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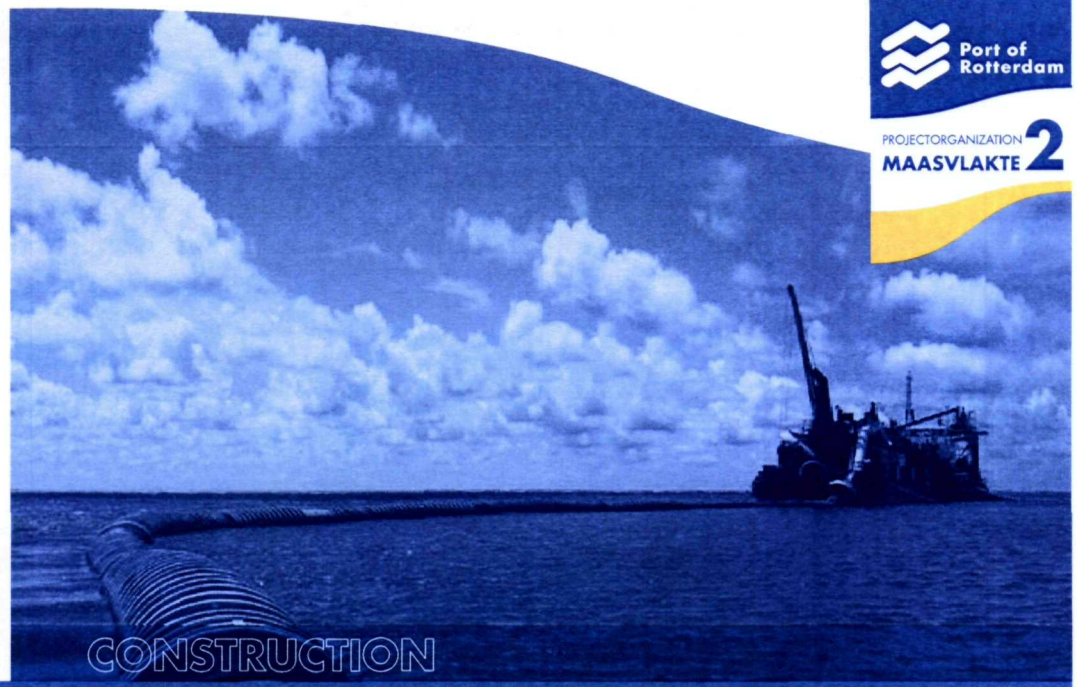
Environmental Impact Assessment

SUMMARY



Port of Rotterdam

PROJECTORGANIZATION MAASVLAKTE 2

CONSTRUCTION

Environmental Impact Assessment

SUMMARY

Document title	Environmental Impact Assessment for Construction of Maasvlakte 2 Summary
Date	April 5, 2007
Project number	9P7008.A1
Reference	9P7008.A1/R012/MVZ/Rott1
Client	Port of Rotterdam Authority Project Organization Maasvlakte 2 Mr R. Paul Director of Project Organization Maasvlakte 2
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Environmental Impact Assessment

SUMMARY

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1 INTRODUCTION

1.1 Maasvlakte 2 at a glance

New port and industrial site in the Port of Rotterdam

Maasvlakte 2 is a new port and industrial site that will be built alongside the existing Maasvlakte. Maasvlakte 2 consists of an inner area with ports and sites surrounded by sea walls. The sand for the sea walls and sites will be extracted largely from the North Sea.

Maasvlakte 2 will provide space for companies that need large sites in the immediate vicinity of a deep sea port, particularly those whose business is large-scale storage and transhipment of containers, and certain sectors of the chemical industry. This kind of deep sea-related activity - one of the pillars of the Port of Rotterdam - has grown steadily in recent years and will continue to grow in the coming period. However, there will soon be a shortage of space for expansions and new business sites in the existing Rotterdam port area. If the Rotterdam port is to continue operating responsively in the years ahead, there will need to be sufficient new space for deep sea-related companies. Maasvlakte 2 will provide that space.

