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Waste Licence Application For Howth Harbour Dredging and Reclamation Project

Operational Report

Department of Agriculture, Food and the Marine

22/11/2023

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Contents

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1 Introduction

The purpose of this document is to clearly describe the construction methodology, the operation of the facility and the overall proposed execution of the works.

The Waste Licence Application relates to the treatment of the dredge spoil dredged from within Howth Harbour and the recovery of it for use as backfill in the formation of an area of reclaimed land to the west of the harbour's West Pier.

Information and methods described in this document will be used to inform several other documents required as part of the Waste Licence Application process.

It is proposed to dredge circa 240,000m3 of dredge material from the seabed within Howth FHC, treat and beneficially re-use this material to the west of the West pier to create an additional land area of circa 4.8Ha. The treatment and placement of the dredge material will take place in accordance with the conditions of the waste licence.

The aim of the overall project is to increase the depth of water in the harbour to provide safe access for the largest range of vessel sizes and types on the widest range of tides, within the structural parameters of the existing harbour quay structures; and, where possible to treat and recover dredge material in an environmentally sustainable and cost-effective manner.

2 Summary of the Project

2.1 General

The proposed development involves the following main elements:

- Coastal protection works to the perimeter of the reclaimed area.
- Construction of slipway for access to the water.
- A reinforced concrete wall perimeter on the west side of the channel between the reclamation area and the northern section of the West Pier.
- Construction of a bridgeway over the channel
- Dredging the harbour (see Figure 1 below).
- Treatment of the dredge material.
- Reclaiming land on the west side of the west pier using treated dredge material. (See Figure 2 below)
- Landscaping on the reclaimed area.
- Provision of pavements e.g., footways, roadways, and parking areas.
- Provision of storage areas for harbour activities both leisure and fishery; and
- Provision of services.

The finished reclamation area will include landscaping, access road, pathways, parking, surface water drainage, mains water supply, electricity supply, viewing areas and water access points. Landscaping works will involve importing and depositing topsoil and planting/grass seeding. Hardstanding areas will be fenced and used as storage areas for harbour activities.

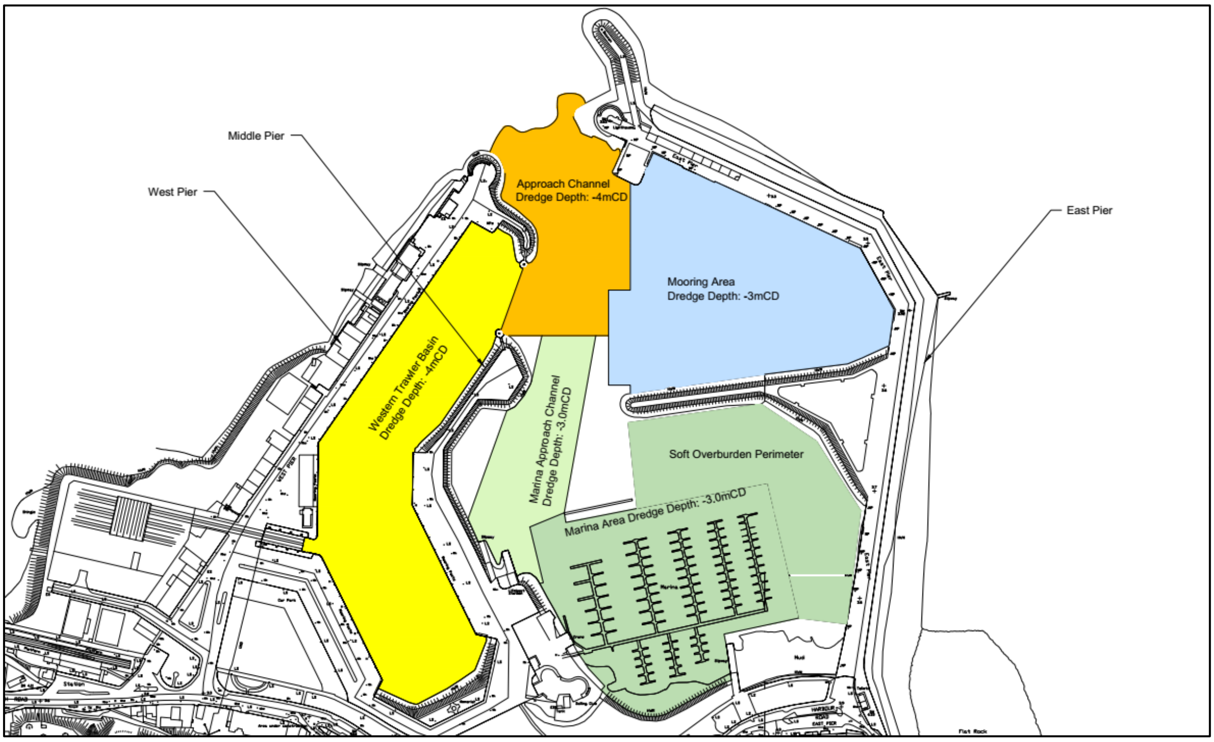

Figure 1 Proposed Dredge Areas

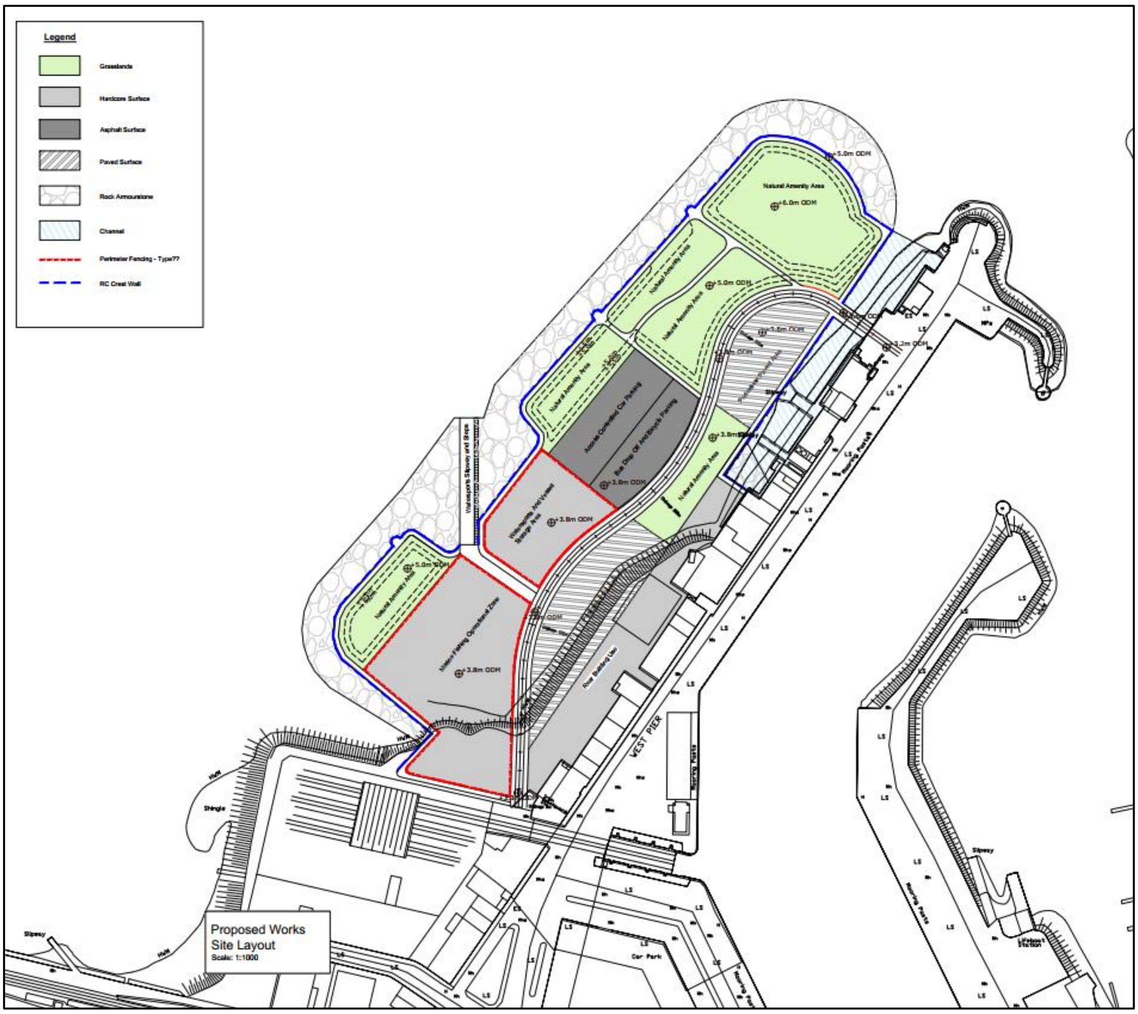

Figure 2 Proposed Reclamation Development. Refer to Dwg 19934-5502 for details.

2.2 Unit Operations Flow Diagram of Activity

The proposed activity is described below in a flow diagram as a summary.

