4.0 PROJECT OPTIONS

Project options considered and evaluated during the planning process are one of the key elements to be documented in the EIA report. In this chapter, the details of the various project options which have been taken into consideration were discussed and deliberated. This includes the site selection which was looked into to ensure minimal impact to the natural habitats particularly the marine resources and the surrounding areas. The principle feature of each option, including the advantages and disadvantages of the proposed options were discussed to attest that the project has been planned adequately during the planning process.

The project options which have been highlighted in the TOR and taken into consideration for this project are as follows;

- No-Project option;
- Sand source option;
- Structural measures for coastal protection option; and
- Reclamation method.

4.1 Site Selection

In general, the criteria used to select the most suitable site are as follows:

Table 4.1: <u>Site Selection Criteria</u>

No.	Reference	Evaluation Factors	Deliberation
1.	National Physical Plan, Structural Plan, Local Plan	Sensitive areas	There is presence of mangroves at the north-eastern part of the site as shown in **Figure 4.1**.
		Coastal erosion	The project site is located within an area with medium rate of coastal erosion (see **Figure 4.2**).
2.	*Akta Warisan Kebangsaan 2005*	Protected zones	The project site is not located within the protected zone under *Akta Warisan Kebangsaan 2005*.

Figure 4.1: Mangroves Observed at the Project Site

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No.	Reference	Evaluation Factors	Deliberation
			Nevertheless, it is situated near Pulau Besar (within 5km radius from the project site) which is a fisheries protected area. *(Remarks: Jabatan Warisan Negara (JWN) requires the project proponent to conduct multibeam survey, sub-bottom profile survey and magnetometer survey before the commencement of the physical works at site. The written comments from JWN are available in* ***Appendix III*** *).*
3.	*Rancangan Fizikal Zon Persisiran Pantai Negara 2010*	Turtle landing and nesting area, coral reef and seagrass	The project site is not located within any turtle landing and nesting, coral reef and seagrass area (see **Figure 4.3**).

