, and thus, the hazard of overharvesting of *A. nodosum* would not represent a detrimental threat to these populations.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(3b): Limpets

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of limpets and/or habitat important to limpets.	Overharvesting of *A. nodosum*	3	3	A	no	n/a	yes	As above in Section C1a (*A. nodosum*). Additionally: ➢ Canopy damage: Harvesters will learn to avoid limpet disturbance by (a) cutting at low tide, (b) aiming to leave between 200-300mm (8-12 inches) of material behind (c) under no circumstances cutting less than 200mm above the holdfast. (d) avoiding holdfast removal ➢ By-catch observed post-harvest must be returned to the water, where possible.	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**3**		As outlined Section C1a above, there is low likelihood of excess removal of *A. nodosum* through hand harvesting. As Kelly et al., (2001) demonstrate that hand harvesting of *A. nodosum* can be associated with increases and decreases in limpet density and size, a probability rating of 3 has been assigned for this potential hazard. While not statistically significant, a recent survey of Clew Bay (Appendix 1) also found a trend towards a positive correlation between *A. nodosum* density and limpet numbers (p=0.084). Therefore, there is likely to be some potential for alterations in winkle numbers should overharvesting occur.
		3	As these species are not protected under EU regulations the severity associated overharvesting of *A. nodosum* is reduced to reside within the range of 1-4. However, a moderate severity score of 3 was assigned given the important role of these species within the *A. nodosum* canopy and their presence in the Clew Bay complex (Kelly et al., 2001; see below for details). A higher score of 4-5 is unjustified. This is due to the fact that that these species also reside within other fucoid biotopes such as *Fucus vesiculosis*, and thus, the hazard of overharvesting of *A. nodosum* would not represent a detrimental threat to these species.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(3c): Barnacles

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of barnacles or habitat important to Barnacles	Overharvesting of *A. nodosum*	3	2	A	no	n/a	yes	As above in Section C1a (*A. nodosum*).	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**3**		Boaden and Dring, 1980 reported a reduction in barnacle numbers due to *A. nodosum* harvest when *A. nodosum* was cut at low levels between 10-15cm (4-6 inches) above the holdfast. These effects were not reported by Kelly et al., 2001. As outlined Section C1a above, there is a low likelihood of excess removal of *A. nodosum* through hand harvesting. This reduces the potential for negative effects on barnacle numbers.
		2	As these species are not protected under EU regulations the severity associated overharvesting of *A. nodosum* is reduced to reside within the range of 1-4. However, a low-moderate severity score of 2 was assigned as these species are widespread on rock substrate in the intertidal zone. A higher score of 3-5 is unjustified as these species also reside within other fucoid biotopes such as *Fucus vesiculosis*, and thus, the hazard of overharvesting of *A. nodosum* would not represent a detrimental threat to these populations.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(3d): Hydroid

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of Hydroid *(Dynamena pumila Linnaeus)* or habitat important to these species.	Overharvesting of *A. nodosum*	3	2	A	no	n/a	yes	As above in Section C1a (*A. nodosum*).	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**3**		As outlined Section C1a above, there is a low likelihood of excess removal of *A. nodosum* through hand harvesting. There is no evidence from the study by Kelly et al., (2001) that hand harvesting of *A. nodosum* in Clew bay is associated with alterations to density of hydroid species. However, their presence on the tips of *A. nodosum* increases the probability of altering their density.
		2	As these species are not protected under EU regulations the severity associated overharvesting of *A. nodosum* is reduced to reside within the range of 1-4. A low-moderate severity score of 2 was assigned given their presence and potential growth on tips of *A. nodosum* (Kelly et al., 2001; see below for details). A higher score of 3-5 is unjustified as Dynamena pumila Linnaeus species typically grows on other fucoid biotopes such as *Fucus serratus*. Hence , the overharvesting of *A. nodosum* should it occur, would not represent a detrimental threat to these populations.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(3e): Sponges

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of Sponges *(e.g., Leucosolenia sp. Bowerbank, Halichondria panicea Pallas* and *Hymeniacidon perleve Montagu)*	Overharvesting of *A. nodosum*	2	2	A	no	n/a	yes	As above in Section C1a (*A. nodosum*).	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		Numbers of these species in the *A. nodosum* biotope in Clew Bay generally are generally low (Kelly et al., 2001). While Boaden and Dring (1980) identified changes in density of *Hymeniacidon* and *Halichondria* species due to harvest of *A. nodosum*, the harvest methodology involved was quite invasive and involved cutting between 10-15cm (4-6 inches).
		2	As these species are not protected under EU regulations the severity associated with overharvesting of *A. nodosum* is reduced to reside within the range of 1-4. A low-moderate severity score of 2 was assigned. While overharvesting or inappropriate hand harvesting of *A. nodosum* may be associated with reductions in sessile animals such as sponges, *Halichondria panicea Pallas* and *Hymeniacidon perleve Montagu* are more widespread and occur in more deeper waters. *Leucosolenia sp.* and *Halichondria panicea* were not found in upper or middle shores of Clew Bay where *A. nodosum* is found, while observed at low numbers increase in the lower zone (Kelly et al., 2001). Likewise, *Hymeniacidon perleve* were absent in the upper zone, at low levels in the middle zone while increasing into the lowers zone.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(3f): Sea squirts

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Alteration to density of Sea squirts *(e.g. Dendrodoa grossularia van Beneden* and *Ascidiella scabra O.F. Müller)*	Overharvesting of *A. nodosum*	1	2	A	no	n/a	yes	As above in Section C1a (*A. nodosum*).	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**1**		Kelly et al., 2001, demonstrate that *Ascidiella* occur at low levels in the *A. nodosum* zone of Clew Bay.
		2	Since seasquirts such as *Ascidiella* are not protected under EU regulations, the severity associated with overharvesting of *A. nodosum* is reduced to reside within the range of 1-4. A low-moderate severity score of 2 was assigned.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(3g): Species/Habitat: Other Mobile species

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

In the study by Kelly et al., 19 mobile animals were identified. However, in some cases, numbers were insufficient to allow for robust statistical analysis of the potential impact of hand harvesting of *A. nodosum*. Harvesting of *A. nodosum* did not have any significant effects on fish and other large mobile epifauna.

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Potential Alteration to density of or habitat important for Mobile species (Phylum Arthropoda (*Amphipods, isopods crabs, Chironomida, Halacaridae, Ostracoda*), Phylum Platyhelminthes (e.g. *Turbellaria*), Phylum Annelida, Phylum Foraminifera, Phylum Nematoda.	• Overharvesting of *A. nodosum.* • Non-return of by-catch	2	2	A	no	n/a	yes	As above in Section C1a (*A. nodosum*). By-catch: any *Animalia* by-catch observed post-harvest must be returned to the water, where possible.	None specified by NPWS or EU regulations.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		The probability of overharvesting *A. nodosum* is outlined in Section C1a above. A higher score of 3-5 was unjustified as there is no evidence for alterations of these species in Clew Bay due to hand harvesting of *A. nodosum*. Of note, there was no recorded mobile species found in a recent survey of Clew Bay, either in dense or recently harvested areas (See Appendix 1). Most amphipods & isopods are relatively inactive at low tide. Harvest at low tide avoids potential by-catch of species which would be active in the intertidal zone during high tide. The likelihood of displacement will be low and harvesters will have full view and control of their activities. Harvesters will work to ensure that co-harvesting of other species does not occur, thus reducing potential for trapping. Any by-catch observed post-harvest will be collected and returned to the water, where possible (See Appendix 4, 'Codes of Practice').
		2	These species are not protected in EU or Irish Law, thus, the severity score is assigned between 1-4.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(d) Continuous Disturbance:

In accordance with EU Law, NPWS recommend that continuous disturbance of each community type should not exceed an approximate area of 15%. To measure the potential impact on structure and function in Clew Bay, BioAtlantis were provided with the marine community type datasets shapefile from NPWS in ESRI format (18/08/2014). Using AutoCAD software, the following was calculated: (a) the Total Area (m^2) in Clew Bay SAC of each Annex I Habitat, (b) the Area affected by harvest activities/annum (m^2 and percentage) and (c) the total area of Large Shallow Inlets and Bays [1160] affected/annum.

(1) Shingle

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Continuous disturbance of shingle exceeds an approximate area of 15%.	Harvest activity taking place on >15% of shingle community type	2	5	A	no	n/a	yes	Management are aware of obligations for ensuring disturbance does not exceed approx. 15% of the area. This requirement is listed in the "Code of Practise" (Appendix 4).	NPWS 2011A.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical:	**2**		There is a low probability that continuous disturbance of shingle will exceed an approximate area of 15%. Calculations performed using shape file data from NPWS indicate that the shingle area affected by harvest activities/annum represents 12.7% of the total shingle community type in the SAC (see below). The percentage of shingle which is Marine Community Types of Large shallow Inlets and Bays [1160] that will be impacted each year is very low. The overall area of Large shallow inlets and bays [1160] in Clew Bay is 10,188.5 hectares (https://eunis.eea.europa.eu/sites/IE0001482). The percentage of shingle to be impacted annually is 0.23% of this area.
		5	Continuous disturbance of shingle over an approx. area greater > 15% per annum would represent unfavorable conservation status for the SAC.
Chemical:			n/a
			n/a

Annex I Habitat (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**		**Area of Large Shallow Inlets and Bays [1160] affected/annum**
		(m^2)	**(%)**	**(%)**
Shingle	1,855,000	235,549	12.7%	0.23%

(2) Reef

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Continuous disturbance of reef exceeds an approximate area of 15%.	Harvest activity taking place on >15% of reef community type	2	5	A	no	n/a	yes	Management are aware of obligations for ensuring disturbance does not exceed approx. 15% of the area. This requirement is listed in the "Code of Practise" (Appendix 4).	NPWS 2011A.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical:	**2**		There is a low probability that continuous disturbance of reef will exceed an approximate area of 15%. Calculations performed using shape file data from NPWS indicate that the reef area affected by harvest activities/annum represents 4.9% of the total reef community type in the SAC (see below). The percentage of the reef which is Marine Community Types of the Annex I habitat, Large shallow Inlets and Bays [1160] that will be impacted each year is very low. The overall area of Large shallow inlets and bays [1160] in Clew Bay is 10,188.5 hectares (https://eunis.eea.europa.eu/sites/IE0001482). The percentage of reef to be impacted annually is 1.31%.of this area.
		5	Continuous disturbance of reef over an approx. area greater than 15% per annum would represent unfavorable conservation status for Clew Bay SAC.
Chemical:			n/a
			n/a

Annex I Habitat (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**		**Area of Large Shallow Inlets and Bays [1160] affected/annum**
		(m^2)	**(%)**	**(%)**
Reef	26,870,000	1,331,699	4.9%	1.31%

(3) Zostera Community

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological/Physical: Continuous disturbance of Zostera Community exceeds an approximate area of 15%.	Harvest activity taking place on >15% of Zostera Community type.	1	5	A	no	n/a	yes	Management are aware of obligations for ensuring disturbance does not exceed approx. 15% of the area. This requirement is listed in the "Code of Practise" (Appendix 4).	NPWS 2011A.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical:	**1**		There is a very low probability that continuous disturbance of Zostera Community will exceed an approximate area of 15%. Calculations performed using shape file data from NPWS indicate that the Zostera Community area affected by harvest activities/annum represents 0% of the total Zostera community type in the SAC (see below). The figure of 0% is assigned to areas where *A. nodosum* does not grow or where BioAtlantis have specifically avoided in this application due to the sensitive nature of some of these areas, in this case, Zostera Community.
		5	Continuous disturbance of Zostera Community over an approx. area greater than 15% per annum would represent unfavorable conservation status for Clew Bay SAC.
Chemical:			n/a
			n/a

Annex I Habitat (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**	
		(m^2)	**(%)**
Zostera Community	1,423,891	0	0.0%

