Environmental Management Framework

Table of Contents

1. Introduction

Environmental Management Framework

This Environmental Management Framework forms the basis for a full Environmental Management Plan (EMP) for the construction of the Galway Harbour Extension.

An Environmental Management Plan is a document consisting of the action map detailing the programme, policies, standards, instructions, guidelines and procedures to be observed, followed and implemented by the project stakeholders to prevent, control and or mitigate the adverse impacts of the environmental and other associated risks that were identified and evaluated by the initially made assessment studies on the project. As a key outcome of the Environmental Impact Assessment (EIA), it is the implementation manual for project's environmental management. The EMP is supposed to be dynamic and updated and that it is capable of meeting the current requirements of the project, addressing the compliance to regulations of governing authorities and be able to anticipate and properly manage the risks and other environmental issues as well as be able to respond properly in cases when negative impacts happen in spite of the measures implemented. It is also a performance tool that indicates the level of environmental compliance of the project by evaluating the identified environmental performance parameters.

The proposed monitoring plan for Galway Harbour Extension entails those parameters that have been identified as significant in the EIA Matrix. This Environmental Management Framework provides the basis for the development of a full EMP prior to construction. This Environmental Management Framework has been developed not only to satisfy the statutory requirements of the EIA process, but also as a consequence of the proper implementation of the proposed development of New Galway Docks project and its relationship to the integrity of the environment and affected public / impact receptors in the area.

Purpose of the Environmental Management Framework

This Environmental Management Framework is for the phased construction of the project and covers the following works:

- Dredging of material from an area of sea bed and the use of these materials to create an area of infill up to a final finished level of + 4.7m OD (7.6m CD). The infill will be surcharged by some 2m above final level initially to accelerate consolidation, with excess amounts to be removed when adequate consolidation has taken place.
- Edge protection of parts of the reclaimed area by use of embankments protected on the seaward side with rock armour revetments.
- Breakwaters and Quay Wall Construction including sheet piling, combi-walls, filling and all accessories including ecologically engineered concrete.

- Marina Infrastructure
- Slipway, Kayak Landing and other water amenity facilities
- Roadways, Yard Pavements, Pathways and associated facilities
- Railway Line including embankments, bridge and associated infrastructure
- All Utilities and Services
- Buildings for a Harbour Office, a Marina Office, a Passenger Terminal, including all security gatehouse facilities, ESB substation and Fire Water Pump house
- Upgrade Works to existing roadway at Lough Atalia Railway Bridge and at existing harbour access junction

Specifically, the purpose of the Environmental Management Framework and in due course the developed EMP is to:

- ☐ Ensure the Contractor's and Subcontractor(s)' commitment in minimising environmental effects;
- ☐ Document environmental concerns and implement appropriate protection measures;
- ☐ Provide guidance to Management regarding procedures for protecting the environment and minimizing environmental impacts;
- ☐ Provide relevant information and training regarding environmental issues, as and when required;
- ☐ Provide a reference to applicable legislative requirements.

The information contained in this Environmental Management Framework and in due course the developed EMP will be supplemented by the contractor's Environmental Implementation Plan (EIP) containing specific action plans of the contractor regarding the requirements of the EMP stated here, such that the Environmental issues and regulatory requirements are properly addressed.

2. Project Overview

Project Environmental and Health and Safety Policy, Objectives & Targets

2.1.1 Environmental Policy, Objectives & Targets

****

- ☐ Preventing damage to the natural environment by minimizing nuisance and disturbance to the natural ecosystems
- ☐ Minimise waste production and ensure correct waste management on site
- ☐ Proper management and control of operations of sources of air and noise

- ☐ Actively promote an environmentally responsible approach to the project activities amongst the entire workforce
- ☐ Ensure Subcontractors/Suppliers/Visitors apply the same or equivalent Environmental practices as those defined by Client and Contractor.
- ☐ Involve and commit Project Management as well as each employee to the Project Environmental Policy, Objectives and Targets;

2.1.2 Health and Safety Policy, Objectives and Targets

The Galway Harbour Company, as Client, will commit to best practice with respect to the Health Safety and Welfare of the community during the preparation, design and construction of this project. It will appoint entities who will allocate adequate and competent resources to fulfil this goal, so that, at a minimum, compliance with all statutory safety health and welfare legislation is met. The key objective will be to proactively prevent harm, damage and loss to all personnel, who could be affected by the project. To achieve this, the Galway Harbour Company, as Client, will: -

- ☐ Appoint designers with the necessary competence and resources to design all of the project elements so that they can be safely constructed
- ☐ Appoint a competent Project Supervisor Design Process who will organize cooperation between all designers and ensure coordination of all their design activities which could affect the safety health and welfare of any persons who could be affected by the construction on this project
- ☐ Appoint a competent Project Supervisor Construction Stage, who will organize cooperation between all contractors and see that arrangements are put in place to construct all of the project elements so as to protect any persons who could be affected by the construction on this project
- ☐ Appoint contractors who will provide adequate and competent resources to construct the project elements so as to protect any persons who could be affected by the construction on this project

The Development

The Galway Harbour Extension is described in detail in the EIS. The Galway Harbour Extension will provide a multifaceted port facility to reasonably meet all port user requirements. These can be summarised as follows: -

- Deep Water Berths for Large Cruise Liners with easy sea approach access
- Safe and Secure Berths for Oil and Bitumen Tankers
- Berths for Coal, Steel and General Cargo with direct linkage to transport infrastructure
- Protected Berths for Fishing Vessels
- Facilities for Marine Sport and Leisure Activities
- Launching Facilities
- Safe and Secure Berths for Yachts and Pleasure Craft
- Land Based Areas for Uncovered Storage, Buildings and associated Harbour Facilities

- Utilities, Transport and Services Infrastructure

Again, as set out in the EIS, these will be achieved by the phased construction of a range of civil, marine and building engineering elements, which can be summarized as follows: -

- Lagoon Walls to contain marine dredged materials and provide access roads to construction areas
- Lagoon Walls protected with breakwater revetment on sides exposed to sea climate
- Use of ecologically engineered concrete to enhance settlement by flora and fauna
- New Approach Channels Dredged to provide safe easy access to all berths
- Dredged Materials Filled into confined Lagoons
- Reclamation of Land comprised by Lagoon Areas
- Creation of Defined Open Areas within Reclaimed Land
- Outer Harbour Protection Breakwater
- Quay Walls for Deepwater Berths for Liners, Oil and Bitumen Tankers, and Cargo Vessels
- Fisherman's Pier
- Nautical Centre Slipway
- Marina Protection Breakwater
- Marina Berths
- Dedicated Utilities and Services to Oil, Bitumen, and Marina Berths
- General Utilities and Services to All Areas
- Rail Transport Link to Outer Quays
- Individual Site Developments

Table 1. Coordinates of Galway Harbour Extension Site (TOBINS)

3. Management Structure and Responsibilities

Project Organisational Structure

In order to deliver this project, Galway Harbour Company has appointed a team of project managers, and specialist consultants, initially to prepare the EIS. These have liaised with Galway Harbour Company during the development of the EIS and the associated design work. They have also carried out consultations with a variety of stakeholders and prescribed bodies, as part of this process. In due course, contractors will be procured to construct the project works. During that construction project, the environmental framework, to meet the environmental standards described in the EIS, herein and in the Planning Permission, will be established in the contract between the Galway Harbour Company and the Contractors, and will be closely monitored for compliance with the standards set down. An Independent Environmental Consultant will be appointed to monitor compliance with those

requirements, and to see that adequate controls are put in place to manage continuous compliance.

Project Management

The owner / developer have the overall responsibility for the project. The overall management and implementation are delegated to the assigned Project Manager, Engineering and Contractor who have their respective allocated responsibilities. Critical to the successful implementation of the EMP is the recognition and active acceptance by the Contractor of its responsibilities as the main implementer of the EMP. The key responsibilities of the Contractor are the following:

- ☐ All contractors shall implement and adhere to the EMP. Uncertainties within the EMP shall be clarified with the Consultant prior to signing of agreement.
- ☐ All contractors shall execute the EMP through the contractor's environmental officer on-site and reports to the Environmental Manager and coordinate with the Consultant.
- ☐ All contractors shall allocate the necessary funds to implement all the EMP specifications as far as reasonably practicable
- ☐ All contractors should provide a detailed plan in the form of Environmental Implementation Plan (EIP) stating how they intend to meet the requirements of the EMP. This will be reviewed and amended by the consultant to verify inclusion of all environmental implications associated with the project.
- ☐ All contractors should ensure staff members, sub-contractors and suppliers understand and adhere to the EMP. Non-compliance with the conditions of the EMP, which will form part of the agreement, will constitute a breach of contract.
- ☐ All sub-contractors should appoint their own individual Environmental Officers who will be taking the same responsibilities as that of the Environmental Officer(s) of the Main Contractor.

The Environmental Manager / Officer has the most critical roles for implementation of the EMP and as such shall be required to prepare an initial implementation programme and procedures for ensuring compliance and to provide regular detailed reports demonstrating compliance i.e. weekly during the works. The onus shall be on the Environmental Manager to immediately report non-conformances so that immediate corrective action is taken. For easy understanding, key tasks and responsibilities of the Environment, Health & Safety Officer or the Contractor's Environmental Representative (CER) are tabulated below:

Table 2. Key Tasks & Responsibilities of Environmental Manager

Item	Tasks	Reports	Additional Notes
Water Quality	Suspended solids sampling to be done as prescribed by ABB; Water sampling to be done at Ballyloughan Beach and at seaward side of lagoon for visual monitoring and comparison	Submission of the laboratory results to environmental consultant within 3 days with proper explanation for occurrence of any incidence of exceedance Daily log on the record book for the monitoring of the observation of SS	A complete water quality test shall be conducted for baseline survey and / or as needed for ecological surveys
Airborne Noise	Airborne noise monitoring will be carried out at each stage or process of construction, e.g. TSHD dredging Cutter Suction dredging Backhoe dredging pile-driving blasting Rock transport and placement General construction activity Noise monitoring locations at Ballyloughan Beach, Liam Mellows Park, Dún Aengus	Routine noise monitoring to be carried out at beginning of each stage/process (with the exception of general construction) and at a minimum quarterly basis unless specific activities warrant more frequent monitoring during the construction stage. When dredging, pile-driving and rock placement stages are complete monitoring to revert to six monthly periods unless specific activities warrant more frequent monitoring.	

	Apartments and Grattan Road to be monitored during both day and night operation. A noise complaint handling procedure will be put in place	Monitoring of Air overpressure will be carried out for each of first 6 blasts. If noise levels are not in compliance with planning permission conditions/limits verbal notification is to be given to the environmental consultant immediately and appropriate remedial measures taken. Noise monitoring reports to be submitted to the environmental consultant within 3 days.	
Underwater Noise	Underwater noise monitoring at different tidal stages will be carried out on sites at lower River Corrib, South of head of Nimmo's Pier, mid-way between Rabbit and Hare Island and mid-way between the Leverets and Mutton Island on a quarterly basis during construction. Underwater noise monitoring will be carried out at the commencement of each stage or process of	Routine noise monitoring to be carried out at beginning of each stage/process (with the exception of general construction) and at a minimum quarterly basis unless specific activities warrant more frequent monitoring during the construction stage. When dredging, pile-driving and rock placement stages are complete monitoring to revert to six monthly periods unless specific	Underwater noise monitoring at different tidal stages will be carried out on sites at lower River Corrib, South of head of Nomo's Pier, mid-way between Rabbit and Hare Island and mid-way between the Leverets and Mutton Island on a quarterly basis prior to start of construction to establish baseline levels. Any change in underwater noise

	construction, e.g. TSHD dredging Cutter Suction dredging Backhoe dredging pile-driving blasting Rock transport and placement General construction activity This monitoring can be substituted for a round of quarterly monitoring where appropriate. Cetacean monitoring and seal surveys to be carried out by a suitably qualified ecologist on a quarterly basis for 1 year prior to construction, during construction and for 2 years post construction	activities warrant more frequent monitoring If noise levels are not in compliance with planning permission conditions/limits verbal notification is to be given to the environmental consultant immediately and appropriate remedial measures taken. Noise monitoring reports to be submitted to the environmental consultant within 3 days. Marine mammal monitoring reports to be submitted to the National Parks and Wildlife Service within one month of completion	levels sufficient to warrant corrective action will be brought to the attention of the environmental consultant and appropriate remedial measures will be undertaken immediately Any significant change in marine mammal use of the area will be notified to the National Parks and Wildlife Service as soon as the environmental consultant becomes aware it.
Vibration	Vibration monitoring locations at Cold Chon tank farm, Enwest oil terminal, Leeside Oil Terminal, Liam Mellows Park, Dún Aengus	If vibration levels are not in compliance with planning permission conditions/limits verbal notification is to be given to the	Vibration is only likely to be an issue during blasting

	Apartments and Grattan Road will be monitored during each blast for first 6 blasts. Subsequently each oil terminal will be monitored in addition to one of the other 3 locations in rotation unless otherwise warranted	environmental consultant immediately and appropriate remedial measures taken. Vibration monitoring reports to be submitted to the environmental consultant within 3 days.	
Air Quality - Dust	Dust deposition monitoring will be carried out on a continuous basis for the full construction period at the east, north and west site boundaries. Dust control suppression sprays will be deployed as required during construction. A wheel-wash facility will be installed at the site entrance for all vehicles exiting the site. Road sweepers will be employed as required during construction on all surfaced areas. A dust complaint handling procedure will be put in place	Dust monitoring reports to be submitted to the environmental consultant within 3 weeks of the end of each month.	