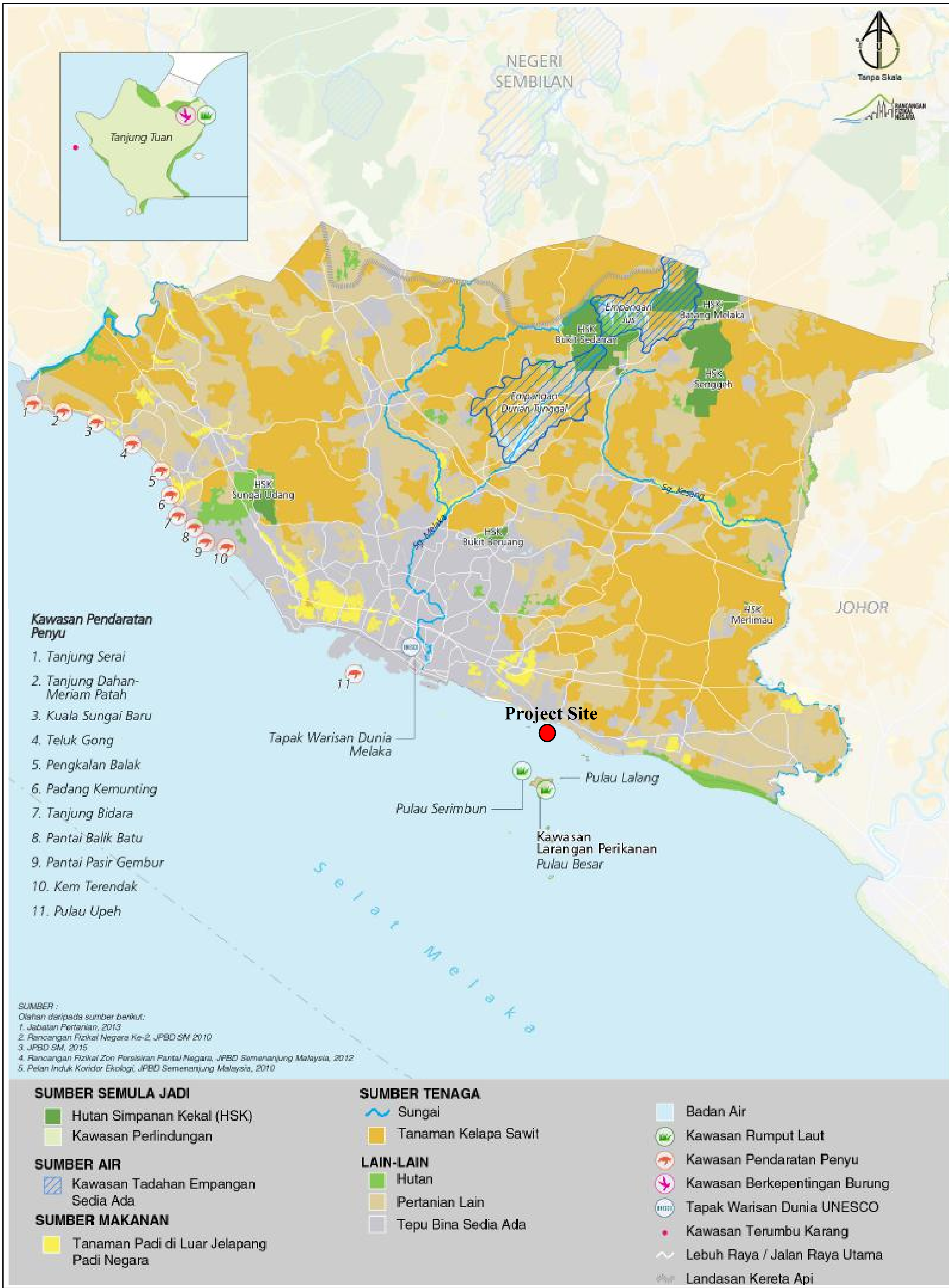
Based on the evaluation above, the project site can be considered as acceptable. However, proper mitigation measures have to be made available to ensure minimal impacts to the environment. Further explanation on the impacts and the proposed mitigation measures can be found in **Chapters 7** and **8**.

4.2 No-Project Option

No-Project option mainly examines the social, economic and environmental aspects that derived from the proposed project. The comparison of "No – Project" option and "With – Project" option is summarised in **Table 4.2**.

Table 4.2: <u>Comparison of "No – Project" and "With – Project" Options</u>

No	No – Project Option	With – Project Option
1.	No new reclaimed land.	A reclaimed land will be established to cater for commercial / residential / tourism development.
2.	No income to the State.	Higher income to the State derived from taxation of land and business activities on the reclaimed land.
3.	Existing noise level remains the same.	Noise levels will increase due to increase in vehicular traffic during construction and urbanisation after completion.
4.	Existing ambient air quality will remain the same.	Short-term increase of suspended particulate during the construction and increase of air pollutants due to



CIRI SELASIH SDN. BHD. ENVIRONMENTAL & TRAFFIC CONSULTANT	*Source: National Physical Plan 3*	**Figure 4.3:** Seagrass, Coral Reef & Turtle Landing Spots In Melaka	4-2a

No	No – Project Option	With – Project Option
		urbanisation, viz., additional vehicle volume and population.
5.	Marine water quality remains the same.	Deterioration of marine water quality during reclamation works. Nevertheless, the impact can be controlled with proper mitigation measures.
6.	Marine ecology at the proposed area remains the same.	Some impacts on the marine ecology of the site are expected to happen.
7.	Socio-economy of the area remains the same.	The development will generate increased business and employment that will benefit the regional economy and local populace.

4.3 Sand Source Option

Since the proposed project involves coastal reclamation, one of the most important aspect to be looked into is the sand source. There are two options which can be considered i.e. getting the sand from an onshore location or sand sourced from offshore.