(4) Maerl Dominated community

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Continuous disturbance of Maerl Dominated community exceeds an approximate area of 15%.	Harvest activity taking place on >15% of Maerl Dominated community type	1	5	A	no	n/a	yes	Management are aware of obligations for ensuring disturbance does not exceed approx. 15% of the area. This requirement is listed in the "Code of Practise" (Appendix 4).	NPWS 2011A.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical:	**1**		There is a very low probability that continuous disturbance of Maerl Dominated community will exceed an approximate area of 15%. Calculations performed using shape file data from NPWS indicate that the Maerl Dominated community area affected by harvest activities/annum represents 0% of the total Maerl Dominated community type in the SAC (see below). The figure of 0% is assigned to areas where *A. nodosum* does not grow or where BioAtlantis have specifically avoided in this application due to the sensitive nature of some of these areas, in this case, Maerl dominated Community.
		5	Continuous disturbance of Maerl Dominated community type over an approx. area greater than 15% per annum would represent unfavorable conservation status for Clew Bay SAC.
Chemical:			n/a
			n/a

Annex I Habitat (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**	
		(m^2)	**(%)**
Maerl Dominated community	2,878,607	0	0.0%

(5) Fine Sands Dominated by *Nephtys cirrosa* community

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Continuous disturbance of Fine Sands Dominated by *Nephtys cirrosa* community exceeds an approximate area of 15%.	Harvest activity taking place on >15% of Fine Sands Dominated by *Nephtys cirrosa* community type	1	5	A	no	n/a	yes	Management are aware of obligations for ensuring disturbance does not exceed approx. 15% of the area. This requirement is listed in the "Code of Practise" (Appendix 4).	NPWS 2011A.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical:	**1**		There is a very low probability that continuous disturbance of this community will exceed an approximate area of 15%. Calculations performed using shapefile data from NPWS indicate that the area of this community type affected by harvest activities/annum represents 0% of the total Fine Sands Dominated by *Nephtys cirrosa* community type in the SAC (see below). The figure of 0% is assigned to areas where *A. nodosum* does not grow or where BioAtlantis have specifically avoided in this application due to the sensitive nature of some of these areas, in this case, Fine Sands Dominated by *Nephtys cirrosa* community.
		5	Continuous disturbance of Fine Sands Dominated by *Nephtys cirrosa* community over an approx. area greater than 15% per annum would represent unfavorable conservation status for Clew Bay SAC.
Chemical:			n/a
			n/a

Annex I Habitat (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**	
		(m^2)	**(%)**
Fine Sands Dominated by *Nephtys cirrosa* community	2,950,308	0	0.0%

(6) Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Continuous disturbance of Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex exceeds an approximate area of 15%.	Harvest activity taking place on >15% of Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex	1	5	A	no	n/a	yes	Management are aware of obligations for ensuring disturbance does not exceed approx. 15% of the area. This requirement is listed in the "Code of Practise" (Appendix 4).	NPWS 2011A.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical:	**1**		There is a very low probability that continuous disturbance of this community will exceed an approximate area of 15%. Calculations performed using shapefile data from NPWS indicate that the area of this community type affected by harvest activities/annum represents 0% of the total Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex type in the SAC (see below). The figure of 0% is assigned to areas where *A. nodosum* does not grow or where BioAtlantis have specifically avoided in this application due to the sensitive nature of some of these areas, in this case, Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex.
		5	Continuous disturbance of Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex over an approx. area greater than 15% per annum would represent unfavorable conservation status for Clew Bay SAC.
Chemical:			n/a
			n/a

Annex I Habitat (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**	
		(m^2)	**(%)**
Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex	7,817,100	0	0.0%

(7) Mudflats & sandflats not covered by seawater at low tide

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Continuous disturbance of mudflats & sandflats not covered by seawater at low tide exceeds an approximate area of 15%.	Harvest activity taking place on >15% of mudflats & sandflats not covered by seawater at low tide	1	5	A	no	n/a	yes	Management are aware of obligations for ensuring disturbance does not exceed approx. 15% of the area. This requirement is listed in the "Code of Practise" (Appendix 4).	NPWS 2011A.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical:	**1**		There is a very low probability that continuous disturbance of this community will exceed an approximate area of 15%. Calculations performed using shapefile data from NPWS indicate that the area of this community type affected by harvest activities/annum represents 0% of the total mudflats & sandflats not covered by seawater at low tide in the SAC (see below). The figure of 0% is assigned to areas where *A. nodosum* does not grow or where BioAtlantis have specifically avoided in this application due to the sensitive nature of some of these areas, in this case, mudflats & sandflats.
		5	Continuous disturbance of Mudflats & sandflats over an approx. area greater than 15% per annum would represent unfavorable conservation status for Clew Bay SAC.
Chemical:			n/a
			n/a

Annex I Habitat (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**	
		(m^2)	**(%)**
Mudflats & sandflats not covered by seawater at low tide	12,541,069	0	0.0%

(e) Broad, holistic examination of the nature, extent and impact of hand harvesting.

(1): The spatial extent of harvesting techniques and activities.

(i) Management of expansive and prolonged operations

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Harvest activities are mis-managed, with low traceability or oversight.	It is difficult to manage, harvest activities over such as large area.	2	5	A	no	n/a	yes	A system is in place which ensures that: • Activities are planned in advance. • Site-specific management approach: Harvest locations, pick-up points, quantities, quality measures & personnel involved are recorded on a daily basis. A full-time Resource Manager is responsible and the system will be regularly monitored and assessed via quarterly and annual audits. • See "Code of Practise" for details (Appendix 4).	Ensuring protection of the Clew Bay SAC.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		There is a low probability of mismanagement. This is because the BioAtlantis harvesting system ensures full control over all aspects of the harvesting activities. It has been designed to be automated and with full oversight and traceability from point of harvest to production. The system also ensures robust follow-up, with corrective actions and measures being issued where applicable, in the event that non-conformances or incidents occur. A higher score of 3-5 was unjustified as BioAtlantis have a proven track record in implementing and managing high quality systems (e.g. GMP+), which require high levels of traceability, oversight and responsibility.
		5	Without full control over harvest activities, it would not be possible to verify that the systems for protecting the SAC are being adhered to.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(ii) Numbers of personnel and exploitation levels

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: • Mismanagement of personnel. • Overexploitation • Increased anthropogenic impacts	• Poor management • Lack of oversight • To many people in site	2	5	A	no	n/a	yes	A system is in place which ensures that: • Activities are planned in advance. • Site-specific management approach: Harvest locations, pick-up points, quantities, quality measures & personnel involved are recorded on a daily basis. A full-time Resource Manager is responsible and the system will be regularly monitored and assessed via quarterly and annual audits. • See "Code of Practice" for details (Appendix 4).	Ensuring protection of the Clew Bay SAC.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological:	**2**		• There is a low probability of mismanagement of personnel or overexploitation. This is because the BioAtlantis system requires full control over where harvesters work and the quantities of harvest involved via the GRN. The full time Resource Manager must inspect and verify on the Site Inspection Form that no more than 20% of the total available biomass per site per annum is harvested, thus monitoring potential for overharvesting on a regular basis. • Increased anthropogenic impacts due to increases numbers of harvesters is unlikely. Approx.3 people will work per hectare, for approximately 6-8 hrs per day. No more than 2-4 harvesters are permitted on small-medium sized sites. Medium to large islands may require between 4-6, while larger islands will likely require approximately 6-10 harvesters. The low number of people over a wide area reduces the potential for anthropogenic impacts (e.g. intensity of trampling) on the biotope. In fact, given that the BioAtlantis plan targets specific areas at specific times of the year, the low levels of trampling events will also be largely episodic in nature.
		5	Mismanagement and overexploitation could damage the SAC.
Chemical:			n/a
			n/a
Physical:			n/a

(2): The potential interaction effects of seaweed harvesting

(i) Targeted removal of species

See C1(a) above for analysis of targeted removal of *A. nodosum*

(ii) Non-Targeted removal of species

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological/ physical: Removal of: • *Fucus* • Periwinkles & Limpets • Amphipods & isopods	• Inappropriate technique • Lack of training • Lack of oversight	3	3	A	no	n/a	yes	A system is in place which ensures that: • Harvest of *Fucus* sp. is not accepted. • Severe reductions in canopy coverage will not occur, thus ensuring sufficient habitat for active feeding stages and reproductive purposes of *Animalia*. • *A. nodosum* mortality does not occur which otherwise could lead to reductions in habitat for *Animalia*. • Harvesters will work to ensure that co-harvesting of other species does not occur. • By-catch: all *Animalia* observed post-harvest will be returned to water, where possible. ❖ For more information on the above, see section C3a (periwinkles), C3b (limpets), C1b (*Fucus*) and C3g (Amphipods and isopods). ❖ All control measures are listed in the "Code of Practise" for details (Appendix 4).	Ensuring protection of the Clew Bay SAC.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological /physical:	**3**		The likelihood of hand harvesting directly affecting non-target species is reduced as systems are in place to ensure that harvesting takes place at low tide when most *Animalia* (periwinkles, amphipods and isopods, etc) are dormant or inactive and located low down in the canopy, thereby preventing their by-catch. Additionally, systems are in place to ensure than sufficient canopy remains post harvest and that holdfasts are not removed, thus ensuring the viability of the biotope for non-target species. *Fucus*, an additional habitat of some *Animalia*, will not be targeted for harvesting, thus preventing further by-catch related impacts and preventing further reductions in total habitat.
		3	While these species are not specifically protected , they form important components of SAC community structures.
Chemical:			n/a
			n/a

(3): Disturbance and displacement of species and habitats:

(i) Reef

See Section A8 above

(ii) Amphipods and isopods:

See section E2(ii) and Section C(3g) above.

(4): Changes in community structure:

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Long term impacts on *A. nodosum* community structure as a whole	While short term impacts of *A. nodosum* hand harvesting on community structure in Clew Bay have been found to be relatively minimal by Kelly et al., (2001), the study is limited by its short duration.	2	5	A	no	n/a	yes	• BioAtlantis will assess the impact of *A. nodosum* harvesting over the life-time of the licence. The experimental design will involve measurement of: (a) rates of re-growth of *A. nodosum* post-harvest, and (b) associated biodiversity. • An experimental site will be chosen for non-harvested Vs. harvested area comparisons • Sections will be large enough to allow for sufficient numbers of replicates. • A range of parameters will be measured including: ➢ numbers of *A. nodosum* plants, numbers of *Fucus* plants, numbers of *Animalia*. • Species assessed: periwinkles, limpets, barnacles, red algae, ephemeral green algae. • Assessments performed on an annually, ideally covering a 5-10 year period. The plan above is included in the "Code of Practise" for details (Appendix 4), as a means of ensuring that BioAtlantis continually validate and improve the methodology on an ongoing basis and on a long term basis throughout the life-time of the licence. This will ensure that scientific knowledge is increased beyond the timeframe assessed by Kelly et al., 2001. This will be important in ensuring that conservation objectives are met continually into the future.	Ensuring protection of the Clew Bay SAC.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**2**		The study by Kelly et al., (2001) demonstrated limited impacts of hand harvesting in Clew Bay in the short term. However, long terms impacts of hand harvesting are unknown, as harvesting by its nature may vary in intensity and severity due to factors such as: unregulated harvesting, over-harvesting, inappropriate techniques. This could give rise to significant changes in the ecosystem (e.g. invasion of *Fucus* and associated impacts). In the absence of unregulated harvesting or over-harvesting, other natural factors such as slow changes over time in abundance and type of *Animalia* species could also occur. The probability of long term impacts on the community structure is reduced, as the BioAtlantis harvesting system has been developed to ensure that over-harvesting and inappropriate techniques are not used in Clew Bay. This ensures that some of the biggest threats to community structure are avoided. A higher probability of 3-5 is unjustified as the proposed system is minimally invasive and therefore, less likely to cause long term impacts.
		5	A high severity rating is assigned, as significant changes to community structure could have negative consequences of the intertidal zone.
Chemical/ Physical:			n/a
			n/a

(5): Changes in hydrodynamics and water quality:

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological/Chemical Exacerbation of impacts of pollution and reductions in water quality	Harvesting in areas near sewage outfalls	1	5	A	no	n/a	yes	BioAtlantis will not harvest in areas near sewage outfalls or other sources of pollution. See "Code of Practise" for details (Appendix 4).	Ensuring protection of the Clew Bay SAC.
Physical: Alteration to hydrodynamics	Excessive removal of *A. nodosum*	1	5	A	no	n/a	yes	The harvest system is designed with sustainability at the forefront and dramatic alterations to biomass levels will not occur. Harvest activities will not reduce height of *A. nodosum* below 200mm (8 inches). See "Code of Practise" for details (Appendix 4).	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological /Chemical	**1**		Polluted water can have negative impacts on *A. nodosum* performance, epiphyte infestation, colonisation and competition by green algae. However, harvest activities will not give rise to significant increase in pollution (see Section A1 above). The probability of exacerbating existing impacts of pollution are low, as hand harvesting in proximity to sewage outfalls, etc, will not occur.
		5	A high severity rating is assigned, as alterations to water quality could have significant impacts on the SAC in broad terms.
Physical:	**1**		It is unlikely that *A. nodosum* harvesting will impact on overall hydrodynamics in the complex. *A. nodosum* is adapted to growing in highly sheltered environs and as such, has difficulty remaining attached to hard substrate in less sheltered waters. Therefore, *A. nodosum* is likely to exert a minor influence on hydrodynamics. The harvesting system is designed to ensure that dramatic changes in biomass levels within the intertidal zone will not occur.
		5	Alterations to hydrodynamics could potentially have significant impacts on other Annex I and II habitats in the complex.