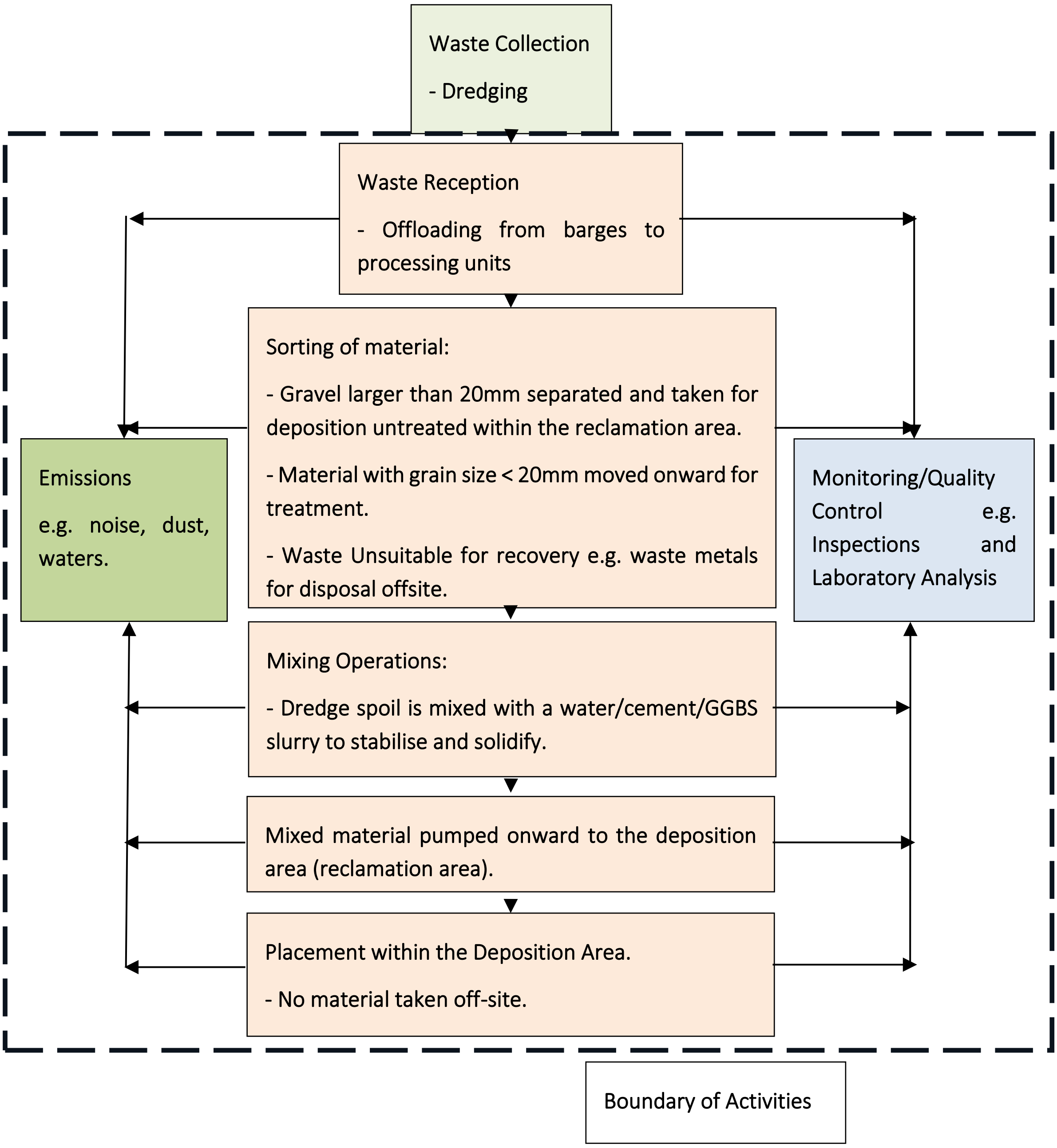

Figure 3 Flow Diagram of Activity

3 Existing Environment

3.1 Site and Project Context

Howth Harbour is situated on the north side of Howth Peninsula, to the north of Dublin Bay (Figure 4 below). The harbour itself comprises of three main areas; a trawler basin entered between two bullnoses to the north, swing moorings area to the east and the yacht club marina.

For the purposes of the dredging project, the harbour is considered to comprise of five areas (see Figure 1 above):

1. Western Trawler Basin.
2. Harbour Approach Channel.
3. Mooring area.
4. Marina Approach Channel.
5. Marina Area - the marina area dredging may include the removal of soft overburden material outside the perimeter of the existing marina.

Howth Harbour operates as a Fishery Harbour Centre under the Department of Agriculture, Food and the Marine. The core fishing fleet is in the order of 50 vessels, and there is significant marine leisure activity, including the Howth Yacht Club and the Howth Sailing and Boating Club. There are also several restaurants and shops along the West Pier. Fish processing and boat repair works are also undertaken in the harbour.

Figure 4 Site Location Map

The proposed site is situated in proximity to several Special Protection Areas (SPA) and Special Areas of Conservation (SAC), the closest of which are Howth Head SAC, Baldoyle SAC, Ireland's Eye SPA and Howth Head Coast SPA. There is a total of eighteen designated Natura 2000 sites within 15km of the proposed works. The specific habitat and species designations for each site are discussed in detail in the Natura Impact Statement prepared for the project.

There are several Recorded Monuments located in the immediate area surrounding the site. The relative significance of these monuments and the potential impacts that the proposal could have on these monuments are discussed in detail in Chapter 10 Archaeology and Cultural Heritage of the EIAR.

3.2 Existing Ground Conditions

Most of the area to be dredged consists of a sandy silt overlying rock. The ground conditions in the reclamation area comprise fine to medium brown sand with underlying fine to course grey, silty gravelly sand. For a full description of the existing ground conditions refer to Chapter 6 Land and Soils of the EIAR. For a full analysis of the dredge material refer to the Quantitative Risk Assessment in Appendix 10 of the EIAR. Subsequent to the preparation of the EIAR further sampling and analysis of the material to be dredged was undertaken 2023 specifically to inform this waste licence application.

3.3 Site History

Howth has been a trading port for many centuries; however, the existing harbour west and east piers were not constructed until the early 19th century (see below Figure 5). The west and east piers are of masonry construction.

Figure 5 Historic 6 Inch OSI Map (c 1840)

The current harbour layout was developed in the early 1980s with the construction of the Middle Pier and East Pier internal breakwater. These works provided segregated areas for fisheries and leisure users i.e., western trawler basin for fisheries; and swing mooring area and marina area for leisure. The marina approach channel was bounded between the new middle pier and east pier internal breakwater. This allowed the drying out of the marina area by closing the gap between the pier and the breakwater and pumping out water. The marina area was then dredged, and the marina constructed in the dry (See Figure 5 below). The proposed dredge levels in this project are in some areas of the harbour like the levels that were previously dredged to in the 1980s. As a result, most of the material to be dredged as part of this project is a soft silt. The remaining material to be dredged is rock. It is anticipated that rock dredging will be minimal to obtain the required depths.

Figure 6 Construction of the marina area in the 1980s. Dredging was carried out in the dry.

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4 Construction Phase of the Project

4.1 Duration of Construction

The works programme is estimated to be 24 months from commencement on site.

4.2 Construction Elements

A preliminary programme of works is given below. The proposed works can be divided into 4 key elements as follows:

- Element 1: Construction of a perimeter embankment and rock armour revetment to the seawards edge of the reclaimed land area and concrete quay wall type construction to the west side of the channel. – Months 1-9
- Element 2: Dredging of the Inner Harbour – Months 4-21
- Element 3: Treatment of the Dredge Material and Land Reclamation – Months 4-21
- Element 4: Finishings – Months 19-24

The programme is dictated to a considerable degree by the rate at which dredge spoil can be treated. Key quantities and plant and personnel are given in the following sections.

Works will commence with Element 1. There may be some overlap between Elements 1 and Elements 2 and 3. This will be possible due to potential phasing of the reclamation into discrete cells. Elements 2 and 3 will be carried out in parallel. There will later be an overlap between Elements 2 and 3 and Element 4 where the formation level of the reclamation area has been reached.

4.2.1 Element 1: Construction of the perimeter embankment and rock armour revetment to reclaimed land area – 9 Months Duration

General

Works to the perimeter embankment will begin at the intersection location of the perimeter embankment with the existing West Pier (see Figure 6 below). It is envisaged that the embankment core material (class 6A stone fill) will be brought to site by road. Works will commence with the placement of larger diameter rocks into the underlying silt material beneath the footprint of the embankment. The larger stones will settle into any soft material overlying the sands and gravels and stiff clays and provide a foundation on which to build the embankment.

A foundation of larger stones will be provided within the matrix of the existing silt layer using a long reach excavator or end tipping to place the stone. A floating pontoon barge may be required to assist. Once a foundation is provided for a short length the bulk of the material will likely be placed by trucks tipping their load onto the foundation and building the embankment to a level sufficiently above high tide to minimise the risk of sea water overtopping the embankment during construction.

Design change

During the planning process, a Request for Further Information (RFI) was issued by Fingal County Council (FCC). A particular concern of FCC related to the potential impact of the development on the built heritage and visual aspects of the west pier. To allay these concerns a change was made in the design during the planning process regarding the proposed covering of the west side of the West Pier with the reclamation works. This involved the creation of a 150m long approximately 15 to 20m wide channel between the reclamation and the West Pier along the northern section of the pier.

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Perimeter embankment construction

While the embankment will form the perimeter of the west and north sides of the reclamation before joining the quay wall type construction of the west side of the channel, it is more efficient construction wise to initially bring the embankment perimeter onto the pier at the northern end, and in this way construct the channel wall in the partial dry within the perimeter bund. Once constructed, embankment material will be removed off the west pier and the channel opened to the sea. There would be no removal or demolition required to the existing west pier.

Depending on the specific contractors sequencing of the reclamation works the channel wall may be constructed during the dredging and reclamation process or it may be constructed after the embankment and before the commencement of dredging and reclamation.

However, the construction of the wall is not likely to impact to a significant degree on the timeline for dredging, processing and placing of the material in the reclamation area. This timeline will be dictated by the rate at which the processing of the dredge spoil is undertaken. Given the lack of storage space on site the dredging, processing and placing will be a continuous process with perhaps periods of no dredging etc when associated perimeter works are undertaken.