The nearest onshore sand source in Melaka can be found at the outskirt of Melaka Tengah, at the central part of Melaka, which is quite far from the project site. Getting the fill material from this area will involve long-distance haulage activities. Based on an estimation done to calculate the amount of fill material needed to fill the 400 acres project area, the total volume of sand needed is about 17,000,000m^3. Assuming that the sand is to be transferred to the project site using a truck with a capacity of 30m^3, it is expected that 567,000 trips are required to bring the total amount of sand needed to reclaim the entire site. This operation alone will take unreasonably long time to be completed, and of course the inconvenience to road traffic and neighbourhoods.

As for offshore sand source, the nearest sand source area is located approximately 16.5km seaward to the southwest of the project site (see **Figure 4.4**) and the sand mining concessionaire for this area happens to be the project proponent i.e. Yayasan Melaka. This sand source area is believed to be able to provide 18,000m^3 of sand per day. Since more sand can be transported from this area to the project site daily, shorter time for haulage activities can be expected. Details on the sand mining activity at the

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Figure 4.4: Sand Source Location

proposed sand source area are available in the approved EIA report entitled "*Permohonan Melombong Pasir Di Bawah Seksyen 4 Akta Pelantar Benua 1966 P.U 2009 Oleh Yayasan Melaka*". Due to the nearer location and shorter haulage distance and time, it is only wise to choose the offshore sand source for the proposed project.

4.4 Structural Measures for Coastal Protection Option

Another important option that has to be taken into consideration for a reclamation project is to have a proper coastal protection measures to prevent water quality degradation during reclamation works and also to prevent erosion after the reclamation works are completed. The following are the available coastal protection structures that can be applied for the project (the following information is extracted online from http://www.fao.org/docrep/010/ag127e/AG127E09.htm).

4.4.1 Groyne

Groyne is a coastal structure constructed perpendicular to the coastline from the shore into the sea to trap longshore sediment transport or control longshore currents (see **Figure 4.5**). This type of structure is easy to construct from a variety of materials such as wood, rock or bamboo and is normally used on sandy coasts. Nevertheless, it has the following disadvantages:

- Induces local scour at the toes of the structures.
- Causes erosion downdrift; requires regular maintenance.
- Typically more than one structure is required.

4.4.2 Seawall

A seawall, as shown in **Figure 4.6**, is a structure constructed parallel to the coastline that shelters the shore from wave action. This structure has many different designs. It can be used to protect a cliff from wave attack and improve slope stability and it can also dissipate wave energy on sandy coasts. The disadvantages of this structure are:

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Figure 4.5: Example of Groyne

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Figure 4.6: Example of Seawall

- It creates wave reflections and promotes sediment transport offshore.
- Scour occurs at the toes of eroded beaches.
- It does not promote beach stability.
- It should be constructed along the whole coastline; if not, erosion will occur on the adjacent coastline.

4.4.3 Offshore Breakwater

An offshore breakwater is a structure that parallels the shore (in the nearshore zone) and serves as a wave absorber (see **Figure 4.7**). It reduces wave energy in its lee and creates a salient or tombolo behind the structure that influences longshore transport of sediment. More recently, most offshore breakwaters have been of the submerged type; they become multipurpose artificial reefs where fish habitats develop and enhance surf breaking for water sport activities. These structures are appropriate for all coastlines. Their disadvantages are:

- They are large structures and relatively difficult to build.
- They need special design.
- The structure is vulnerable to strong wave action.

4.4.4 Artificial Headland

This structure, which is shown in **Figure 4.8**, is constructed to promote natural beaches because it acts as an artificial headland. It is relatively easy to construct and little maintenance is required. The disadvantages are:

- It is a relatively large structure.
- It can cause erosion downdrift of the protected length of coastline.
- Has poor stability against large waves.