(6): Potential disturbance of Marine Fauna:

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Physical disturbance of marine fauna	• Inappropriate technique • Lack of training • Lack of oversight	1	3	A	no	n/a	yes	The "Code of Practise" (Appendix 4) will be implemented which ensures that marine fauna are unaffected, i.e.: • Harvest at low tide, • Harvest sustainably, • Return by-catch, where possible.	Ensuring protection of the Clew Bay SAC.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical:	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**1**		The technique employed during *A. nodosum* harvest requires cutting at heights well above the holdfast, thus avoiding any fauna present at the base of the canopy. Harvest at low tide also prevents any immediate effects on marine fauna which are otherwise exclusively active around the area during high tide. By ensuring maintenance of sufficient canopy, marine fauna can still utilize the *A. nodosum* environment at high tide. Moreover, the long term effects of harvesting is minimized as sufficient photosynthetic tissue left behind which will allow for faster *A. nodosum* recovery post harvest. Moreover, limiting the harvest to 20% of the total available biomass will ensure that sufficient biotope coverage remains.
		3	While most marine fauna in Clew Bay are not protected under EU Law, they occupy an important position within the overall ecosystem.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(7): Potential interactions with coastal habitats:

A. nodosum contributes to the organic deposition throughout the littoral zone and marine environment. The rocky shoreline by its very nature is not a closed system and organic matter will tend to transfer from the area into the wider marine environment. As a primary producer located close to the back shore, the potential impact of any loss of *A. nodosum* on nearby coastal habitats must be examined. From an assessment the scientific literature, there is potential for impacts on Atlantic salt meadows and Sand dune habitats. No potential impacts are identified for other coastal habitats. The hazard assessment for Atlantic salt meadows and Sand dune habitats is presented below.

(i) Atlantic salt meadows (ASM)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Levels of *S. alterniflora* are reduced due to harvesting	Harvesting *A. nodosum* along the fringes of Atlantic Salt Meadows.	1	5	A	no	n/a	yes	Harvest along the fringes of Atlantic Salt Meadows will not occur "Code of Practise" (Appendix 4)	EU Dir. 92/43/ EEC & NPWS To restore the favourable conservation condition (ref: Objective 2, NPWS, 2011B, pg. 9)
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Prob-ability**	**Sever-ity**	**Reason for Decision**
Biological:	**1**		Harvesting *A. nodosum* along the fringes of Atlantic Salt Meadows could give rise to reductions in cordgrass, *S. alterniflora*. Harvesting cannot take place at Atlantic Salt Meadows.
		5	EU Dir. 92/43/EEC & NPWS, requires that the favourable conservation condition of Atlantic salt meadows be restored (ref: Objective 2, NPWS, 2011B, pg. 9).
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(ii) Sand dune habitats

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Reduction in organic drift litter levels to an extent which would negatively affect *Ammophila* plant growth, and in turn, sand dune formation and integrity.	Over harvesting of *A. nodosum* to levels which significantly reduce total organic drift litter in the Clew Complex.	1	5	A	no	n/a	yes	The management system requires that over-harvesting, which could have potential indirect impacts on organic matter levels and in turn potentially sand dunes, will not occur. See "Code of Practise" (Appendix 4) for details.	EU Dir. 92/43/ EEC & NPWS To restore the favourable conservation condition. (ref: Objective 3, NPWS, 2011B, pg. 15).
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**1**		Some studies indicate that *A. nodosum* organic drift litter material can increase Ammophila leaf length potentially due to a C:N ratio of 15:1 in algae (Maun, 2009). As such, *A. nodosum* organic drift litter may contribute to the formation and integrity of sand dune habitats. As the hand harvesting system ensures that over-harvesting does not take place and that *A. nodosum* mortality is mitigated against, the likelihood of over harvesting of *A. nodosum* to levels which significantly reduce total organic drift litter in the Clew Complex, is low.
		5	EU Dir. 92/43/EEC & NPWS, requires the favourable conservation condition of sand dune habitats be restored (ref: Objective 3, NPWS, 2011B, pg. 15).
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(f) Existing Operations: potential in-combination effects and interactions.

(1): Unlicensed, traditional and casual harvesting of seaweed.

For a detailed analysis of risks associated with other harvest activities, please see Appendix 7 to this application.

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Y/N		
Biological: Negative impacts on: Protected Fauna: ➢ Annex II harbour seals & protected bird species Annex I habitats: ➢ Intertidal zone	This may occur due to cumulative and in combination impacts due to interactions with existing hand harvesting activities: • Other commercial companies • Traditional or casual harvesting & small-scale harvesting for personal use • Seaweed harvesting "discovery days" in Mulranny.	2	5	A	no	n/a	yes	• BioAtlantis will be responsible for commercial *A. nodosum* harvesting. If unlicensed large-scale commercial harvesting is observed to occur, this will be recorded and advice will be sought from the relevant authorities on how to proceed. BioAtlantis will not harvest in such areas until *A. nodosum* has regenerated and will work to ensure that any harvesting is limited to 20% of the total available biomass/site/annum and continuous disturbance of each community type does not exceed the required limit. • Commercial users with small requirements of ~1 tonne per annum (e.g. hotels, health Spas) will be identified and BioAtlantis will work to prevent in combination effects. • BioAtlantis will not harvest beyond Rossmurvagh, thus avoiding much of the Mulranny area. This avoids in combination effects with excursions in the area (e.g. Seaweed harvesting "discovery days". • Harvesting cannot occur in areas where there are existing appurtenant rights or burdens in relation to the harvesting, gathering or removal of seaweed from the shore. • Where Profit-à-Prendre rights to harvest seaweed are successfully registered with the PRAI, the harvesting plans will be adjusted to ensure that those individuals can continue to harvest *A. nodosum*. • Harvesting activities must not impact on other people who harvest small volumes of seaweed, edible seaweeds or invertebrates for their own personal use, e.g. dillisk, carrageenan, limpets, mussels, clams, periwinkles and scallops. The above measures are included in the "Code of Practise" (Appendix 4). For detailed analysis of risks associated with other harvest activities, see Appendix 7.	Protecting the Clew Bay SAC.
Chemical:none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	Probability	Severity	Reason for Decision
Biological	**2**		There is a risk of cumulative and in combination impacts due to interactions between existing hand harvesting activities. However, the likelihood of such hazards occurring are reduced significantly as the BioAtlantis will be responsible for large scale commercial harvesting within the complex. Other commercial, large-scale, unlicensed harvesting activities will be recorded and advice will be sought from the relevant authorities on how to proceed. Small scale harvesting of <1 tonnes will have minimal impacts and does not significantly increase the probability of significant in combination effects with the BioAtlantis plan. Harvesting will not take place in areas where there are existing appurtenant rights or burdens in relation to the harvesting, gathering or removal of seaweed from the shore, thus lowering the likelihood of harvesting at inappropriate locations. Likewise, harvesting plans will be revised in the event of Profit-à-Prendre rights to harvest seaweed being successfully registered with PRAI.
		5	In combination effects due to presence of more than one large-scale harvesting operator within the same area, would be detrimental to the integrity of the Clew Bay SAC.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(2): Recreation and Tourism.

For a detailed analysis of risks associated with recreation and tourism, please see Appendix 7 to this application.

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological/ Physical: Negative impacts on: Protected Fauna: ➢ Annex II harbour seals & protected bird species Annex I habitats: ➢ Intertidal zone	This may occur due to cumulative and in combination impacts associated with interactions of harvesting with recreation and tourism-related activities: ➢ In vicinity of seal and bird sites ➢ Involving transfer of equipment across the intertidal zone ➢ At Collanmore island during peak tourist season	2	5	A	no	n/a	yes	• **Activities in vicinity of seal and bird sites: Hand harvest will not take place at harbour se**al and bird sites at sensitive times of the year, thus preventing any in combination effects. • **Activities involving transfer of equipment across the intertidal zone:** Hand harvesters will not work within 50m of bases where equipment or vessels are manually introduced in the water. This ensures that no in combination effects occur. • **Activities at Collanmore island during peak tourist season:** Harvest will only occur on Collanmore between Sept-April. This prevents any in combination effects associated with increased anthropogenic disturbances which may occur at peak summer season (May-Aug) due to increased numbers of tourists on the island. The measures are included in the "Code of Practise" (Appendix 4), along with a range of additional measures to prevent interactions with these activities. For a detailed analysis of risks associated with recreation and tourism, please see Appendix 7.	Protecting the Clew Bay SAC.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical	**2**		There is a risk of cumulative and in combination impacts due to interactions between existing recreation and tourism activities. However, the likelihood of such hazards occurring are reduced significantly as BioAtlantis have measures in place to (a) avoid seal/bird sites at sensitive times, avoid (a) Collanmore at peak tourist season (May-Aug) and avoid sites near active tourism bases.
		5	In combination effects with recreation and tourism activities could be detrimental to the integrity of the Clew Bay SAC.
Chemical:			n/a
			n/a

(3): Aquaculture.

For a detailed analysis of risks associated with aquaculture, please see Appendix 7 to this application.

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.

*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological/physical : Negative impacts on: • Protected Fauna: ➢ Annex II harbour seals & protected bird species • Annex I habitats: ➢ mudflats and sandflats • Direct impact on reef due to removal of species	Exacerbation of effects by existing aquaculture: ➢ At sites located in vicinity of seal and bird sites could cause disturbance ➢ At sites located in vicinity of mudflats and sandflats may cause damage. ➢ Direct impact on reef due to removal of species	2	5	A	no	n/a	yes	• The BioAtlantis harvesting systems requires seasonal avoidance of protected seal and bird sites See "BioAtlantis Code of Practise" for protection of harbour seals and bird species for more details (Appendix 4). • Ensure implementation of Code of Practice to ensure that harvesters do not attempt to navigate at low tide to rocky shorelines located beyond mudflat/sandflat areas (see Appendix 4). • Caution is required when approaching or operating near areas where existing aquaculture sites may be in relatively close proximity to harbour seal breeding sites (e.g. Inishcarrick, Inishcorky, Inishdasky, Inishilra), harbour seal moulting sites (e.g. Inisheeny), harbour seal resting sites (e.g. Inishtubrid), bird breeding sites (e.g. MoynishBeg, Inishcorky, Mauherillan) and bird wintering sites (e.g. Inisheeny). • Follow the Code of Practice to prevent impacts on navigation routes or physical interactions with aquaculture units. For a detailed analysis of risks associated with aquaculture, please see Appendix 7 to this application.	Protecting the Clew Bay SAC.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Proba bility**	**Sever ity**	**Reason for Decision**

Biological	**2**		Contact with harbour seal and breeding and wintering birds at protected sites will be minimal. Harvest cannot occur at these sites during sensitive times of year. A study by the Marine Institute (2014) assessed potential impacts of licensed aquaculture activities on species and habitats in Clew Bay and made the following conclusions: • Existing aquaculture activities are non-disturbing to harbour seals species or otter species. • Unlikely that hand harvest of seaweed and intertidal shellfish culture will overlap in Clew Bay, as reef is not considered suitable for culture of shellfish. • It is "unlikely that the in combination effects of transport routes across intertidal flats will give rise to persistent disturbance of >15% on intertidal mudflats and sandflats".
		5	In combination effects with protected Annex II harbour seals & protected bird species or Annex I habitats could have negative effects on the conservation status of Clew Bay SAC.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(4): Harvesting of invertebrates.

