ARCADIS Design & Consultancy for natural and built assets

ENVIRONMENTAL IMPACT REPORT for the extraction of marine aggregates in control zones 1, 2 and 3 in the Belgian part of the North Sea

Zeegra | Coastal division | Maritime Access division

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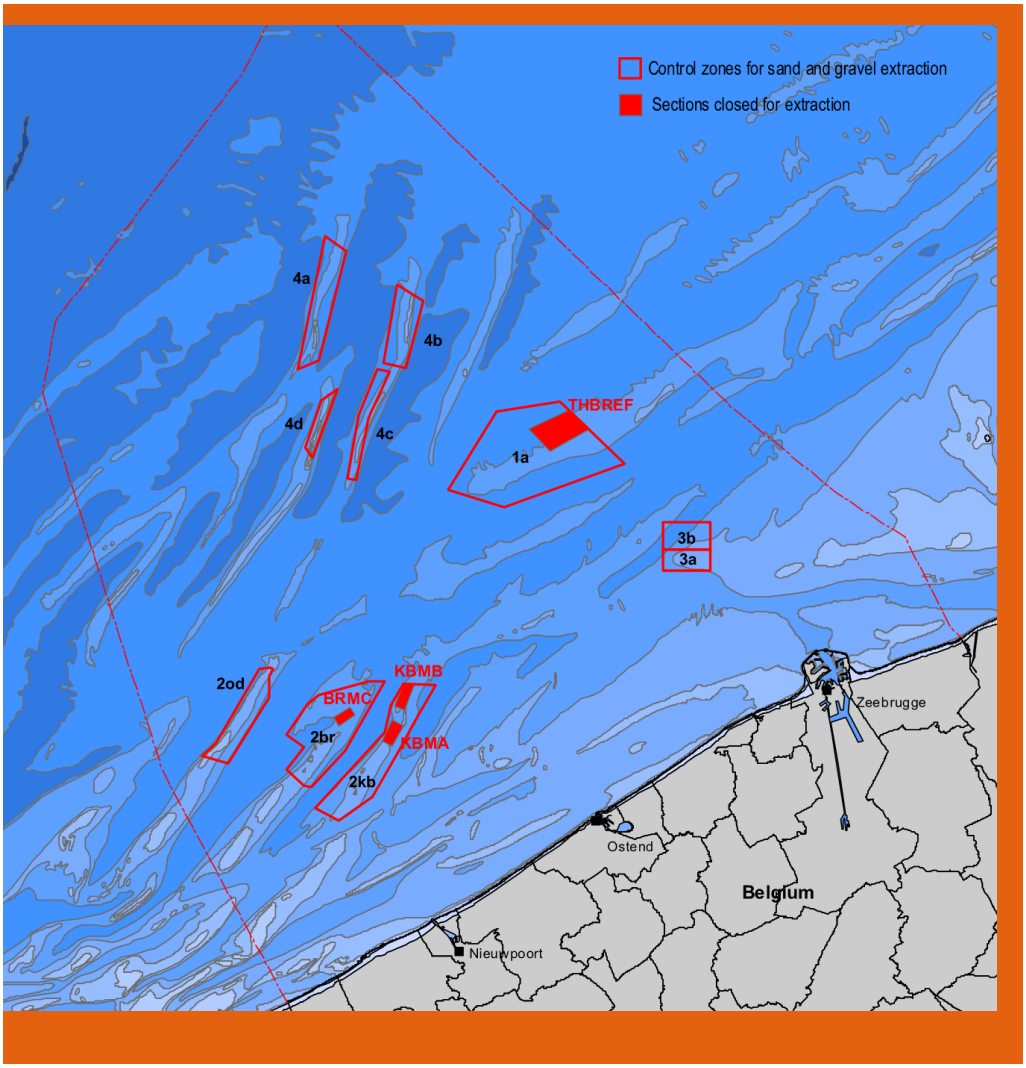
1 PROJECT DESCRIPTION

This environmental impact report has been prepared for the **sand and gravel extraction carried out in control zone 1, 2 and 3** within the Belgian part of the North Sea (BNS). This study assesses the combined effect of the extraction activities that the initiators (Zeegra, Flemish government – Coastal division and Flemish government – Maritime Access division) will develop in control zones 1, 2 and 3.

The extraction activities will be carried out using trailing suction hopper dredgers. The requested extraction volume is 15 million m³ per successive period of 5 years (3 million m³/year as a rolling average over 5 years).

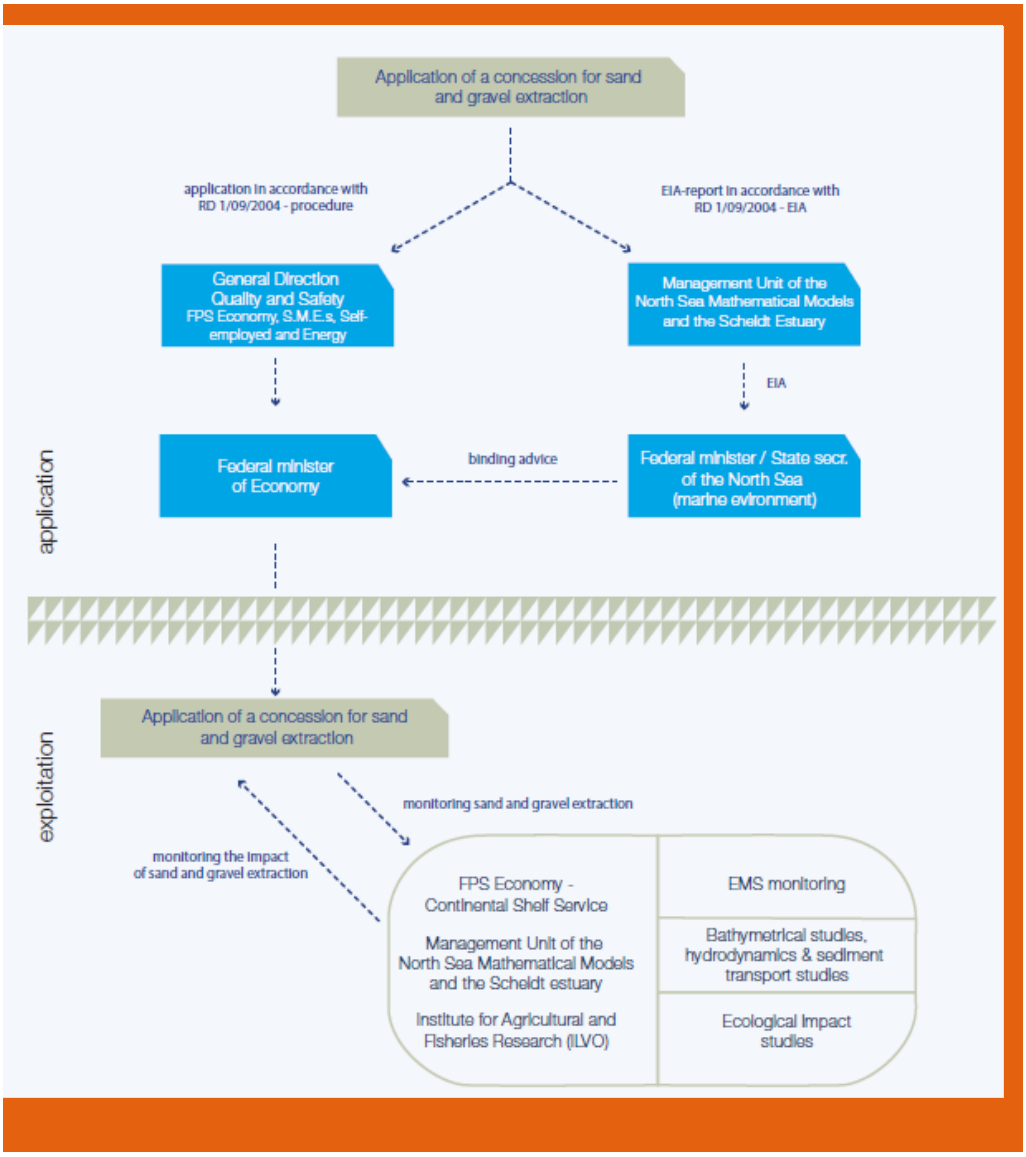
The extracted marine aggregates are an important source of construction materials where, depending on the quality and the grain size, the sand is used as filler or as a raw material in asphalt production or in the mortar or concrete industry. On the other hand, the extracted sediments are used for coast protection (sand replenishments) and other marine constructions such as offshore windmills.