Based on the initial information received from the appointed engineering consultant for this project, seawall (rock revetment) will be applied as the coastal protection. The final detail design of the coastal protection structure will be included later during the Environmental Management Plan (EMP) stage.

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Figure 4.7: Example of Offshore Breakwater

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Figure 4.8: Example of Artificial Headland

4.4.5 Rock Revetment

Revetments are onshore structures with the principal function of protecting the shoreline from erosion. Revetment structures are flexible and typically consist of armour rock or cast concrete blocks. Revetments rest on the surface being protected and depend on it for support. They are relatively light structures and are well suited at locations free of heavy wave attack. Properly designed and constructed revetments are long life structures and require little maintenance. Almost all concrete armour revetment rely on their interlocking design for stability. Voids within the revetment permit quick drainage over the surface of the slope and hence reduces wave run-up (Department of Irrigation and Drainage, 2017). **Table 4.3** shows the advantages and disadvantages of using rock revetment.

Table 4.3: Advantages and Disadvantages of Rock Revetment

Advantages	Disadvantages
• Absorb wave energy through the slats. • Effective for many years. • Can be cheap compared to other techniques.	• Not effective in stormy conditions. • Can make the beach inaccessible for tourists. • Regular maintenance is required. • Visually obtrusive.

Source: https://getrevising.co.uk/grids/revetments_disadvantages_coasts

In most cases, the typical slope design for a rock revetment is 1:4 or better. For this project, rock revetment is chosen as the coastal protection.

4.5 Reclamation Method

There are a number of available reclamation methods, depending upon suitability of fill material, sand source location, availability of equipment, etc. Below are the reclamation methods which can be considered for this project (the following information is extracted from https://www.encyclopedia.com/construction/trade-magazines/reclamation-methods).

4.5.1 Dry Method

The dry method is suitable for filling material from land sources, especially rock, hill cut and clay fill. Filling or transporting clay fill material into the sea would create viscous slurry which would take much longer to become usable land.

The dry method usually uses a truck or conveyor belt to transport fill material to extend the land towards the sea. Generally, the dry method works well for foreshore locations with underlying competent seabed soil. If the seabed soil is weak, a mud wave will be created in front of the fill because of displacement. In that case, a greater quantity of fill material would be required. In addition, the dry method usually results in a loose profile of fill especially when granular soil is used as fill material.

4.5.2 Hydraulic Reclamation Method (Direct Dumping)

A wet method of reclamation is implemented when fill material is obtained from an offshore borrow source. However, this method is only suitable for granular fill, which has good drainage characteristics.

A direct dumping method is used when the seabed is deep or the underlying seabed soil is soft. A bottom-opening barge usually carries fill material from the borrow source and either sails with a self-propeller or pushed by the powerful tugboat to the designated location. At the location, fill material is dumped by opening the bottom of the barge. Sufficient draft and clearance are required for this method. Generally, a seabed of 6 – 8 meters depth is suitable for bottom dumping. This method is used not only for granular material but also for stiff clay and soft clay. However, dumping of soft clay is not appropriate for deeper seabed conditions since soft clay can be dispersed, and the environment can be affected. Bottom-opening barges usually have a capacity of a few thousand cubic meters and the production rate of reclamation using bottom-opening barges is largely dependent upon the number of barges used and the distance between the borrow sources and the reclaimed area. The dumping location is generally controlled by a global positioning system. However, bottom dumping alone cannot complete the reclamation because it can only operate up to 2 – 3 meters depth below sea level. The next level of fill has to be raised by hydraulic filling or other means.

4.5.3 Rehandling Pit Method

Sometimes, if cutter suction hopper trailers are not available or direct dumping is not feasible, a rehandling method is used. The rehandling method involves transporting sand by barges and dumping the fill material temporarily in the pit for storage. The pit should have a storage capacity of a few million cubic meters. Rehandling pit locations are generally selected at natural depressions on a firm seabed or created by dredging. To create a rehandling pit, one needs to consider the stability of the pit slope. Such an operation would require two stationary cutter suction dredgers, one at the borrow source and another at the rehandling pit. In that case, sand barges are required to transport sand to the rehandling pit.