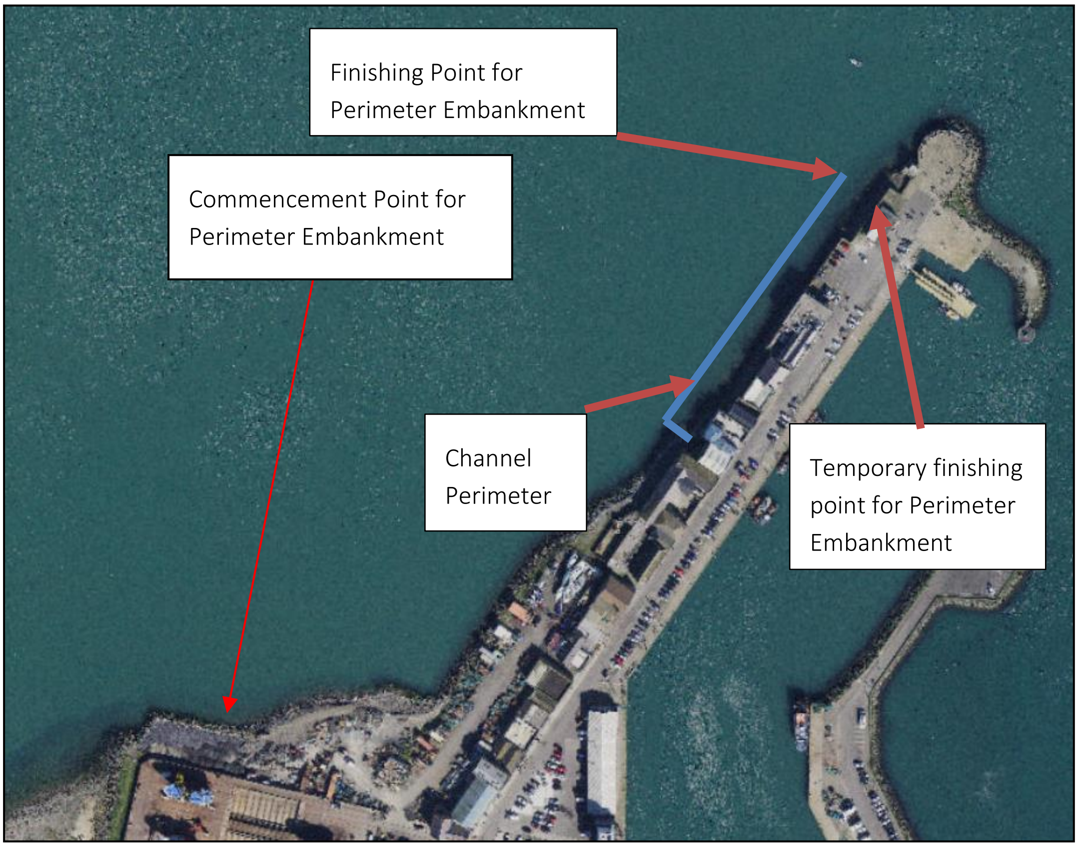

Figure 7 Aerial photograph showing potential commencement/finishing points for the perimeter embankment.

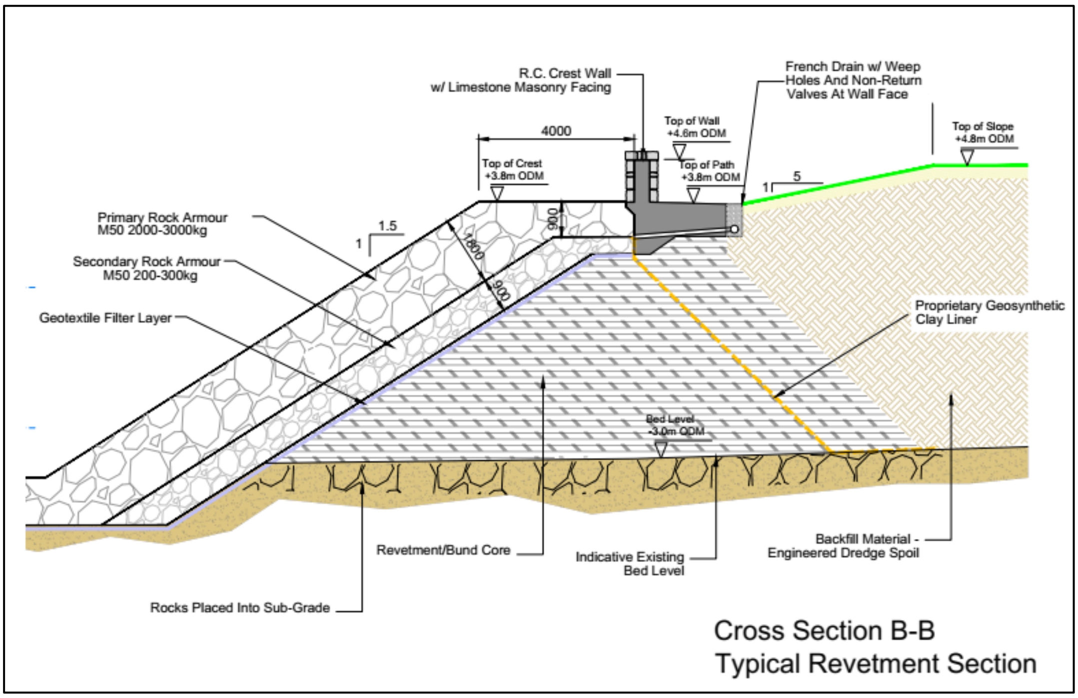

Figure 8 Typical revetment section B-B showing internal layers

Figure 8 above shows the internal layers of the revetment embankment. The core of the bund will be constructed of imported granular stone fill (such as TII Class 6A or similar). "Class 6A" or similar stone fill is a well graded granular material. It is specifically graded such that it can be placed below water without the requirement to compact. The material is natural gravel, crushed gravel or crushed rock. The core stone fill will initially be placed in layers with a long reach excavator bucket or by end tipping until it reaches a level that is feasible to track the excavator and delivery trucks. Once a section of embankment is built to a level above high tide, the embankment can be advanced by tipping truck loads at the seawards end of the embankment (see below **Figure 9**). A long reach excavator will also be in attendance to place the larger foundation stone if necessary and to grade the slopes of the embankment to the required slope for rock armour or geotextile.

Two layers of geotextile will be used in the construction of the perimeter embankment. A permeable high-performance geotextile will be used between the seawards face of the core material and the protective rock armour. In addition, an impermeable clay liner type geotextile will be placed within the core to mitigate any potential risk of treated dredge spoil (material and water) from migrating out through the perimeter embankment during the short period this material remains fluid. After a number of days, the treated dredge material will have solidified into a very low permeability matrix.

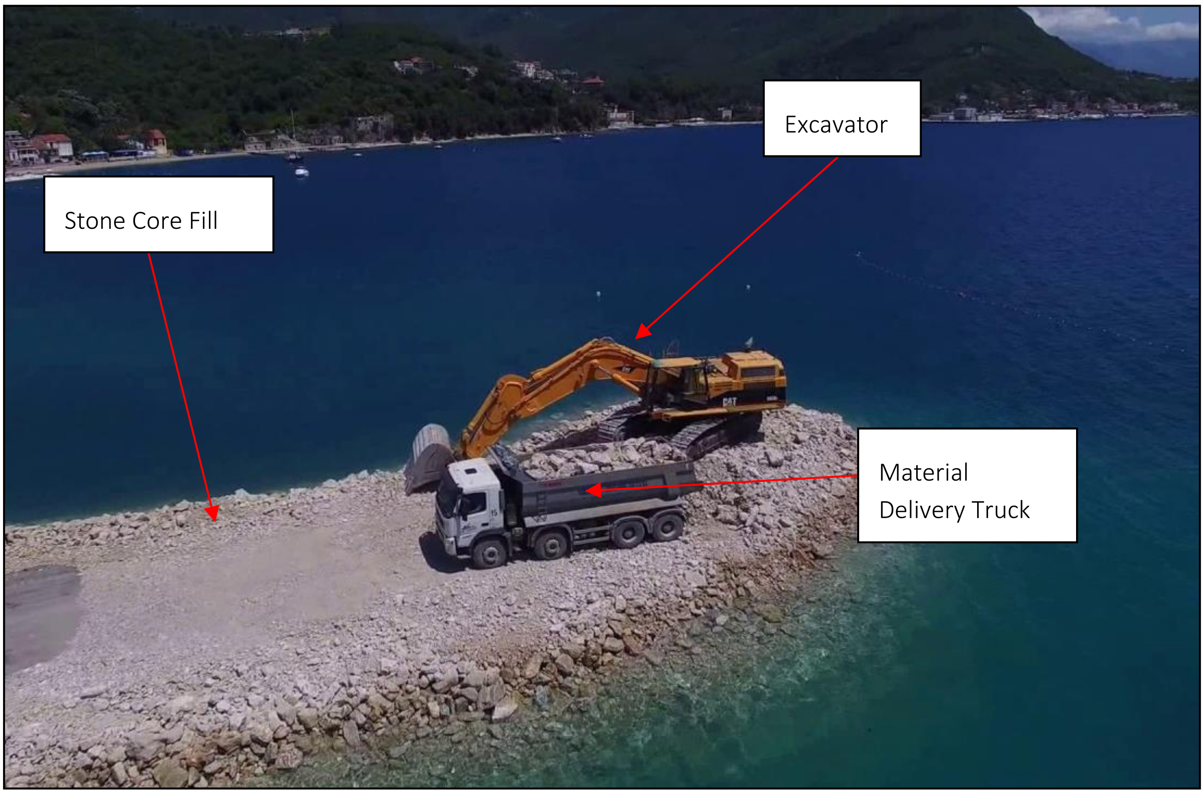

Figure 9 Shows typical operations for construction and embankment from land out into water.

The revetment geotextile filter layer will be placed on the outer face of the profiled embankment (see Figure 9 below). Geotextiles are permeable sheet materials. It is placed on the class 6A finer embankment material beneath the armourstone to prevent escape of the smaller particles while allowing the free passage of water. The geotextile provides a stable and consistent filter layer for armourstone and saves the need to import further additional layers of armourstone resulting in cost and material savings. The geotextiles used will be of the non-woven needle punched type. They are stable and durable materials with high strength under tension, against punching from rock placement, and with considerable elasticity (i.e., they can elongate by > 50% and still maintain the required filter characteristics).