Air Quality - Odour	A weather station will be maintained for the duration of construction. Daily weather data including wind speed, wind direction, precipitation and sunshine hours will be logged. Odour monitoring transects will be established on the site boundary for the duration of the TSHD dredging phase. Daily logs of subjective odour observations at the site boundaries will be maintained for the duration of TSHD activity. TSHD material placement will be carried out in limited areas with odour suppressant sprays deployed as required An odour complaint handling procedure will be put in place	Daily weather observations and subjective odour assessments will be logged on site and made available to the planning authority when requested. Documented procedures for corrective action taken as a result of noted elevated levels or odour complaints will be maintained on site and made available to the planning authority when requested.	
Other attributes: Site and Work Management, , Light, Traffic & Security, Waste Management, Emergency Management, Supply of Materials	Regular implementation and monitoring of the tasks specified for each attribute	Reports should be included in the regular monthly report to the consultant	Check sheets will be helpful as quick guidance to look into for conducting checks to similar items on a regular basis. Check sheets should be made for

and Storage, Ecological Concerns			each of the attributes identified
Construction Progress Monitoring	Dredger operation monitoring which includes volume of dredged spoil and daily log of the location of dredger	Daily reports from the production / construction engineer should be obtained and filed for inclusion in the monthly report	Bathymetric surveys must be done before and after pre-determined production cycle or as needed
Recording & Reporting	Maintain records of the EHS incidents, accidents, emergency situations; records and schedules of equipment, backhoe, trucks, dozers / sources of emissions, waste disposal records and disposal, maintenance of dredger and floating pipelines.	Incidences of breaches of standard limits or any form of emergency situation or accident must be all reported as soon as possible to the stakeholder / environmental consultant to include full details of the incident, extent of damage / impact (quantifiable and unquantifiable), proposed solution / countermeasures and remediation plan	Records should be kept regularly updated
Communication	Maintain regular communication with environmental consultant and project stakeholders; coordination and regular meeting with the consultant to the authorities, nearby development projects and the public whenever necessary; participation to regular meetings with stakeholders	Minutes during meetings should be properly documented for references	Monthly Meeting with Harbour Board; Weekly EHS Team Meeting (internal), Weekly Productivity Meeting with project stakeholders

	and conduct of regular meeting with his team		
Other Management and Administrative Tasks	Dispatching regular team inspection at the site, management system audit for environmental performance, planning and scheduling of regular tasks	Inspection and audit check sheets, environmental appraisal sheets, schedule and job assignment tables must be generated	Team inspection of representatives of stakeholders can also be arranged from time to time, to include site inspection and dredger visit Monthly activity site schedule should be coordinated and submitted to the consultant at least a week before the month's schedule

Environmental Consultant

The Environmental Consultant will have their own set of responsibilities and for clear delineation with the task of the Contractor and key roles are stated as follows: The consultant is reporting to the developer/ owner or to the delegated Project Manager as desired by the owner / developer.

The external independent environmental consultant will prepare an audit compliance report. This monthly report will:

- ☐ State whether the proponent has complied with each condition and procedure contained within the EIA approval documentation;
- ☐ Provide verifiable evidence of compliance with each condition and procedure contained within the EIA approval documentation;
- ☐ State whether the proponent has conformed with each key action contained in the EMP;
- ☐ Provide verifiable evidence of conformance with each key action contained in the EMP;
- ☐ Identify all non-compliances and non-conformances and describe the corrective and preventative actions taken in relation to each non-compliance or non-conformance;
- ☐ Review the effectiveness of all corrective and preventative actions taken

Other responsibilities of the environmental consultant include:

- ☐ Conducting periodic cross-checking site visits (at least one (1) visit per two (2) working days) or as necessary to ensure that the contractor adheres to all requirements addressed in this EMP;
- ☐ Carrying out / supervise the collection of field measurements e.g. sediment samples, noise, dust and water samples etc.
- ☐ Preparing and submitting monthly reports (one (1) report per month) to be submitted latest on the 15th of the following month; and
- ☐ Meeting with stakeholders and preparing the Minutes of Meetings.

All Persons involved

All other persons and groups involved at the work at the site must;

- ☐ Comply with the requirements of this EMP
- ☐ Comply with all legal requirements expressed within the approved contract, laws and relevant acts;
- ☐ Exercise "Duty of Care" [1]to the environment and to the people at all times, and
- ☐ Report all incidences

4. Environmental Criteria

The Environmental Criteria as laid out in Section 7 of this EMP will be made to serve as reference and guidance in the implementation of the EMP. The Contractor will be tasked to read the details of this EMP to fully understand the tasks and measures being discussed in this document.

5. Regulatory Framework

5.1 National and Local Environmental Regulations

The Contractor will abide by the regulatory standards as a minimum, to protect the environment, and any others who may be affected by the project activities. The Contractor and his Subcontractors should comply with the following:

- ☐ Applicable environmental codes and regulations of Ireland;
- ☐ Applicable international laws, as relevant;
- ☐ Contract environmental requirements;

- ☐ Contractor internal environmental requirements;
- ☐ Industry Standards and good practices, where appropriate.

6. Construction Methods

The construction methods, briefly summarized below, are all described in detail in Chapter 3 of the EIS.

6.1 Survey and Preparation

Topographic surveys will be performed prior to commencement of the dredging and reclamation operations to determine the initial conditions of the site, access roads, surrounding, beaches, public places, etc. The findings of these surveys will establish the baseline against which the site restoration work will be evaluated after dredging, reclamation, civil and marine engineering works and other construction operations have been completed. Pre-dredging bathymetric surveys will be carried out to verify the actual depths, immediately prior to dredging and the volume of materials that is intended to be dredged. During the progress of the construction, close monitoring of the progress of the dredging works and production volumes will be performed through ongoing surveys that the dredging operation are being executed based on the requirements and that the operation is being carried out within the boundaries of the dredge area. At the completion of the operation, post-dredge surveys will verify the total amount of dredged material and that the dredging operation was executed based on the requirements and within the boundaries of the dredge area. Results of the surveys will be submitted in a formal report within 2 months of the completion of the field work.

6.2 Vessels and Equipment

The precise vessels and equipment that will be used will depend on the particular contractors carrying out the works. In the EIS, details of the proposed methodologies have been described with reference to generic vessel and equipment types. There will be a significant variety of vessels and equipment used during the works and the separate sections below for the key elements of the project will summarise these.

Table 3. Vessels and Equipment

Illustration	Number	Vessel /Equipment	Operation
	To be finalized by the contractor	Trailing Suction Hopper Dredger (TSHD)	Appropriate for dredging at deeper portions of the area; can dredge and at the same time store materials temporarily in its hull and transport in distances
	To be finalised by the contractor	Cutter Suction Dredger (CSD)	Suitable in fairly shallow waters; utilizes floating pipelines to deliver and dispose of dredged materials; may need additional booster for pipes for long distances
	To be finalised by the contractor	Back hoe dredger (BHD)	Excavation of coarser materials including rock fractured by explosives
	To be finalised by the contractor	Jack up rig	Drilling holes for emplacement of explosives

	To be finalised by the contractor	Sediment Carrier / with push boat transport barge with tug	Transports materials from the dredge area to the reclamation site or re-handling area
	To be finalised by the contractor	Floating pipeline	Transports sediments from the dredge area to the reclamation site
	To be finalised by the contractor	Bull Dozer	Will be utilized to push transported materials within the lagoon during the formation of bunds and for spreading the dredged materials around the site
	To be finalised by the contractor	Backhoe	As above

	To be finalised by the contractor	Dump Truck	For transport of materials from the quarry and dredged materials within the reclamation site
	To be finalised by the contractor	Dumper	For transport of materials within the reclamation site

6.3 Dredging & Reclamation Operation

In the EIS, the methodologies for dredging and reclamation are described in detail.

For dredging, two types of dredger are proposed, (i) the Trailer Suction Hopper Dredger (TSHD) and (ii) the Backhoe Dredger (BHD).

The type of dredger to be used will depend on the sediment/material being dredged. The TSHD will excavate the softer sediments and these will be transferred via pump through sealed floating pipelines into the lagoons. In the case of soft sediment, the cutter head will hydraulically suck in the slurry mixture of the sand and water and pump the fluidized materials into a floating pipeline to be discharged at the bunded lagoon area.

The BHD will excavate the firmer sediments and the blasted/loose rock, in turn transferred via barge and another quay mounted backhoe dredger onto trucks for distribution into the lagoons using grab buckets, dumpers and spreaders as appropriate.

The infilling process will commence as soon as the area is fully bunded via the floating pipeline of the dredger or by a back hoe dredger. Except for seepage of transport water through the geotextile material lining the lagoon bund walls, no discharge will occur from the bunded area.

The contractor will implement surcharging to maintain the distribution of materials inside the reclamation site and prevent possible problems due to unequal bearing strength and compaction brought by natural separation of particles inside the reclamation footprint, as well as eliminate the possibility of disposal of undesirable fine materials. Heavier particles will settle nearer the inflow pipe because finer particles are carried further away by water flow. Bulldozers, backhoes, trucks and dumpers will then transfer materials throughout the site. A separate detailed method statement will also be presented by the contractor regarding soil quality improvement, surcharging and soil waste disposal.

Shore protection from sea waves will be provided by lagoon walls faced with outsourced rock armour revetment. The method statement will be forwarded by the contractor to the environmental authority for comments and approval.

6.4 Breakwaters and Quay Wall Construction

The outer commercial port and the Western side of the Marine will be protected from the sea by breakwaters. These will comprise sheet piling and combi-walls containing rock fill up to approximately Mean High Water Springs level. Armour rock revetment faced breakwaters will extend above this level to protect against overtopping. The armour rock will be placed by barge mounted crane grab. All rock armour will be delivered by sea.

The quay walls generally comprise steel sheet piling and combi-wall construction. These include large diameter (up to 1200mm diameter) tubular steel piles and heavy sheet piling (typically Larssen 6) anchored in pre-blasted rock trenches. All of these operations will involve sea barge mounted pile driving equipment and guide frames. Divers will be used to monitor for any potential grout seepage into the water column which will be carefully controlled by installation through the tubular piles and into trenches capped with stone and sandbags. Rock fill installed between the piling to form the quays will be carried out from the shore side with the rock fill being generally imported by road to supplement rock recovered from the underwater rock blasting operations. The quays will be capped generally with concrete slabs.

The design of all quay walls, revetments and breakwaters will take into account recent research (*e.g.* Firth, 2013; Chapman and Brown, 2011; Martins and Thompson, 2009) which has shown that minor design changes *e.g.* the addition of pools, pits, crevasses and water retaining features, leads to a statistically significant increase in the settlement and diversity of marine flora and fauna on these artificial structures.

6.5 Marina Infrastructure

The Marina Infrastructure will comprise floating pontoons fixed to steel piling guides. The pontoons will be pre-fabricated and delivered to site via road, and installed by land-based crane. The equipment involved will include delivery trucks and trailers and mobile cranes. The remainder of the equipment comprises lighting, electrical fittings, water delivery connections anchor cleats and general pontoon fitting (e.g. light rubbing fenders).

6.6 Slipway, Kayak and Water Amenity Facilities

The slipway will be formed using precast concrete flat slabs, delivered to site using road truck and trailer. Mobile cranes will be used to lift the slabs into final position. Prior to this, carefully prepared stone filling will be placed to grade and protected using armour rock revetment either side of the slip. The placing of the stone and rock armour will be carried out from land, using truck and trailer delivery and crane grab.

The bottom edge of the slipway will be protected using sealed Fabriform bagged concrete.

6.7 Roads, Yards and Pathways

Once adequate consolidation has been achieved, excess surcharge will be removed from the reclaimed land lagoon areas; this will be placed largely into Lagoon 7.These areas will then rolled capped with imported and compacted stone capping, prior to finishing. The type of finish to yards, roads and paths will depend on the use, varying to compacted stone, to concrete to bitumen macadam. Normal land-based machinery will be used including graders, dozers, vibratory rollers, bitumen macadam layers and associated delivery trucks to import materials via road.

6.8 Railway Line including embankments, bridge and associated infrastructure

The New Port will incorporate a new dedicated rail connection spur line of the main Galway to Dublin Rail Link. This will involve the construction of a new embankment using imported granular material to supplement materials recovered on site. These will be placed and compacted in layers using dumpers, rollers and dozers. On the top of the embankments, imported stone railway ballast will be placed once the precast concrete rail sleepers are in place. The ballast and rail track will be imported by rail and placed with dedicated Irish Rail mounted equipment. The bridge will be formed using in-situ concrete abutments and standard precast bridge beams. The bridge beams will be delivered by road and erected onto the abutments using mobile cranes.

Pallisade security fencing will be installed each side of the embankment and will be delivered by truck and trailer and erected by light crane.

6.9 All Utilities and Services

There will be a significant amount of utilities and services to be installed, from oil and bitumen delivery pipelines from the new outer commercial quay, into the existing storage facilities in the Enterprise Park. In addition, there will be pipelines for water, sewerage (both connected to the public system), and surface water all to be installed using conventional pipeline systems. In addition, there will be telecom, gas, ESB and data connections. All of these utilities and services will be installed in pre-formed precast concrete ducts, within the roadways typically, so that they can be accessed easily in the future for maintenance. All the materials will be delivered by truck and trailer by road and installed using backhoe excavators, cranes (for precast ducts and pipes).

6.10 Buildings for a Harbour Office, a Marina Office, a Passenger Terminal, including all security gatehouse facilities, ESB substation and Fire Water Pump house

These will all be constructed using conventional building methodologies, either block work for the smaller buildings and steel or concrete frame for the larger. All materials will be imported by road on truck and trailer or fixed truck. The ESB substation will involve transformer and switch gear installation, again delivered by truck and installed by crane and skids.

The foundations for these buildings are likely to comprise piled systems due to the nature of the reclaimed ground. It would be intended to utilize drilled piling systems, where boulders may be encountered and precast driven piles where the building is located within lagoons with soft sediments above solid existing ground.

Upgrade Works to existing roadway at Lough Atalia Railway Bridge and at existing harbour access junction

On the Lough Atalia Road, the existing railway bridge presents a significant height restriction to commercial and construction traffic. The bridge cannot be moved or raised and it is proposed to excavate the road and provide a lower road level with the environs of the bridge. This will involve careful excavation, so as not to affect the integrity of the existing bridge structure; the foundation of the abutments being below the proposed lowered road formation level avoids any risk of undermining. The excavated material will be used to fill the lagoons. The new road will comprise a concrete pavement and will be drained into a concrete tidal tank to be disposed of to suit tidal conditions. An oil interceptor will ensure that no oil contaminants are allowed into the water column.

At the junction of the Lough Atalia and the existing entrance to the Enterprise Park, an upgrade is proposed to improve the access and the interface with existing public traffic. This will mean realigning the kerb lines and improving the road width and structure.

All materials will be delivered by road.

6.11 On-shore Site Works

The onshore works during the dredging and reclamation phase will involve the following:

- ☐ Providing the site offices, yard and workshop facilities
- ☐ Providing land-based machinery for reclamation work in which the dredged material will be spread and leveled and also for placement of rock revetment

The location and maps of the proposed pipelines, offices and large vessels (e.g. dredgers) will be provided upon finalization of the selection of the contractor.

6.12 Demobilization and re-instatement

After completion of the works, all construction equipment will be removed along with any temporary facilities. All equipment, tools and surplus materials will be placed in shipping containers and shipped off site. The various work sites will then be cleaned of any remaining debris.

7. Environmental Management

7.1 Site and Work Management

7.1.1 Site and Work Preparations

To ensure smooth and continuous construction operation, the contractor must secure necessary approval to governing authorities regarding several items that need to be consulted for their installation at the site.