Alternatively, one cutter suction hopper dredger dredges the sand at the borrow source and transports it to the rehandling pit, while another stationary cutter suction dredger will operate at the rehandling pit to fill the reclamation area. The production rate of such reclamation is dependent upon the stationary cutter suction dredgers and the number of barges used for transportation. Filling up to 2,000,000m^3 per month is possible with this method of reclamation.

4.5.4 Hydraulic Filling

The hydraulic filling method is suitable for granular fill. Generally, this method is used when filling is carried out from an offshore source, either from a rehandling pit, as explained earlier, or from a trailer suction hopper dredger. In the case of pumping from a cutter suction hopper dredger, the fill material is dredged from the borrow source with its own trailer suction dredger which is moved adjacent to the reclamation area and then pumped through the discharge pipe. Bulldozers are used to grade and spread the fill material around the discharge pipe. The discharge pipe is usually set slightly above the required finished level.

Pumping is usually done with a mixture of fill material and water. The ratio of fill material to water is adjusted according to the grain size of the fill material. A large ratio of material to water would lead to wearing of the inner walls of the sand transportation pipe. On the other hand, a smaller ratio of material to water will reduce the production rate. After a certain amount of land has formed, the pipes are extended accordingly. Usually, the diameter of the sand transportation pipes is about 800 – 1,000m and 10m in length. Normally, wearing occurs at the bottom of the pipe, therefore, frequent rotation of the pipe after usage is necessary. Pipes that have to run above water can be floated with floaters attached to the pipes (see **Figure 4.9**).

To carry out direct hydraulic filling from a trailer suction hopper dredger, sufficient draft of the seabed is needed near the reclamation area. Now as big as 33,000m^3 trailer suction hopper dredgers are available, and either dredging or unloading can be carried out within two hours. The sailing time is dependent upon the distance between the borrow source and the reclamation area. If the source is close to the reclamation area, many trips per day are possible. In such a situation, as much as 4,000,000m^3 per month of production is possible with the trailer suction hopper dredger.

If the sand source is less than 5 km from the reclamation area neither a rehandling pit nor a cutter suction dredger is feasible. Direct pumping from the sand source to the reclamation area is possible. Pumping through a discharge pipe is possible up to 10km. Some intermediate booster pumps may be added to pump over such a long distance.

If the seabed is deeper or the location of the reclamation is far away from the dredger location, rainbow pumping is implemented. Rainbow pumping is normally suitable for underwater filling. Hydraulic filling is not suitable when the seabed is too shallow or the seabed soil is too soft. In that case, a sand spreading method is applied.

4.5.5 Sand Spreading

Sand spreading is implemented when a shallow seabed is encountered or when the seabed soil is too soft. When sand spreading is carried out, a rehandling pit is generally necessary. The spreader is mounted on a small floating barge. The end of the discharge pipe is usually closed and several perforations are provided along the last two to three