2 PROCEDURE

The offshore extraction of sand and gravel requires a **concession permit**. In order to obtain a permit, an application form has to be submitted to the director of the General Direction Quality and Safety of the FPS Economy, according to the procedure stipulated in the royal decree of 1 September 2004 concerning the granting procedure. Furthermore, the royal decree of 1 September 2004 about the environmental impact assessment (EIA) defines that an environmental impact report has to be submitted to the Management Unit of the North Sea Mathematical Models (MUMM) (RBINS). The EIA by MUMM is subsequently transferred to the minister/state secretary competent for the marine environment, who in turn formulates a binding recommendation to the federal minister competent for economy.

This document presents the non-technical summary of the environmental impact report that the initiators (will) use as part of their ongoing or future permit applications for control zones 1, 2 and 3.



3 ALTERNATIVES

For this environmental impact report, two scenarios are developed that are assessed for their impact. In **scenario 1 'Business as usual'** the current situation is used, as far as possible. In **scenario 2 'Maximum dispersion'** it is assumed that there will be a maximum geographical dispersion of the extraction activities over the different concession zones (not just the maximum dispersion over the different control zones and sectors, but also over the whole area within a specific sector). For this, the total maximum quantity of aggregates to be extracted is homogenously distributed over the sand banks of the various sectors. In this scenario it is important to note that a truly homogeneous distribution of the extraction activities is an ideal situation that in reality is not feasible since it cannot be assumed that there is a homogeneous distribution of the various types of aggregate over the various locations and sub-zones. It can also not be assumed that it is simply practicably feasible to effectively achieve a homogeneous extraction. Scenario 2 will rather be a reflection of a *'best case scenario'*, since a maximal geographic dispersion is assumed and the impact per m² is therefore minimal.

SCENARIO 1: BUSINESS AS USUAL (BAU) IN CONTROL ZONES 1, 2 & 3 **Extraction volumes per successive period of 5 years per sector**					
Sector 1a	**Sector 2kb**	**Sector 2br**	**Sector 2od**	**Sector 3a**	**Sector 3b**
6 940 000 m³	2 015 000 m³	4 030 000 m³	2 015 000 m³	0 m³	0 m³
6 940 000 m³	2015 1 646 000 m³ 2016 1 629 000 m³ 2017 1 612 000 m³ 2018 1 595 000 m³ 2019 1 578 000 m³ **total over 5 years: 8 060 000 m³**			**0 m³**	
15 million m³					

SCENARIO 2: MAXIMUM DISPERSAL IN CONTROL ZONES 1, 2 & 3 **Extraction volumes per successive period of 5 years per sector**					
Sector 1a	**Sector 2kb**	**Sector 2br**	**Sector 2od**	**Sector 3a**	**Sector 3b**
5 577 264 m³	2 789 409 m³	3 631 437 m³	1 639 148 m³	605 752 m³	756 989 m³
5.577.264 m³	2015 1 646 000 m³ 2016 1 629 000 m³ 2017 1 612 000 m³ 2018 1 595 000 m³ 2019 1 578 000 m³ **total over 5 years: 8 060 000 m³**			**1 362 740 m³**	
15 million m³					

In fact, a quantity of sand may also be extracted in control zone 4. This control zone is however not part of this project, but will also be discussed in the chapter on the 'Cumulative impacts'.

4 IMPACT DESCRIPTION AND ASSESSMENT

4.1 Soil / Seabed

4.1.1 Reference situation

The sand banks in the Belgian part of the North Sea are tidal banks and coastal sand ridges, created by the interaction of fluvial adduced sand and SW-NE oriented tidal currents.

Control zone 1 (sector 1a) covers the western part of the Thorntonbank, one of the Zeeland Banks. The THBREF area in sector 1a has been closed for extraction since 1 October 2010 to act as a reference area for biological monitoring.

Control zone 2 covers three areas of the Flemish Banks: Oostdyck, Buiten Ratel and Kwintebank. The sand in this zone is generally very high quality. Two areas (KBMA and KBMB) at the Kwintebank were closed because two 5 m deep depressions occurred with respect to the reference level. From 2015 the central part of sector 2br (Buiten Ratel) has been closed due to the observation of a 5 m deep depression with respect to the reference level.

The sectors in control zone 2 were redefined in the Marine Spatial Plan in order, on the one hand, to comply with a safety zone around a new anchor area, and on the other hand, to exclude the high value gravel beds between the banks.

Control zone 3 is a small zone on the south-western protrusion of 'de Vlakte van de Raan'. This protrusion is called the Sierra Ventana. This zone is divided into a northern and a southern part (3a and 3b). The southern part of control zone 3 (sector 3a) is open for extraction. The northern half (sector 3b) coincides with dredge disposal site S1 and is closed as long as dredged material is dumped there. Sector 3a and 3b are alternately open for extraction. For safety reasons, dumping and extraction are never combined. Control zone 3 is intended to reduce the pressure on the natural sandbanks, but the quality of the sand is quite poor. The sand from zone 3 is for example not suitable for the construction industry.