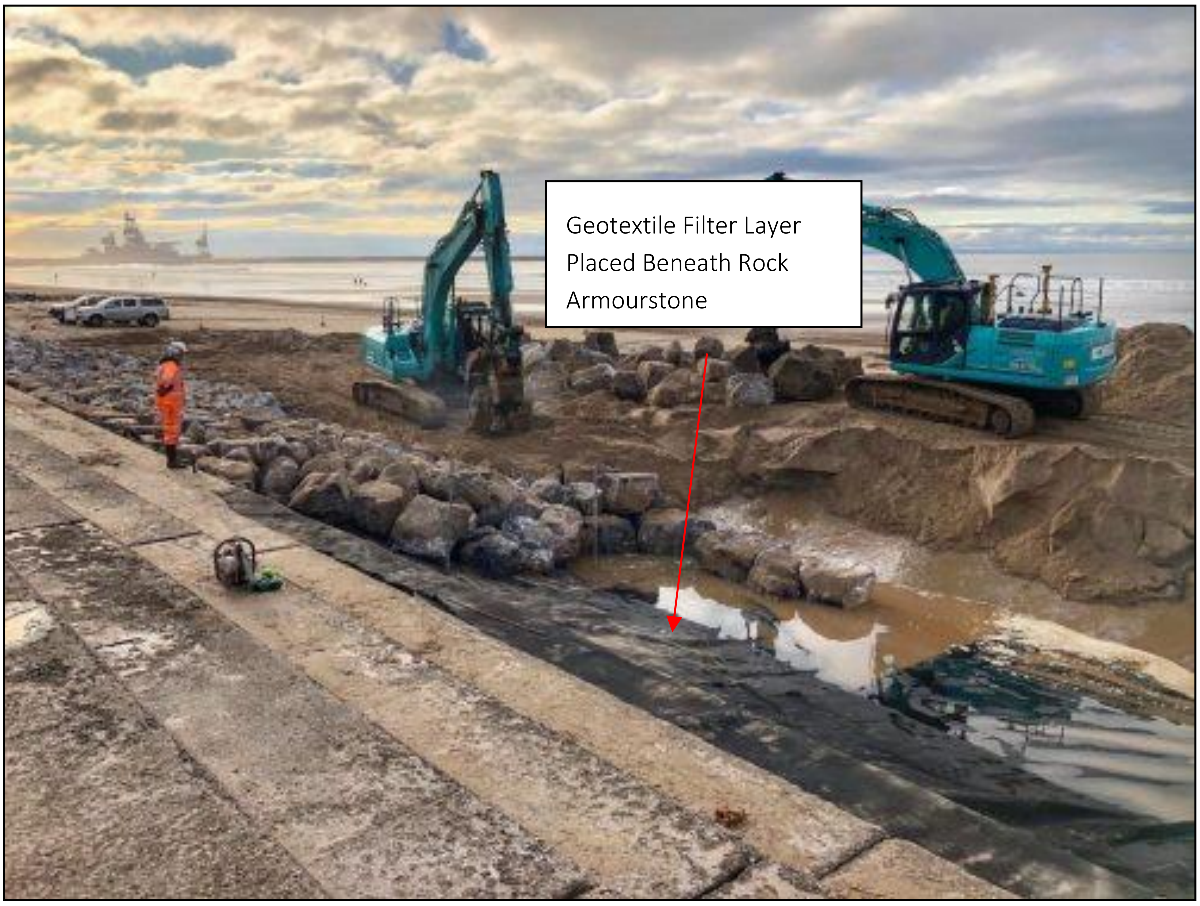

Figure 10 shows a typical arrangement of laying geotextile as a filter layer beneath the main rock armourstone in a coastal revetment.

The revetment under-layer rocks (smaller in size compared to the outer primary layer of rock) will be placed with a long reach excavator to provide a well graded and interlocked slope to receive the larger primary layer rocks. Primary and underlayer rock armour is placed first below water level to provide a stable toe to build the armour layers up the slope. Dump trucks will deliver core and large stone material to the excavator at the end of the embankment/causeway and armour along the length of the causeway. This process will continue out along the line of the perimeter until a closed perimeter is constructed. It is likely that there will be temporary cross bunds constructed within the reclamation area to allow the phased infill of the reclamation area. Such cross bunds will consist almost entirely of class 6A material. This phased infilling can happen in conjunction with the building of the perimeter embankment so that reclamation of the land can happen partly in parallel with as the perimeter embankment is being built and extending into the sea (see below Figure 10).

Treatment of the dredge spoil is a relatively slow compared to the rate at which dredging typically happens. Given the lack of storage area and issues with such storage, the treatment rate will dictate the dredging rate. A slower dredging rate will result in lower concentrations of suspended sediment in any dredge plume. It also has an impact on the rate of infill of the reclamation area.

Figure 11 Aerial photograph showing perimeter embankment construction with examples of temporary bunds. As perimeter construction progresses, discrete cells are made, and infilling can take place. Locations of the temporary bunds are not final. It should be noted that each temporary bund takes up volume within the reclamation area and there is a limit to the number and volume of such bunds.

The perimeter embankment will be constructed almost to its full height including rock armour prior to the commencement of infilling with treated dredge material. The area necessarily constructed to the full height at any time will depend on the intermediate temporary bunds used.

On the crest of the revetment, a reinforced concrete crest wall will be constructed (see Figure 11 below). This wall acts as both part of the revetment structure to reduce wave overtopping during extreme wave and water level conditions into the reclaimed area behind, and, also as a barrier for pedestrians from accessing the rock revetment. This wall will be constructed after the infilling of the reclamation area.

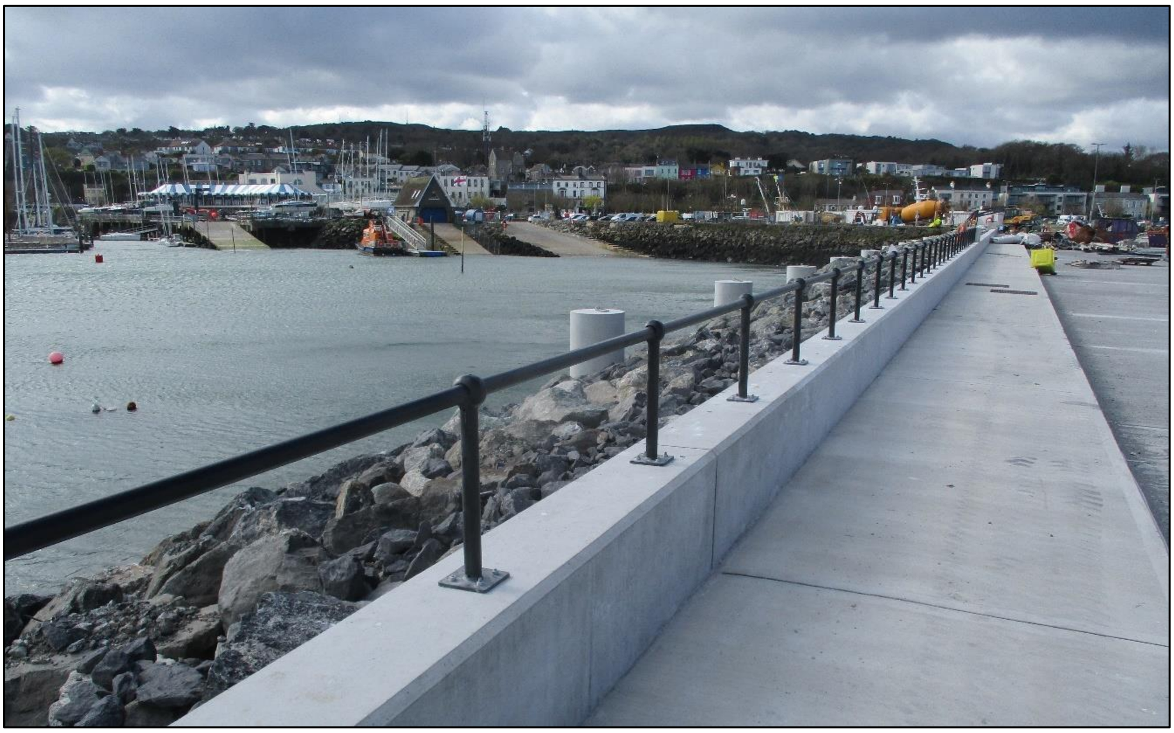

Figure 12 Example revetment crest wall located on the Howth Middle Pier.

As part of the construction of the embankment an internal face within the embankment will be lined with an impermeable clay liner to act as a barrier to restrict movement of water, dredge slurry and contaminants in and out of the area to be reclaimed (see above Figure 12) prior to the treated material solidifying into an almost impermeable mass. The liner is to be placed within the class 6A core to withstand water pressures from rising tides causing it to lift out of position. This liner will continue to act for several years after the infilling of the reclamation area. Geosynthetic Clay Liners (GCLs) are reinforced composites which combine two durable geotextile outer layers with a uniform core of natural bentonite clay to form a hydraulic barrier. A stone fill (Class 6A) layer will be placed on top of the GCL to keep it in fixed in place during the in-filling process. The GCL will be constructed down to the existing bed level within the reclaimed land area in order to restrict the flow of water under the embankment structure.

Figure 13 Showing a typical Geosynthetic Clay Liner (GCL) installation process.

When completed, the sealed perimeter embankment will retain a volume of seawater behind it. Some of this water will be removed prior to infilling. A non-return outfall will have been constructed into the embankment with its invert at Low Water. Constructing the outlet at this level will allow the lowering of water level within the perimeter embankment down to Low Water. Sealing the embankment at this low level for the full area could enclose approximately 72,000m^3 of water remaining. The treated dredge spoil could be pumped into this water which is the likely scenario. However, some of the enclosed seawater could be pumped from behind the embankment out into the open water. Based on a rate of 500l/s, 2-3 days would be required to empty down to bed level. Because of the difficulties in fully sealing the perimeter of the reclamation – the west pier itself is relatively permeable - it is envisaged that not all the water will be removed from within the boundary perimeter prior to infilling. In this case the treated spoil will displace the water and in time after the underlying material has solidified this water can be discharged into the sea. This would only occur when the top level of the underlying processed material has been raised above low tide level or higher. To mitigate potential impacts from such discharge, this water can be pumped through a large geotextile tube to reduce material remaining in suspension in the overlying water. Some of this water can also be used as required to ensure that the dredge spoil is sufficiently fluid prior to treating.