Access route plan for transport of materials and people connecting to the public roads must be submitted to the Galway City Council for approval, together with the approximate number of vehicles that will be using these routes.

The Harbour Master must be properly informed for the arrival and usage of any marine vessels within the area. Communication facilities may be required to be installed at these vessels as deemed necessary for the monitoring of location and regular contact during the operation of the vessels.

7.1.2 Workplace Requirements

Site offices must be installed to house the contractor's personnel, consultants and other members of the project stakeholders to perform their management and administrative duties, with water and power supplies and facilities such as meeting rooms, rest rooms and first aid or emergency area. Emergency fire fighting portable equipment must be installed at selected areas.

Waste containers are to be provided at strategic places at the offices, accommodation areas and construction sites for responsible disposal of solid domestic wastes, such as food wrappers and containers, cigarette butts, etc. Waste segregation will be required prior to disposal or collection.

Construction wastes on the other must be properly stored at a separate area away from the work site, properly labeled and to be collected regularly to prevent accumulation.

Portable toilets and washrooms will be installed at strategic areas in the site

Entrance and exit gates will be installed to control ingress and egress to the site. Security rules and guidelines are separately discussed under Light, Traffic and Security Section.

Life saving ring buoys must be provided and installed at strategic areas at the reclamation site.

7.1.3 Maintenance of equipment, vessels and vehicles

Contractor should take the maintenance of equipment very seriously and this ought to form the basis of the implementation of the preventive maintenance program. The Project Managers are responsible for the accurate implementation of the policy.

The primary goal of Contractor's preventive maintenance program is to avert the failure of equipment before it actually occurs, thus avoiding downtime and impacts on the health, safety & environment, as well as in quality and productivity. The preventive maintenance program should be designed to preserve and enhance equipment reliability by replacing worn components before they actually fail. The preventive maintenance activities include equipment checks, partial or complete overhauls at specified periods, oil changes, lubrication and so on. In addition, the engineers and mechanics should record equipment deterioration to know when to replace or repair worn parts before it can cause system failure and contaminate the environment.

Long-term benefits of preventive maintenance include:

1. Improved system reliability;
2. Decreased cost of replacement;
3. Decreased system downtime;
4. Better spares inventory management;
5. Protection of the environment.
6. Improved safety and health of workers

Maintenance efforts that have to be performed during the execution of the project are routine oil changes, replacement of filters, etc. and corrective/breakdown repairs. The scheduled maintenance is based on the actual running hours of each individual piece of plant & equipment and is therefore too broad to detail in this document. In general, all equipment undergoes minor maintenance every 250 running hours with a major oil change every 1,000 -1,250 hours.

Material Safety Data Sheets for all fuel oils and greasing products used should be made available in the maintenance workshop.

All waste oil should be placed in drums and transported to a waste oil depot / treatment facility. All other materials should be placed in waste containers and disposed of in approved landfill sites by an approved waste transport contractor.

Regular Schedules of preventive maintenance must be properly informed to Project stakeholders, especially to the monitoring consultant who normally visit and inspect the construction operation.

7.1.4 Equipment Refueling

For the equipment, such as earth shifting machines, dump trucks, generators etc refueling will take place at specific bunded locations within the works site during construction activities. To ensure that refueling activities cause no harm to the environment, the Contractor must take the following preventive measures to avoid possible environmental incidents:

- Only trained and well-experienced personnel should be allowed to perform refueling activities, however, in absence of sufficient number of trained persons, refueling operations must be supervised by the said trained worker(s);
- During refueling activities the machines will be switched off and no open flames allowed;
- A fire extinguisher is to be available at all times within easy reach;
- During the refueling activities a spill kit must be available in order to contain any spillage and prevent contamination.
- Valves and taps must not be left open unattended and must be locked when not in use;
- Personnel carrying-out refueling activities are to be made aware of the requirements listed in this EMP and be instructed in the use of spill kits and emergency procedures.
- Refuelling also includes safety issues and concerns and must be addressed with utmost care. Ensure that no sources of ignition are near or with the person doing the refueling (i.e. two way radio, mobile phone, cigarette lighter). Minimise risk of fire and explosion from static electricity by touching metal parts of the vehicle or equipment during refueling

Materials and Storage

All materials and supplies delivered must be properly documented, segregated and stored at allocated areas at the site based on their sizes, volumes, types and characteristics.

Store rooms will be allotted to keep supplies and materials organized and properly accounted for. It is encouraged that storekeeper install labels and proper segregation of materials inside the store to keep the area orderly and easy to manage. Bulk and materials in volumes must be stored outside the store room away from the traffic and segregated, arranged, properly covered / enclosed.

Flammable, reactive and hazardous materials and chemicals must be stored separately from the rest as these may cause accidents and contamination that could, in the end, affect the workers or pollute the environment.

Liquid chemicals and supplies such as paints, thinner, petrol, and oil should be stored in tightly sealed containers in bunded cemented facilities or placed on top of catch basins during storage.

Light, Traffic & Security

Security and traffic rules and regulations will be made and widely implemented by the contractor for the operations of the construction site. This may include the following items:

Contractor will provide directional map indicating the route going to the site to the project stakeholders, to authorities and visitors who intend to visit the site.

Road signage will be conspicuously displayed and installed along the roads leading to the entrance of the site, and within the traffic routes inside the side. Signage should include but not limited to, directional arrows, speed limit, parking area, no parking signs, humps, one way, and other traffic information signs.

Dedicated group of security officers will be stationed at security posts of entrance and exit gates to control the ingress and egress of materials, equipment and people to and from the site.

Visitors' ID shall be provided to the visitors at site upon entry in exchange for personal IDs'. This ID pass shall be surrendered back to the security post upon exit and personal IDs will be returned properly to the owner. Frequent visitors will be provided with dedicated ID Pass that they can bring anytime and qualifies them for entry upon presentation to the officer on duty at the security post.

All persons entering the work area aside from the regular workers shall be properly logged in the security record book together with the persons who invited or coordinated the visit to site. As deemed necessary, visitors will be accompanied by security or safety personnel during their entire stay at the site.

No persons shall be allowed to enter the site by the security officer on duty without wearing the required set of personal protective equipment. These are hard hat, reflector vest and safety shoes.

Deliveries of materials and supplies cannot be accepted without proper documentation and prior advice by the supplier to the representative of the contractor. The volume of Flammables, reactive and hazardous substances shall be strictly controlled and monitored only at the specified level accepted by the contractor management. Overstocking of these materials will not be allowed due the entailed risks these substances bring to the site.

Specific areas at the site shall be allotted for parking. No visitor vehicles shall be allowed directly to the site without undergoing proper security checks. Request permission from the safety and security department if the vehicles can be driven safely to the reclamation area prior to use, if not, a dedicated contractor vehicle shall bring the visitors at the location so desired.

Restricted areas will be identified at the site to control the movement of the vehicles and the people. Restrictions will be based on the presence of risks and on contractual obligations that the contractor need to protect based on the agreement with the owner / developer.

Vehicle drivers shall follow strictly the maximum allowable speed of 30 kph. Strict implementation and punishment to violators shall be imposed since aside from safety reasons, speed of vehicles is regulated to control the fugitive emissions of dusts and noise. Violators' licenses will be confiscated and shall be suspended from work a certain period of time deemed just.

Traffic roads shall be clearly identified with road signs and traffic cones and barriers and shall be maintained in safe, flat and compacted working conditions. For speed control purposes, contractor may choose to put humps along the roads together with the reminders of the presence of humps to the vehicles as they approach their locations.

The contractor may choose to install fences and gates around the site to deter and discourage unauthorized entry of any person without permission to the site. This will also reduce the risk of having accidents or incidents associated with unwanted intruders to happen inside the site which could cause unnecessary legal obligations burdened to the contractor and the developer.

For safety purposes impose all vehicles and equipment to open their warning and hazard lights upon entry and during operation at the site both for day and night operations.

Warning / flashing lights must be installed along the edges of the reclamation to warn night navigators

Flood light post should be erected at strategic areas to provide sufficient illumination for the construction operation during the night. Care must be put in mind that these lights must not create nuisance to nearby villages, industrial areas and public roads.

7.1.5 Marine Navigation

All vessels must secure approval from the Dept. Marine to be used. All crews must be properly licensed to work aboard the marine vessels.

A standby boat must be provided to give ferry services for the dredger crews, supplies and be used during water sampling and marine monitoring.

Vessel speeds will be restricted as per typical low speeds when approaching the Harbour.

Air Quality

This is a large scale construction project which has the potential to generate undesirable air emissions in the form of nuisance dust and odours. Careful planning however can ensure that the project can be carried out in a manner which seeks to prevent any visible airborne emission or odour outside the site boundary.

Dust Emissions

Dust is a generic term used to describe fine particles that are suspended in the atmosphere. Dust comes from a wide variety of sources, including soil, vegetation (pollens and fungi), sea salt, fossil fuel combustion, burning of biomass, and industrial activities. It is formed when fine particles are taken up into the atmosphere by the action of wind or other physical disturbances or through the release of particulate into the atmosphere.

Particle size is an important factor influencing the dispersion and transport of dust in the atmosphere and the effects of dust on human health. Suspended dust particles in the atmosphere can be as small as a few nanometers and as large as 100µm. Particles larger than 100µm tend to settle very close to the source. A particle of 100µm can stay buoyant for periods of 15 minutes whereas particles of 1000µm settle within 1 second of release.

Visible dust is in the range 50µm to 10,000µm and the size range of dust from construction activities is normally on the upper end of this scale. Specific activities such as welding or cutting materials can generate finer dusts which, in the context of this project, will result in very small quantities.

Studies of large open sites have shown that 40% of nuisance dust arises from haul-roads and a further 10-20% from loading activities, the balance coming from various other activities.

Odour Emissions

The primary source of odours during the construction phase of this project will arise during dredging. The material dredged from the bottom of Galway Harbour is a combination of muddy sand, natural organic plant life and seawater. Dredged material will form an important material resource for the construction of the harbour extension working area.

Occasionally, low level odours emanate from dredged material in the immediate proximity of the discharge point. Hypoxic / anoxic conditions give rise to these odours and are principally due to the minute presence of hydrogen sulphide gas, a natural byproduct of anaerobiosis.

The human olfactory mechanism is capable of detecting the presence of hydrogen sulphide gas in quantities as low as 0.001 parts per million (ppm). Hydrogen sulphide is a colourless toxic gas which is heavier than air and in low concentrations (below 1ppm) and smells like rotten eggs. Levels over 500 ppm are fatal, so a short term exposure limit of 10ppm and a daily exposure limit of 5ppm is generally applied for safety reasons in industry.

Dredging activity will be controlled to the extent that hydrogen sulphide limits at the site boundary will be maintained below 1 ppm at all times. In the event of levels reaching 0.01ppm at the site boundary corrective action will be put in place immediately.

Air Quality Monitoring

A weather station will be maintained for the duration of construction with real-time data on wind speed, wind direction, precipitation and sunshine hours. This weather data will form a template over which air quality monitoring is carried out and reported. Air quality monitoring will include daily and routine monitoring in addition to any complaints that may arise.

Daily logging of visible dust plumes and detectable odours at the site boundary will be carried out and the results maintained on site in addition to being made available to the planning authority when requested.

Continuous dust deposition monitoring for the duration of construction will be carried out. A minimum of three sites will be monitored on the west, north and eastern site boundaries. Additional locations may be required for specific construction activities. Dust deposition monitoring will be carried in accordance with TA Luft VDI Method 2119 (Bergerhoff Gauge).

Daily odour monitoring will be carried out during dredging activity when odour may be an issue by means of a transect survey on the site boundaries. The methodology for the transect survey will be that outlined in the UK Environment Agency Odour Guidance.

In order to provide numerical data on odour levels a weekly transect survey of the boundaries will be carried out during dredging phases when odour may be an issue using an Arizona Instruments model Jerome 631-X Sulphur Dioxide Analyser or an equivalent instrument having a range of 0.003 ppm to 50 ppm (parts per million)

Frequency and Reporting

Monitoring will be carried out as outlined above on a daily and weekly basis. In the event of an odour complaint, a transect survey will be carried out using the Sulphur Dioxide Analyser and action based on the air quality threshold levels will be implemented.

Reporting Action Guidelines

In the event that any planning condition or threshold limit as set out below is not being complied with, the environmental consultant will be informed immediately along with a recommendation of appropriate remedial action. A full written report will be submitted to the environmental consultant within 3 days.

A formal air quality complaint handling procedure will be put in place on site.

Plan of Actions based on Air Quality Levels

The following Dust Threshold limits are proposed.

Table 43. Dust Deposition Limits

Table xx – Dust Deposition Limits		
Day & Time	Mean monthly dust deposition	No one sample to exceed
At any time on the site boundary	350 mg/m^2/day	650 mg/m^2/day

The following H_2S Threshold limits are proposed.

Table 54. Odour Threshold Limits

	Table xx – H_2S Threshold Limits		
Day & Time	Caution Level	Warning Level	Breach Level
At any time on the site boundary	0.01ppm	0.1ppm	1ppm

Based on these levels, Alert levels are so designed with threshold limits as decision points for each alert level. Thus, having the following scheme of Alerts:

Table6. Noise Alert Levels

Alert Level	Air Quality Level/Complaints	
	Site Boundary Location	External Complaint
Normal	**Mean monthly dust deposition level is less than 100 mg/m2/day** **H_2S level below 0.01ppm**	**No complaints**
Caution	**Mean monthly dust deposition level exceeds 100 mg/m2/day** **H_2S level 0.01 to 0.1ppm**	**Single complaint**
Warning	**Mean monthly dust deposition level exceeds 200 mg/m2/day** **H_2S level 0.1 to 1ppm**	**Complaint from more than one person**
Breach	**Mean monthly dust deposition level exceeds 350 mg/m^2/day** **H_2S level exceeds 1ppm**	**Complaint from regulatory agency**

Corresponding suggested actions are then arranged for each level that the contractor will undertake in the event of any air quality alert level. It should be noted that this system is so designed so that it will practically adapt to the operational conditions of the contractor by having the continuous improvement aspect on its cycle. The following pages describe the corresponding actions for each alert level.

Table 7. Action Plans Based On Noise Alert Levels

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
N O R M A L	**Mean monthly dust deposition level is less than 100 mg/m2/day H_2S level below 0.01ppm or no complaints**	No need to advise Alert Level.	Normal Level operations. No necessary precautionary measures to implement. Continue monitoring with the normal frequency.						Review the effectiveness of the system and modify for further improvement, on a monthly basis. Adjust the scaling for each level to be more adaptable to real condition of the operation. Re-assess the flow of procedure to be more responsive to its objectives.