4.1.2 Impact description and assessment

Bathymetry – The removal of marine aggregates in the BNS has a permanent effect on the bathymetry of the seabed. The effect is however local and not cumulative. The effect of the removal of marine aggregates and altering the bathymetry of the seabed is considered to have a moderate negative impact (--) on both scenarios. The difference in the lowering of the seabed in both scenarios is limited, namely 0.40 m (scenario 1) and 0.12 m (scenario 2) over a successive period of 5 years.

Seabed morphology – The emergence of dredge tracks has a temporary and local effect on the seabed morphology. The change in the heights of sand dunes, on the other hand, is a permanent effect. Since this is a local effect, the effect of marine aggregate extraction on the morphology of the seabed is assessed as moderately negative (--). This assessment applies to both scenarios.

Sedimentological changes – For scenario 1 (business as usual) it is more likely that sedimentological changes (shift of grain sizes) will occur in one or more zones, given the extraction activities will be more concentrated than in scenario 2, where there will be maximal dispersion of the extraction. The effect in scenario 2 is considered to be negligible (virtually no effect) (0), while the effect is judged to be slightly negative in scenario 1 (-).

4.2 Water

4.2.1 Reference situation

The flow of the North Sea water comes, driven by the tides and predominant winds, in Belgian waters predominantly from the SW to WSW.

The sediment transport on the sand banks is the reverse direction: to the NE on the western bank flank and to the SW on the eastern bank flank.

The turbidity or clarity of the sea water is determined by the amount of floating (in suspension) matter in the water. On satellite images, measuring the amount of suspended solids in the upper water layer, a clear geographical variation in concentrations is visible, with a decrease from the Belgian coast towards the sea. At the sand banks there is always a lower concentration than at the coast (for example, Zeebrugge, where the highest concentrations occur) because of the sandy sediment.

4.2.2 Impact description and assessment

Hydrodynamics and sediment transport – It is assumed that scenario 1 (business as usual) will potentially trigger a greater effect on the flow and sediment transport than scenario 2 (maximum dispersion) because the chances of a larger lowering of the local seabed structure in scenario 1 is larger, and so the chances of a significant effect on the water flow and geographical erosion/deposition pattern is greater. The effect of scenario 2 is therefore considered to be slightly negative (-), while the effect of scenario 1 is rated as moderately negative (--). The impact on the safety against flooding (coastal defense) is negligible (0).

Turbidity – The increase in turbidity as a result of the sand extraction is very temporary and limited in extent. In addition, the increased turbidity is at most of the same order of magnitude as the natural turbidity during a storm. Therefore, the effect of the increase in turbidity is considered to be negligible (virtually no effect) (0) in both scenarios.

Sedimentation from the turbidity plume – Sedimentation of the turbidity plume is not negligible. Recent research shows that there is a risk that fine material from the overflow has far-field effects. Given the potential consequences for the seabed functions and thus the seabed integrity, the effect of the sedimentation of the turbidity plume is considered to be moderately negative (--) for scenario 1 (business as usual) and slightly negative (-) for scenario 2 (maximum dispersion). The extraction activities in scenario 1 are indeed more geographically concentrated and the sedimentation of fine material will be more concentrated, so that the probability of there being effects on the seabed functions and the seabed integrity is greater than in scenario 2.

Water quality – The effect of sand extraction on the water quality is considered to be negligible (virtually no effect) (0), for both scenarios.

4.3 Fauna & Flora

4.3.1 Reference situation

Macrobenthos

Four common microbenthic communities can be distinguished in the subtidal mobile substrates of the Belgian part of the North Sea, named after the most common species in this community. In between, another 6 transitional communities are defined. Each of these is characterized by typical species, diversity and density and each is observed in a specific and well-defined environment.

Control zone 1 (sector 1a) consists of a mix of *Abra*, *Nephtys* and *Ophelia* communities. In particular, the northwestern region of this sector is dominated by the *Ophelia* community. In control zone 2 there is a dominance of the *Nephtys* community, although the *Abra* (mainly in sector 2kb) and *Ophelia* (mainly in sector 2br) communities have a strong local presence. Control zone 3 is pronouncedly characterized by the *Abra* community.

The valuation map for macrobenthos shows that control zone 1 (sector 1a) mainly forms a complex of high value and very low value patches. Control zone 2 is mainly high value for macrobenthos, with some very low value spots. Control zone 3 is charted mainly as a very high value area.

Epibenthos & Fish communities

From sampling at Buiten Ratel, Oostdyck, Thorntonbank and the Hinder Banks it appears that the general temporal and geographical patterns, such as known for the Belgian part of the North Sea, are dominant in the structures of the epibenthos and fish communities of the extraction areas.

Temporal patterns – Differences in communities are observed between Spring and Autumn. Some species were present in only one season, in the Spring, such as sprat, horse mackerel and mullet in the Autumn. While others occurred in much higher numbers in one of the two seasons, such as grey shrimp in the Spring and squids in the Autumn.

Geographical patterns – In addition to the dominant seasonal pattern, a clear geographical pattern was observed within each season:

- At the Hinder Banks and the Oostdyck fewer species, and also lower densities were observed in the Spring. Samples in the Autumn were dominated by lesser weever and horse mackerel; samples from the Spring only by lesser weever, complemented by grey shrimp and sprat in some locations.
- At the Buiten Ratel and Thorntonbank a larger number of species occurred, and mainly in the gullies in higher densities. In the Spring, samples were dominated by grey shrimp in both areas, supplemented with mainly hermit crab and starfish at the Buiten Ratel, and with several other species at the Thorntonbank. In the Autumn, the impact area of the Buiten Ratel was dominated by starfish, hermit crab, shrimp and swimming crab, while in the reference area one location was dominated by lesser weever and horse mackerel and the other location by starfish and hermit crab. In the Autumn samples from the Thorntonbank, other species occurred in more or less equal densities, although with a slight dominance of lesser weever at the top of the sand bank.

Avifauna

The BNS is an important wintering and foraging area for sea birds. Especially the shallow western coastal banks are of great importance. In addition, the relationship with the land is also of great importance:

- The seasonal migratory route runs parallel to and in the vicinity of the coastal strip, both on water and on land, and is part of the East Atlantic migratory route. This is a gathering and foraging place on a global scale.
- For the feeding and sleeping migration, the birds fly to and from the different areas of the country that are important to them, such as the West Coast (De Panne-Westende area), the port of Zeebrugge, the coastal polders of the Zwin area…

The largest number of movements is observed in the port of Zeebrugge, from where the birds move to the staging areas in the area.

The importance of a zone close to the coast is clearly apparent from the biological valuation map for the seabirds. Control zones 1 and 3 are identified on this map as highly valuable for seabirds, while control zone 2 is partly considered to be highly valuable.

Marine mammals

The occurrence of the harbour porpoise, both geographically and in time, is difficult to predict, given that the harbour porpoise is a highly mobile species, so that its dispersal depends on numerous factors that can not only be influenced by management in protected areas (e.g. climate change, with effects on the food chain). The animals found in Belgian waters do not constitute an isolated population, but are part of a much larger population that spreads across the Southern and Central North Sea.