It is probable that instead of completing the full embankment perimeter prior to infilling, the infill will be undertaken in discrete cells, for example one third or one quarter of the proposed reclamation area being bunded off and infilled at a time. This would allow the quicker draw down of water levels in bunded area for each section. These volumes would be easier to manage, and infilling of the discrete cells would reach above MHWS at a quicker rate than infilling the reclamation area, as a whole. In this way uncertainties with regard to sealing of the base of the perimeter and storms overtopping the perimeter will be more manageable.

<u>Monitoring of embankment and temporary bunds</u>

The perimeter embankment will have a wide core and will be protected by rock armour that will be designed to withstand extreme waves. Provided that the perimeter is built to such a level that limits overtopping by wave action it will be stable in the temporary condition before the final reinforced concrete wall is constructed on top. Intermediate temporary bunds are likely to consist of predominantly class 6a material which would be more susceptible to wave action.

To ensure that there is low risk of damage to the perimeter embankment in its partly constructed formation and to ensure that there is low risk of damage to any temporary bunds it is proposed to undertake the following:

- Specify the sequencing of the construction and the nature of the materials to be used in the perimeter embankment and any temporary bunds to minimise risk in the temporary position. During construction the contractor is to provide construction method statements and material data sheets prior to importing material to site and prior to construction.
- There will be ongoing checks during construction that the contractor is undertaking the construction of the perimeter and temporary bund using the agreed materials and in line with the agreed method statements.
- There will be ongoing checks of the dimensions and side slopes of the perimeter and temporary bunds by the contractor and the clients resident engineering staff during construction.
- In relation to the temporary bunds there would be daily inspections by the contractor and the clients resident engineering staff. There would also be monthly walkover inspections by the client's designer.

It should be noted that the greatest risk to the perimeter and temporary bunds would be due to wave overtopping – where the cause and evidence of damage is visually apparent. The forces from the infilling of material are relatively low and will only be high from the top layer of processed material prior to it solidifying which will take a matter of days. Given the relatively slow rate of infilling, see section 4.2.3 it is only a relatively thin layer (less than 1 to 2m) of fluid that will act against the temporary bund.

- It is proposed to place two control points on the top of any temporary bunds to allay concerns regarding movement/ failure of temporary bunds. These control points would be surveyed in prior to infilling and at monthly intervals during the infilling. Such a requirement is not considered necessary for the perimeter embankment.

<u>Channel</u>

A channel is to be constructed on the east side of the reclaimed land between the old West Pier facing and the new reclaimed area. The channel will be formed with a reinforced concrete wall on its western side. (See below Figure 13). The existing bed under the footing of the wall will be excavated down to sand. A bed of stone fill will be placed to form the foundation of the wall. The wall will be built from this foundation. Dredge material can then be placed behind the wall.

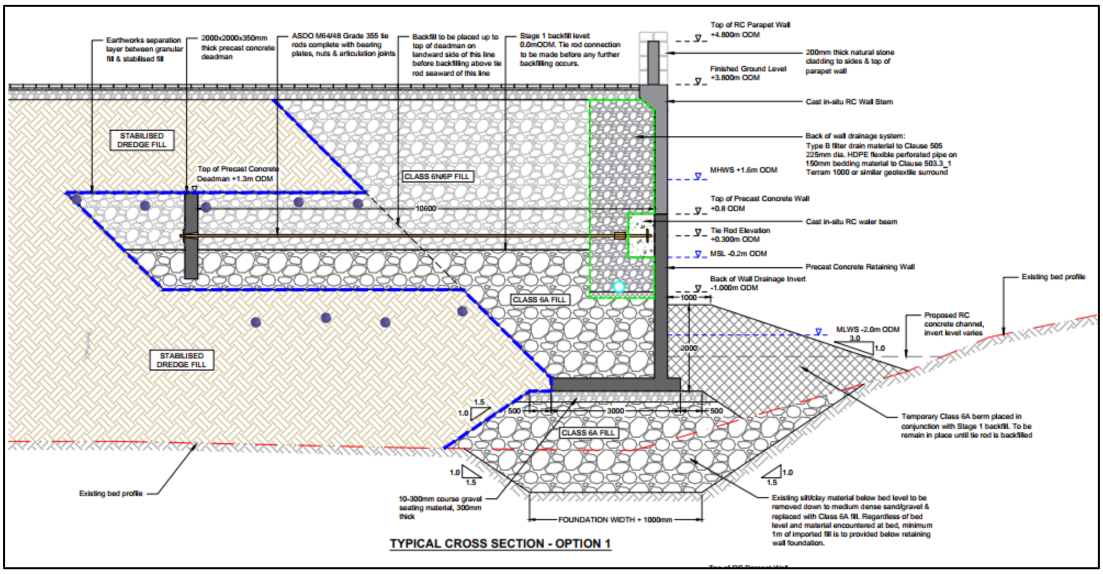

Figure 14 Showing channel wall cross section.

Bridge

A bridge is proposed to span the channel to provide access to/from the northern end of the reclaimed area. The bridge will be of reinforced concrete construction. See below Figure 14.

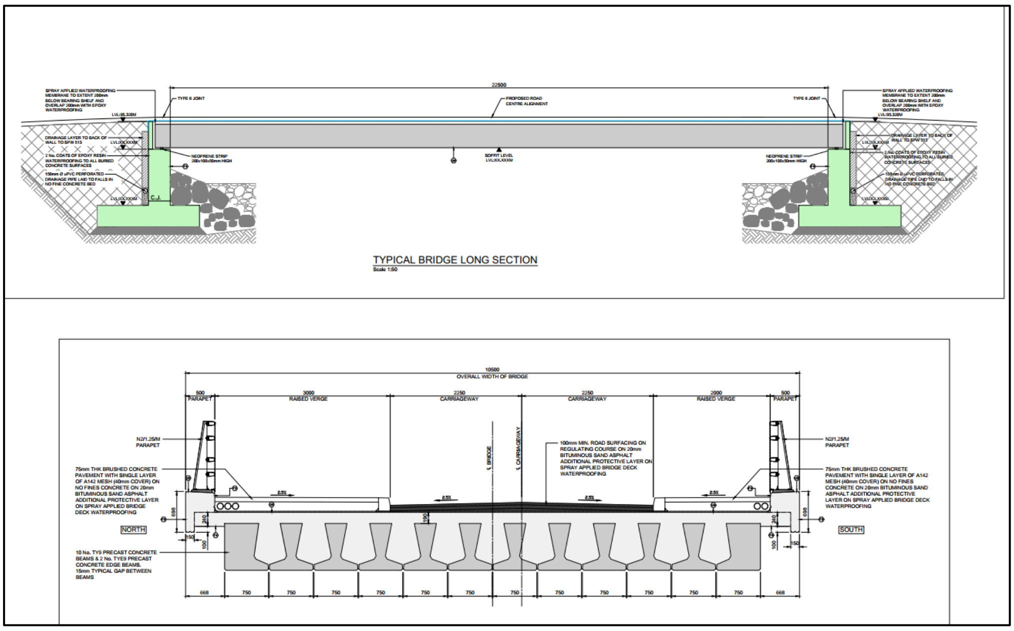

Figure 15 Showing channel bridge.

4.2.2 Element 2: Dredging of the Inner Harbour - 18 Months Duration

Dredging of Inner Harbour

The dredging works will be undertaken using a long reach excavator or grab operating from a floating pontoon barge or an equivalent configuration (see Figure 2.15 below). The timeline for dredging will be dictated by the rate at which dredge material can be processed.

As part of the hydrodynamic assessment undertaken for the EIAR an assessment of the grain size of the material to be dredged was made based on the grain size distribution of the samples taken from the overburden from a ground investigation undertaken within the harbour during 2015. This assessment indicated that a portion of the dredge spoil will be coarse enough (>0.6mm) to quickly fall through the water column if disturbed into the water column. However, some 60% of the overburden to be dredged will be finer than 0.6mm, with 50% in the clay silt fraction.

It has been estimated that:

- Fine sand, silt and clay makes up 60% of the overburden material to be dredged.
- Silt and clay make up 50% of the overburden material to be dredged.

Figure 16 Example dredging operations using a floating barge and long reach excavator.

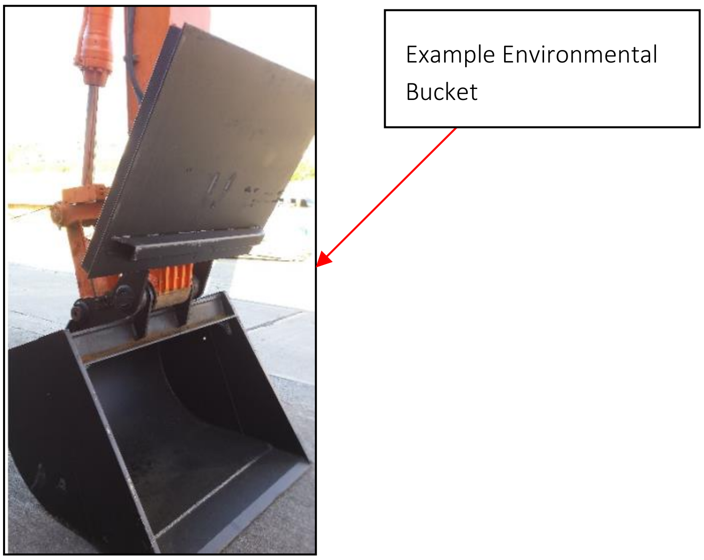

Figure 17 Example environmental bucket showing a lid that can be closed to seal contents during lifting.