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
C A U T I O N	**Mean monthly dust deposition level exceeds 100 mg/m2/day H_2S level 0.01 to 0.1ppm or single complaint**	Advise Caution Alert Level Report to Site Manager Advise the consultant. Advise the concerned operator/ people that will assess what if any corrective action is warranted.	Exercise Caution on operations by starting to look into possible causes of increase in dust/odour level. Continue with the normal monitoring frequency	Check possible factors such as weather conditions, nearby activities, measurement methodology, human factor and operational adjustments.	If external factor that's beyond control is the cause of the increase in dust/odour such as weather condition, no further action required Advise concerned people if human factor was identified the cause. Imposed administrative rules if necessary. Consult resident engineer concerning matters of operation. Implement any corrective actions within 3 days.	For Site Manager to evaluate countermeasures proposed. Prioritize which actions have high importance	For Site Manager to approve implementation plan. He may seek advice of consultant.	Monitor the implementation of the countermeasures and record on the incident log. Respond to complainant regarding action taken	

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
W A R N I N G	Mean monthly dust deposition level exceeds 200 mg/m2/day H_2S level 0.1 to 1ppm or more than one person complains	Advise Warning Level Report the condition to the Site Manager Advise other consultant, client / developer and other concerned.	Elevate to Warning Level Verify reading with the audit findings of consultant, if data is available. Decide if necessary to increase monitoring to daily basis. Consider changes to operations to reduce dust/odour levels	Look into external factors such as weather condition, nearby activities, measuring methodology, human factor and operational adjustments.	The site manager will advise concerned groups or people to come up with measures for the identified causes within 24 hours.	For the site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and preventive measures.	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan	Monitor the implementation of the countermeasures and record on the incident log. Respond to complainants regarding action taken	

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
B R E A C H	**Mean monthly dust deposition level exceeds 350 mg/m2/day H2S level exceeds 1ppm or complaint/action by regulatory authority**	Advise Breached Level Report Condition to Site Manager. Advise consultant, client / developer and others concerned	Elevate to Breached Level Verify reading with the audit report of consultant, if data is available. Increase monitoring to daily basis. If the dust/odour levels persist beyond the allowable limits, the contractor must stop the work.	Look into external factors such as weather condition, nearby activities, measurement methodology, human factor and operational adjustments.	Call immediately for a meeting to all concerned to come up with joint corrective measures within the day.	For the site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and measures	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan. Report to the governing authority regarding the incident.	Monitor the implementation of the countermeasures and record on the incident log.	

Vibration

Vibration levels from all activities other than blasting will be confined to areas inside the site footprint. Blasting however has the potential to cause elevated vibration levels outside the site boundary. These impacts need particular consideration in relation to potential property damage and disturbance of sensitive species e.g ground nesting birds

In relation to property damage, it is well established that vibration levels of 50mm/s peak particle velocity (ppv) are required to cause structural damage to modern to modern constructions. Levels of 12mm/s ppv have been set by bodies such as An Bord Pleanála, The Environmental Protection Agency and the National Roads Authority for various projects. In line with EPA guidance a more conservative limit of 8mm/s is being adopted for this project.

All blasting, drilling and pile driving activities will be restricted to daylight hours and will not take place during the nesting season. In relation to explosives a maximum instantaneous charge of 10kg will be permitted (see chapter 3 of the EIS).

The areas identified as 'critical' for blasting vibration levels are the three tank farms, in case of damage to pipes or tanks which could result in a spillage. Due to the separation distances involved vibration levels are likely to be under 4mm/s ppv, providing a significant safety factor for these locations.

A secondary impact of blasting is air overpressure. This comprises a low frequency wave generated by the blast, which can be sensed by mammals and birds as 'vibration'. The impact is generally felt in the air cavities and is a single shot event. Due to the distances involved air over pressure levels due to blasting will not have any impact.

The Alaskan Department of Fish and Game Blasting Standards for the protection of Fish require an underwater ppv level of 0.5 inches per second (12.5 mm/s). There are no known limits for the sensitivity of birds to air overpressure.

While no blasting will take place during the nesting season, birds are known to be sensitive to sudden noise events although they habituate to them in time. A study on 211 raptor nests[2], exposed to blasting, gunshots and low altitude overflights found that no eggs or young were ever ejected. Parents on nests were four times less likely to startle than roosting parents and when startled the birds usually left for a matter of a few minutes.

Nesting birds in the inner part of Galway Bay are currently exposed to gunfire from the Military Range at Renmore Barracks and could to some extent be habituated to impulsive noise.

Pile driving could produce ground-borne vibration levels that may be perceptible within approximately 100-200 meters of the pile-driving activity. Ground-borne vibration levels at distances of approximately 60 meters or more will not result in adverse effects. Pile driving very close to structures, within 18 meters, can cause structural damage due to displacement

[2] Knight, R.L., and K.J. Gutzwiller, editors. 1995. *Wildlife and Recreationists: Coexistence Through Management and Research*. Island Press, Washington, DC. 372 pp.

of soil and resulting lateral movement. No structures are within this range and no sensitive species other than possibly salmon will be present within 20 metres of pile driving activity.

Vibrations from blasting and pile driving activities may harass the harbour seals when foraging in waters close to the development. Appropriate mitigation measures to avoid impacts to harbour seals will include monitoring of an exclusion zone by a Marine Mammal Observer (MMO) prior to piling. The NPWS draft guidance to Manage the Risk to Marine Mammals from man-made sound sources in Irish Waters (2012) outlines how soft start methods will be used to mitigate during works. The harbour seal haul-out site at Rabbit Island is a located a considerable distance from proposed pile driving and blasting activities and will be monitored periodically during construction activities to determine if seals are substantially disturbed even with these measures. Blasting will only occur (a) outside the pupping season and (b) when the harbour seals are not present within the safety zone.

Blasting and dredging activities are addressed in the EIS and are likely to result in localized elevated suspended sediment concentrations. Mitigation measures to avoid and minimize impacts to fish and salmon critical habitat include measures such as the selection of certain dredge types (*e.g.*, the cutterhead dredge, which may lower concentration of suspended materials), limiting maximum instantaneous charge and construction sequencing, where blasting and dredging will be avoided during the peak smolt migration period.

Pre-construction nesting bird surveys inside the site boundary and immediate environs will be conducted by an Ecologist no more than 10 days prior to planned construction in order to locate nests within and adjacent to the proposed work area. An additional verification survey will be performed no more than 3 days prior to construction to assure discovery of any new nesting activity initiated since the original survey. If a nest is detected during the pre-construction nest survey, the Ecologist will include the details of nesting areas along with appropriate minimisation, avoidance measures and buffer zones (if required).

If nesting is detected during a verification survey or during construction monitoring, the details will be included in a Nest Monitoring Log. In addition to the pre-construction nesting bird survey and the verification survey, the Ecologist will perform a weekly sweep for each week during construction activities within the breeding season to look for biological resources, including nesting birds. If a nest is identified during the weekly sweep, the Ecologist will subsequently observe the nest and report the findings as appropriate.

Vibration Monitoring

Vibration monitoring will be carried out at the following locations during blasting.

1. Cold Chon tank farm
2. Enwest Oil terminal
3. Leeside Oil terminal
4. Liam Mellows Park
5. Dún Aengus Apartments
6. Grattan Road
7. Hare Island

Frequency and Reporting

The vibration (and air overpressure) monitoring will be carried out for the first six blasts and the data evaluated by a qualified ecologist to determine if any further monitoring is required on Hare Island (to minimise disturbance on nearby Rabbit Island).

Reporting Action Guidelines

Subsequently all of sites 1 to 3 above and one of sites 4 to 6 in rotation will be monitored. The results of the monitoring will be provided to the environmental consultant on the day of the blast and a written report will be provided and kept on site within 2 weeks of the blast taking place.

Plan of Actions based on Noise Levels

The following vibration exposure limits are proposed.

Table 8 – Vibration Limits – Peak Particle Velocity at the closest part of any sensitive property to the source of vibration at a frequency of		
Less than 10 Hz	**10 to 50 Hz**	**Above 50 Hz**
8mm/s	12.5mm/s	20mm/s

Table 85. Vibration Limits

Based on these levels, Alert levels are so designed with threshold limits as decision points for each alert level. Thus, having the following scheme of Alerts:

Table9. Noise Alert Levels

Alert Level	**Vibration level, Complaint or Observation**	
	Vibration Level	Observation
Normal	**< 4mm/s**	**No Complaints**
Caution	**6mm/s**	**Any single complaint or note of disturbance to sensitive species noted by MMO or Ecologist**
Warning	**8mm/s**	**More than one complaint or note of injury to sensitive species noted by MMO or Ecologist**

Breach	**>8mm/s**	**Complaint from regulatory agency**

Corresponding suggested actions are then arranged for each level that the contractor will undertake in the event of any vibration alert level. It should be noted that this system is so designed so that it will practically adapt to the operational conditions of the contractor by having the continuous improvement aspect on its cycle. The following pages describe the corresponding actions for each alert level.

Table 10. Action Plans Based On Vibration Alert Levels

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
N O R M A L	**< 4mm/s or no complaints**	No need to advise Alert Level.	Normal Level operations. No necessary precautionary measures to implement. Continue monitoring with the normal frequency.						Review the effectiveness of the system and modify for further improvement, on a monthly basis. Adjust the scaling for each level to be more adaptable to real condition of the operation. Re-assess the flow of procedure to be more responsive to its objectives.

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
C A U T I O N	6mm/s or any single complaint or note of disturbance to sensitive species noted by MMO or Ecologist	Advise Caution Alert Level Report to Site Manager Advise the consultant. Advise the concerned operator/ people that will assess what if any corrective action is warranted.	Exercise Caution on operations by starting to look into possible causes of increase in vibration level. Continue with the normal monitoring frequency	Check possible factors such as weather condition, nearby activities, measurement methodology, human factor and operational adjustments.	If external factor that's beyond control is the cause of the increase in vibration such as weather condition, no further action required Advise concerned people if human factor was identified the cause. Imposed administrative rules if necessary. Consult resident engineer concerning matters of operation. Implement any corrective actions within 3 days.	For Site Manager to evaluate countermeasures proposed. Prioritise which actions have high importance	For Site Manager to approve implementation plan. He may seek advice of consultant.	Monitor the implementation of the countermeasures and record on the incident log. Respond to complainant regarding action taken	

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
W A R N I N G	8mm/s or more than one complaint or note of injury to sensitive species noted by MMO or Ecologist	Advise Warning Level Report the condition to the Site Manager Advise other consultant, client / developer and other concerned.	Elevate to Warning Level Verify reading with the audit findings of consultant, if data is available. Decide if necessary to increase monitoring to daily basis. Consider changes to operations to reduce vibration levels	Look into external factors such as weather condition, nearby activities, measuring methodology, human factor and operational adjustments.	The site manager will advise concerned groups or people to come up with measures for the identified causes within 24 hours.	For the site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and preventive measures.	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan	Monitor the implementation of the countermeasures and record on the incident log. Respond to complainants regarding action taken	

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
B R E A C H	>8mm/s or complaint from regulatory agency	Advise Breached Level Report Condition to Site Manager. Advise consultant, client / developer and others concerned	Elevate to Breached Level Verify reading with the audit report of consultant, if data is available. Increase monitoring to daily basis. If the vibration levels persist beyond the allowable limits, the contractor must stop the work.	Look into external factors such as weather condition, nearby activities, measurement methodology, human factor and operational adjustments.	Call immediately for a meeting to all concerned to come up with joint corrective measures within the day.	For the site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and measures	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan. Report to the governing authority regarding the incident.	Monitor the implementation of the countermeasures and record on the incident log.	

Occupational and Public Health & Safety

During construction the PSCS shall develop a Safety & Health Plan including consultation with all of the contractors, including reference to all of the safety statements, equipment, certification, competence certification, induction procedures, risk assessments and method statements for all works, organizational H&S assignments, reporting procedures, etc. These shall be cross referenced to the information provided by the designers of permanent works and temporary works. The S&H Plan shall specifically reference interfaces with non-project personnel including marine traffic road traffic and the general public and traffic management procedures in this regard."

7.1.6 Management Commitment

In order for the EMP to work, the contractor must define its road map of implementing the EMP by having a strong commitment to it though a fully defined management policy (Environment, Policy). This can be achieved by translating the management policy into operational objectives with characteristics of being SMART (Specific, Measureable, Attainable, Realistic and Time-bound). From these objectives, key performance indicators can be extracted which can be used to check and evaluate performance against set objectives.

7.1.7 EHS Contractor Organization

To ensure execution of the written plans, it is necessary to organize, delegate and distribute responsibilities of planning, implementing, evaluating and reviewing the system, and thus the need to create an EHS Committee. This committee has the ultimate responsibility of executing the plan in order to achieve the goal of EHS. Take note that responsibilities can be transferred and delegated, however, the accountabilities for acts during the performance of these responsibilities remain to the person(s) who delegated the responsibilities. It is necessary then to establish the individual commitment of the people involved, provide all the necessary information and knowledge and awareness on EHS and keep the priority, on top of everything else, on Environment, Health and Safety.

The organization must be composed of all people involved in the operations headed by the top person of the contractor. Specialized roles of the EHS and medical professionals are in advisory capacity, audit and tasks involving highly technical qualifications on EHS. Other members should come from all stakeholders of the project, from the client / developer, project management, project technical team, the site management team, foreman / supervisors and group laborers. Each group of individuals and stakeholders must realize and fully define their roles in EHS. Being complacent for having safety officer / engineer on site who is being assigned with all the responsibilities on EHS and then later "putting all the blame to the poor person once there is a failure" is a wrong mindset, which is unfortunately being practiced by most of the organization, a mindset that must be changed. A failure in the management system is a failure of everyone in the organization with the biggest accountability to the top management. EHS success can only be realized by accepting the fact that "Safety is everyone's responsibility".