Harbour porpoises occur throughout the year in the Belgian marine areas but there is a clearly visible seasonal pattern. During the greater part of the year, less than 1% of the population swims in Belgian North Sea waters but seasonally (Spring-Summer) this can increase to more than 5% of the population in the North Sea.

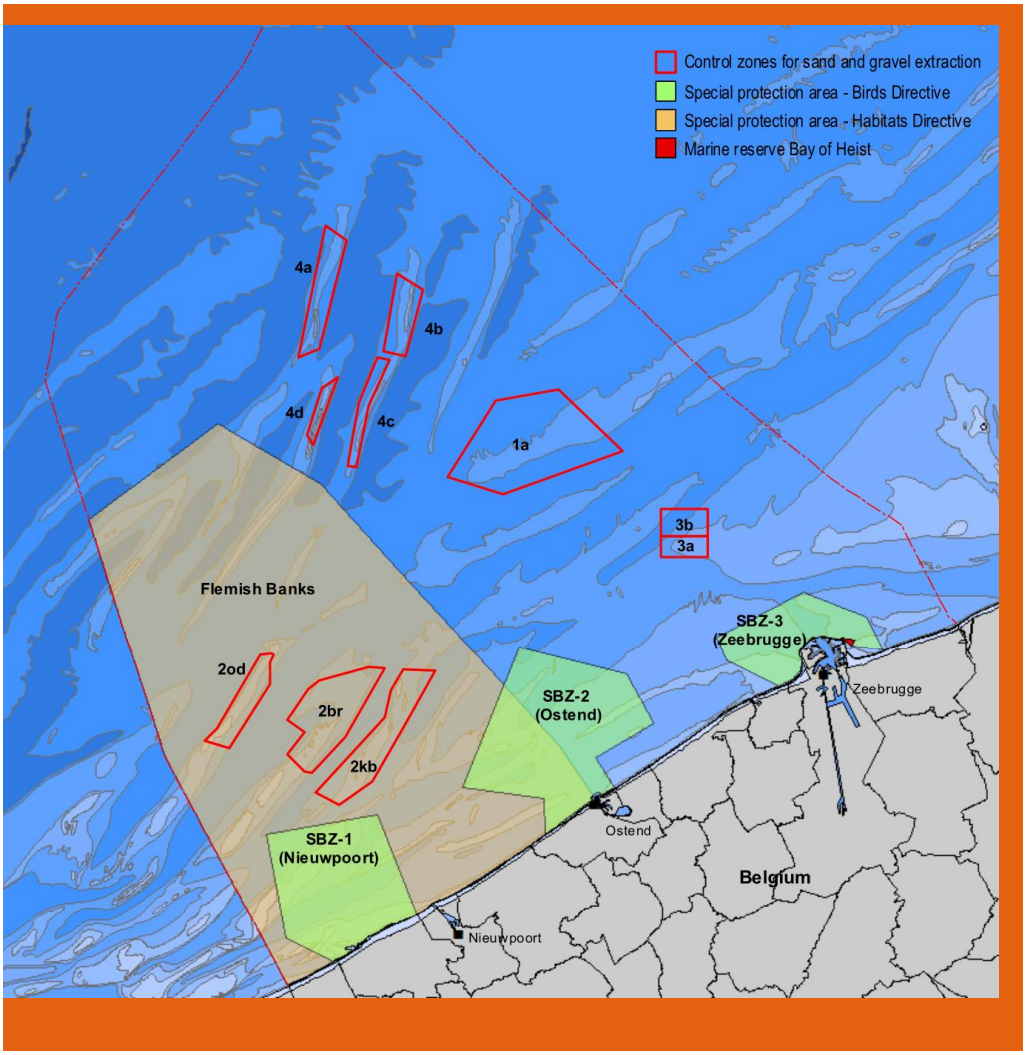
It is very difficult to determine migration corridors within the BNS or to identify areas that are more or less important for marine mammals because of the mobility of the marine mammals, the large area in which populations occur and the unpredictable nature of their occurrence.

Appropriate assessment

Control zone 2 is located inside the Special protection area 'Vlaamse Banken' (Flemish Banks) (Habitats Directive). This area was selected because of its high ecological value and high proportion of valuable habitats. The region namely includes 35% of the area of habitat type 1110[1] in the BNS, 29 % of the *Lanice conchilega* aggregations and 38 % of the gravel beds[2]. On the basis of the European Habitats Directive (art. 6) and its further transposition in RD 14/10/2005, RD 05/03/2006 and RD 16/10/2012 an appropriate assessment must be made for the sand and gravel extraction activities within this zone as these activities may potentially have a significant impact on the protected habitats.

[1] Habitat type 1110 'Sandbanks', as stated in Annex I of the Habitats Directive

[2] *Lanice conchilega* aggregations and gravel beds are habitats that can be considered as Habitat type 1170 'Reefs' (as stated in Annex I of the Habitats Directive), or as a 'special feature' under Habitat type 1110 'Sandbanks'.



4.3.2 Impact description and assessment

Macrobenthos

Habitat loss – In both scenarios, a major local habitat loss occurs due to the removal of the top layer of the seabed. In scenario 2, the habitat loss occurs over a larger area (more widely spread out), while the habitat loss in scenario 1 is more concentrated. Given that the extraction area in both scenarios, however, is limited in comparison with the total area of the BNS, the impact of the habitat loss for both scenarios is assessed as slightly negative (-).

Increase in turbidity – The increase in turbidity as a result of the sand extraction is very temporary and limited in extent. In addition, the maximum increased turbidity is of the same order of magnitude as the natural turbidity during a storm. Since the benthos of the subtidal sand banks is adapted to these natural dynamics, the impact of the increase in turbidity as a result of the extraction activities is considered to be negligible (virtually no effect) (0), in both scenarios.

Sedimentation of the turbidity plume – Taking into account the (possible) direct and indirect effects, the sedimentation of the turbidity plume is not negligible. Recent research shows that there is a risk that fine material from the overflow has far-field effects. Given the potential consequences for the seabed functions and ecosystem efficiency, the impact of sedimentation of the turbidity plume is considered to be moderately negative (--) for scenario 1 (business as usual) and slightly negative (-) for scenario 2 (maximum dispersion). The extraction activities in scenario 1 are indeed more concentrated geographically and the sedimentation of fine material will be more concentrated, so that the probability of occurrence of effects on the seabed features and the seabed integrity is greater than in scenario 2.