While it is not expected that the dredge plume will escape the harbour in sufficient quantities to cause issues in sensitive areas outside the harbour, if concerns were raised during the course of the works it would be possible to mitigate this by surrounding the dredge plant with a silt curtain. An assessment of suspended sediments/plumes was undertaken and given in the "Hydrodynamic and Sediment Regime Assessment" report included within the EIAR. This assessment assumed a silt curtain was not used.

It should be noted that silt curtains are feasible in areas of low current where there is less risk of material being carried in suspension to a sensitive area - such as the SAC and beach to the west of the harbour. See example below in Figure 2.17.

Figure 18 Example silt curtain arrangement surrounding dredging activities.

The total volume of material to be dredged during the construction of the proposed development is estimated to be 240,000m^3. The majority of this (>90%) comprises overburden material.

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The rate of dredging will be dictated by the processing rate for the binder and dredge spoil. It is anticipated that the maximum processing rate is approximately 500m3/day for each mixing unit, and this rate would dictate the average dredge rate as there is little scope for storing dredge material prior to mixing. Based on a 10 hour day, this gives a dredging rate of less than 1m3/minute. It is possible to have more than one treatment process in operation at the same time.

However, to permit some flexibility in the dredging rate during construction a high value was used for impact assessment in the EIAR, and it was assumed that this high value continues 24/7. A rate of 2,400m^3/day was used based on dredging for 24 hours. This gives a rate of 100m^3/hr or 1.67m^3/min. This rate was used together with an assumed (high) density of seabed material of 1800kg/m^3 in the EIAR and indicates that the rate of mixing and infilling of the reclamation area could vary between 500 and 2400m^3/day. This together with the plan area of the reclamation or smaller intermediate areas gives the rate of infill of the reclamation area.

Table 2 below presents a breakdown of the estimated dredge volumes and durations (based on 500m3/day) by area and material type.

Table 2 Estimated dredge volumes and durations

Location	Design dredge Depth mODM	Estimate Overburden Volume to be dredged m^3	Weeks Dredging No.	Estimate Rock Volume to be removed m^3	Weeks Dredging Rock No.	Total Volume m^3	Estimate No. Weeks Dredging
Trawler Basin	-6.5	31230	10	3270	1	34500	11
Harbour Approach Channel	-6.5	39730	11	2220	1	41950	12
Marina Approach Channel	-5.5	19430	7	3190	1	22620	8
Moorings	-5.5	74140	21	1730	1	75870	22
Marina	-5.5	47100	13	17960	10	65060	23
Totals	-	211,630	63	28,370	14	240,000	77

The volumes in the above table are based on an estimate that some 10% of the dredge material is rock. The volume of rock is likely to be less than 10% and if all the material to be dredged is soft material the overburden quantities would equal the total volumes in the above table. This will have little impact on the overall duration of the dredging as the soft material dredging rate is dictated by the processing rate.

Dredge spoil will be transferred into floating dump barges from the floating pontoon/ dredger. Once loaded, the barges will be towed to an unloading quay side point within the harbour. The unloading point will be located adjacent to the stabilisation and solidification process facility located on the Middle Pier or to the west of the West Pier. The locations of dredging, quantities, times, etc will be recorded. The treatment and placement in the reclamation area is discussed in section 4.2.3 below.

<u>Monitoring of dredging and reclamation works</u>

Bathymetric surveys will be used to ensure the correct dredge depths are achieved and to identify high-spots for further dredging. Bathymetric surveys will be undertaken prior to dredging to confirm the quantities of material to be dredged and during dredging to ensure that required dredge depths are achieved.

Monitoring of turbidity will be undertaken within the harbour and at sensitive locations outside the harbour to ensure that excess suspended sediment from the dredge plume do not impact on such areas. These monitoring points will also be used to monitor any excess suspended sediment when the seawater initially trapped within the perimeter embankment is drained to the sea.

Potential monitoring points are given in Dwg 5502.

Monitoring within the harbour will be on a continuous basis during the dredging operations.

Monitoring of turbidity outside the harbour will be undertaken on a discrete basis. During the dredging process monthly sampling of water from the water column at a location off Charlemount Beach will occur and tested for suspended sediment concentrations and water quality parameters.

<u>Other waste</u>

Waste debris (such as discarded metal or plastic items) collected from the harbour during dredging works will be segregated and removed offsite by a licenced haulier to a licensed facility. See below Figure 18 as an example.

Figure 19 Example waste segregation arrangement

Dredging work can be undertaken in parallel with the perimeter construction if the perimeter construction is undertaken in a phased manner using temporary cross bunds.

4.2.3 Element 3: Treatment of the Dredge Material and Land Reclamation

It is being proposed to stabilise and solidify the dredge material. The purpose of this treatment is twofold:

1. To reduce the leaching of contaminants. Refer to the Quantitative Risk Assessment for further details on this.
2. To process the dredge material into a usable engineering backfill that can support harbour operational uses.

Dredge material will be brought to an unloading point within the trawler basin of the harbour. For the Waste Acceptance Procedure please refer to the Waste Acceptance Procedure report.

Coarser spoil (>20mm) material will be screened out from the dredge spoil and temporarily stockpiled. This material will then be transferred to the reclamation area by truck where it will be directly placed in layers and compacted into the infill area or used in temporary bunds or in the perimeter embankment.

Sandy and silty material will undergo engineering stabilisation and solidification prior to placement into the reclaimed infill area. Such finer material will be transferred (likely by pumping through a pipeline) into a mixing unit. A binder in the form of a slurry will be added to this dredge spoil within the mixing plant until a homogenous mix of binder and dredge material is attained. The binder will consist of a combination of Portland Cement and Ground Granulated Blast Furnace Slag (GGBS) or equivalent. The mix will then be pumped as a wet mix from the mixing unit plant to the bunded area where it will be deposited. Excess water (supernatant) will be collected from the surface of the deposited material and returned to the treatment area for reuse to help fluidise the dredge spoil as necessary to make it pumpable.

The below Figure 20 shows an example treatment facility layout. In the case shown, the dredge spoil is brought to the quayside in a barge. Within the barge the material is agitated and fluidised to allow it to be pumped into the mixing unit. Material could similarly be transferred to bunded areas on land where the material can be agitated and fluidised and screened for larger sized particles.

Refer to 19934-5505-P01-Site Plan-Construction Stage for a detailed site layout plan.

Silos containing cement/GGBS/ Binder are based within the facility. These components are conveyed to the mixing process plant in liquid form. Mixing is undertaken in an enclosed system. Dust emissions are controlled within an enclosed plant operation, and as all elements are wet. A controlled and consistent end-product is produced with predicable engineering characteristics.

The quantities of dredge spoil, binders, and treated material, when mixed and where deposited will be recorded. It is estimated that the bulking factor will be between 5-10%.

Stabilisation, solidification and placement within the reclamation area will be undertaken in parallel.

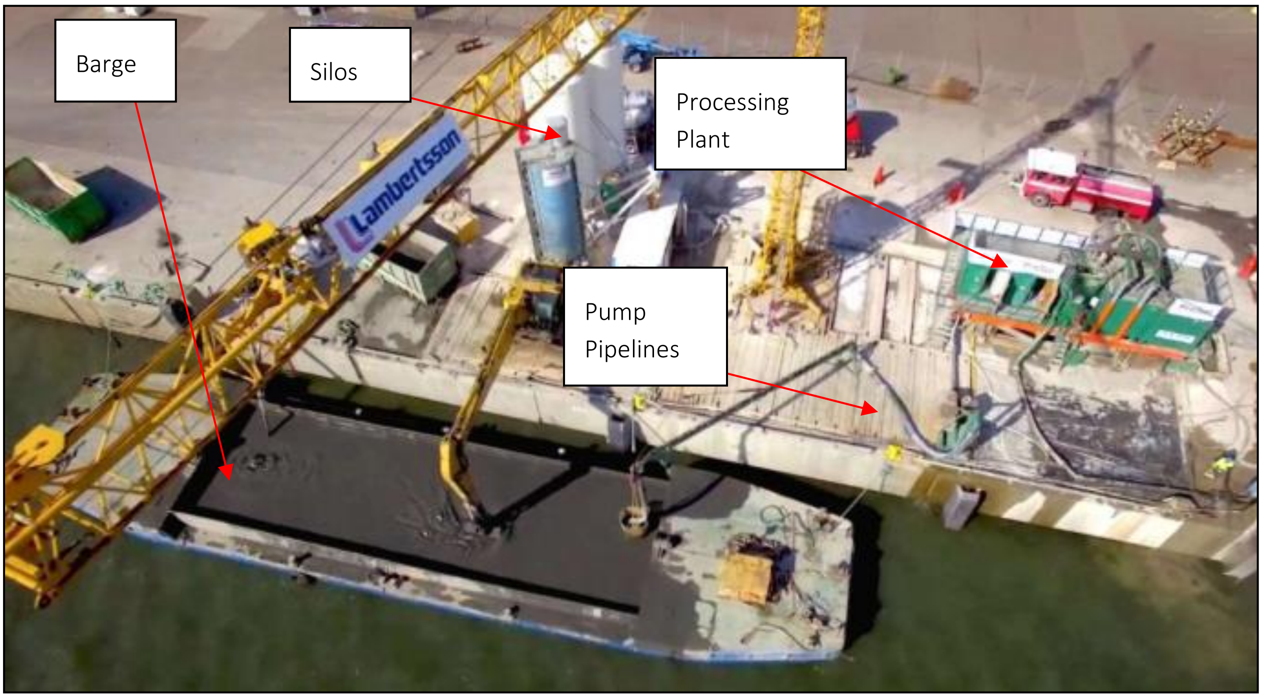

Figure 20 Example dredge spoil treatment facility

Infilling of the Reclamation area

Treated dredge material will be pumped via a pipeline to the reclamation area. When placed it will be in a wet and slurry like form. Gradually the material will bind together into a stiff clay like material.