Housekeeping

1. Cleanliness and orderliness are the first fundamentals of good housekeeping.
2. Contractors are responsible for cleaning up and removing hazardous and non-hazardous waste generated on site.
3. Each Contractor shall be responsible to maintain areas where he is performing work free from waste materials, debris and rubbish. Work will not be considered complete until all waste materials are removed and the work area returned to a clean and orderly condition on a daily basis. Waste material must be disposed of off-site.
4. All protruding nails in form lumber, boards, etc., must be withdrawn or bent into the wood before the wood is stacked or piled.
5. Rags, packing materials, paper cups, and sawdust in saw areas must be collected daily and placed in proper containers.
6. All objects with sharp edges (scrap sheet metal, scrap glass, bottles, metal cans) shall be collected daily and placed in containers.
7. Avoid placing debris and other obstacles in roadways, walkways, aisles and other travel routes.
8. Allow sufficient time at the end of each day for proper cleanup of the work area. Place all debris in proper refuse containers.
9. All stored materials must be kept in an orderly manner at all times.
10. Provide a proper collection container and floor protection when using cutting oil, solder flux, hydraulic oil, and other fluids.
11. Vehicles and heavy equipment must also be regularly cleaned. No equipment should be left unclean at the end of its daily operation.
12. In the event of a large spill, immediately install acceptable containment barriers. A full Oil Spill Response Plan is currently in place as part of the GHC operations. This will be implemented in full in the event of a major spill or accident (see appendix 2A of the NIS)

Tools & Equipment

1. Defective tools and equipment must be taken out of service and shall be properly repaired before reuse.
2. Machinery, tools (including portable grinders and buffers) and equipment with exposed gears, belts, power transmission, couplings, etc. shall not be operated without effective guards in place.
3. A motor vehicle engine shall not be left running if the vehicle/equipment is unattended unless it is necessary in the normal operational requirement of the unit. Unattended means that the operator has left the normal control position of the vehicle.
4. All moving equipment must be equipped with back-up alarms.
5. Store or stack equipment and material so that it will not create a falling or tripping hazard or block access to fire extinguishers or emergency exits.

Compressed Gas Cylinders

1. Defective cylinders and parts must be taken out of service and shall be properly repaired or replaced before reuse.

2. To avoid accidental displacement, keep compressed gas cylinders standing and securely tied off, whether empty or full. Make sure valve protection caps are on when cylinders are not in use. The valve shall be closed on all empty cylinders.
3. When moving cylinders by crane or derrick, a cradle, boat or suitable platform shall be used. Slings or hooks shall not be used.
4. When cylinders are not in use, they must be secured and capped.
5. If cylinders are not used within a 24-hour period, they are considered to be in storage, and must be secured, capped and separated. Separate oxygen and fuel gas cylinders by a minimum of 20' or a 5' high, ½ hour fire-rated barrier.
6. Colour coding and labeling will assist in organizing storage of these gas cylinders.

Fire Prevention

1. Use only approved cleaning agents — never gasoline or flammable liquids.
2. Gasoline and similar flammable liquids must be stored only in approved safety containers and in areas free of burning hazards.
3. Keep all heat sources from flammable liquids, gases or other combustible materials.
4. Open fires are strictly prohibited.
5. Every hot work operation must have a properly trained and equipped fire watch with appropriate fire extinguishers for the specific hazard in the work area. The fire watch must remain in the work area for at least 30 minutes after the hot work activity is completed.
6. Segregate materials properly so that those that react to each other are separated.
7. Mark areas that are prone to fire.
8. Restrict smoking, cooking, welding and other hot works at designated places only.
9. Train all people in fire fighting and provide awareness regarding fire safety.
10. Install sufficient firefighting equipment at strategic areas at the office, construction site, security post, storage areas and other areas that are prone to fire.

7.1.8 Occupational Noise

Monitoring of noise levels will be conducted during day and night (if there will be night shifts schedules) on a monthly basis throughout the construction period. Noise levels will not exceed the following noise exposure limits based on criterion level of 85 dB (A) and exchange rate of 3 dB (A): This exposure limit is more preferable compared that of the “5 dB (A) rule” since it is more stringent, logical and generally when it is used, there is normally no separate regulation for impulse/impact noise. The equivalent sound exposure level takes impulse noise into account in the same way as it does to continuous or intermittent noise.

Airborne Noise

The scale of this project is such that it will cause increased noise close to any of the construction activities. The purpose of this Environmental Management Framework is to ensure that the activities can be carried out in a manner that is as environmentally efficient as possible, i.e. minimising the environmental impacts at locations outside the site boundaries.

With large construction projects it is always necessary to strike a balance between working quietly and working quickly. The duration of a project can be extended significantly in order to implement noise reduction measures thus prolonging the noise exposure period. The National Roads Authority (NRA) Guidelines as cited in the Environmental Impact Statement provide a balance in this regard. By permitting these noise levels the construction period is minimised.

Noise levels as set out in the NRA Guidelines are the maximum permitted level at any noise sensitive location during construction. This does not mean that these noise levels will be present for the entire period. The large scale of the site means that construction activities will take place in different areas at different periods so some areas will have no change on pre-existing noise levels for long periods during construction but may experience levels up to those set out in the Guidelines for short periods. This Environmental Management Framework is designed to ensure that such periods are minimised.

Noise levels can be controlled by various mitigation measures as set out in the Environmental Impact Statement. Best practice measures will be adopted for noisy activities and a noise monitoring programme will be implemented for the duration of construction.

Noise Monitoring

Noise sensitive locations (NSLs) are deemed to be any location in which the inhabitants can be disturbed by noise from the construction site. This incorporates Environmental Protection Agency and the Department of the Environment, Culture and Local Government's (DoECLG) guidance, i.e. any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels and may include areas of particular scenic quality or special recreational amenity importance.

In order to provide a representative sample of such locations 4 external noise monitoring locations have been chosen:

1. Ballyloughan Beach
2. Liam Mellows Park, Renmore
3. Dún Aengus Apartments, Galway Docks
4. Grattan Road

All noise measurements shall be made in accordance with I.S.O. Recommendations R1996/1, 2 and 3 "Acoustics – Description and measurement of Environmental noise".

Construction noise measurements will take the form of a noise survey over two measurements of 30 minutes (separated by a minimum of 4 hours) during the daytime period and one 15 minute measurement during the night time period at each noise sensitive location. Concurrent wind speed, wind direction and rainfall data should be collected on the site. The commonly used noise indices of LAeq, LAmax, LAmin and LAn statistical parameters, including the LA90, should be logged with rainfall and wind speed and direction. Any data corresponding to periods of heavy rainfall will be excluded from analysis.

Measurements will be taken at the four noise sensitive locations to determine the 'worst-case' impacts from the site operations. To ensure 'free field' levels are measured, the monitoring will be positioned at least 3.5 m away from a reflecting surface at a 'typical' receiver height of 1.2 to 1.5 m.

An independent environmental consultant will be assigned to monitor and audit the noise monitoring programme.

Frequency and Reporting

Monitoring will be carried out at the commencement of each phase of operation or stage of construction, including but not limited to; TSHD dredging, Cutter Suction dredging, Backhoe dredging, pile-driving and rock transport and rock placement. This is to ascertain the noise level attributable to each stage or process so that if required mitigation measures can be implemented from an early stage.

Noise monitoring will be carried out on a quarterly basis for all of these activities.

For each of the first 6 blasts carried out air overpressure and vibration monitoring will be carried out at 6 locations as follows:

1. Cold Chon Tank Farm
2. Enwest Tank Farm
3. Leeside Oil Tank Farm
4. Liam Mellows Park
5. Dún Aengus Apartments
6. Grattan Road

Subsequently all of sites 1 to 3 above and one of sites 4 to 6 in rotation will be monitored. The results of the monitoring will be provided to the environmental consultant on the day of the blast and a written report will be provided and kept on site within 2 weeks of the blast taking place.

During general construction activity post sediment settlement noise monitoring will reduce to six monthly intervals unless more frequent monitoring is required.

Reporting Action Guidelines

In the event that any planning condition or NRA Guideline is not being complied with, the environmental consultant will be informed immediately along with a recommendation of

appropriate remedial action. A full written report will be submitted to the environmental consultant within 3 days.

A formal noise complaint handling procedure will be put in place on site.

Plan of Actions based on Noise Levels

The following Noise Threshold limits are proposed.

Table 116. Noise Limits

Table xx – NRA Construction Noise Limits		
Day & Time	LAeq (1 hr) dB re 20 µPa	LpA (max) slow dB re 20 µPa
Monday to Friday07:00 to 19:00 hrs	70	80
Monday to Friday 19:00 to 22:00 hrs	60	65
Saturday 08:00 to 16:30 hrs	65	75
Sundays and Bank Holidays 08:00 to 16:30 hrs	60	65
All other Times	-	-

Based on these levels, Alert levels are so designed with 50%, 80% and 100% of threshold limits as decision points for each alert level. Thus, having the following scheme of Alerts:

Table 12. Noise Alert Levels

Alert Level	Noise Level/Complaints	
	Noise Sensitive Location	Noise Complaint
Normal	**10dBA below limit**	**No complaints**
Caution	**5dBA below limit**	**Single complaint**
Warning	**At limit value**	**Complaint from more than one person**
Breach	**Above limit**	**Complaint from regulatory agency**

Corresponding suggested actions are then arranged for each level that the contractor will undertake in the event of any noise alert level. It should be noted that this system is so designed so that it will practically adapt to the operational conditions of the contractor by having the continuous improvement aspect on its cycle. The following pages describe the corresponding actions for each alert level.

Table 13. Action Plans Based On Noise Alert Levels

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
N O R M A L	**10 dBA below limit value or no complaints**	No need to advise Alert Level.	Normal Level operations. No necessary precautionary measures to implement. Continue monitoring with the normal frequency.						Review the effectiveness of the system and modify for further improvement, on a monthly basis. Adjust the scaling for each level to be more adaptable to real condition of the operation. Re-assess the flow of procedure to be more responsive to its

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
C A U T I O N	**5 dBA below limit value or single complaint**	Advise Caution Alert Level Report to Site Manager Advise the consultant. Advise the concerned operator/ people that will assess what if any corrective action is warranted.	Exercise Caution on operations by starting to look into possible causes of increase in noise level. Continue with the normal monitoring frequency	Check possible factors such as weather conditions, nearby activities, measurement methodology, human factor and operational adjustments.	If external factor that's beyond control is the cause of the increase in noise such as weather condition, no further action required Advise concerned people if human factor was identified the cause. Imposed administrative rules if necessary. Consult resident engineer concerning matters of operation. Implement any corrective actions within 3 days.	For Site Manager to evaluate countermeasures proposed. Prioritize which actions have high importance	For Site Manager to approve implementation plan. He may seek advice of consultant.	Monitor the implementation of the countermeasures and record on the incident log. Respond to complainant regarding action taken	objectives.

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
W A R N I N G	Noise level at limit value or more than one person complains	Advise Warning Level Report the condition to the Site Manager Advise other consultant, client / developer and other concerned.	Elevate to Warning Level Verify reading with the audit findings of consultant, if data is available. Decide if necessary to increase monitoring to daily basis. Consider changes to operations to reduce noise levels	Look into external factors such as weather condition, nearby activities, measuring methodology, human factor and operational adjustments.	The site manager will advise concerned groups or people to come up with measures for the identified causes within 24 hours.	For the site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and preventive measures.	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan	Monitor the implementation of the countermeasures and record on the incident log. Respond to complainants regarding action taken	

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
B R E A C H	**Noise level limit value exceeded or complaint/action by regulatory authority**	Advise Breached Level Report Condition to Site Manager. Advise consultant, client / developer and others concerned	Elevate to Breached Level Verify reading with the audit report of consultant, if data is available. Increase monitoring to daily basis. If the noise levels persist beyond the allowable limits, the contractor must stop the work.	Look into external factors such as weather condition, nearby activities, measurement methodology, human factor and operational adjustments.	Call immediately for a meeting to all concerned to come up with joint corrective measures within the day.	For the site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and measures	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan. Report to the governing authority regarding the incident.	Monitor the implementation of the countermeasures and record on the incident log.	

Ecological Monitoring

As set out and required in the EIA, an ecological monitoring survey must be performed at least in three periods or as maybe required. Marine ecological surveys must be performed at least two weeks prior to the commencement of the operation. .

During the course of operations, a survey called Interim Ecological Survey, shall be performed to assess how much of the changes have been resulted from the activities in proportion to how has the operation has gone to since the start of the operations.

A third and final ecological survey will be conducted at the end of the dredging and reclamation operations. Results of both Interim and Post shall be compared to that of the Pre-ecological survey results.

Reports of such surveys shall be submitted within two months after the field surveys have been undertaken to Dept. Marine of which findings shall be treated as baseline data for marine ecology to both borrow and reclamation areas for the pre-ecological survey, and the data of the aftermath of the construction from the interim and post ecological surveys. Comparative results will be found useful reference for the compensation plans set forth for the project.

Underwater Noise

The scale of this project is such that it will cause increased underwater noise levels close to any of the construction activities. The purpose of this Environmental Management Framework is to ensure that the activities can be carried out in a manner that is as environmentally efficient as possible, i.e. minimising the environmental impacts.

There has been increasing concern internationally about the potentially harmful effect of man-made sound on the marine environment and species therein that could be sensitive to it. Under the 1976 Wildlife Act and its subsequent Amendments (2000, 2005 and 2010), it is an offence to hunt (except in some instances under licence or Ministerial permit), injure (except when hunting under such licence) or wilfully interfere with, disturb or destroy the resting or breeding place of a protected species.

Species of particular concern regarding underwater noise levels potentially raised due to this development include the Harbour Seal (*Phoca vitulina)*, Otter (*Lutra lutra*), Salmon (*Salmo salar*), Sea lamprey (*Petromyzon marinus*), Great Northern Diver (*Gavia immer*), Red-breasted Merganser (*Mergus serrator*) and Cormorant (*Phalacrocorax carbo*) all of which are qualifying interests or species of conservation interest (SCI) for the Galway Bay Complex cSAC / SPA. Additionally, Common Tern (*Sterna hirundo*) and Sandwich Tern (*Sterna sandvicensis*) are also SCIs for the SPA. They are shallow diving species which would be at less risk than the deeper diving birds such as Divers, Cormorant and Saw bills. Even though they are not qualifying interest for the cSAC, it should be noted that three species of cetacean forage or transit through the area, the most common being the Harbour Porpoise (*Phocoena phocoena).*

The excavation of material from the seabed during dredging operations is known to produce significant underwater noise in addition to the sound from attendant vessels. Sound exposure levels from this operations are below that expected to cause injury to a marine mammal, except at close range, they have the potential to cause lower level disturbance, masking or behavioural impacts, for example.

Dredging activity will occur in a defined area for a prolonged period of months. Therefore it has the potential to introduce continuous anthropogenic sound at levels that may impact upon marine species and the risk of acoustic impacts associated with this activity will be mitigated to ensure good environmental management.

Pile driving is widely acknowledged to produce substantial levels of anthropogenic sound both in air and in water with quite rapid rise times in each pile strike impulse.
The noise level is proportional to the diameter or maximum width of the pile and potentially can cause permanent hearing injury (i.e., PTS), temporary hearing loss (i.e., TTS) or other injury for some marine species in close proximity to such operations. The potential of this development to cause significant behavioural disturbance to marine species is limited by the size of the proposed piles and the shallow water environment.