Changes in structural and functional characteristics of the benthic ecosystem - As long as marine aggregate extraction takes place at low intensities (such as so far at Oostdyck, Thorntonbank, the southern central part of the Buiten Ratel) or at high, but infrequent intensities (Oosthinder, control zone 4), it can be assumed that the current sandy benthic ecosystem of the BNS is resilient enough to buffer the biological impact of extraction, both structurally and functionally. On the other hand, when the extraction pressure is high and focuses on a limited area, which is frequently visited and where large volumes are extracted, changes in the sediment composition are expected to lead to biological changes. Since these biological changes are, however, relatively limited and do not give rise to measurable changes in ecosystem functioning, no significant adverse effects are to be expected.

In addition, there appears to be a real chance that fine material from the overflow has far-field effects, with possible consequences for the benthic communities. Such effects are most likely to occur with intensive extraction that is localized within a limited area (whether or not frequently visited).

In scenario 1 (business as usual) the extraction activities are more geographically concentrated than in scenario 2 (maximum dispersion), thus the chance of the occurrence of changes in sediment composition in scenario 1 is larger, and the sedimentation of fine material will therefore be more concentrated. Therefore, the effect of marine aggregate extraction on the structural and functional characteristics of the benthic ecosystem is considered to be moderately negative (--) for scenario 1 and slightly negative (-) for scenario 2.

Ecotoxicological impacts – Ecotoxicological effects on benthos as a result of marine aggregate extraction are considered to be negligible (virtually no effect) (0) for both scenarios.

Epibenthos & Fish communities

The effect of **habitat loss and habitat change**, **increased turbidity** and **mortality** on the epibenthos and the fish communities is considered to be slightly negative (-) for both scenarios.

Ecotoxicological impacts on the epibenthos and the fish communities as a result of marine aggregate extraction are considered to be negligible (virtually no effect) (0) for both scenarios.

Avifauna & Marine mammals

Food availability – It is expected that a reduced availability of benthos as a food source may occur only in the intensively mined zones, with potential direct and/or indirect effects on seabirds and marine mammals. The area of the zones to be intensively mined, however, is very limited in comparison to the total area of the BNS.

At the moment there is no clear general impact of aggregate extraction on the demersal fish communities. In addition, there is no knowledge of high sensitivity (mortality) in relation to marine aggregate extraction of specific species that are of great importance in the diet of the common seabird and marine mammal species in the BNS.

On the other hand, marine aggregate extraction can also cause a temporary facilitation of food availability.

Consequently, it is assumed that both for seabirds and marine mammals almost no changes will occur in the food availability as a result of marine aggregate extraction in the BNS. The impact is considered to be negligible (virtually no effect) (0) for both scenarios.

Increased turbidity – Given that the increased turbidity occurs only temporarily and, moreover, is at most of the same order of magnitude as the natural turbidity during a storm, the impact of the increase in turbidity as a result of the extraction activities on seabirds and marine mammals is considered to be negligible (virtually no effect) (0) for both scenarios.

Disruption – Disruption as a result of marine aggregate extraction is temporary in nature and will take place in restricted zones in the BNS. The number of ship movements is limited compared to the existing shipping traffic in the Belgian part of the North Sea. Seabirds and marine mammals are

mobile species that, if desired, can avoid the zones of disturbance. The loading and unloading activity in the coastal ports is part of the currently prevailing port activities to which the present avifauna is accustomed, and does not take place in the vicinity of the resting places of seals. Consequently, the effect of disruption (including noise) as a result of marine aggregate extraction is considered to be slightly negative (-).

Appropriate assessment

Habitat type 1110 'Sandbanks which are slightly covered by sea water all the time' –The physical habitat is affected only very locally in the intensively mined areas within control zone 2. The sandbank-gullies ecosystem as a whole is not affected. Moreover, a gradual decrease in the extractable volume is enforced in control zone 2 resulting in a gradual decrease in the degree of disturbance of the habitat type 1110 within the Special protection area.

Habitat type 1170: 'Reefs – Gravel beds' – Because of redefinition of the sectors of control zone 2 and the introduction of a ban on gravel extraction in control zone 2, the direct impact of marine aggregate extraction on gravel beds within the Special protection area 'Vlaamse Banken' is reduced to a minimum.

On the other hand, it appears there is a real chance that fine material from the overflow has indirect effects on gravel beds. However, no direct relationship has been established yet between the enrichment with fine material and the extraction activities.

Habitat type 1170 'Reefs – *Lanice* aggregations' – The *Lanice conchilega* aggregations within the Special protection area 'Vlaamse Banken' are mainly located near the shore, while control zone 2 is in deeper water.

Harbour porpoises – No changes are expected in the availability of food for harbour porpoises resulting from marine aggregate extraction in the BNS. The noise disturbance caused by marine aggregate extraction is temporary in nature and takes place in the restricted zones in the BNS. Moreover, harbour porpoises are mobile animals that can avoid the disruption zones if necessary.

Conclusion – No significant adverse effects are expected on the Special protection area 'Vlaamse Banken' and the harbour porpoise.

Any indirect effects on gravel beds as a result of enrichment of the seafloor matrix with fine sediments (possibly from overflow) do constitute a gap in knowledge and should be investigated further.

4.4 Air & Climate

4.4.1 Reference situation

In the coastal zone there is a clear positive impact on air quality as a result of the predominant southwesterly-westerly winds observable, where clearer air comes in over the sea. At the port of Zeebrugge and, to a lesser extent, in the port at Ostend, there are typically higher concentrations of pollutants predicted in relation to the rest of the coastal region and West Flanders. The reason for the increased values of these port areas is the large presence of shipping, more road traffic (freight traffic) and more industrial emissions. However, the measurement results for past years show a decrease in the concentrations of pollutants in these zones, which is the result of a decrease in emissions.

RO-RO ships and container ships together represent half of the total shipping emissions in 2014. This is not surprising given the importance of these types of goods in traffic in the Flemish ports.

4.4.2 Impact description and assessment

The proportion of emissions from marine aggregate extraction in control zones 1, 2 and 3 relative to the total emissions from inland shipping is limited for both scenarios. Given, in addition, that the

amount of material to be extracted in control zones 1, 2 and 3 (in total) remains virtually unchanged compared to the present situation and given the continuing decline in emissions of air pollutants (by systematic implementation of various standards and fleet renewal), it can be assumed that the impact of the marine aggregate extraction in control zones 1, 2 and 3 on the air quality will rather decrease with respect to the current situation or at least will remain the same. The effect of marine aggregate extraction in control zones 1, 2 and 3 on the air quality is therefore considered to be slightly negative (-).

4.5 Noise

4.5.1 Reference situation

The natural background noise level under water is between approximately 90 and 100 dB (re 1µPa) in the frequency range 100 Hz to a few kHz. The sound of shipping engines constitutes one of the main sound sources of human origin. The noise and vibration from the engine room, the propeller noise and the sound of the currents cause an increase in the background noise level under water. The channel between the UK and the continent is considered to be a 'hot spot' in the literature because of the underwater noise caused by the high density of shipping. Dredging activities, seismic investigation of the seafloor conditions and pile driving activities for the construction of wind turbines are major anthropogenic sources of noise.