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological/physical : Negative impacts on: • Periwinkle populations • Cockle populations • Other invertebrates	Exacerbation of effects by existing harvesting of invertebrates: ➢ Periwinkles, cockles and other invertebrates	2	5	A	no	n/a	yes	**Periwinkles:** • Harvesters will leave between 8-12 inches of the crop behind. This approach avoids: ➢ Extensive removal of *A. nodosum* canopy coverage and damage to the ecosystem and ➢ Interactions with or by-catch of dormant/ resting winkles positioned at the base of the *A. nodosum* canopy ➢ Ensures that developing free-living forms of *L. Littorina* are able to settle and establish within intact canopies. • *L. obtusata* eggs: Harvesters will work to avoid *A. nodosum* plants which contain visible *L. obtusata* egg masses. This is important to prevent harvest of viable eggs, thereby promoting maintenance of population size. • Do not harvest *Fucus*: *Fucus* content of harvested *A. nodosum* will be limited to <5%, thus preventing removal of an additional canopy source which supports periwinkles and other species. • By-catch: co-removal of periwinkles identified as by-catch post-harvest will be returned to the water, where possible. **Cockles:** A code of practice is in place to ensure environmentally safe navigation when operating mudflats and sandflat areas. This will prevent any impact on intertidal sedimentary communities (See Appendix 4). **Other invertebrates:** • Harvesters will work to ensure that co-harvesting of other species does not occur. • Inadvertent co-removal of Animalia identified post-harvest will be collected and returned to the water, where possible. The above measures are included in the "BioAtlantis Code of Practise" (Appendix 4).	Protecting the Clew Bay SAC.
Chemical: none	n/a	na	na	na	na	na	n/a	n/a	

Hazard	**Prob-ability**	**Sev-erity**	**Reason for Decision**
Biological/ physical	**2**		**Periwinkles:** Hand gathering occurs within the intertidal zone. Risks include reductions in periwinkle population numbers due to the removal and anthropogenic disturbances caused by trampling. While there is potential for in-combination effects associated with *A. nodosum* hand harvest activities and existing periwinkle harvest activities, the standards developed as part of the Codes of Practice (Appendix 4) reduce the likelihood. **Cockles:** There is potential for in-combination effects associated with *A. nodosum* hand harvest activities and cockle hand gathering, as seaweed hand harvesting may involve activities along the rocky shoreline beyond mudflats and sandflats. Cockles occur on intertidal muddy sand shores east of Mullranny. Hand gathering may occur at a low scale. Potential impacts of cockle gathering include impacts on intertidal sedimentary communities (Mudflats and sandflats not covered by seawater at low tide [1140]). The Codes of

			Practice reduce the likelihood that navigation will impact on these environs, a navigation into these areas will occur exclusively at high tide or when the tide begins to recede. **Other invertebrates:** Other invertebrates are removed from Clew Bay, many of which are limited to deeper water, thus removing any risk of in-combination effects associated with hand harvesting activities. However, there is a low risk that hand harvesting may impact on slow moving invertebrates in general given that nets/bags are used along the intertidal zone. The likelihood of such impacts occurring is low as nets/bags will take up a small area and harvesters will be required to ensure that co-harvesting other species does not occur.
		5	Mudflats and sandflats have stated objectives for their conservation. EU Dir. 92/43/EEC & NPWS, requires maintenance of *Tubificoides benedii* and *Pygospio elegans* community complex in intertidal sandy mud areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14). Harvest activities in these areas could significantly damage these community complexes and/or their habitat.
Chemical:			n/a
			n/a

(g) Planned Operations: potential in-combination effects and interactions.

(1): Harvest activities.

No planned operations identified.

(2): Recreation and Tourism.

For a detailed analysis of risks associated with planned recreation and tourism, please see Appendix 7. KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required. *probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological/ Physical: Anthropogenic disturbances at: • Roman Is. • Wesport harbour	Mayo County Council plan to increase tourism and recreation at these sites. This could involve or give rise to: ➢ Impacts associated with transfer of equipment across intertidal zone ➢ Increases no.s of people at the intertidal zone	2	5	A	no	n/a	yes	• **Activities involving transfer of equipment across the intertidal zone:** Harvesters will not work within 50m of bases where equipment or vessels are introduced in the water. This ensures that no in combination effects occur. • **Activities at Roman Island or Westport harbour during peak tourist season:** Hand harvesters will not work at Roman Island or Westport harbour between May and August. This prevents any in combination effects from occurring during peak season. Measures are included in the "BioAtlantis Code of Practise" (Appendix 4). For a detailed analysis of risks associated with planned recreation and tourism, please see Appendix 7 to this application.	Protecting the Clew Bay SAC.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Prob-ability**	**Severity**	**Reason for Decision**
Biological /physical	**2**		Westport Towns & Environs Development Plan 2010-2016 targets Roman Is. for development of marine-based activities and tourism (ref: Mayo County Council 2010), thus raising potential for interactions with harvesting (e.g. anthropogenic disturbances). Increased no.s of bases may be developed for recreation activities. Transference of equipment from bases into the water may give rise to small patches with low density of seaweed, thus raising potential for in combination effects. Funding is granted as part of the Mayo County Council 2014 Budget, for new marine tourism/leisure infrastructure at Westport Harbour (ref: Hynes, 2014), thus raising potential for interaction between harvesting & increased tourism-related activities at Westport Quay (e.g. anthropogenic disturbances). However, the likelihood of interactions are reduced as BioAtlantis will avoid Roman Is. or Westport harbour at peak tourist season(May-Aug) and avoid sites near active bases.
		5	In combination effects with recreation and tourism activities could be detrimental to the integrity of the Clew Bay SAC.
Chemical: none			n/a
			n/a

(3): Aquaculture.

For a detailed analysis of risks associated with aquaculture, please see Appendix 7 to this application.

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.

*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Negative impacts on: • Protected Fauna: ➢ Annex II harbour seals at Inishcorky	There is currently a licence application for abalone culture in the vicinity of Inishcorky island (ref: (pg. 78, Marine Institute (2014). Hand harvesting could interact to impact on harbour seals.	2	5	A	no	n/a	yes	· The BioAtlantis harvesting systems requires seasonal avoidance of protected seal and bird sites See "BioAtlantis Code of Practise" for protection of harbour seals and bird species for more details (Appendix 4). • Seasonal avoidance of sensitive harbour seal sites must be adhered to for all haul out sites, including Inishcorky. Caution is required when approaching or operating near areas where planned aquaculture sites may be in relatively close proximity to harbour seal breeding sites (e.g. Inishilra) and bird breeding sites (e.g. Mauherillan). • Follow Code of Practice to prevent impacts on navigation routes or physical interactions with aquaculture units. For a detailed analysis of risks associated with aquaculture, please see Appendix 7 to this application.	Protecting the Clew Bay SAC.
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological	**2**		Hand harvest activities may exacerbate existing effects attributed to licensed aquaculture activities, e.g. disturbance at sites relevant to harbour seals. Overall the risk of such interactions is considered low (Marine Institute, 2014). Impacts on Otter (*Lutra lutra*) is deemed not significant. However, the Marine Institute cannot rule out potential effects of aquaculture on seal behaviour at Inishcorky and potentially neighboring site: Inishdeashmore, Inishdeasbeag, unnamed neighbouring island of Inishdeasbeag and Inishnacross (pg. 78, Marine Institute, 2014). A number of additional aquaculture license applications have recently been filed (Marine Institute, 2019 and Department of Agriculture. Food and the Marine).The risk of in combination effects with hand harvesting are reduced as the BioAtlantis harvesting systems requires seasonal avoidance of protected seal sites.
		5	In combination effects with protected Annex II harbour seals could have negative effects on the conservation status of Clew Bay SAC.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(4): Harvesting of invertebrates.

No planned operations identified.

(h) Invasive species

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Biological: Spread of *Didemnum vexillum, Styela clava, etc.*	Due to harvest activities functioning as a vector, e.g. adherence of species to underside of boats.	1	5	A	no	na	yes	• The main collection boat (if deemed applicable to the area), will be painted once a year with appropriate anti-fouling paint. • The harvester's boats will not leave Clew Bay. In the rare case that they do leave Clew Bay, harvesters are required to implement a cleaning measure on land which will involve cleaning with appropriate cleaning agents or using other suitable methods. • All nets/bags must be cleaned with appropriate cleaning agents or using other suitable methods on delivery to production facilities and returned to harvesters in a clean condition. • Harvesting will be limited to the *A. nodosum* zone and will not take place in subtidal areas, exposed or semi-exposed sites. • Harvesters will keep distance from aquaculture units to prevent the spread of any species that may be associated with artificial structures. • Harvesters will prevent disturbance to rocky substratum, will avoid co-harvesting non-*A. nodosum* material and will ensure that inadvertent by-catch of other *Animalia*, algae or dead, drifting material/algae will be prevented and minimized.	Protecting the Clew Bay SAC. MSFD targets (2016)
Chemical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Physical: none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Hazard	Probability	Severity	Reason for Decision
Biological	**1**		**Non-indigenous species previously reported in Clew Bay: Cercozoa:** *Bonamia ostreae.* **Cordgrass:** *Spartina anglica,* **Crustaceans:** *Caprella mutica,* **Molluscs:** *Crepidula fornicate, Crassostrea gigas,* **Sea Squirts (Tunicata):** *Perophora japonica, Botrylloides violaceus, Styela clava, Didemnum vexillum,* **Seaweed:** *Sargassum muticum.* • ***Bonamia ostreae:*** Parasitic to the oyster *Ostrea edulis* (direct transmission). Measures are in place in this application to avoid non-*A. nodosum* habitats, thus reducing the potential for interactions. • ***Botrylloides violaceus:*** Associated with hard natural and artificial substrates, pontoons, shellfish beds, marine floating structures (e.g. those used for mussel culture), ropes and hulls and boats in marinas. Mainly found in submerged habitats. Can be found in habitats containing *Didemnum vexillum*. It has been reported in Clew Bay (ref: Shellfish Associated Species Inventory (SASI) Surveys, 2018 - 2022). Measures are in place in this application to prevent interactions with aquaculture activities in the bay, thus reducing the potential spread of this species. • ***Caprella mutica:*** Primarily a fouling organism that may associated with fish farms, aquaculture sites/structures, hulls or ships, recreational boats and artificial man-made objects, structures and materials. It has been reported in Clew Bay (ref: Shellfish Associated Species Inventory (SASI) Surveys, 2018 - 2022). Spreads on hulls and potentially by rafting on drifting material including drifting algae. This application does not involve the harvesting of drift weed or free-drifting macroalgae. Measures are also in place to avoid co-harvesting non-*A. nodosum* material and prevent inadvertent by-catch of other algae or dead, drifting material/algae, thus reducing the potential for interactions. • ***Crassostrea gigas****:* Farmed in Clew Bay. Reported as occurring on Bertra Beach, Westport, Mayo. Measures are in place in this application to prevent interactions with aquaculture activities in the bay, thus reducing the potential spread of this species. • ***Crepidula fornicata*****:** There were accounts of specimens of *C. fornicata* in Clew Bay in the 1960s, however none were found in subsequent searches. The population may have been transient or may have been purged/died out due to the 1962/63 winter and frosts (ref: O'Rourke E and O'Flynn C, 2014). • ***Didemnum vexillum*****:** An invasive species which can smother marine life. It has been identified in Clew Bay and other parts of Ireland and may be spread by boats. It has also been reported to be associated with aquaculture units such as oyster bags on trestle installations. Measures are in place in this application to prevent interactions with aquaculture activities in the bay, thus reducing the potential spread of this species. • ***Perophora japonica:*** Can occur on artificial substrata in harbours and marinas and under boulders and stones on the lower shore in sheltered, silty areas. Colonies were identified at Annagh Island in southern Clew Bay on the lower shore under boulders & on *Fucus serratus* (ref: Minchin D *et al.*, 2016). As measures are already in place to prevent disturbance to rocky substratum, the likelihood of interactions with *P. japonica* are very low. Measures are also in place to prevent harvesting of other species such as *F. serratus*, thus reducing the potential for interactions to occur. • ***Sargassum muticum*****:** An invasive seaweed that grows in semi-exposed areas, primarily in rock pools. This species has been reported in exposed areas where *A. nodosum* does not grow, such as Clare Island. It has also been reported in Clew Bay (ref: Shellfish Associated Species Inventory (SASI) Surveys, 2018 - 2022). As *S. muticum* does not thrive in highly sheltered areas within the *A. nodosum* zone, the likelihood of occurring post-harvest is very low. Measures are also in place to prevent harvesting of other non-*A. nodosum* material or other algae species such as *S. muticum*, should they occur, thus reducing the potential for interactions. • ***Spartina anglica:*** Some species of cordgrass are considered as invasive species in Ireland. Measures are in place to avoid interactions in sensitive areas such as Atlantic salt meadows or other areas such as tidal flats where *S. anglica* may potentially occur. • ***Styela clava*****:** Club tunicate, leathery tunicate, fouls ship hulls and aquaculture infrastructure. Can be found in shallow water on hard surfaces, occurs in warm sheltered waters, docks and harbour installations (ref: https://invasives.ie/ and https://www.marlin.ac.uk/). Recently observed to occur in Clew Bay. While *S. clava* can occur in sheltered areas, it is a low tidal to subtidal species; therefore the potential overlap with *A. nodosum* is likely to be very low.