The use of explosives or other blasting methods to break sections of bedrock or seabed (for pier construction) will be required during this project. Man- made explosions mainly produce pulsed sounds at low frequencies (several Hz to several kHz), which are detectable by a wide range of marine species. Active blasting will occur intermittently in a defined area for a prolonged period of months. Preparation for underwater blasting will take place from fixed platforms (i.e., rig, platform or barge) which will be moved a safe distance away for the time of explosion.

Pulsed sounds created by coastal or underwater explosions have been reported to contain significantly high SPLs, high SELs and very rapid rise times[3] and they are acknowledged to be among the highest energy man-made sounds introduced into the sea. While the duration and extent of underwater sound transmission from an individual explosion is limited by blast design and the shallow water environment. Such operations can incur the highest known level of risk to marine species from an anthropogenic sound source, with energy introduced at sufficient magnitude and velocity to cause a physical shock wave at close distances that propagates differently through the environment than does the acoustic energy and can result in direct traumatic or lethal injury to marine species.

Noise mitigation measures such as the use of bubble curtains have been examined but the significant currents in the area limit their effectiveness. In order to minimise the impact of construction the following general measures have been adopted:

- Use of alternative, lower impact equipment and methods where possible (e.g., vibratory hammer, smaller pile diameter, limiting maximum instantaneous charge).

- Use of clear “ramp-up” or “soft-start” procedures, whereby sound energy input to the marine environment is gradually or incrementally increased from levels unlikely to cause significant behavioural impact on marine species to the full output necessary for completion of the activity.

- Use of trained marine mammal observers (MMO's) to provide effective means of detecting marine species in the vicinity of operations.

- Use of Rigid Inflatable Boat to deter bird species prior to blasting activities.

Underwater Noise Monitoring

Underwater noise levels have only recently been measured in Irish Waters. The technology for carrying out this type of measurement on sites without significant infrastructure such as undersea cables is in its infancy.

In order to provide a representative sample of underwater background noise levels in the area surrounding the proposed development 4 underwater noise monitoring locations have been chosen:

1. Mid-channel on the lower section of the River Corrib at Nimmo's Pier
2. Approximately 100m south of the head of Nimmo's pier
3. Mid-way between Rabbit and Hare Islands
4. Mid-way between the Leverets and Mutton Island

All noise measurements shall be reported in accordance with TNO-DV 2011 C235 *Standard for measurement and monitoring of underwater noise, Part I: physical quantities and their units*

Pre-construction underwater noise measurements will take the form of a noise survey over a diel cycle once per quarter prior to the start of construction. The commonly used noise indices of Lmax, Lmin and LAn statistical parameters, including the LA90, will be logged with rainfall and wind speed and direction. Any data corresponding to periods of heavy rainfall will be excluded from analysis.

An independent environmental consultant will be assigned to monitor and audit the noise monitoring programme.

Frequency and Reporting
Monitoring will be carried out at the commencement of each phase of operation or stage of construction, including but not limited to; TSHD dredging, Cutter Suction dredging, Backhoe dredging, pile-driving and rock transport and rock placement. Monitoring will follow the same methodology and will be carried out at the same locations as pre-construction monitoring. This is to ascertain the noise level attributable to each stage or process so that if required mitigation measures can be implemented from an early stage.

Noise monitoring will be carried out on a quarterly basis for all of these activities.

For each of the first 6 blasts carried out air overpressure and vibration monitoring will be carried out at the 4 locations as outlined above.

During general construction activity post sediment settlement noise monitoring will reduce to six monthly intervals unless more frequent monitoring is required.

Reporting Action Guidelines

In the event that any underwater noise limit identified in the EIS being exceeded, the environmental consultant will be informed immediately along with a recommendation of appropriate remedial action. A full written report will be submitted to the environmental consultant within 3 days.

An underwater noise reporting procedure will be put in place on site.

Plan of Actions based on Noise Levels

The following Underwater Noise exposure limits are proposed.

Table 147. Noise Limits

Table xx - Proposed Underwater Noise Exposure Criteria			
Criterion	Metric	Type of Impact	Reference
Cetaceans			
230 dB re 1uPa peak	SPL peak unweighted	PTS	Southall et al, 2007
198 dB re 1 uPa^2-s	SEL (based on pulsed noise sources)	Instantaneous exposure PTS	Southall et al, 2007
215 dB re 1 uPa^2-s	SEL (based on non-pulsed noise sources)	Instantaneous exposure PTS	Southall et al, 2007
224 dB re 1uPa peak	SPL	Instantaneous exposure, behavioural response, single pulse	Southall et al, 2007
183 dB re 1 uPa^2-s	SEL	Instantaneous exposure behavioural response, single pulse	Southall et al, 2007
183 dB re 1 uPa^2-s	SEL (high frequency weighted)	TTS onset	Southall et al, 2007
140 dB re 1uPa peak	SPL	behavioural response, non-pulsed	Southall et al, 2007
Pinnipeds			
218 dB re 1uPa peak	SPL peak unweighted	TTS onset single pulse	Southall et al, 2007
186 dB re 1 uPa^2-s	SEL (pinniped frequency weighted)	Single pulse	Southall et al, 2007
186 dB re 1 uPa^2-s	SEL (pinniped frequency weighted)	Multiple pulses	Southall et al, 2007
203 dB re 1 uPa^2-s	SEL (pinniped frequency weighted)	Non pulsed	Southall et al, 2007
190 dB re 1uPa peak	SPL	behavioural response, non-pulsed	Southall et al, 2007
Fish			
195 dB re 1 uPa^2-s	SEL	PTS onset Blast 0.1 kg Fish	Popper et al.
200 dB re 1 uPa^2-s	SEL	PTS onset Blast 1.0 kg Fish	Popper et al.
187 dB re 1 uPa^2-s	SEL	Behavioural response Blast 0.1 kg Fish	Popper et al.
192 dB re 1 uPa^2-s	SEL	Behavioural response Blast 1.0 kg Fish	Popper et al.

Based on these levels, Alert levels are so designed with threshold limits as decision points for each alert level. Thus, having the following scheme of Alerts:

Table15. Noise Alert Levels

Alert Level	Noise Criterion/Observation	
	Criterion	Observation
Normal	**10dBA below criterion**	**No Observations**
Caution	**5dBA below criterion**	**Any note of biologically significant disturbance to marine species noted by MMO or Ecologist**
Warning	**At criterion level**	**Any note of injury to marine species observed by MMO or Ecologist**
Breach	**Above criterion level**	**Complaint from regulatory agency**

Corresponding suggested actions are then arranged for each level that the contractor will undertake in the event of any noise alert level. It should be noted that this system is so designed so that it will practically adapt to the operational conditions of the contractor by having the continuous improvement aspect on its cycle. The following pages describe the corresponding actions for each alert level.

Table 16. Action Plans Based On Underwater Noise Alert Levels

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
N O R M A L	**10 dBA below criterion value or no observations**	No need to advise Alert Level.	Normal Level operations. No necessary precautionary measures to implement. Continue monitoring with the normal frequency.						Review the effectiveness of the system and modify for further improvement, on a monthly basis. Adjust the scaling for each level to be more adaptable to real condition of the operation. Re-assess the flow of procedure to be more responsive to its objectives.

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
C A U T I O N	**5 dBA below criterion value or observation of biologically significant disturbance**	Advise Caution Alert Level Report to Site Manager Advise the consultant. Advise the concerned operator/ people that will assess what if any corrective action is warranted.	Exercise Caution on operations by starting to look into possible causes of increase in noise level. Continue with the normal monitoring frequency	Check possible factors such as weather conditions, nearby activities, measurement methodology, human factor and operational adjustments.	If external factor that's beyond control is the cause of the increase in noise such as weather condition, no further action required Advise concerned people if human factor was identified the cause. Imposed administrative rules if necessary. Consult resident engineer concerning matters of operation. Implement any corrective actions within 3 days.	For Site Manager to evaluate countermeasures proposed. Prioritize which actions have high importance	For Site Manager to approve implementation plan. He may seek advice of consultant.	Monitor the implementation of the countermeasures and record on the incident log. Respond to complainant regarding action taken	

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
W A R N I N G	Noise level at criterion value or observation of injury	Advise Warning Level Report the condition to the Site Manager Advise other consultant, client / developer and other concerned.	Elevate to Warning Level Verify reading with the audit findings of consultant, if data is available. Decide if necessary to increase monitoring to daily basis. Consider changes to operations to reduce noise levels	Look into external factors such as weather condition, nearby activities, measuring methodology, human factor and operational adjustments.	The site manager will advise concerned groups or people to come up with measures for the identified causes within 24 hours.	For the site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and preventive measures.	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan	Monitor the implementation of the countermeasures and record on the incident log. Respond to complainants regarding action taken	

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**Status**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
B R E A C H	**Noise level criterion exceeded or complaint by regulatory authority**	Advise Breached Level Report Condition to Site Manager. Advise consultant, client / developer and others concerned	Elevate to Breached Level Verify reading with the audit report of consultant, if data is available. Increase monitoring to daily basis. If the noise levels persist beyond the allowable limits, the contractor must stop the work.	Look into external factors such as weather condition, nearby activities, measurement methodology, human factor and operational adjustments.	Call immediately for a meeting to all concerned to come up with joint corrective measures within the day.	For the site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and measures	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan. Report to the governing authority regarding the incident.	Monitor the implementation of the countermeasures and record on the incident log.	

Waste Management

This section of the EMP is designed to ensure that effective waste management is undertaken for the New Galway Docks Project activities, which will ensure compliance with all waste management legislations and to introduce project waste minimization objectives, where practical. Proper segregation, collection and disposal of waste shall be implemented based on the scheme implemented by local authority.

The Contractor has the overall responsibility for managing waste at the work sites. Contractor and Subcontractor employees will be responsible for ensuring that they minimize the amount of wastes produced by their activities and are expected to fully cooperate with Contractor / requirements for waste minimization.

7.1.9 Waste Minimization

During the execution of the work, Contractor ought to evaluate the following:

- Re-use of materials thus reducing the need for the use of primary materials;
- Minimization of packaging materials and/or usage of returnable containers, if applicable, to establish agreement with manufacturers and suppliers;
- On-site segregation, recycling and processing of waste materials, where practical;
- Recovery of materials that are still viable to be used for the present requirement or for future construction activities instead of dumping them as wastes
- Periodic review of the history of material consumption in order to optimize control on supply and usage of materials

7.1.10 Waste Control Measures

During the execution of the work, the Contractor shall implement the following waste control measures:

- ☐ At each location, a dedicated area will be established for waste management and segregation i.e. Temporary Waste Hauling Station;
- ☐ Contractor and Subcontractor will be required to maximize the opportunities for reuse and recycling of materials to minimize waste and/or separate as required;
- ☐ Contractor shall ensure that only licensed waste transporters, waste processing companies and/or landfill sites are used to ensure compliance with legislative requirements.
- ☐ Contractor shall ensure that suitable protection measures and good housekeeping are incorporated in the design of the waste management facility to prevent pollution and harbouring of pests and vermin;
- ☐ Environmental Officer will regularly inspect and manage the area to ensure that stored wastes are covered to prevent accidental spillages and wastes from being blown away;

- ☐ Contractor shall ensure that sufficient waste disposal containers are available on site;
- ☐ No liquid waste shall be allowed to dispose at open water. Sewage shall be temporarily stored at sewage tanks and will be collected on a regular basis.
- ☐ Contaminated soil wastes collected prior to disposal shall be wrapped and stored in plastic so as to minimize, if not eliminate the potential for leachate formation;
- ☐ The site must be left in a clean and tidy condition at the end of each working day.
- ☐ Maintain updated records of waste generation per type of waste and study the trend over a period of time;
- ☐ Identify possible sources of irregularities in the amount of waste being generated and implement necessary measures to mitigate, control and avoid such incidents to happen in the future.
- ☐ Educate employees through advocacies, small talks during meeting and training to encourage people to actively participate in the waste management campaign.

7.1.11 Waste Disposal

Waste Classification

Due to the nature of project, all materials used will be of a temporary nature and the amount of waste generated will maintained at the least possible level.

Project Wastes will be classified into two (2) groups:

Non-hazardous Waste – Category A

This term is generally used to describe categories of waste for disposal at licensed land fill sites. The term refers to a waste that has no known or immediate hazard connected with handling or disposal; however it may possess certain reactive properties.

Examples of non hazardous wastes are:

- Paper;
- Cardboard;
- Wood products (hardboard, chipboard, etc);
- Plastics as finished products or manufacturing scrap only (including thermosetting plastics);
- Metals (iron, steel, aluminum) in solid form only;
- Wool, Cotton, Linen, Hemp, Sisal, Hessian, String, Rope and any other natural or manmade fiber;
- Cement, brick work.

Hazardous Waste Category B

The term Hazardous Waste is used as a general, often non-technical description of waste that contains a substance in such a quantity liable to cause death, injury or impairment to living beings, pollution of waters, or unacceptable environmental impact if improperly handled, treated or disposed of. It is primarily used to describe categories of waste for disposal at licensed waste disposal sites, if so required by local legislation and the like.

Examples of hazardous wastes are:

- Oil based products;
- Diesel oil;
- Petrol;
- Contaminated water from oil/water separators;
- Paints and thinner;
- Contaminated soil;
- Black water from bilges;
- Waste water from chemical toilets;
- Batteries;
- Fluorescent lamps
- Contaminated rags, sand, saw dusts and papers

Waste Material Documentation

Waste transfer notes and special waste consignment notes must be completed in full and copies are to be retained by Contractor´s nominated waste hauler / transporter.

Contractor should maintain copies of all waste documentation for a minimum period of two (2) years after project completion and these documents should be available for inspection upon demand.

Materials such as waste oil, chemicals and batteries are classed as special wastes and will require special handling, storage and disposal. All special wastes must be clearly labeled and stored and disposed of separately to (licensed) waste management sites.

Contractor should keep a record of all environmental incidents associated with waste management and remedial action taken in an environmental incident logbook.

Monitor implementation of remedial actions, review its effectiveness and revised if necessary. Standardize the actions into internal regulations and /or standards.

Complaints received in relation to waste management should also be recorded and investigated.

All waste documentation should be made available to Galway City Council and to the environmental Consultant upon request.

7.1.12 Management of Silt or Fine Materials

Fine materials are inherent to the quality of materials at the source. There are many ways that the construction of the proposed new structure can impact water quality during the operation and at post operation stage amongst which are overflowing at the dredger, sediment release during dredging and re-handling at the bunded area, all of which can have a detrimental effect on the marine environment if they are not properly controlled and monitored. The details of monitoring for these activities are discussed at the SS Monitoring Section of this document.