Above water, in open sea, the background noise level is estimated to be 35 ± 5 dB(A).

4.5.2 Impact description and assessment

The **underwater noise caused by marine aggregate extraction** (the dredging itself) is, in favorable weather conditions, significantly louder than the background noise up to a few kilometers from the source. The sound of the trailing hopper suction dredger(s) above the water can be observed up to at a distance of 1 to 2 km from the source. In view of the fact that the activity considered constitutes a continuation of the existing activity, there is no question of an increase of the ambient noise environment but the situation with respect to the current situation remains substantially unchanged. The effect of marine aggregate extraction (activity within the control zones) below and above water on the sound climate is considered to be slightly negative (-).

The influence of the **passing trailing suction hopper dredgers on the current overall ambient noise above and below water** is limited compared to the current shipping. The noise emissions during the loading and unloading of ships are relatively low and take place in an environment with an already highly disturbed noise environment (port area). In view of the fact that the activity considered constitutes a continuation of the existing activity, there is no question of an increase in the ambient noise environment but the situation with respect to the current situation remains substantially unchanged. The effect of ship movements for marine aggregate extraction and from the unloading of the extracted marine aggregates on the noise environment is considered to be negligible (0).

4.6 Sea view & Cultural heritage

4.6.1 Reference situation

Sea view

The sea and the beach are experienced by the population as positive. The coast is a major tourist attraction in Belgium, both for day trippers and for long-stay tourists. In contrast to the sea view, the view of the coast line in the direction of the interior is characterized by a succession of high rise buildings. Movements in the landscape caused by cargo ships, fishing, recreational boating, surfing, etc. are part of the landscape experience for the people on the dike. Especially in the sea ports there is heavy traffic from arriving and departing ships.

Cultural heritage

The term ‘maritime archeological heritage’ covers a many things:

- Shipwrecks and other wrecks (including aircrafts);
- In the sea, rivers or other patches of water, drowned settlements or other traces or remnants of human activities under water and their paleo-landscape context;
- Archaeological traces and sites situated on land and their (paleo)landscape context that, as far as their former operation was fully focused on the sea or on the water, such as lighthouses, fishing villages, shipyards, dikes, peat extraction, salt-boilers, quays, dewatering canals, etc.;
- Archaeological remains of sea fish which are also found far inland during archaeological research;
- Paleontological remains of terrestrial fauna found in the sea.

4.6.2 Impact description and assessment

Sea view

There is no question of an increase in the **disruption of the sea view** by the marine aggregate extraction in control zones 1, 2 and 3 since it is a continuation of the already existing activity. The ship movements are not noticeable in the prevailing busy shipping traffic, which is part of the experience of the seascape. Consequently, the effect of marine aggregate extraction on the sea view is considered to be negligible (0).

Cultural heritage

Marine aggregate extraction means a possible loss of, or damage to **maritime cultural heritage**. Provided that the practical recommendations are respected and maximum use is made of the practical guide from the SeArch project (once available), the effect is considered to be slightly negative (-).

4.7 Compatibility with other activities

4.7.1 Reference situation

Many activities, in addition to sand and gravel extraction, take place in Belgian marine waters. According to the Marine Spatial Plan (Royal Decree of 20 March 2014), the control zones 1, 2 and 3 for the extraction of marine aggregates overlap in geographical use with following activities:

- fishing;
- the zones for cables and pipelines;
- the zones for military use;
- one of the zones for dumping dredged materials;
- tourism and recreation.

In addition, the control zones are in the vicinity of several major shipping routes, two anchor zones and a zone for aquaculture.

4.7.2 Impact description and assessment

Fishing – The direct effect (temporal incompatibility) of marine aggregate extraction on the fisheries is limited given the fact that benthic fisheries focus more on the flanks and gullies between the sandbanks, and the fact that shrimp fishing takes place mainly outside the zones where the most intensive extraction will take place. In addition, there is no change with respect to the current situation. The possible indirect effect is also limited since in the BNS to date no clear overall impact has been observed from aggregate extraction on the demersal fish communities. Consequently, the effect of marine aggregate extraction on the fisheries is considered to be slightly negative (-).

Marine aquaculture – Marine aggregate extraction has possible ecotoxicological effects on the (potentially future) farmed organisms in aquaculture zones by the potential release of toxic substances during the extraction activity. Due to the strong current of the sea water, however, such a rapid dilution occurs that the effect of marine aggregate extraction in the BNS on aquaculture is considered to be negligible (0).

Shipping / maritime transport – The control zones for sand and gravel extraction do not show any overlap with the main shipping routes and traffic flows that are necessary for shipping to approach the Belgian and Scheldt ports.

Shipping traffic can occur anywhere within the extraction zones. This shared space use brings a risk of collisions between ships. A discussion and assessment of the risk of collisions is given in the chapter 'Safety aspects'.

Dredging and dumping – No geographical conflicts are observed between marine aggregate extraction and dredging activities (including the dumping of dredged materials). The effect is considered to be negligible (0).

Energy – Current knowledge indicates only local (significant) changes in current patterns and erosion/sedimentation patterns at very intensively mined zones. It can therefore be assumed that such significant changes to current patterns will not extend beyond the limits of the control zones. Therefore, no effect (0) on the stability of the wind turbines and any future energy atolls is expected.

Marine aggregate extraction has a negligible effect (0) on cables and pipelines, provided that the applicable regulations and safety perimeters are respected.

Safety against flooding – Marine aggregate extraction has a possible direct impact (increased wave impact during a storm) and indirect impact (coastal erosion) on the safety against flooding (coastal defense). Both effects are considered to be negligible (0), essentially as a result of the relatively large distance from the sand extraction to the coast and the presence of other sandbanks that weaken the wave energy.

Military use – Marine aggregate extraction has a negligible effect (0) on military activities, provided that the prohibition on access to the relevant military zones during notified military exercises and other activities is respected.

Tourism and recreation – Marine aggregate extraction has no impact on the tourist-recreational activities in the coastal area. Provided that the shipping regulations are respected, the chance of collision of an extraction ship with recreational navigation is also considered to be very small. The effect of marine aggregate extraction is considered to be negligible (0).

4.8 Safety aspects

4.8.1 Reference situation

Shipping

The Belgian seaports are located on some of the busiest shipping lanes in the world, with more than 150,000 ship movements a year, in the so-called Le Havre-Hamburg range. Approximately 15% of these ships are tankers (oil, chemical and gas tankers), and nearly half (approximately 50%) are container ships and RoRo (Roll-on Roll-off) ships. Cargoes of oil and other harmful or (environmentally) hazardous substances are largely carried on board of tankers, container ships and RoRo ships. A striking trend here is that maritime transport has steadily continued to increase over the years, which translates not so much into 'more ships' in the BNS, but rather a strong increase in the average ship size.