The average plan area of the infill is approximately 36,000m^2. Note that this is less than the overall footprint of the reclamation area of 4.8ha.

- If infilling occurs at 500m^3/day, it will give an average rise of material of 14mm per day within the infill area.
- If infilling occurs at 2,400m^3/day, it will give an average rise of 67mm per day within the infill area.
- If the area is divided into say four areas the average rate of rise will be 42 to 201mm and 56 to 268mm per day.

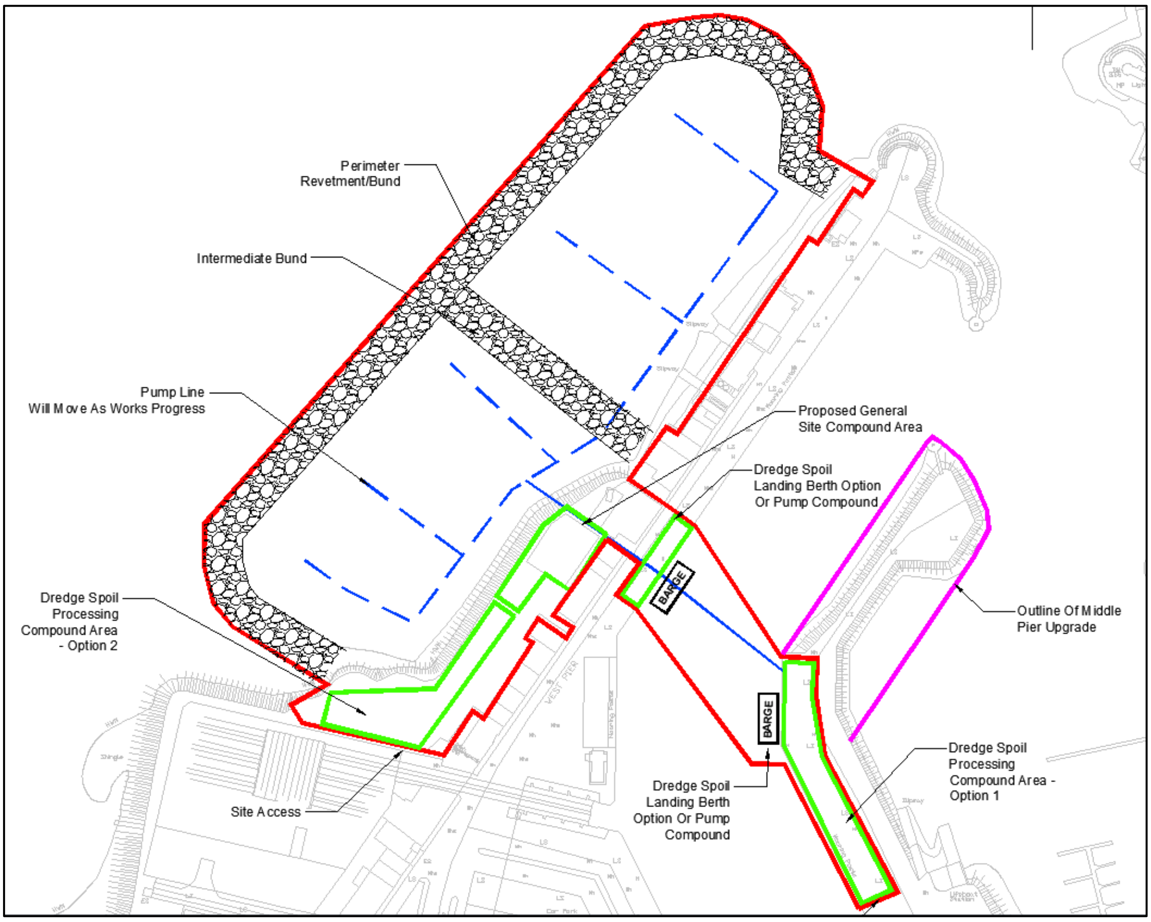

Figure 4.21 Proposed Site layout during construction.

<u>Howth Middle Pier stabilisation and solidification</u>

A similar but in situ mixing process was used in the reclamation of a 0.2ha area on the east side of the middle pier in Howth during the recently (May 2022) completed Middle Pier Upgrading works (Waste Facility Permit No. WFP-FG-18-0003-02). In this case, dredge material was placed and stored within a bunded area like but considerably smaller in scale than proposed for this project. Then, using an Allu type system approximately 190kg/m3 of binder was added to each cubic metre of dredge material. The binder consisted of 70% Ground Granulated Blast Furnace Slag (GGBS) and 30% Ordinary Portland Cement (OPC). The binder was first mixed with water before being injected into the insitu dredge spoil via a pipe on the arm of a long reach excavator to which a mixing unit was attached. The storage area had been divided into 4 by 4m plan sections and the mixing was controlled by a GPS device on the arm and by measuring the rate of feed of the binder into the pipe.

The required ratio of binder to dredge spoil and of GGBS to OPC within the binder had been set following the testing of a range of mixes prior to and during construction. The testing prior to construction indicated that optimum strength would be obtained by using 150 to 175kg of binder per cubic metre of dredge spoil. The optimum GGBS to OPC ratio was found to be 70% GGBS to 30% OPC.

The contractor used a greater proportion of binder to dredge material, 190kg/m3 in order to achieve a quicker rate of strength gain to suit his in-situ mixing method. This additional binder caused the processed material to gain strength quicker enabling the mixing plant to track onto the processed material earlier than would otherwise be the case. Tests carried out on the processed material indicated greater strength gains than indicated by the laboratory tests.

A paper was prepared by and presented by MWP personnel at the Civil Engineering Research Association of Ireland (CERAI) Conference held in the TUD in August 2022. The title of the paper was "Dredge sediment stabilisation works at Howth FHC".

While the scale of the proposed development is an order of magnitude greater than the Howth Middle Pier project, the essence will be the same in the term of the mix required to stabilise the dredge material, albeit with a potentially better mixing process.

This work was carried out under Waste Facility Permit No. WFP-FG-18-0003-02.

<u>Quality control and monitoring of the infilling and reclamation process.</u>

The quality control and monitoring of the infilling and reclamation process will include:

- Location: the intermediate cell location, quantity and level of each week's infilling will be recorded
- Samples taken every 3,000m^3 will be tested for
    - Strength of processed material, UCS, 5 concrete type cubes of the processed material would be taken for crushing at 7, 28, 56 and 112days with one spare.
    - Strength of binder, UCS, 3 concrete type cubes of the binder taken for crushing at 7and 28days with one spare.
    - Contaminant concentrations: tested for total content of the following parameter values; Arsenic, Barium, Cadmium, Chromium, Copper, Mercury, Mickel, Lead, Antimony, Selenium, Zinc, Chloride, Flouride, Soluble Sulphate, Total Organic Carbon, BTEX, 7 PCBs, Mineral Oil C5 to C44, 17 PAHs, DBT and TBT. The results can be used if required to establish the material waste classification.
    - Waste Acceptance Criteria (WAC) to be tested for leachate values using monolithic tank tests (as per "NEN 7375:2004 Leaching Characteristics of Moulded or Monolithic Building and Waste Materials"). The results are to be compared against the WAC limits. Two samples, one to be broken down prior to testing and the other to be tested as a monolith.
    - Permeability of a cured (28day) cube of processed dredge spoil. Initially every 3000m3 for 4 weeks and then monthly.
    - Consolidation characteristic of a cured (28day) cube of processed spoil. Initially every 3000m3 for 4 weeks then monthly.

Following construction – approximately 28 days following the filling of each cell, the following engineering tests will be undertaken. They relate to strength characteristics.

- Plate load tests to establish CBR values. 12 locations.
- SPT tests undertaken in 8 cable percussive boreholes.
- Dynamic probing at 32 locations.
- Settlement monitoring at 8 locations.
- Monitoring of placed material temperature (4 locations).

<u>Water requirement and supply</u>

There is a water requirement for dredge spoil mixing with binder, welfare facilities and cleaning.

Water for mixing during the dredge spoil process will be freshwater for the binder. Approximately 15,000m^3 of freshwater will be required for this purpose. This is the greatest demand on freshwater for this project. Seawater will be used to create a pumpable dredge material for processing and transfer to the reclamation area.

Excess supernatant water will arise on the surface of the stabilised mass. This water will be contained within the impermeable perimeter of the reclaimed land area and prevented from loss into open water. Supernatant water will be re-circulated by pump back into the processing plant for further use in mixing the dredge material and binder.

Trucks will be cleaned in a wheel wash at the site exit. Dirty water will be collected and disposed of at a licensed waste facility.

4.2.4 Element 4: Finishings – 6 Months Duration

When the reclaimed area is filled to the required level, works can commence on the surface finishings. These works will include landscaping, access road, pathways, parking, surface water drainage, mains water supply, electricity supply, viewing areas and water access points.

Landscaping works will involve importing and depositing topsoil and grass seeding. It will take approximately 1 to 2 months depending on the time of year. Grass seeding will be undertaken in the late summer/mid-autumn or mid-spring.

Pedestrian pathways will be constructed on a base of stone fill and paved with a bituminous flexible pavement. The pathways will be suitably edged. As discussed previously, there will be a low (1.1m) reinforced concrete revetment crest wall along the seawards edge of the path adjacent to the top of the revetment.

Surface water drainage will be constructed to collect and drain away surface water from areas with impermeable surfaces. Trenches will be excavated, drains will be placed on a stone bedding material and backfilled with stone fill. Surface water will be collected via gullies. Surface water will be discharged to the sea via a hydrocarbon interceptor/silt trap. Surface water from wave overtopping will be collected in French drains constructed along the landward edge of the proposed crest wall pathway. Land drains will be used to drain surface water from landscaped areas. All surface water drainage from hardstanding areas will pass through petrol interceptors prior to discharge to the sea.