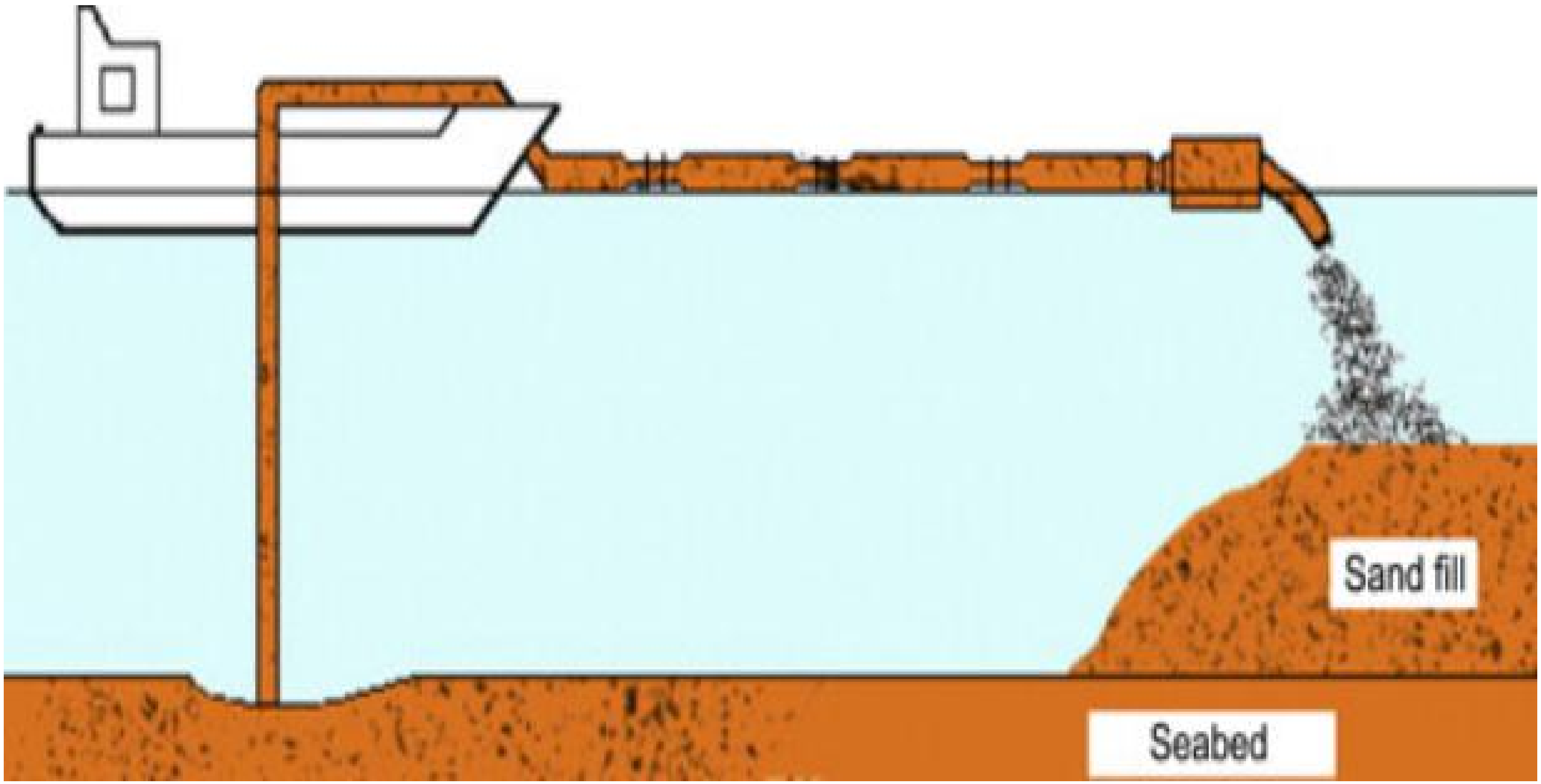

Figure 4.9: Example of Hydraulic Filling

sections of the discharge pipes. Sand is discharged through the perforations with water (see **Figure 4.10**).

Since sand spreading is not stationary and requires movement from one end to another, moving the spreader is made possible with a winch system and a heavy-duty bulldozer. Sand deposits using sand spreading method usually results in a loose profile.

Based on the initial information received from the project proponent, the reclamation method to be used for the proposed project might consist of combinations of two or more methods mentioned above. Detail reclamation method statement will be provided by the appointed contractor and will be included in the EMP later.