The probability of these species being spread by harvesting, harvester boats or nets/bags is reduced, as the Code of Practice has been developed to ensure that appropriate precautionary measures are in place.

Other non-indigenous species of relevance, not identified in Clew Bay:

- **Annelida:** Marenzellaria viridis,
- **Bryozoans:** *Schizoporella_cf_japonica*, *Smittoidea_prolifica*,
- **Chordata:** Neogobius *melanostomus, Pseudorasbora parva*,
- **Comb Jellyfish:** *Mnemiopsis leidyi*,
- **Crustaceans:** *Amphibialanus amphitrite, Balanus trigonus, Eriocheir sinensis, Hemigrapsus sanguineus, Hemigrapsus takanoi, Dikerogammarus haemobaphes, Dikerogammarus villosus, Hemigrapsus sanguineus, Hemigrapsus takanoi, Hesperibalanus fallax,*
- **Ctenophora:** *Mnemiopsis leidyi,*
- **Dermocystida:** *Sphaerothecum destruens,*
- **Dinoflagellates:** *Alexandrium catenella, Alexandrium tamarense,*
- **Endomyxa:** *Marteilia refringens,*
- **Molluscs:** *Ensis leei, Ocinebrellus inornatus, Rapana venosa, Urolsalpinx cinerea, Corbicula fluminalis, Corbicula fluninea, Dreissena bugensis, Ocenebra inornate,*
- **Negarnaviricota:** *Infectious haematopoietic necrosis virus, Infectious salmon anaemia virus,*
- **Ochrophyta:** *Heterosigma akashiwo,*
- **Peploviricota:** *Ostreid herpesvirus 1-microvariant,*
- **Platyhelminthes:** *Gyrodactylus salaris,*
- **Porifera:** *Celtodoryx ciocalyptoides,*
- **Pseudomonadota:** *Vibrio cholorae,*
- **Seaweed:** *Caulacanthus okamurae, Grateloupia turuturu, Undaria pinnatifida, Laminaria ochroleuca,*
- **Tunicata:** *Corella eumyota*.

The probability of these species being introduced or spread by harvesting, harvester boats or nets/bags is reduced, as they are not currently identified as present in Clew Bay. The Code of Practice has also been developed to ensure that appropriate precautionary measures are in place to prevent the spread of invasive species into the future.

Information sources are outlined below:

- https://bim.ie/invasivespecies
- https://invasives.ie/
- www.biodiversityireland.ie
- National Invasive Species Database
- BIM and Dutch Shellfish Importers - Shellfish Associated Species Inventory (SASI) Surveys, 2018 - 2022
- https://www.marlin.ac.uk/
- Lucy FE, Davis E, Anderson R, Booy O, Bradley K, Britton JR, Byrne C, Caffrey JM, Coughlan NE, Crane K, Cuthbert RN. Horizon scan of invasive

			alien species for the island of Ireland. Management of Biological Invasions. 2020;11(2):155-77. • Minchin D *et al.*, 2016. The most nothern records of the exotic ascidian Perophora japonica Oka, 1927 (Ascidiacea: Perophoridae) in the north-east Atlantic. BioInvasions records 5, no. 3 (2016): 139-142.). • Minchin D. Risk assessment of non-indigenous marine species, Ireland: including those expected in inland waters. The Centre for Environmental Data and Recording (CEDaR), Department of Natural Sciences, National Museums, Northern Ireland (NMNI) and the Department of Arts, Heritage and the Gaeltacht, Ireland. 2014;64:16. • O'Rourke E and O'Flynn C, 2014. Risk Assessment of *C. fornicata*. A joint project by Inland Fisheries Ireland and the National Biodiversity Data Centre to inform risk assessments of non-native species for the European Communities (Birds and Natural Habitats) Regulations 2011, supported by the National Parks and Wildlife Service. • Schoenrock KM, O'Callaghan T, O'Callaghan R, Krueger-Hadfield SA. First record of *Laminaria ochroleuca* Bachelot de la Pylaie in Ireland in Béal an Mhuirthead, County Mayo. Marine Biodiversity Records. 2019 Dec;12(1):1-8.
		5	Spread of the above species in Clew Bay could negatively impact on the conservation objectives for this SAC.
Chemical:			n/a
			n/a
Physical:			n/a
			n/a

(i) The conservation status of marine Annex I habitats in Clew Bay Complex SAC.

(1) Sandbanks which are slightly covered by sea water all the time [1110]

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Impacts on: • Area. • Structure and function. • Future prospects.	Damage to sublittoral soft sediment communities with a limited range of species and sediment types (e.g. potentially due to installation of physical structures or dredging; ref: Scally et al., 2020).	1	3	A	no	n/a	yes	**The conservation status of marine Annex I habitats:** The Code of Practice (Appendix 4) provides a range of measures that will be undertaken to ensure that the conservation status of marine Annex I habitats is maintained or improved. In relation to sandbanks, harvesting will not occur in these areas.	EU regulations.

Hazard	**Proba bility**	**Sever ity**	**Reason for Decision**
Biological/ physical/ chemical	**1**		*A. nodosum* harvesting has no spatial overlap with this habitat. This habitat is mainly found along the east coast of Ireland but also occurs in the Shannon Estuary and off the Donegal coast. It is not listed as a protected habitat in Clew Bay SAC. Potential threats may include: Wind energy infrastructure in the vicinity of the habitat and benthic dredging from commercial fishing vessels (Scally et al., 2020)
		3	As this habitat is not protected under EU regulations in Clew Bay the severity associated with impacts is reduced to reside within the range of 1-4. Conservation assessments show that this habitat is in favourable condition nationwide in terms of (a) area, (b) structure and function and (c) future prospects (Scally et al., 2020).

(2) Estuaries [1130]

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes/No		
Impacts on: • Area. • Structure and function. • Future prospects.	Damage associated with increased sediment input and/or sediment mobilization (e.g. may be caused by factors related to agriculture, maintenance dredging, urbanization; ref: Scally et al., 2020).	1	3	A	no	n/a	yes	**The conservation status of marine Annex I habitats:** • Measures are in place to ensure that hand harvesting does not impact on estuary habitat, either directly or indirectly, and that no cumulative or in combination effects occur. In particular, harvesting will be limited to the *A. nodosum* zone. • Adherence to environmentally safe navigation techniques is required to prevent disturbance of soft substratum areas. Harvesting can take place within the *A. nodosum* zone at suitable sites located within Westport Bay and Newport River Estuary areas, subject to adherence to the code of practice in relation to environmentally safe navigation, thus ensuring sea-floor and water column integrity. • Estuarine areas containing soft mud or marsh at the mouths of rivers will be avoided between Sept-April to avoid impacts on breeding or wintering bird species. Caution must be ensured if in the vicinity of these areas between May-Aug. See Appendix 4, Code of Practice.	EU regulations.

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical/ chemical	**1**		As estuaries [1130] are not listed as a protected habitat in Clew Bay SAC, interactions with protected forms of these habitats will not occur. The spatial overlap between the *A. nodosum* zone and estuarine waters is low and in many cases is absent. *A. nodosum* also grows at low levels in muddy estuarine areas. In addition, measures are in place to ensure that hand harvesting does not impact on estuary habitat.
		3	The conservation status of estuaries is deemed 'Unfavourable-Inadequate' at a number of sites in Ireland: (Lough Swilly SAC, Dundalk Bay SAC and Lower River Shannon SAC; (Scally et al., 2020). As this habitat is not protected under EU regulations in Clew Bay the severity associated with impacts is reduced to reside within the range of 1-4.

(3) Mudflats and sandflats not covered by seawater at low tide [1140]

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures ? Yes / No		
Impacts on: • Area, • Structure and function • Future prospects	**General:** Damage caused by increase in alien invasive species on *Zostera noltei* beds *(e.g. Spartina anglica)*, change in sediment composition, increased sediment loads from activities upstream of rivers, discharge of untreated effluent and intensive agriculture causing disruption of sandy mud habitat in intertidal areas (Scally et al., 2020). ***A. nodosum* harvesting:** Use of boats during low tide to access rocky shorelines which lie beyond mudflat or sandflats.	2	5	A	no	n/a	yes	**The conservation status of marine Annex I habitats:** The Code of Practice (Appendix 4) provides a range of measures that will be undertaken to ensure that the conservation status of marine Annex I habitats is maintained or improved. In relation to mudflats and sandflats, harvesting will not occur in these areas. Harvesters will also ensure the implementation of Code of Practice to ensure that they do not navigate at low tide to rocky shorelines located beyond mudflat/sandflat areas (see Appendix 4)	EU Dir. 92/43/ EEC & NPWS The permanent habitat area is stable or increasing, subject to natural processes (Ref: Target 1 of Objective 2, NPWS, 2011A, page 14).

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical/ chemical	**2**		The probability of mudflats and sandflats being altered due to harvest activities in Clew Bay is relatively low given that: (a) this substrate is not suitable for *A. nodosum* growth and will not be targeted for harvest activities and (b) in most areas, mudflats and sandflats exhibit little overlap with the rocky shorelines. (c) accessing rocky shorelines lie beyond mudflats and sandflats at low tide in particular, is very difficult and would be avoided by harvesters. (d) harvesting has no impact on sedimentation rates. (e) mitigation measures are in place to prevent the spread of invasive species. While *Z. noltei* beds may be susceptible to increases in *S anglica*, neither species are reported to occur in Clew Bay.
		5	The overall conservation status of Mudflats and sandflats not covered by seawater at low tide in Ireland has been assessed as Unfavourable-Inadequate. In Clew Bay, the conservation status is favourable in terms of Area, Structure and function, future prospects, and the site's overall status (Scally et al., 2020). EU Dir. 92/43/EEC & NPWS, requires maintenance of *Tubificoides benedii* and *Pygospio elegans* community complex in intertidal sandy mud areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14). Harvest activities in these areas could significantly damage these community complexes and/or their habitat.

(4) Reefs [1170]

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).
NOTE: The *A. nodosum* biotope has been assessed in Section C of this Appendix.