Oil pollution

Since the project area is situated in the North Sea, it is covered by the regulations applicable to the MARPOL 'special zones', Annex I. The discharge of oil-containing liquids is therefore prohibited. A

loss of oil from ships can have several causes: a collision between two ships, ships that collide with a stationary obstacle or a floating obstacle, cracks in the hull, sinking, fire on board, serious negligence, intentional (criminal) discharge activities... Once an (accidental) discharge has taken place, it will spread and form a possible threat to the marine ecosystem and coastal areas.

Despite the increase in maritime transport, there is a clear downward trend in the number of illegal oil contaminations detected each year in Belgian waters. The reason for the generally downward trend can be found in the more stringent policy and legislative framework on safety and pollution from ships, and the dissuasive nature of the current supervisory resources. On the other hand, during observation flights, an increasing trend is observed in operational discharges of harmful substances other than oil.

4.8.2 Impact description and assessment

Maritime safety – Building on the conclusions of the environmental impact reports of 2006 and 2010, it can be assumed that the probability of the occurrence of an accident at the marine aggregate extraction in control zones 1, 2 and 3 is small. The increase in the risk of shipping accidents compared to the current situation due to the increasing importance of control zone 1 is negligible. The effect of marine aggregate extraction in control zones 1, 2 and 3 on maritime safety is therefore considered to be slightly negative (-).

Risk of oil pollution – The chance of oil pollution is considered to be very low. The biggest danger on the stranding of an oil spill comes from a discharge in areas 3a and 2kb (at high wind friction (5%)). The precautionary principle should be applied where, in the first place, a shipping accident must be avoided as much as possible and, if this turns out to be impossible, a discharge must be avoided or limited as quickly as possible.

The avifauna in particular, and possibly also marine mammals, will mainly experience the major short term effects of oil pollution. The impact of a discharge on the birds is on the one hand a function of the species present, their density and vulnerability and, on the other hand, the contaminated area. In addition to the direct victims that a disaster causes, there may also be negative effects for the population (long-term effect). However, it is often not easy to distinguish the effect of an oil spill from natural fluctuations in a population.

The effect of marine aggregate extraction on the probability of the occurrence of oil pollution is considered to be slightly negative (-).

4.9 Impact on the Good Environmental Status and Environmental Targets

Marine aggregate extraction has a potential impact on the Good Environmental Status and on the achievement of the Environmental Targets of Belgium as defined within the context of the Marine Strategy Framework Directive 2008/56/EC. The following descriptors are relevant: D1 (biological diversity), D2 (non-native species), D4 (marine food chains), D6 (seafloor integrity), D7 (hydrographic properties), D8 (contamination) and D11 (underwater noise).

D1/D4/D6 – Because of the redefinition of the sectors of control zone 2, the introduction of a ban on gravel extraction in control zone 2 and the gradual decrease in the extraction volume in control zone 2, a positive trend compared to the initial status (2012) is expected for various indicators that demonstrate the achievement of the Good Environmental Status for descriptors D1, D4 and D6 (at least with respect to marine aggregate extraction). Marine aggregate extraction does not therefore mortgage the achievement of the Environmental Targets in the BNS for these descriptors.

The possible indirect effects as a result of enrichment of the seabed matrix with fine sediments (possibly from overflow) form a gap in knowledge and should be monitored further.

D6 – For descriptor D6 (seafloor integrity) the assessment is nuanced:

- It is assumed that the actual removal of substrate and changes in topography due to aggregate extraction do not have a significant impact on the integrity of the seafloor and the connectivity of the habitats.
- In the near-field (in the intensively mined areas), sedimentological changes may occur; this results in a more heterogeneous habitat. There is no question of significant unilateral refinement of the sediments. For this aspect there is likewise no significant impact expected on the Good Environmental Status of D6.
- In the far-field, no 'smothering' (suffocation) of the gravel beds was observed as a result of the turbidity plume. On the other hand, there is a risk that fine material from the overflow has far-field effects by captation and buffering of these fines in the soil matrix, with possible consequences for the seabed functions. For this aspect, a significant impact on the sea floor integrity and the achievement of the Good Environmental Status for D6 cannot be excluded.

Given the currently prevailing gaps in knowledge concerning this effect, further research and monitoring is initially appropriate. If it appears from this that the integrity of the seabed is indeed compromised, mitigating measures should be sought.

D2 – Marine aggregate extraction does not give rise to the introduction of new non-native species. Hence no impact is expected on the achievement of the Good Environmental Status for descriptor D2.

D7 – On the basis of the discussions of the effects within the disciplines of 'Soil/Seabed', 'Water' and 'Fauna and Flora', it is decided that no significant impact is expected as a result of marine aggregate extraction on the achievement of the Good Environmental Status and Environmental Targets for descriptor D7 (hydrographic conditions).

D8 – The risk of the occurrence of an accident at the marine aggregate extraction in control zones 1, 2 and 3 is small. The risk of the occurrence of oil pollution is also very low. Careful compliance with the current legislation on maritime safety as a strict constraint applies at all stages of the marine aggregate extraction process. In addition, the precautionary principle must be applied where, in the first place, a shipping accident must be avoided as much as possible and, if this turns out to be impossible, a discharge must be avoided or limited as quickly as possible. These aspects taken into consideration, it can be decided that marine aggregate extraction does not therefore mortgage the achievement of the environmental targets in the BNS for descriptor D8.

D11 – In general, it is decided that marine aggregate extraction in control zones 1, 2 and 3 will not cause a positive trend in the annual average environmental noise levels since it can be considered to be a continuation of an existing activity. Marine aggregate extraction does not therefore mortgage the achievement of the environmental targets in the BNS for descriptor D11.

5 CUMULATIVE IMPACTS

The marine aggregate extraction in control zones 1, 2 and 3 can, in combination with the marine aggregate extraction in control zone 4, lead to an accumulation of effects. In addition, cumulative effects may also occur as a result of marine aggregate extraction in combination with other human activities at sea which (partly) cause similar effects:

- The construction and operation of wind farms in the BNS;
- The laying of the HVDC interconnector between the UK and Belgium; the Nemo Link**;**
- Dredging and dumping of dredged material in the BNS;
- Fishing, in particular trawling fisheries.

In many cases, the cumulative effect is **equal to the sum of the effects** of the individual activities (1+1=2). One example is the cumulative effect on the seafloor of marine aggregate extraction in control zones 1, 2 and 3 in combination with marine aggregate extraction in control zone 4.

In some cases, the cumulative effect is **less than the sum of the effects** of the individual activities (1+1>1):

- Marine aggregate extraction in control zones 1, 2 and 3 in combination with the dumping of the dredged material: cumulative impact on the seafloor;
- Marine aggregate extraction in control zones 1, 2 and 3 in combination with marine aggregate extraction in control zone 4: cumulative impact on turbidity (water).