A preliminary design surface water drainage plan is given in drawing no 19934-5506.

Mains water will be supplied to the open water access area. Watermains will be constructed in trenches in accordance with Irish Water specifications.

Viewing areas will be established by means of two roundheads extending west from the perimeter path/ seawall towards the northwest of the reclamation area.

A slipway will be constructed at the water sports access area. The slipway will be constructed in concrete. It will be constructed into the rock revetment.

Hardstanding areas will be surfaced initially with a granular material such as clause 804 and subsequently with tarmac surfacing for future parking, roadways and areas for potential harbour operations.

Further finishings will include fencing.

4.3 Temporary Site Compound

The site compound will include the following temporary buildings:

- Offices.
- Stores.

- Canteen.
- Toilets.
- Dry room; and
- Washroom.

In addition, the site compound will include areas for temporary lay down storage of materials, plant and some car parking for workers and visitors. Site compounds will be fenced off to prevent access from the public and hoardings will be placed in appropriate areas to reduce construction impact on people passing by.

4.4 Working Hours

Dredging and mixing activities will be carried out from 7am to 9pm (Monday to Friday) and 7am to 5pm (Saturday) with no work on Sundays. All other activities such as construction of the perimeter embankment, rock armour protection, landscaping and drainage will be undertaken during normal working hours i.e. 7am to 7pm (Monday to Friday) and 7am to 5pm (Saturday) with no work on Sundays.

Any works required outside these stipulated hours will be agreed in writing with the Planning Authority with not less than 10 working days' notice to undertake some necessary works at low water tides which usually occur at approximately 6am and 6pm.

4.5 Construction Plant Requirements

Table 3 below presents the estimated main construction equipment requirements on site.

Table 3 Estimated main construction equipment requirements

Construction Plant Type	Construction Plant No.	Project Role
Element 1 – Perimeter Embankment – including channel wall and bridge		
Long reach excavators (65T)	2	Construction of the perimeter embankment.
20 T excavator	2	Lighter excavating and lifting requirements e.g. laying clay liner, geotextile, shutters reinforcement etc
Floating pontoon barge	1	Construction of the perimeter embankment with long reach excavator
Work boat	1	Movement of unpowered floating plant.
Safety boat	1	Safety and Health requirements.
Landing craft (e.g. RIB)	1	Movement of people between land and floating plant.
Delivery trucks		Delivery of materials, plant etc to site
100T Crane	1	Construction of channel quay wall and bridge
90T Excavator	1	Construction of channel quay wall and bridge
Piling Rig	1	Construction of bridge abutments

Element 2 – Dredging of the Inner Harbour		
Long reach excavator (65T)	2	Dredging.
Floating pontoon barge	2	Dredging.
Floating dump barges	3	Transport of dredge spoil to the quayside unloading point.
Work boat	1	Movement of unpowered floating plant.
Safety boat	1	Safety and Health requirements.
Landing craft (e.g. RIB)	1	Movement of people between land and floating plant.
Dump trucks	1	Transport of rock and gravel material on site.
Delivery trucks		Delivery of materials, plant etc to site
Element 3 – Land Reclamation		
Excavators	4	Excavating and lifting requirements on the quay and within the reclamation area.
Soil processing plant	1	Processing dredge spoil into suitable engineered fill
Binder storage silos	2	Storage of Portland cement and GGBS required for mixing with dredge spoil.
Pumps and piping		Movement of unmixed from the dredge spoil storage area, through the mixing plant and delivery of mix to the reclaimed land area.
Delivery trucks		Delivery of materials, plant etc to site
Element 4 – Finishings		
20 T excavator	3	Excavating and lifting requirements during finishings.
Compactors	1	Compacting imported stone fill for placement under pavements
Pavers	1	Laying bituminous pavements
Rollers	1	Rolling bituminous pavements
Delivery trucks		Delivery of materials, plant etc to site

4.6 Staffing Requirements

Table 4 below presents the estimated daily main staffing requirements on site during the construction phase.

Table 4 Estimated daily main human resources requirements

Staff Type	Staff No.	Details

Management, DAFM and Visitors		
Contractors Management	6	e.g. project director (off site), contracts manager, PSCS, site foreman, site engineer, waste facility manager, H&S manager, community liaison contact, traffic manager
DAFM Site Staff	2	Resident Engineer, Clerk of Works
Site visitors	2	Employer's representatives, DAFM management staff, local authority staff etc
Sub-Total	**10**	
Element 1 – Perimeter Embankment including quay wall and bridge		
Excavator drivers	6	Long reach, Crane excavators
General operatives	8	General works
Element 1 Sub-Total	**14**	
Element 2 – Dredging of the Inner Harbour		
Excavator drivers	2	Long reach excavators
Floating pontoon crew	4	Captain and crew
Work boat crew	2	Captain and crew
Safety boat crew	1	General operative
General operatives	2	General works
Element 2 Sub-Total	**11**	
Element 3 – Land Reclamation		
Excavator drivers	4	
Dump truck drivers	1	
Soil processing plant operators	6	
General operatives	4	General works
Element 3 Sub-Total	**13**	
Element 4 - Finishings		
Excavator drivers	3	
Paving crew	5	
Carpenters	4	Reinforced concrete works
Steel fixers	4	Reinforced concrete works

General operatives	5	General works
Element 4 Sub-Total	**21**	

There will be an overlap between the different elements during different periods of the programme. **Table 5** below presents the total daily human resources estimates during each period. Please refer to the "Preliminary Programme of Works" outlined earlier.

Table 5 Staffing requirements estimates during each period

Programme Period	Estimated Daily Staff No. on Site
Months 1 – 3	43
Months 4 – 9	72
Months 10 – 18	42
Months 19– 21	55
Months 22 – 24	26

4.6.1 Material Quantities

Table 6 presents the estimated main construction material quantities which will be required as part of the proposed works.

Table 6 estimated main construction material quantities

Material Type	Estimate Quantity	Estimate Truck Delivery No. Total	Truck Deliveries Daily Average
Element 1 – Perimeter Embankment			
6A Stone Fill (embankment core)	53,000m^3	5,300	30
6A stone fill channel wall	4,800m^3	480	5
Geotextile filter layer on seaward side	10,000m^2	20	<1
Rock armourstone	25,000m^3	2,500	14
Impermeable clay liner	10,000m^2	20	<1

Material Type	Estimate Quantity	Estimate Truck Delivery No. Total	Truck Deliveries Daily Average
Reinforced Concrete Crest Wall	1,800m^3	300	2
Reinforced Concrete Channel wall	1650m^3	275	2
Masonry Facing Crest Wall	300m^3	30	<1
Surface water drains	700m	2	<1
Element 1 Sub-Total		**8927**	**57**
Element 2 – Dredging of the Inner Harbour			
Dredge spoil	240,000m^3	Internal harbour movements by barge.	
Element 2 Sub-Total		N/A	N/A
Element 3 – Land Reclamation			
Dredge spoil with binder	240,000m^3	Internal site movements by pump/pipe (sand/silt)	N/A
Cement/GGBS Binder	36,000 tonnes	1,800	5
Fresh water for mixing with binder	15,000m3	Not applicable	40m^3/day
Dredged rock/gravel[1]	24,000m^3	1,200 (Internal site truck movements)	4
Reinforced concrete	1400m3	200	2
Element 3 Sub-Total		**2,050**	**4**
Element 4 – Finishings			
Surface water drains	8,000m	20	<1
Stone fill (surface water drains)	12,000m^3	1,200	10
Topsoil (landscaping)	8,100m^3	810	7
Stone fill (pavements)	3,500m^3	350	3
Pedestrian Paving	1,500m^2	30	<1
Tar and Chip Paving	7,200m^2	145	1

Material Type	Estimate Quantity	Estimate Truck Delivery No. Total	Truck Deliveries Daily Average
Element 4 Sub-Total		2,555	23

1 The overall dredge quantity is estimated to be 240,000m3. Given that there is rock close to the base of the soft material there may be some rock and gravel in the dredge spoil. An allowance of 10% is included here. It should be noted that the actual quantity may be less, though the overall dredge quantity remains the same.

Table 7 below presents the estimated daily trucks numbers for each main works period as per the outline programme.

Table 7 Estimated daily trucks numbers for each main works period.

Programme Period	Estimated Daily Delivery Truck No.
Months 1 – 3	57
Months 4 – 9	62
Months 10 – 18	5
Months 19– 21	28
Months 22 – 24	23

4.7 Construction Management

4.7.1.1 Construction and Environmental Management Plan

It is proposed that prior to commencement of the proposed development a detailed Construction and Environmental Management Plan (CEMP) will be issued to the local authority for agreement prior to commencement of the development. A preliminary CEMP has been prepared and is provided in this application.

4.7.1.2 Communication with the Local Community

In terms of local communication and engagement, before construction works start for each of the phases, a letter will be issued to the Harbour Users Forum members and local community groups. The letter will outline the timeframe and type of construction works taking place. A public consultation exercise was undertaken as part of the EIAR. In addition, a number of meetings have been held with Fingal County Council as part of the planning process.

4.7.1.3 Traffic Management

The Main contractor shall prepare and implement a construction traffic management plan for the duration of the works. The traffic management plan will consider all health and safety construction traffic guidelines.

4.7.1.4 Waste Management

Waste management procedures will be outlined in the construction environmental management plan (CEMP). Fully registered waste management companies will only be used for waste coming from the site. Standard good practice of only ordering the required amount of materials will be implemented.

Refer to the preliminary Construction Environmental Management Plan for a detailed description of the proposed waste management at the project. A Waste Management Plan will be agreed and instituted during the works and the waste management measures for the project will include:

- Waste management targets.
- The potential waste materials produced during the project.
- Waste handling procedures.
- Waste Permits where required.
- Waste reuse, recycling and disposal techniques; and
- A map showing designated waste handling areas.

Contractors working on site during the works will be responsible for the collection, control and disposal of all wastes generated by the works.