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Impacts on: • Area, • Structure and function • Future prospects	**Pressures on reef may arise as follows (ref: Scally et al., 2020):** • **General:** Physical impacts on geogenic reef. • **Intertidal reef habitat:** Increase in invasive alien species and effects on intertidal marine algae potentially associated with harvesting. • **Sublittoral reef habitats:** examples of pressures include loss of fishing gear and the use of tangle nets and potentially the harvesting of macroalgae. • **Biogenic reefs:** Intertidal: honeycomb worm *(Sabellaria spinulosa), Mytilus edulis;* Subtidal: polychaete worm *(Serpula vermicularis).* ***A. nodosum* harvesting:** • Removal of habitat (i.e. reef): Potential removal of small quantities of stones, rocks, etc. • Removal with or without holdfast material: Small, stony, friable substrate occurs frequently in Clew Bay. • Disruption or disturbance of reef: Impact by boats or disturbance or displacement may occur with inappropriate technique, lack of training or oversight.	2	5	A	no	n/a	yes	**The conservation status of marine Annex I habitats:** The Code of Practice (Appendix 4) provides a range of measures that will be undertaken to ensure that the conservation status of marine Annex I habitats is maintained or improved. When operating within the intertidal zone where *A. nodosum* is present (sheltered reef and shingle substratum areas), harvesters will ensure adherence to all aspects this Code of Practice. This will ensure that the habitat area is maintained and that structure and function is maintained or improved. It also ensures that future prospects and conservation status of reef and shingle areas are maintained or enhanced, whilst also preventing in combination effects with existing and planned activities. Key aspects of the Code of Practice and the harvesting system include but are not limited to the following: • Hand harvest techniques employed along rocky shores will ensure that *A. nodosum* is severed above point of contact with underlying substrate (see Appendix 4). • Levels of disturbance/displacement that could give rise to presence of reef and/or associated holdfast material, will be monitored and recorded via 'Goods received Notes' (GRN) and also at production facilities. • A code of practice will be implemented to ensure that harvesters employ good boating practices, particularly when landing on shores (See Appendix 4). • Harvesters provided with training, where necessary, to ensure that reef is not disturbed or displaced. • Ensure that there are no physical interactions with biogenic reef in the rare event that it is encountered on the shore (e.g. honeycomb structures or mussels).	EU Dir. 92/43/ EEC & NPWS Maintenance of reef habitats and species therein (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).

Hazard	Probability	Severity	Reason for Decision
Biological / physical/ chemical	**2**		It is unlikely that the Area, Structure & function and Future prospects of Reef [1170] will be altered due to harvest activities in Clew Bay given that: • ***A. nodosum* harvesting:** ➢ It is unlikely that distribution, abundance, diversity or area of reef will be altered due to harvesting of *A. nodosum.* While *A. nodosum* may be harvested in from rocky shores which contain reef as underlying substrate, the hand harvesting technique used ensures that *A. nodosum* vegetative growth is severed well above the point of contact with reef. Contact with reef would also lead to damage to the harvester's sickle/blade, thus, reef will always be avoided. ➢ It is unlikely that significant levels of disturbance or displacement would occur, to levels which would lead to co-removal of reef with or without holdfast material. This is due to the fact that the hand harvest methodology involves working at low tide and harvesters have full view of the cutting process, allowing them to take care not to disturb the substrate. ➢ It is unlikely that reef will be damaged due to harvesting of *A. nodosum* given that: (a) harvesters will be using small boats to land on islands and coastal areas. Care will be taken in order to ensure that contact with reef is minimal, therefore avoiding any damage being inflicted on boats. (b) The collection boat (if deemed applicable to the area) will be fitted with a depth can device to ensure that contact with the reef is avoided as it will damage both the reef and the boat. ➢ Measures are in place to prevent impacts of harvesting and impacts on any associated species. See above and section A (8) and C (1a to 3g). • **Intertidal reef habitat:** ➢ **Increase in invasive alien species:** Mitigation measures are in place to prevent the spread of invasive species. See Section H above. ➢ **Effects of harvesting intertidal marine algae:** See above. In addition, measures are in place to prevent impacts of *A. nodosum* harvesting and impacts on any associated species. See above and section A (8) and Section C (1a to 3g). • **Sublittoral reef habitats:** Harvesting in subtidal areas will not take place. • **Geogenic reef:** Geogenic reef is unlikely to be vulnerable to change in Area due to the hard rock substrates from which they are formed. Other than minor alteration of the rock face due to the effects of natural erosion, habitat loss is highly unlikely (ref: Scally et al., 2020). It is unlikely that *A. nodosum* harvesting will impact on overall hydrodynamics as *A. nodosum* is adapted to growing in highly sheltered environs and as such, has difficulty remaining attached to hard substrate in less sheltered waters. Therefore, *A. nodosum* is likely to exert only a minor influence on hydrodynamics. The harvesting system is designed to ensure that dramatic changes in biomass levels within the intertidal zone will not occur. • **Biogenic reefs:** ➢ Honeycomb worm *(Sabellaria spinulosa):* It is unlikely that *Sabellaria* sp. will be affected due to harvesting as it mainly occurs in sublittoral zones in areas with moderate exposure, typically outside the *A. nodosum* zone. *S. spinulosa* is rare in Ireland and is not reported to occur in Clew Bay. ➢ Polychaete worm *(Serpula vermicularis)* occurs between the intertidal zone to depths down to 100 m. It has a broad depth range and is not reported to occur in Clew Bay. ➢ *Mytilus edulis:* occurs in exposed and non-exposed areas and occurs in a range of non-*A. nodosum* habitats. As such, it is unlikely to be impacted by *A. nodosum* harvesting activities.
		5	The overall conservation status of Reef in Ireland has been assessed as Favourable in terms of Area, Structure and function, future prospects. This includes both inshore and offshore reef areas (Scally et al., 2020). EU Dir. 92/43/EEC & NPWS, requires the maintenance of reef in a natural condition (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).

(5) Submerged or partially submerged sea caves [8330].

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Impacts on: • Area, • Structure and function • Future prospects	• Alteration of the rock face due to natural erosion and loss of area (Scally et al., 2020). • Removal of cave habitat or human activities that would influence community structure of seacaves. • Unauthorized harvest in these protected areas.	1	5	A	no	n/a	yes	**The conservation status of marine Annex I habitats:** The Code of Practice (Appendix 4) provides a range of measures that will be undertaken to ensure that the conservation status of marine Annex I habitats is maintained or improved. In relation to submerged or partially submerged areas, harvesting will not occur in these areas.	EU Directives.

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical/ chemical	**1**		Sea caves in Ireland are formed from hard rock. Other than minor alteration of the rock face due to the effects of natural erosion, loss of area is highly improbable. The inaccessible nature of sea caves makes them less vulnerable to anthropogenic impacts (Scally et al., 2020). The probability of the Area, Structure and function or Future prospects of sea caves and their habitat being altered due to harvest activities is low given that: (a) Intertidal *A. nodosum* zone is largely confined to unexposed, sheltered areas and will not occur in the vicinity of seacaves. (b) There will be no activities which will negatively affect key resources to sea caves, including water quality.
		5	The overall conservation status of submerged or partially submerged sea caves in Ireland has been assessed as Favourable in terms of Area, Structure and function, future prospects (Scally et al., 2020).

(6) Large shallow inlets and bays [1160]

Target 1: Permanent habitat area.

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).
NOTE: The *A. nodosum* biotope has been assessed in Section C of this Appendix.

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Impacts on habitat area	Non-conformance with harvest procedures leading to inadvertent removal of habitats, e.g. excessive removal of sand, shingle, stones, pebbles, rock, debris, holdfasts).	1	5	A	no	n/a	yes	**The conservation status of marine Annex I habitats:** The Code of Practice (Appendix 4) provides a range of measures that will be undertaken to ensure that the conservation status of marine Annex I habitats is maintained or improved. Addition measures are outlined below in relation to permanent habitat area. • Harvesters will be provided with training, where necessary, to ensure that no removal of permanent habitat occurs, i.e. ➢ No removal of excessive levels of sand, shingle, stone, pebble, gravel, etc. ➢ No removal of *A. nodosum* holdfasts that could carry sand, shingle, stone, etc. • Resource Manager will inspect the harvest on collection or during the washing bagging operation on the collection boat, if deemed applicable for the area. ➢ If excessive sand, shingle or debris is observed, the harvesters will be provided with training, where necessary. • Checks will be recorded on the Goods Received Notes (GRNs, Appendix 3). • Production Operators will also inspect incoming harvested seaweed on production logsheets. The following will apply: ➢ If excessive levels of sand, shingle or debris etc is present in harvested weed: -Removal by sand filter and decanter and clarifier. - Harvesters provided with training, where necessary. ➢ If stones or rocks are present: - Harvesters provided with training, where necessary. • Non-conformance is reported, particularly in the serious event of *A. nodosum* holdfasts being present.	EU Dir. 92/43/EEC & NPWS Target 1 of Obj. 1, NPWS, 2011A, pg. 12

Hazard	Probability	Severity	Reason for Decision
Biological/ physical/ chemical	**1**		The likelihood of impacting on habitat area is very low and substratum will not be removed or altered. In addition, the sustainable hand harvest method employed ensures regeneration of *A. nodosum* post harvesting. The likelihood of sand and rocks being removed along with harvested *A. nodosum* is low as. Given that sand and rocks may damage production equipment and end product, harvesters will be required to ensure such materials are not included in the bags/nets. The collection of floating bags/nets at high tide or as high tide approaches also reduces the likelihood of excessive levels of sand or other material being removed from the foreshore. This system ensures settlement to the seabed of any rarely occurring sand or other foreshore material that may be attached to the bottom or sides of the bag or in the netting. In addition, *A. nodosum* will be harvested no less than 200mm above the holdfast. This reduces the likelihood of holdfasts being removed, which could otherwise, inadvertently lead to removal of attached pebbles or stones (see Appendix 4 for Code of Practise).
		5	• The national conservation assessment indicates that shallow inlets and bays [1160] in Ireland are classified as 'unfavourable-bad' (Scally et al., 2020). The 'area' conservation attribute is classified as 'favourable', while 'structure & functions' and 'future prospects' are considered as 'unfavourable-bad' and 'unfavourable-inadequate' respectively. Clew Bay is categorized as 'unfavourable-bad' for three attributes: 'structure & functions' and 'future prospects' and 'overall site assessment'. In terms of 'area', Clew Bay SAC is classified as favourable. The unfavourable status of Clew Bay has been attributed to the loss of eelgrass beds, a significant decrease in the abundance of eelgrass shoots within a bed and an increase in negative indicators, e.g. epiphytic algal cover on eelgrass leaves, the presence of opportunistic species and invasive alien species. • The overall conservation status of Reef in Ireland has been assessed as Favourable in terms of Area, Structure and function, future prospects. This includes both inshore and offshore reef areas (Scally et al., 2020). In accordance with EU Dir. 92/43/EEC & NPWS, areas must be maintained at favourable conservation conditions to ensure stability of the permanent habitat area (Ref: Target 1 of Obj. 1, NPWS, 2011A, pg. 12). Removal of habitat may contravene this directive (e.g. removal of excessive levels of sand or rock).

Target 2: Community extent (*Zostera* and maërl dominated communities)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required. *probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2). NOTE: The *A. nodosum* biotope has been assessed in Section C of this document.