As a consequence of uneven distribution of materials inside the bunded area due to positioning of the dredger pipe, the contractor uses several ways to improve the density and compact strength of the soil and minimization of fine contents. In Bahrain, surcharging is most widely used. Other than improving the characteristics of the soil, it avoids the disposal of fine materials by mixing them with added good materials resulting to ground soil with acceptable level of fine components.

Emergency Management

Though most of the hazards can be controlled, there are still remaining hazards that are recognized to be of little control at early or no control at all. These mostly are natural hazards such as weather conditions, uncontrollable and fast chemical reactions such as fire, and explosion and situations with immediate catastrophic consequences such as spills.

Emergency by definition is a situation with the following characteristics:

- Poses an immediate threat to life, health, property, or environment.
- Have already incurred losses to life, health detriment, property or environment damages, and
- Has the potential to escalate to catastrophic level to create massive effect.

Planning for Emergency should be based on the three (3) stages: Preparedness, Response, and Recovery.

7.1.13 Emergency Preparedness

This portion of the emergency is based on the stage before the emergency occurs. This part consists of all the necessary preparations in terms of emergency facilities and equipment, capability building of the emergency team and providing sufficient knowledge and proper orientation to all the people that will be likely get affected. Emergency Preparedness of the Contractor should consist of the following:

- Organizing the team who will be overall in-charge, who will mobilize during occurrence of emergency and who will take actions during the recovery period
- Training, regular drills, evaluation and review of emergency response procedures to ensure readiness of the team and all the people
- Plan of advisory to the workers and public through warning and provision of emergency hotline numbers where anybody can call to report or for assistance.

- Planning for the Action Levels in reference to warning levels
- Plan of Communication among emergency team members and coordination with the government entities and private agencies that readily can help
- Plan of evacuation which will include escape routes, emergency exits and assembly areas,
- Preparation and installation of necessary emergency equipment and medical facilities, including personal protective equipment that the response team will be using
- Maintenance of emergency equipment and medical facilities

7.1.14 Emergency Response

This is the stage where emergency situation actually occurs. The contractor must have specific workable step-by-step procedures on how to address different types of emergencies. The contractor must create, at the least, the following emergency procedures:

1. Fire
2. Chemicals / Hazardous Materials Spills
3. Accident
4. Evacuation
5. Water emergencies, as applicable

7.1.15 Emergency Recovery

This is the stage of post emergency period where the contractor needs to create procedures and recovery plan on how to go back systematically and fast to its normal full operations level after a major catastrophic incident happened. The objective of the part of this planning is to avoid as much as possible losses from the disruption of operations due to the effects of the incident that just recently happened. The faster a project goes back to full operation, the lesser the associated damages it will incur such as loss of money (penalties, cost of recovery, and the like) and loss of opportunities (schedule deadlines, business targets, etc.).

In creating procedures and recovery plan, worst case scenario must be assumed to come up with timely actions. Logistical preparations must also be done to manage the continuation of the operations remotely at pre-defined area(s) not affected by the incident while the affected site is undergoing recovery process. At the least, the recovery plan must include:

1. Pre-defined temporary operations office site, strategically in a safe distance from the original site
2. A remote back up site for important records and files and/or a remote backup system of all electronic files that can easily be retrieved wherever and whenever possible
3. List and number of all office machines and equipment that will be needed to run the temporary office such as computer, printer, tables, chairs, communication devices (telephone, fax machine, radios), etc.

4. List of construction machines and equipment that will be needed for the recovery and for the continuing limited capacity operations
5. List and number of workers that will be called for work during limited operational capacity
6. Manner of coordination with subcontractors and the list of their contact numbers
7. Communication plan during this stage

An action plan must be designed to identify the systematic steps to be undertaken by the contractor based on the number of days that have lapsed since the time of occurrence of the emergency. A suggested format could be seen in the table below:

Table 17. Emergency Recovery Time Table

Key Operation	2 days	1 Week	2 Weeks	1 Month	3 months
Engineering / Management Office / Subcontractors management	Setting up of temporary office; installing the office equipment;	Selected Subcontractors whose operations are not affected by the emergency can start to mobilize and resume work	Subcontractors whose works are least affected by the emergency can commence work.	Subcontractors whose operations are partially paralyzed by the emergency can commence work.	Subcontractors whose works are completely paralyzed by the emergency can commence work.
	skeletal workforce reports to plan and coordinate with subcontractors and suppliers;	Equipment and manpower to mobilize	Equipment and manpower to mobilize	Equipment and manpower to mobilize	Full operations commence from all the subcontractors.
	prepare all the necessary documentation and reports for the emergency incident that occurred;				
	coordinate with different departments and agencies regarding reporting, legal arrangements, insurance claims, etc.				

This plan must be reviewed by all contractor and subcontractor managers, supervisors, foremen, and safety personnel. All other project personnel performing activities will receive a site-specific project safety orientation summarizing the content of this Safety Plan. If requested, project personnel will be provided the time necessary to review the entire plan.

All personnel will be required to sign the appropriate documentation acknowledging an understanding of the Safety Plan. Visitors, suppliers and people who will have temporary stay at the site for various reasons will also be required to receive an abbreviated project safety orientation (safety induction), in addition to being escorted by an authorized project team member when going to the site.

Ecological Concerns / Flora & Fauna

Marine flora and fauna have been identified and documented in the EIA. However the development will create an entirely new environment through the creation of newly reclaimed area designed landscapes and greeneries, in which the species at the reclamation footprint will be totally wiped out, except for the mobile ones. These new types of environment are expected to be a renewed habitat for those existing species around the area.

In order to minimise the effects of the construction phase on migrating Atlantic Salmon and other anadromous species, dredging, blasting, piling and infilling will be limited to periods when juvenile stage salmonids are not passing through the vicinity of the proposed development. Work will be completed between 1st August and 31st March inclusive to remove the impact of these activities, by avoiding the downriver run of smolts

Water Quality and Suspended Solids

The basic approach in water pollution control programme is to control the increase in suspended sediment concentrations during reclamation, control of oil and hazardous spills and disposal of wastewater from dredgers and associated vessels.

Potential sources of water quality impacts associated with the construction works of the project include:

(i) Bund construction;
(ii) Rock armour construction;
(iii) Steel sheet pile quay construction
(iv) Construction runoff and drainage;
(v) General construction activities;
(vi) Use of chemicals or oils;
(vii) Sewage effluent from workforce;

Pollution avoidance and mitigation measures must be adopted to avoid or reduce the adverse impacts from these sources on water quality and must be fully discussed in Contractor's Environmental Implementation Plan.

7.1.16 Water Quality

The water quality parameters that should be monitored at the sampling stations identified are:

- Temperature (^{0}C); Dissolved oxygen (mg/l); Salinity (practical salinity units (psu)); Depth (metres (m)) and transparency (*Secchi***)**
- Suspended solids (surface, mid water and off bottom sampled +/- 1 h of High Water.

The test method for each parameter is presented in the table below.

7.1.17 Suspended solids (SS) monitoring

Increases in suspended solids concentrations are inevitable during dredging and bund construction and to a lesser extent, infilling activities. However, it can be managed and controlled by incorporating best operating practices.

Closed bunding and careful filling together with strict monitoring should be properly observed in order to ensure minimum impact to the marine environment.

Dealing first with dredging operations in relation to the approach channel and turning circle, suspended Sediments shall be monitored at both static and mobile stations. Monitoring station locations will be selected based on the requirements stipulated in the dredging licence issued by the EPA. These are the suggested monitoring stations:

Table 18. Station Monitoring Sampling Station Guidelines

1	500 meters downstream from the boundary of dredge area	SS level must not exceed 10 mg/L above the baseline reading
2	100 meters downstream from the dredger.	SS level must not exceed 50 mg/L above the baseline reading
3	Control Sites Triplicate samples 200 m equidistant from each other to be taken from 1 to 2 km upstream to serve as control sites.	Source of baseline reading
1	1 sample to be taken in the middle of the plume.	SS level not to exceed 500 mg/l

Concerning the period of bund construction, monitoring will be required during the construction periods when rock is being deposited on the sea bed through the water column.

Water samples are to be collected to within 10m of the bunds being constructed at surface, mid water and off bottom downstream of the works area.

Values must not exceed 50 mg/l over background levels.

With regard to filling of lagoons and settlement of material, although it is intended to use a geotextile to minimise escape of sediments from the lagoon, it will be a requirement to monitor for any seepage. The location of these sites cannot be predicted at this time. 10m is a suggested distance from the bund wall and a level of 20 mg/l above background is suggested.

The monitoring duration must commence one month before dredging operation and bund construction begin and continue for one month after the completion of both activities.

Sampling Methodology, Frequency and Reporting

SS samples will be collected from above locations once a day. Samples will be collected in plastic 1l bottles at the surface, midwater and off bottom using a water bottle. Three replicates will be sampled at control while only one (1) replicate will be obtained from the rest of the stations. Samples will be sent to an approved laboratory for determination of SS. Results of these analyses will be submitted to the EPA on a weekly basis.

An independent environmental consultant will be assigned to monitor and audit the SS monitoring programme.

Data Analysis

SS readings from the samples are recorded and compared to readings at Control Stations to determine significant differences in concentrations. Differences are calculated by subtracting the actual measurements from the control measurements. Readings will also be compared with indicator level in the guidelines set by Marine Resources Directorate.

Results will be presented graphically showing the comparison of average value of control stations with that of the standards and the actual SS sample readings

Reporting Action Guidelines

Immediate reporting of the incidence of exceedance if any of the critical limits mentioned below are exceeded:

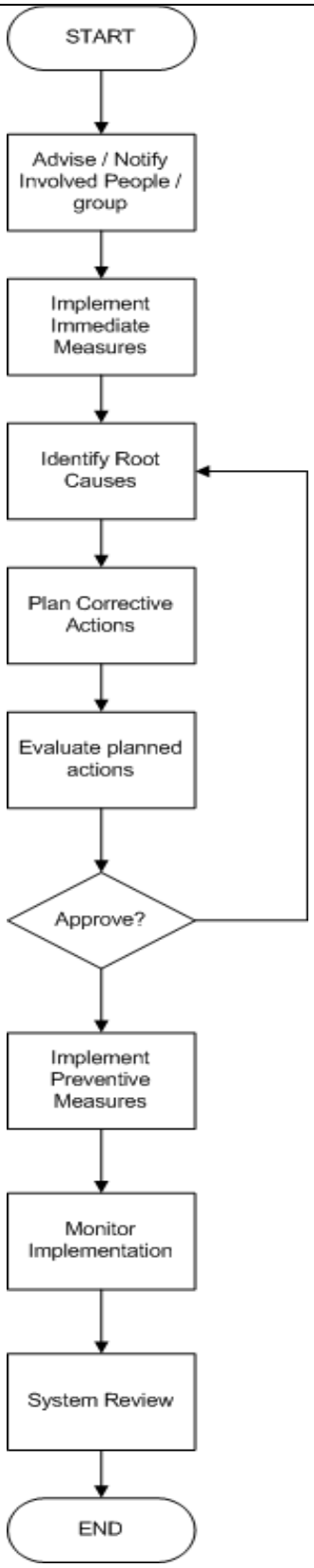
Table 19. Reporting Action Guidelines

Location	SS Reading
500 meters downstream from the dredger	10 mg/L and above

Plan of Actions based on SS Alert Levels

This plan of actions is undertaken based on the levels of SS monitored by the contractor on a regular basis. The logical flow of actions is best described in the flow chart shown below:

Table20. Procedures for Taking Actions based on SS Alerts

Notification		All people / groups are notified and advised regarding the SS Alert Level and location where it was identified.
Immediate Countermeasure		Concerned people / groups execute the written immediate plan based on the advised alert level.
Planning for Preventive Measures to avoid reoccurrence in the future		Site Manager and / or members of an ad hoc monitoring committee (members are various stakeholders of the project) meets and plans for preventive measures to ensure that similar incident can be prevented to occur in the future. Situation is analyzed and root cause(s) are identified by looking at uncontrollable factors (prevailing weather condition, current flow, nearby activities) and controllable factors (human factor, operational adjustments, procedures, mechanical failures, etc.) Corresponding actions are drawn up from the identified root causes. Action plans are evaluated and prioritized based on its effectiveness and impact. Implementation of Action Plans is executed based also on the current SS Alert Level advised. Implementation is monitored to ensure success of the preventive action plan.
Review		The overall system is reviewed and SS Alert Level Scaling maybe adjusted to adapt to real condition of the operation, all for the purpose of continuous improvement.

The following SS Threshold limits are proposed.

Table 21. SS Limits

Location	Suspended Solids Limit
500 meters downstream of the dredger	10 mg/L above baseline
100 meters downstream of the dredge area	50 mg/L above baseline
Within the plume	500 mg/l above baseline
10m from bund construction area	50 mg/l above baseline
10m from lagoon for seepage	20 mg/l above baseline

Based on these levels, Alert levels are so designed with 50%, 80% and 100% of threshold limits as decision points for each alert level. Thus, having the following scheme of Alerts:

Table 22. TSS Alert Levels

Alert Level	Suspended Solids Reading	
	500 m from dredger; 500 m from dredge area;	
Normal	**SS < 5 mg/L** above baseline	
Caution	**5 =< SS < 8 mg/L** above baseline	
Warning	**8=< SS < 10 mg/L** above baseline	
Breach	**SS = > 10 mg/L** above baseline	

The following pages describe the corresponding actions for each alert level.

Table23. Action Plans Based On SS Alert Levels

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**SS Reading**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
N O R M A L	**SS < 5 mg/L** above baseline at 500m from dredger.	No need to advise Alert Level.	Normal Level operations. No necessary precautionary measures to implement. Continue monitoring with the normal frequency.						Review the effectiveness of the system and modify for further improvement, on a monthly basis. Adjust the scaling for each level to be more adaptable to real conditions of the operation.

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**SS Reading**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
C A U T I O N	**5 =< SS < 8 mg/L** above baseline at 500m from dredger.	Advise Caution Alert Level Report to Site Manager Advise the consultant. Advise the concerned operator, in case the alert level goes up.	Exercise Caution on operations by starting to look into possible causes of increase in SS readings. Continue with the normal monitoring frequency	Check possible factors such as weather conditions, current flow, nearby activities, sampling methodology, laboratory testing procedures, human factor and operational adjustments.	If an external factor that is beyond control is the cause of the increase in SS such as weather conditions, dredging operations can proceed with caution. Advise concerned people if human factor was identified the cause. Imposed administrative rules if necessary. Consult resident engineer concerning matters of	Site Manager to evaluate countermeasures proposed. Prioritise which actions have highest importance	Site Manager to approve implementation plan. Seek advice of consultant.	Monitor the implementation of the countermeasures and record on the incident log.	