Finally, there are various aspects in which the cumulative effect is (potentially) **greater than the sum of the effects** of the individual activities (1+1<1):

- Marine aggregate extraction in control zones 1, 2 and 3 in combination with seabed disturbing fishing: cumulative impact on seabed;
- Marine aggregate extraction in control zones 1, 2 and 3 in combination with marine aggregate extraction in control zone 4: cumulative impact of sedimentation of the turbidity plume (water);
- Marine aggregate extraction in control zones 1, 2 and 3 in combination with all other relevant activities: cumulative impact on macrobenthos (Fauna & Flora);
- Marine aggregate extraction in control zones 1, 2 and 3 in combination with all other relevant activities: cumulative impact on epibenthos & fish communities (Fauna & Flora);
- Marine aggregate extraction in control zones 1, 2 and 3 in combination with all other relevant activities: cumulative impact on noise under water (noise) and on marine mammals (Fauna & Flora);
- Marine aggregate extraction in control zones 1, 2 and 3 in combination with all other relevant activities: cumulative impact on maritime safety (safety aspects).

Cumulative effect of marine aggregate extraction in control zone 1, 2 and 3 combined with	Marine aggregate extraction in control zone 4	Windfarms	Nemo Link	Dredging and dumping of dredged material	Fishing
Soil / Seabed	S	S	S	S <S	>S ?
Water	S <S S or >S ?	S	S	S	S
Fauna & Flora: macrobenthos	>S				
Fauna & Flora: epibenthos & fish fauna	>S				
Fauna & Flora: marine mammals	>S				
Air	S				
Noise	>S				
Cultural heritage	S				
Compatibility with other activities	*See maritime safety*				
Maritime safety	>S				

In the assessment of the cumulative effects, it is important to note that the activity for which this environmental impact report is produced, namely marine aggregate extraction in control zones 1, 2 and 3, is a continuation of an already existing activity. The cumulative effects discussed are already present and will, as a result of the continuation of the marine aggregate extraction in control zones 1, 2 and 3 (in much the same way, apart from some shifts in the importance of certain sectors in response to legal conditions and the needs of the sector) change little or not at all in the future. So there is no question of an increase in the various cumulative effects compared

with the current situation (taking into account the autonomous development), regardless of the fact that the cumulative effect is the same, less than or greater than the sum of the effects of the individual activities.

6 MONITORING

In accordance with the law of 13 January 1969 which states that the exploration and exploitation should be subject to an ongoing review of the impact of the activities carried out, regular monitoring of the extraction activities in the BNS has been conducted since the end of 1999.

The possible far-field effects of sedimentation should be examined in more detail within the current monitoring program.

In addition, monitoring is recommended of the cumulative impact of marine aggregate extraction in combination with trawling, and of the cumulative impact of sedimentation of the turbidity plume resulting from sand extraction in control zone 2 and 4 on the highly valuable gravel beds.

7 CROSS-BORDER IMPACTS

Considering that in this environmental impact report no significant environmental effects for the Belgian part of the North Sea were identified as a result of marine aggregate extraction, it is evident that there will also be no significant adverse cross-border environmental impacts. Significant cumulative effects from marine aggregate extraction in combination with projects abroad are not expected either.

8 SUMMARY AND CONCLUSIONS

The main effects of marine aggregate extraction relate to the disciplines soil/seabed, water and fauna & flora (macrobenthos).

- As (intensive) extraction affects the volume of sand banks (permanent impact on the bathymetry, both local and non-cumulative) this may lead to disrupted morphology and global sediment dynamics. In turn, this may lead to changes in flow patterns and abnormal erosion/sedimentation patterns.
- The physical disturbance of marine aggregate extraction can lead to changes in the structural and functional characteristics of the benthic ecosystem. When the extraction pressure is high and focuses on a limited area that is frequently visited and where large volumes are extracted, changes in the sediment composition are expected to lead to biological changes. However, the biological changes observed to date remain limited.
- With regard to sedimentation from the turbidity plume there is a risk that fine material from the overflow has far-field effects on the ecologically highly valuable gravel beds. These potential indirect effects on gravel beds are now a gap in knowledge and need to be investigated further.

These main effects are considered to be **minor (-) to moderately (--) negative**. In scenario 1 (business as usual) some effects are considered to be a degree more negative with respect to scenario 2 (maximum dispersion). In scenario 1, the extraction activities are indeed more geographically concentrated so that various effects have a greater chance of occurrence in comparison with scenario 2 where the dispersion of the extraction is maximal. In both scenario 1 and scenario 2, however, all the effects still remain acceptable (maximally moderately negative).

The other effects (within these and other disciplines) are all considered to be **negligible (0) to slightly negative (-)**.

Effect	Assessment	
	Scenario 1 (business as usual)	Scenario 2 (maximum dispersal)
SOIL / SEABED		
Substrate removal – Seabed bathymetry changes	--	--
Morphological changes	--	--
Sedimentological changes	-	0
WATER		
Impact on hydrodynamics and sediment transport	--	-
• Increase in turbidity • Sedimentation turbidity plume	0 --	0 -
Impact on water quality	0	0
FAUNA & FLORA – Macrobenthos		
Habitat loss	-	-
• Increased turbidity • Sedimentation turbidity plume	0 --	0 -
Changes in structural and functional characteristics of the benthic ecosystem	--	-
Ecotoxicological effects	0	0
FAUNA & FLORA – Epibenthos & Fish communities		
Habitat loss and habitat change	-	-
Increased turbidity	-	-
Mortality	-	-
Ecotoxicological effects	0	0
FAUNA & FLORA – Avifauna & Marine mammals		
Food availability	0	0
Increased turbidity	0	0
Disturbance	-	-
AIR & CLIMATE		
Effect on air quality	-	-

Effect	Assessment	
	Scenario 1 (business as usual)	Scenario 2 (maximum dispersal)
NOISE		
Effect of marine aggregate extraction (activity within the control zones) on the noise climate under water	-	-
Effect of marine aggregate extraction (activity within the control zones) on the noise climate above water	-	-
Effect of ship movements for marine aggregate extraction	0	0
Effect of the dumping of the extracted marine aggregates	0	0
SEA VIEW & CULTURAL HERITAGE		
Effects on sea view	0	0
Effects on cultural heritage	-	-
COMPATIBILITY WITH OTHER ACTIVITIES		
Effects on fishing	-	-
Effects on aquaculture	0	0
Effects on shipping	*See discipline 'Safety aspects'*	
Effects on dredging and dumping	0	0
Effects on energy	0	0
Effects on safety against flooding	0	0
Effects on military use	0	0
Effects on tourism and recreation	0	0
SAFETY ASPECTS		
Maritime safety	-	-
Risk of oil pollution	-	-

- slightly negative effect
-- moderately negative effect
--- significantly negative effect
+ slightly positive effect
++ moderately positive effect
+++ significantly positive effect
0 negligible effect