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Impacts on Community extent	Removal of habitat of rare & endangered species (i.e. *Zostera* Seagrass and associated communities; Maerl Dominated communities), potentially due to unauthorized harvest in these protected areas.	1	5	A	no	n/a	yes	**The conservation status of marine Annex I habitats:** The Code of Practice (Appendix 4) provides a range of measures that will be undertaken to ensure that the conservation status of marine Annex I habitats is maintained or improved. In relation to *Zostera* and maerl, harvest of *A. nodosum* will not take place in these areas.	EU Dir. 92/43/ EEC & NPWS Targets 2-4 of Obj.1, NPWS, 2011A, pg:12,13

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical/ chemical	**1**		It is highly improbable that the distribution, abundance, diversity or area occupied by *Zostera* Seagrass (and associated communities) will be altered due to harvesting of *A. nodosum* given that: (a) these areas and communities exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) the sandy substrate supporting *Zostera* growth are insufficient to support *A. nodosum* and thus, will not be affected by harvest activities. It is highly improbable that the distribution, abundance, diversity or area occupied by maerl and associated communities will be altered due to harvesting of *A. nodosum* given that: (a) these areas and communities exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) the coarse, mixed, sandy mud and muddy sand sediment substrates which support maerl growth are insufficient to support *A. nodosum* and thus, will not be targeted for harvest activities.
		5	• The national conservation assessment indicates that shallow inlets and bays [1160] in Ireland are classified as 'unfavourable-bad' (Scally et al., 2020). The 'area' conservation attribute is classified as 'favourable', while 'structure & functions' and 'future prospects' are considered as 'unfavourable-bad' and 'unfavourable-inadequate' respectively. Clew Bay is categorized as 'unfavourable-bad' for three attributes: 'structure & functions' and 'future prospects' and 'overall site assessment'. In terms of 'area', Clew Bay SAC is classified as favourable. The unfavourable status of Clew Bay is due in part to the loss of eelgrass beds, a significant decrease in the abundance of eelgrass shoots within a bed and an increase in negative indicators, e.g. epiphytic algal cover on eelgrass leaves, the presence of opportunistic species and invasive alien species. • EU Dir. 92/43/EEC & NPWS, requires the maintenance of the natural extent of Zostera Seagrass and associated communities and maerl and associated communities (Ref: Targets 2-4 of Objective 1, NPWS, 2011A, pages 12, 13). Harvest activities in these areas could significantly damage these areas and associated communities. • EU Dir. 92/43/EEC & NPWS, requires the maintenance of the natural extent of maerl and associated communities (Ref: Targets 2-4 of Objective 1, NPWS, 2011A, pages 12, 13). Harvest activities in these areas could significantly damage maerl and associated communities

Target 3: Shoot density *(Zostera)*

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).
NOTE: The *A. nodosum* biotope has been assessed in Section C of this Appendix.

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Impacts on *Zostera* shoot density (shoots per m2)	Removal of habitat of rare & endangered species (i.e. Zostera Seagrass and associated communities), potentially due to unauthorized harvest in these protected areas.	1	5	A	no	n/a	yes	**The conservation status of marine Annex I habitats:** The Code of Practice (Appendix 4) provides a range of measures that will be undertaken to ensure that the conservation status of marine Annex I habitats is maintained or improved. In relation to *Zostera*, harvest of *A. nodosum* will not take place in these areas.	EU Dir. 92/43/ EEC & NPWS Targets 2-4 of Obj.1, NPWS, 2011A, pg:12,13

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical/ chemical	**1**		As above for target 2
		5	As above for target 2

Target 4: Community Structure (Maerl)

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).
NOTE: The *A. nodosum* biotope has been assessed in Section C of this Appendix.

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Impacts on community structure (maerl)	Removal of habitat of rare & endangered species (i.e. Maerl Dominated communities), potentially due to unauthorized harvest in these protected areas.	1	5	A	no	n/a	yes	**The conservation status of marine Annex I habitats:** The Code of Practice (Appendix 4) provides a range of measures that will be undertaken to ensure that the conservation status of marine Annex I habitats is maintained or improved. In relation to maerl, harvest of *A. nodosum* will not take place in these areas.	EU Dir. 92/43/ EEC & NPWS Targets 2-4 of Obj.1, NPWS, 2011A, pg:12,13

Hazard	**Probability**	**Severity**	**Reason for Decision**
Biological/ physical/ chemical	**1**		As above for target 2
		5	As above for target 2

Target 5: Community distribution

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).
NOTE: The *A. nodosum* biotope has been assessed in Section C of this Appendix.

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk Assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Impacts on community distribution:								**The conservation status of marine Annex I habitats:** The Code of Practice (Appendix 4) provides a range of measures that will be undertaken to ensure that the conservation status of marine Annex I habitats is maintained or improved. Addition measures are outlined below. **Sandy mud (polychaetes and bivalves), fine sand *(Nephtys cirrosa)* and intertidal sandy mud (*Tubificoides benedii* and *Pygospio elegans*):** • Ensure implementation of the Code of Practice (Appendix 4) to ensure that harvesters do not attempt to navigate at low tide to rocky shorelines located beyond ➢ Mudflats and sandflats. ➢ Clean, fine sand areas in the south west of the complex. **Shingle:** • A system is in place which ensures that: ➢ Hand harvest techniques employed along shingle areas will ensure that *A. nodosum* is severed above point of contact with underlying substrate. ➢ Levels of disturbance or displacement that could give rise to presence of shingle, friable substrate and/or associated holdfast material in the harvested seaweed, will be monitored and recorded via 'Goods received Notes' (GRN) and also at production facilities. ➢ A code of practice will be implemented to ensure that harvesters	EU Dir. 92/43/ EEC & NPWS
Sandy mud with polychaetes and bivalves community complex	Unauthorized harvest in mudflat/sandflat areas during low tide.	2	5	A	No	n/a	Yes		
Fine sand dominated by *Nephtys cirrosa* community	Unauthorized harvest in these protected areas during low tide.	2	5	A	No	n/a	Yes		
Intertidal sandy mud with *Tubificoides benedii* and *Pygospio elegans* community complex	Use of boats to access rocky shorelines which lie beyond mudflats at low tide.	2	5	A	No	n/a	Yes		
Shingle	• Potential removal of small quantities of stones, rocks, etc. Small, stony, friable substrate occurs frequently in Clew Bay. • Impact by boats • Disturbance or displacement may occur with inappropriate technique, lack of training or oversight	2	5	A	No	n/a	Yes		

Reef	As per Section i(4) above and Section C of this Appendix.	2	5	A	No	n/a	Yes	employ good boating practices, particularly when landing on shores. ➢ Harvesters provided with training, where necessary, to ensure that reef or shingle is not disturbed or displaced. See "Code of Practise" for details (Appendix 4). **Reef:** As per Section i(4) above and Section C of this Appendix. Control measures in relation *A. nodosum* and species associated with this biotope are outlined in Section 1 (1a to 3g).	

Hazard	Probability	Severity	Reason for Decision
Biological/ physical/ chemical	**2**		**Polychaetes and bivalves community complex:** The probability of polychaetes and bivalves community complex and their habitat (sandy) being altered due to harvest activities in Clew Bay is relatively low given that: (a) sandy mud areas containing this community exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) sandy mud areas are insufficient to support growth of *A. nodosum* and thus, will not be targeted for harvest activities. (c) accessing rocky shorelines that lie beyond sandy mud areas at low tide in particular, is very difficult and would be avoided by harvesters by default. ***Nephtys cirrosa* communities:** The probability of *Nephtys cirrosa* communities and their habitat (clean, fine sand area) being altered due to harvest activities in Clew Bay is relatively low given that: (a) the fine sand areas containing this community exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested (b) fine sand areas are insufficient to support growth of *A. nodosum* and thus, will not be targeted for harvest activities. (c) accessing rocky shorelines that lie beyond clean, fine sand areas at low tide in particular, is very difficult and would be avoided by harvesters by default. ***Tubificoides benedii* & *Pygospio elegans:*** The probability of *Tubificoides benedii* & *Pygospio elegans* species and their habitat (intertidal sandy mud) being altered due to harvest activities in Clew Bay is relatively low given that: (a) *A. nodosum* does not grow on intertidal sandy mud substrate, and therefore will not be subjected to harvest activities. (b) in most areas, intertidal sandy mud areas exhibit little overlap with the rocky shorelines. (c) accessing rocky shorelines that lie beyond intertidal sandy mud areas at low tide in particular, is very difficult and would be avoided by harvesters by default. **Shingle:** • It is unlikely that distribution, abundance, diversity or area of shingle will be altered due to harvesting of *A. nodosum* given that shingle is considered contaminant material and will not be removed during harvest. • It is unlikely that shingle areas will be damaged due to harvesting of *A. nodosum* given that harvesters will be using small boats to land

			on islands and coastal areas. Care will be taken in order to ensure that contact with shingle and reef is minimal, therefore avoiding any damage being inflicted on boats. • It is unlikely that significant levels of disturbance or displacement of shingle will occur. This is due to the fact that the hand harvest methodology involves working at low tide and harvesters have full view of the cutting process, allowing them to take care not to disturb the substrate. **Reef:** • It is unlikely that distribution, abundance, diversity or area of reef will be altered due to harvesting of *A. nodosum.* While *A. nodosum* may be harvested in from rocky shores which contain reef as underlying substrate, the hand harvesting technique used ensures that *A. nodosum* vegetative growth is severed well above the point of contact with reef. Contact with reef would also lead to damage to the harvesters sickle/blade, thus, reef will always be avoided. • It is unlikely that significant levels of disturbance or displacement would occur, to levels which would lead to co-removal of reef with or without holdfast material. This is due to the fact that the hand harvest methodology involves working at low tide and harvesters have full view of the cutting process, allowing them to take care not to disturb the substrate. • It is unlikely that reef will be damaged due to harvesting of *A. nodosum* given that: (a) harvesters will be using small boats to land on islands and coastal areas. Care will be taken in order to ensure that contact with reef is minimal, therefore avoiding any damage being inflicted on boats. (b) The harvest collection boat, if deemed applicable for the area, will be fitted with a depth can device to ensure that contact with the reef is avoided as it will damage both the reef and the boat.
		5	• **EU Dir. 92/43/EEC and NPWS conservation requirements:** The following communities should be maintained in a natural condition: Sandy mud with polychaetes and bivalves community complex; Fine sand dominated by *Nephtys cirrosa* community; Intertidal sandy mud with *Tubificoides benedii* and *Pygospio elegans* community complex; shingle and reef (Ref: NPWS, 2011A) • **National assessment:** The national conservation assessment indicates that shallow inlets and bays [1160] in Ireland are classified as ‘unfavourable-bad’ (Scally et al., 2020). The 'area' conservation attribute is classified as ‘favourable’, while ‘structure & functions’ and ‘future prospects’ are considered as ‘unfavourable-bad’ and ‘unfavourable-inadequate’ respectively. • **Clew Bay:** Scally et al., (2020) assessed status of community distribution in Large shallow inlets and bays in Clew Bay. In their study, three community/habitats were assessed: (a) Sandy mud with polychaetes and bivalves community, (b) Fine sand dominated by *Nephtys cirrosa* community and (c) Intertidal sandy mud with *Tubificoides benedii* and *Pygospio elegans* community. Sampling took place in subtidal and intertidal sediment areas and on mudflat/sandflat habitats. Clew Bay was categorized as ‘unfavourable-bad’ for three attributes: ‘structure & functions’ and ‘future prospects’ and ‘overall site assessment’. The unfavourable status of Clew Bay has been attributed to the loss of eelgrass beds, a significant decrease in the abundance of eelgrass shoots within a bed and an increase in negative indicators, e.g. epiphytic algal cover on eelgrass leaves, the presence of opportunistic species and invasive alien species. In terms of ‘area’, Clew Bay SAC is classified as favourable. • **Reef:** The overall conservation status of Reef in Ireland has been assessed as Favourable in terms of Area, Structure and function, future prospects. This includes both inshore and offshore reef areas (Scally et al., 2020).

(j) Potential pressures on the marine environment.