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**SS Reading**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
					operation. Advise laboratory for necessary corrective actions. Corrective actions should be received within 3 days.				

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**SS Reading**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
W A R N I N G	Reading to be **8=< SS < 10 mg/L** above baseline at 500m from dredger.	Advise Warning Level Report the condition to the Site Manager Advise other consultant, client / developer and other concerned.	Elevate to Warning Level Verify reading with the audit findings of consultant, if data are available. Decide if necessary to increase monitoring to daily basis. Reduce dredging activity.	Look into external factors such as weather conditions, current flow, nearby activities, sampling methodology, laboratory testing procedures, human factor and operational adjustments.	The site manager will advise concerned groups or people to come up with measures for the identified causes within 24 hours.	Site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and preventive measures.	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan	Monitor the implementation of the countermeasures and record on the incident log.	

Alert		Immediate Action		Preventive Actions					Review
Alert Level	**SS Reading**	**Advisory**	**Immediate Measure**	**Identification of Root Cause**	**Plan Corrective Measure**	**Evaluate**	**Approval**	**Monitoring / Report**	**System Review**
B R E A C H	**SS = > 10 mg/L** above baseline at 500m from dredger.	Advise Breached Level Report Condition to Site Manager. Advise consultant, client / developer and other concerned	Elevate to Breached Level Verify reading with the audit report of consultant, if data are available. Increase monitoring to daily basis. If the SS readings persist beyond these limits, cease operations.	Look into external factors such as weather conditions, current flow, nearby activities, sampling methodology, laboratory testing procedures, human factor and operational adjustments.	Call a meeting for all concerned to come up with joint corrective measures within the day.	Site manager to evaluate the effectiveness of the plan and prioritize implementation of corrective and measures	In consultation with the consultant, client/developer and other concerned, the manager will get their consensus for the implementation of the plan. Report to the governing authority regarding the incident.	Monitor the implementation of the countermeasures and record on the incident log.	

7.1.18 Sedimentation Monitoring

In addition to SS monitoring settlement of suspended sediments is also required. Monitoring is carried out by installing silt traps with triplicate samples at identified locations with the area near the dredge location and at sites distant from such activities which are more prone to these impacts. The basic sediment trap consists of a broad funnel with a collecting jar at the bottom. The funnel opening has baffles at the top to keep out very large objects that might clog the funnel. The content of each trap shall be collected monthly and sent to an approved laboratory. Sediments should be dried at 180^{o}C and weighed. Sediment rate can be calculated by the following relation.

$$\text{Sedimentation Rate (mg/cm}^2\text{/day)} = \frac{W}{A \times D}$$

Where, W = Dried weight of sediment collected in the trap (mg)
A = Area for opening of the trap (cm^2)
D = Number of days in the field

Results of the calculations are included in the monthly monitoring reports.

The locations of these sedimentation monitoring stations will be finalized by the monitoring consultant with the approval of the EPA.

7.1.19 Ecological Monitoring

Intertidal benthos

Intertidal annual seasonal sampling should commence pre-construction and for one year post-construction at the following locations: Ballyloughan, Lough Atalia, Renmore Lough, east and west of the causeway and at an agreed control site to record macrofaunal assemblages and sediment granulometry at High, Mid and Low water levels on the shoreline. Sampling should incorporate quadrates, cores and photography (including Sediment Profile Imagery). Post-completion, the additional 1 year's data can be reviewed to see if seasonal sampling is still required or if it can be reduced to once a year.

Subtidal benthos

Annual benthic sampling should be commenced pre-construction at the following sites: south of Ballyloughan Beach, Lough Atalia, Renmore Lough, west of the causeway, south of Mutton Island and at an agreed control southwest of the Margaretta using a 0.1 sqm grab and a 1 mm sieve. 3 faunal samples a 1 sediment sample should be collected and analysed using the same techniques as were used in the

EIS. Sediment Profile Imagery should also be incorporated into the monitoring methodologies. The sampling should continue for at least 5 years post-completion.

Salmon smolts

The acoustic tagging study that was carried out as part of the EIS should be re-done during and post the construction period to document changes in patterns of migration routes that the smolts undertake.

Marine Mammals

A Marine Mammal Watch Plan including marine observers will be employed, during the construction phase, prior to and during blasting and pile driving. The use of acoustic deterrent devices will be employed if required.

Monitoring of harbour seal populations prior to, during and for at least two years post construction will be completed as part of ecological monitoring of the development. This will follow a similar methodology to that employed as part of the baseline surveying, using similar techniques and haul out locations to allow for comparative analysis with baseline information.

Survey for otter holt sites will be completed immediately prior to construction phase and on two occasions post construction phase, following a similar methodology to that employed as part of baseline surveys. During the construction phase, observation surveys for otter activity will be made and notes from marine observers and bird surveyors will also be included as part of the dataset.

Birds

Monitoring of bird populations prior to, during and for at least two years post construction will be completed as part of ecological monitoring of the development. This will follow a similar methodology to that employed as part of the baseline surveying, using similar techniques and point count locations to allow for comparative analysis with baseline information.

Marine chemistry

As the proposed development has the potential to alter salinity regimes in the area, *in situ* monitoring of salinity should commence prior to construction at the following sites: at the mouth and within Lough Atalia, Renmore Lough, off Ballyloughan, south of Mutton Island and southwest of the Margaretta. This monitoring should continue for at least two years post-construction.

Marine physics

As the proposed development has the potential to alter current velocities and wave heights in the area, appropriate measuring devices should be deployed pre-construction to measure current speeds and wave heights at the following sites: south of Ballyloughan, east of the existing shipping channel, south of Mutton Island and southwest of the Outer Margaretta buoy.

Underwater Noise

Annual seasonal sampling will commence one year pre-construction, during and for one year post-construction at the following locations:

1. Mid-channel on the lower section of the River Corrib at Nimmo's Pier
2. Approximately 100m south of the head of Nimmo's pier
3. Mid-way between Rabbit and Hare Islands
4. Mid-way between the Leverets and Mutton Island
5. An agreed control site

Post-completion, the monitoring will be reduced to once a year.

Following species identification, statistical analysis is to be carried out using the PRIMER® package or similar statistical software. (PRIMER® consists of a wide range of univariate, graphical and multivariate routines for analyzing the species/samples abundance (or biomass) matrices that arise in biological monitoring of environmental impact and more fundamental studies in community ecology, together with associated physical/chemical data). CLUSTER analysis can used to identify 'natural groupings' of samples based on the faunal assemblages at each station. MDS plots are another way of graphically representing the samples based on their similarity (or dissimilarity) to each other. SIMPER analysis allows the identification of the species responsible for the similarities (or dissimilarities) seen between stations. PCA plots are similar to MDS plots; however, they are based on environmental parameters not species abundance.

Particle size distribution is generated from the results of Particle Size Analysis (PSA) that will be carried out as a part of ecological surveys.

Overall Environmental Monitoring Plan

7.1.20 Monitoring Schedule

A generic monitoring schedule is plotted in the following page to guide the consultant in-charge of monitoring how and when to execute the tasks. This schedule is customised and adjusted specifically to the requirements of the client. However, it must be noted that frequency and inspections, audits and monitoring site visits indicated in this schedule are based from those suggested in existing regulations and those observed as best practices of industries and other dredging and reclamation operations.

Environmental Monitoring Schedule

Table 8. Sample Monitoring Schedule

Item	Frequency	Month 1				Month 2				Month 3				Month 4				Month 5				Month 6			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Monitoring																									
SS Sampling	every day																								
Noise Monitoring	once a month																								
Emissions & Dust Monitoring	once a month																								
Underwater Noise Monitoring	Quarterly																								
Health & Safety (OHS, Security, Traffic, Waste Mgt, Emergency)	2X a week																								
Sedimentation Monitoring	Once a month																								
Ecological Monitoring	pre/interim/post																								
Report																									
Fortnightly EHS Report																									
Monthly Report																									
Annual Report																									
Completion Report	after completion																								

7.1.21 Monitoring Forms / Check Sheets

Dedicated forms are developed to facilitate periodic monitoring by concerned persons responsible for monitoring. These forms cover relevant environmental attributes specified in this EMP and those that are indicated in the monitoring schedule. These monitoring forms should be included and attached to the contractor's implementation plan. A sample of the check sheet is attached at the end of the document. The Monitoring Consultant must create these check sheets prior to start of the monitoring program.

7.1.22 Appointed Environmental Consultant

Upon finalisation of selection of the Environmental Monitoring Consultant, its tasks, duties and responsibilities and the scope of work must be cleared properly in the contract. Its duties and responsibilities can be annexed to this document as a reference.

7.1.23 Environmental Reports

Environmental Report should be submitted to EPA in both hard and soft digital formats. Report should be submitted to their office on or before the 15th of the following month. Raw data such as field measurements, laboratory results must be annexed the report. Soft copies of these data must also be separately provided. 6 monthly, Annual Reports and separate Completion reports may be imposed to be submitted depending on the extent and level of criticality / sensitiveness of the project.

The report may be structured and/or contain the following items:

- Executive Summary – this is the report in a nutshell; if the reader does not want to get thoroughly into the detail of the report, this is the section where he should read, and thus must contain the important details of the report; this portion must also show the overall evaluation of the consultant on the environmental performance of the project and if EMP is successfully implemented
- Introduction – this portion of the report should cover the brief description of the project, the background of the EIA conducted and the results of the assessment study particularly on what are the significant impacts identified, plus a brief background about the capability of the monitoring consultant
    - Project Description
    - Overview of the EIA
    - Monitoring Consultant

- Management Team – this section must include the list of the key persons of each of the project stakeholders and their corresponding contact details, to mention that of the Owner / Developer, Project Manager, Project Engineer, Contractor / Sub-Contractors and the Consultants.
- Work Progress – a review of the month's achievement based on productivity of the dredger, rates or average rate of production for the month, quality and dredged material production, borrow area covered, reclamation covered, manpower, tools and equipment utilized, production challenges encountered for the month, environmental-related issues that affected the work progress
- Monitoring of EMP Implementation- this section discusses the implementation of the action points of each environmental aspect mentioned here in the EMP. The individual check sheet results of the environmental aspects (if check sheets are available), should be discussed and included here
- SS Monitoring Protocol - this is special section that is solely dedicated to discussion about the results of SS Monitoring, to include but not limited to procedure in taking SS samples, which includes the dates and locations of the sampling sites, pictures or videos of the actual sampling being done at each site, discussion of the monitoring results for both static and mobile sampling sites and that of the contractor results specifically focusing on occurrences of exceedance and the reasons why there are such occurrences, conclusions and recommendations
- Other Environmental Attributes- all other discussions about the identified environmental aspects of the EMP must be discussed briefly here; if there are no findings for a certain aspect, its section may be skipped during that particular period
- Complaints – this section will tackle any complaints or information regarding public's or any other institutions' any form of interferences to the project and how these things are resolved or being resolved
- Conclusions & Recommendations – this will state the consultant's overall generalization of the environmental performance of the project for the period and corresponding suggestions and recommendations for further improvement of the performance
- Next Steps- this section will contain the plans for next month's monitoring, specific environmental programmes that will be implemented, changes in the production plans and the corresponding environmental plans that goes with it
- Attachments – raw data tables, sets of environmental aspect check sheets, copies of documents mentioned in the report

Managing Communications & Complaints

It is a standard protocol that all the communications should course through to the highest official on the site, normally the Project Manager of the Contractor, whose main responsibility is to decide, assign and or dispatch to the responsible individual, team or group to respond to the specific concern at hand. This communication setup ensures that the Project Manager is fully aware of all issues and concerns pertaining to the project. In order to facilitate this Standard Operational Procedure, the contractor must arrange specific individuals, teams or groups who will take roles in managing specific concerns on emergency, incidents / accidents, complaints from the public and various stakeholders and labour and other internal issues.

7.1.24 Responsibilities:

Project Manager

1. Overall in-charge of the decision making, assigning and dispatching teams to respond to specific concerns in a systematic and timely manner
2. Organising the teams and selecting individuals who will compose these teams
3. Though responsibilities are assigned to teams, he/she takes the overall accountability for the actions and the corresponding results of such actions

Public Relations

1. Reporting to the Project Manager, takes necessary actions on all public complaints and other issues and concerns pertaining to the project that involve external relations including that of the government authorities, regulatory agencies and non-governmental organizations.

Project

1. This team manages the necessary action plans pertaining to issues and concerns that are technical and project-related such as supply of materials, equipment, modification of plans and the like

Labour Relations

1. This individual, team or group implements the necessary actions pertaining to concerns arising from labor related issues such as compensation, labour facilities, internal conflicts, etc.

EHS / Emergency

1. This specialised team will handle all concerns regarding EHS, incident/accident reporting and emergency aspects of the overall operations

7.1.25 Methods of Exchange of Communications

Incoming communications or complaints from concerned people or parties whether internal or external can be made by calling telephone number(s) or specific hotline numbers designated for such purposes. Such numbers must be legibly displayed at all strategic areas of the site.

Another way of receiving and transmitting communications from the originator to the proper receivers, which complementing to the previous one, is through a systematic exchange of information through hierarchical channels of the organization called a Call Tree.

7.1.26 Call Tree Mechanics

The communication starts from the any person who experience, witness or received first hand external or public complaints. The information is relayed by personally reporting, or calling his/her immediate superior. The immediate superior then relays the information to his/her immediate superior. This information relay continues until the important details are received by the Project Manager. The Project Manager, in turn, activates the particular to team to appropriately respond to the information received. To manage the risk of losing the important details of the information, all people involved in the project will be oriented, and trained, through the Induction, to relay and receive important information. The information should contain at least the following: Name of the Originator, Date and Time, Location, and the Specific Concerns. As a reference for supervisors and managers, they must have a listing of contact numbers of all of their subordinates and their immediate superiors.

7.1.27 Information Control, Recording and Monitoring

Once the information has been received by the Project Manager, he/she prioritises and decides which concerns must be acted upon immediately and those that possibly can wait for a certain period of time. Progress of the action plans are monitored based on the committed date of implementation and completion of the actions indicated in the log. For handling multiple concerns, it may be necessary for the Project Manager to assign this task to an individual to manage updating of the Information Register and follow up to the concerned teams regarding the implementation of action plans.

Monthly reports of the completions in terms of “closed issues” and progress of actions for the “ongoing issues” are delivered to the Client.