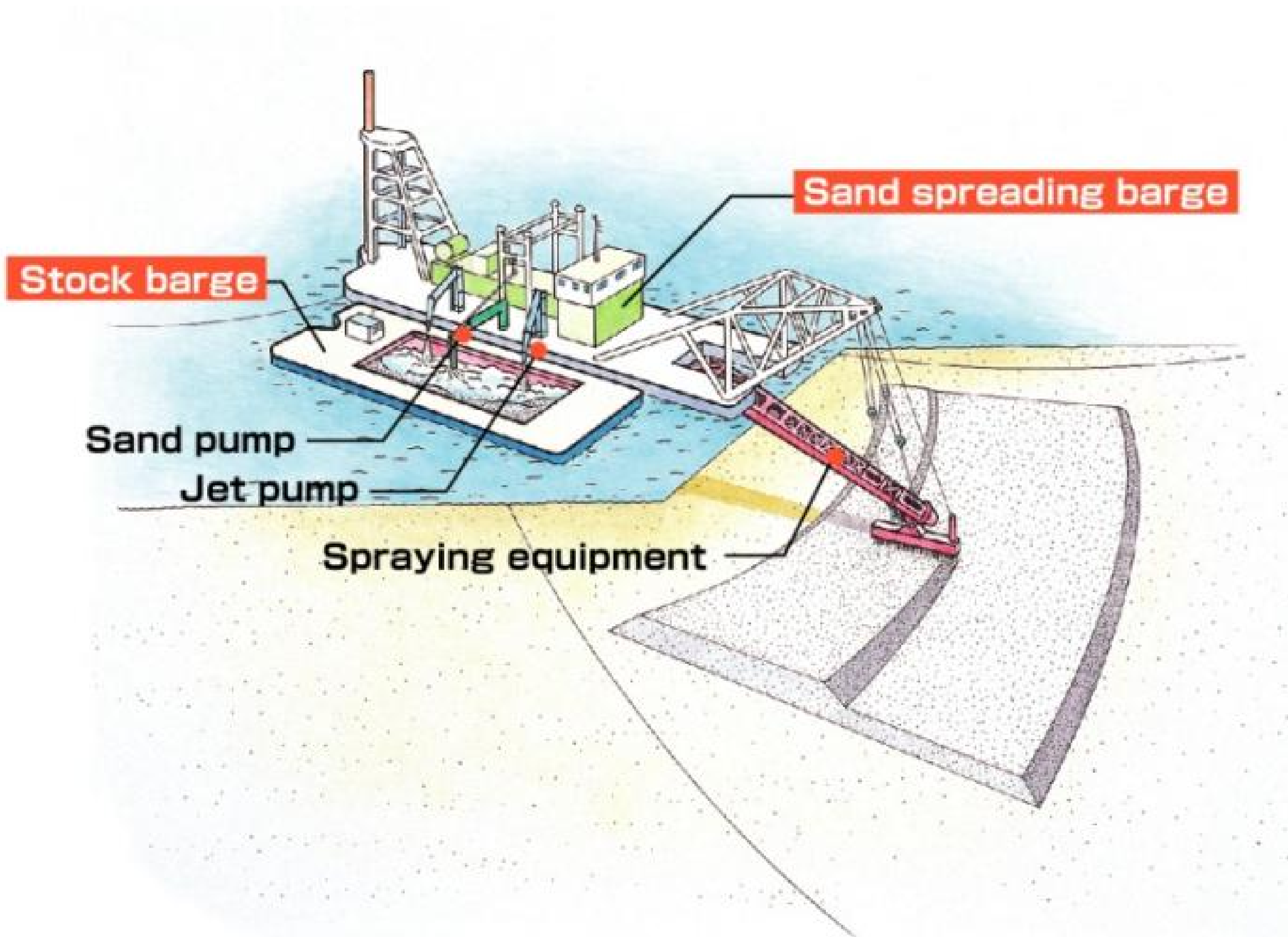

Figure 4.10: Example of Sand spreading