(1) Hydrological

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*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Y / N		
Hydrological pressures/hazards:								The harvest system is designed with sustainability at the forefront and dramatic alterations to biomass levels will not occur. Harvest activities will not reduce height of *A. nodosum* below 200mm (8 inches). See "Code of Practise" for details (Appendix 4).	None specified.
Ocean acidification	No potential effects of *A.nodosum* harvesting.	0	5	A	no	n/a	No		
Sea level rise		0	5	A	no	n/a	No		
Increased UV		0	5	A	no	n/a	No		
Emergence regime changes (tidal level)		0	5	A	no	n/a	No		
Salinity change		0	5	A	no	n/a	No		
Temperature changes		0	5	A	no	n/a	No		
Water flow (tidal current) changes	Over-harvesting.	1	5	A	no	n/a	yes		
Wave exposure changes		1	5	A	no	n/a	yes		
Deoxygenation		1	5	A	no	n/a	yes		

Hazard/ Pressure	**Prob-ability**	**Severity**	**Reason for Decision**
Hydro-logical	**0 to 1**		• Seaweed harvesting is not considered as an activity that gives rise to the following hydrological pressures: ocean acidification, sea level rise, increased UV, emergence regime changes (tidal level), salinity change, temperature changes (ref: Marine Protected Area Advisory Group, 2020 and references therein). • It is highly unlikely that *A. nodosum* harvesting will impact on water flow (tidal current) changes or wave exposure changes. *A. nodosum* is adapted to growing in highly sheltered environs and as such, has difficulty remaining attached to hard substrate in less sheltered waters. Therefore, the potential influence of *A. nodosum* on hydrodynamics, water flow and wave exposure (if any) is likely to be minor. As the harvesting system is designed to ensure that dramatic changes in biomass levels within the intertidal zone will not occur, the likelihood of such effects arising is further reduced. • Dissolved oxygen enters water via two mechanisms: (a) entry directly from the air leading to aeration of water; e.g. either through slow diffusion of air across water surfaces or from quick mixing via wind, waves and other related factors and (b) as a byproduct of photosynthesis. The contribution of seaweed to oxygenation via photosynthesis is relatively minor. In particular, marine macrophytes account for low levels of global net primary production (NPP) of carbon per annum (<1%) compared to other sources, e.g. the combined category of land sources (e.g. land plants, forestry, crops) and marine phytoplankton together account for 99% of global NPP of carbon per annum (Field *et al.*, 1998). NPP is the total amount of carbon fixed in the process of photosynthesis (the conversion of carbon dioxide, water and light energy into glucose and oxygen) by plants in an ecosystem [Gross Primary Production] minus respiration. As hand harvesting of *A. nodosum* (a renewable resource) will be undertaken in a sustainable manner to allow regeneration of the resource, net primary production of carbon and production of oxygen as a by-product of photosynthesis will not be significantly affected.
		5	Alterations to hydrodynamics, water flow (tidal current) changes, wave exposure changes and deoxygenation could potentially have impacts on the Clew Bay Complex and its conservation requirements.

(2) Chemical

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*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Yes / No		
Chemical pressures/hazards:					no	n/a		• BioAtlantis will not harvest in areas near sewage outfalls or other sources of pollution. • The management system requires that over-harvesting does not occur. • Routine maintenance of boat engine, etc. • Harvesters will be provided with training, where necessary, to ensure cleaning takes place in a manner which does not lead to wash off of cleaning agents into the environment, e.g. use of designated washing bays where available. See "Code of Practise" (Appendix 4) for details.	None specified.
Nutrient enrichment	• Harvesting near sewage outfalls. • Over-harvesting.	1	5	A	no	n/a	Yes		
Organic enrichment	• Harvesting near sewage outfalls. • Over-harvesting.	1	5	A	no	n/a	Yes		
Radionuclide contamination	• No potential effects of harvesting.	0	5	A	no	n/a	n/a		
Synthetic compound contamination	• Fuel oil leak from harvest recovery/collection boat caused by engine malfunction, fuel line rupture, etc. • Non-conformance with procedures for storing and cleaning of boat.	1	5	A	no	n/a	Yes		
Non-synthetic compound contamination	• Harvesting near sewage outfalls	1	5	A	no	n/a	Yes		

Hazard/ Pressure	**Probability**	**Severity**	**Reason for Decision**
Chemical	**0-1**		• Seaweed harvesting is not considered an activity that gives rise to radionuclide contamination or synthetic compound contamination (ref: Marine Protected Area Advisory Group, 2020 and references therein). • BioAtlantis Ltd. will manage harvesting in a sustainable manner to ensure that excessive removal of A. nodosum does not occur and is limited to 20% of the total available biomass per site per annum and that *A. nodosum* mortality is mitigated against. This reduces the likelihood of any potential effects occurring in terms of nutrient and organic enrichment and ensures that substantial levels of unharvested *A. nodosum* remain in situ post-harvesting. • It is highly unlikely that *A. nodosum* harvesting will give rise to chemical pressures such as nutrient enrichment, organic enrichment or non-synthetic compounds contamination. In particular, harvest activities will not give rise to significant increases in pollution (see Section A1 above). It has been suggested that seaweeds may reduce the impact of anthropogenic mediated nutrient-enrichment of marine waters and in turn, the

Hazard/ Pressure	Probability	Severity	Reason for Decision
			removal of seaweed could potentially exacerbate the impacts of pollution. However, *A. nodosum* is low in protein content and its capacity absorb nitrogen and nutrients is minimal. Polluted water can also have negative impacts on *A. nodosum* performance, epiphyte infestation, colonisation and competition by green algae. As such, *A. nodosum* is a species that is susceptible to the effects of pollution. The likelihood of exacerbating existing impacts of pollution are also low as hand harvesting in proximity to sewage outfalls, etc, will not occur. • It is highly unlikely that nutrient cycling in marine and coastal areas will be affected by sustainable harvesting, as *A. nodosum* is typically low in nutrient content and has a low capacity to absorb nitrogen. The sustainable nature of the harvesting plan ensures that the likelihood and magnitude of any effects are low. • It is highly unlikely that harvesting of *A. nodosum* will have any impacts on the level of detritus, drift litter, dissolved organic matter (DOM), organic enrichment or secondary production in sandy beach locations or other areas. *A. nodosum* is mainly restricted to sheltered rocky/shingle substratum areas and rarely accumulates at high levels in sandy beach locations or other exposed coastal areas. Furthermore, as the plan requires harvesting to take place on a sustainable basis in terms of the nature, scale, intensity and duration of the activity, the likelihood or magnitude of any effects are low. As the hand harvesting system ensures that over-harvesting does not take place and that *A. nodosum* mortality is mitigated against, the likelihood of over harvesting of *A. nodosum* to levels which significantly reduce total organic drift litter, detritus or organic matter in the Clew Complex, is low. • Contamination with non-synthetic compounds will not occur due to harvesting, as the harvesting plan ensures appropriate removal of any rubbish, debris, waste or other foreign matter when at port.
		5	A high severity rating is assigned, as alterations to water quality due to chemical pressures/hazards could have significant impacts on the SAC in broad terms.

(3) Physical

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Y/N		
Physical pressures/hazards:								As per Sections A (7) and A (8), a system is in place to ensure: • Hand harvest techniques employed along rocky shores and shingle areas will ensure that *A. nodosum* is severed above point of contact with underlying substrate. Sites will be inspected post harvest to check the sustainability of the methods employed and the harvest locations (Site Inspection Form, SIF, Appendix 3). • Levels of disturbance or displacement of substratum that could give rise to presence of reef, shingle, friable substrate and/or associated holdfast material, will be monitored and recorded via 'Goods received Notes' (GRN) and also at production facilities. • Harvesters will employ good boating practices, particularly when landing on shores. • Harvesters will be provided with training, where necessary, to ensure that reef and shingle is not disturbed or displaced. • Levels of disturbance or displacement that could give rise to presence of substratum material in the harvested seaweed, will be monitored and recorded via 'GRN and at production facilities.	None specified.
Habitat structure changes - removal of substratum (extraction)	• Removal of habitat (i.e. reef, Shingle, pebbles and gravel): Potential removal of small quantities of stones, rocks, etc. • Removal with or without holdfast material: Small, stony, friable substrate occurs frequently in Clew Bay. • Disruption or disturbance of reef or shingle: Impact by boats, disturbance or displacement may occur with inappropriate technique, lack of training or oversight.	2	5	A	no	n/a	Yes		
Disturbance of the substrate		2	5	A	no	n/a	Yes		
Physical change to seabed or sediment type	• No potential effects of harvesting.	0	5	A	no	n/a	No	N/A	
Physical loss (to land or freshwater habitat)	• No potential effects of harvesting.	0	5	A	no	n/a	No	N/A	
Barrier to species movement	• No potential effects of harvesting.	na	5	A	no	n/a	No	Not required as proposal does not include artificial barriers. However, the Code of Practice includes measures to prevent barriers to commuting or connectivity of Annex II species.	
Changes in suspended solids (water clarity)	• No potential effects of harvesting.	0	5	A	no	n/a	No	N/A	

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Requirements**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Y/N		
Death or injury by collision	• H&S not adhered to. • Physical contact with or disturbance to Annex II species and Annex I habitats.	1 2	5 5	A A	no no	n/a n/a	Yes Yes	• Ensure that all necessary H&S equipment is maintained. Adherence to H&S practices will be checked by the Resource Manager and noted in the site Inspection Form, if applicable. • Ensure suitable use of bags/nets and implement steps to minimize co-harvesting other species or by-catch of other *Animalia*. • Follow measures to prevent interactions or disturbance with Annex II species in the water (harbour seals and otters). • Ensure adherence to environmentally safe navigation requirements to prevent impacts on Annex I habitats. See Appendix 4 for details.	
Electromagnetic changes	• No potential effects of harvesting.	0	5	A	no	n/a	No	N/A	
Light pollution	• No potential effects of harvesting.	0	5	A	no	n/a	No	N/A	
Introduction of other substances (solid, liquid or gas)	• No potential effects of harvesting.	0	5	A	no	n/a	No	N/A	
Litter	• Debris from the boat may inadvertently be deposited into the environment.	1	3	A	no	n/a	Yes	Appropriate removal of rubbish, debris or other foreign matter when at port.	
Smothering and siltation rate changes	• No potential effects of harvesting.	0	5	A	no	n/a	No	N/A	
Noise pollution	• No potential effects of harvesting.	0	5	A	no	n/a	No	N/A	
Vibration	• No potential effects of harvesting.	0	5	A	no	n/a	No	N/A	
Visual disturbance	• No potential effects of harvesting.	2	5	A	no	n/a	Yes	See Sections A10, 11, 12, 13, 14 and 19 of this document for measures to prevent disturbance of Annex I species (otter and harbour seals) and birds and Appendix 4 for the associated Code of Practice.	

(4) Biological

KEY: P=Probability. S=Severity. UA=Unacceptable Risk (Risk>15), NIS and mitigation required. A= Risk may be acceptable (Risk<15), NIS may be required.
*probability and severity determined based on risk assessment matrix (Fig. 1) and decision tree (Fig. 2).

Hazard *(What can go wrong)*	**Cause** *(Why did it go wrong?)*	**Risk assessment**			**Decision Tree**			**Control Measure** *(What can I do about it?)*	**Compliance Require-ments**
		P*	***S****	***A/UA***	Q1	Q2	Control Measures? Y/N		
Biological pressures/hazards:								See Section H of this document. See Section E(2)(ii) of this document. See Section C1(a) of this document	None specified.
Genetic modification and translocation of indigenous species.	No potential effects of harvesting.	0	5	A	no	n/a	no		
Introduction of microbial pathogens.	No potential effects of harvesting.	0	5	A	no	n/a	no		
Introduction or spread of invasive non-indigenous species (INIS).	See Section H of this document.	1	5	A	no	n/a	yes		
Removal of non-target species.	See Section E(2)(ii) of this document.	3	3	A	no	n/a	yes		
Removal of target species.	See Section C1(a) of this document	2	5	A	no	n/a	yes		

Hazard/ Pressure	**Probability**	**Severity**	**Reason for Decision**
Biological	**0-3**		Seaweed harvesting is not considered as an activity that gives rise to any of the following: Genetic modification and translocation of indigenous species, introduction of microbial pathogens. (ref: Marine Protected Area Advisory Group, 2020). The likelihood of occurrence of the other biological pressures listed above are relatively low (see Sections H, E(2)(ii) and C1(a) of this document for details).
		3-5	Medium to high severity scores are assigned, as biological pressures may have the potential to significantly impact on the SAC in broad terms. See Sections H, E(2)(ii) and C1(a) of this document for details.

(5) Other Marine-related Activities

See Section 3(c) of Appendix 7.