Figure 1.1: artist's impression of Maasvlakte 2

Construction in two phases

Maasvlakte 2 will be constructed in two phases. The objective is to start reclaiming land and extracting sand in 2008. The first phase, scheduled to be ready not later than in 2013, will be dominated by the construction of sea walls and the building of the first approximately 600 ha of sites of the inner area. The first companies can be operational on Maasvlakte 2 from 2013 onwards. In the second phase, after 2013, the remaining sites will be constructed and will gradually go into service.

In the final situation there will be 1000 ha of net allocable port and industry land on Maasvlakte 2. The sea walls, port basin, infrastructure and other facilities will also take up approximately 1000 ha. This means the gross size of Maasvlakte 2 will be approximately 2000 ha.

1.2 From Key Planning Decision (PKB) to implementing decisions

Key Planning Decision: outlines and constraints

A large project like Maasvlakte 2 requires careful preparation that includes extensive research, consultation with stakeholders and various decision-making procedures. Much of the preparatory work has already been completed. It was carried out in the framework of the procedure of the Key Planning Decision ("PKB – Planologische Kernbeslissing") for the Rotterdam Mainport Development Project ("PMR – Project Mainportontwikkeling Rotterdam"). The end result of the procedure is a document entitled PKB PMR (2006), referred to hereafter as "PKB".

In the PKB the Dutch government set down its decision to build Maasvlakte 2. The PKB validates the usefulness and necessity of building Maasvlakte 2. It also spells out different types of constraints for taking the plan forward. They include constraints for the maximum size of the land reclamation and the confines of the area within which sand may be extracted. The PKB also states that, in line with nature conservation laws, damage to protected nature must be avoided or mitigated to the fullest extent possible. Wherever a significant nature impact is found to be unavoidable, there will have to be compensatory measures. The PKB makes "spatial reservations" for this compensation for nature.

Follow-up: environmental impact assessments for construction and zoning

The PKB is the point of departure for two follow-up steps:

- construction: detailed plans for land reclamation and sand extraction;
- zoning: preparation of a zoning plan to serve as a spatial guideline for activities that will take place on Maasvlakte 2.

An environmental impact assessment (EIA) was carried out for each of these steps. The results have been bundled into two separate EIAs, one for construction of Maasvlakte 2 and one for zoning of Maasvlakte 2.

Decisions to proceed with construction of Maasvlakte 2

This document is the summary of the EIA for Construction of Maasvlakte 2. The EIA was drawn up under the responsibility of the initiator of the project, Havenbedrijf Rotterdam N.V. ("Port of Rotterdam Authority"). The EIA contains the information that decision-making authorities need to be able to weigh up properly the environmental interests that need to be addressed in the decisions to go ahead with the construction of Maasvlakte 2:

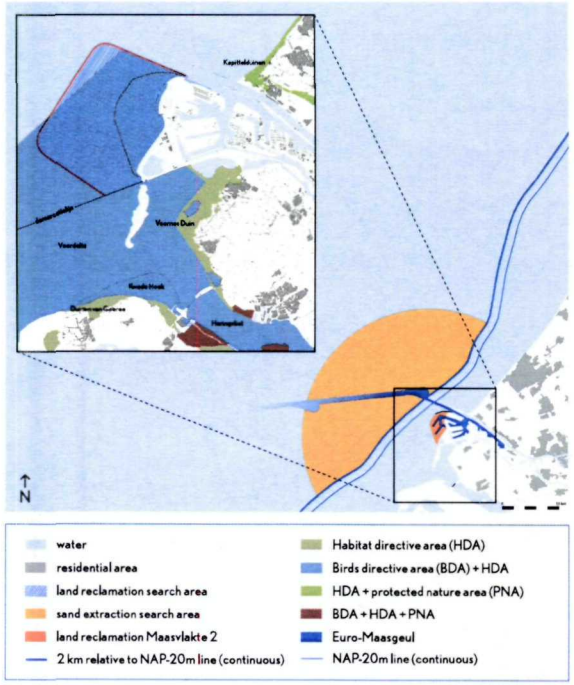
- land reclamation concession, earth removal licence and a licence under the Public Works (Management of Engineering Structures) Act (competent authority is the Ministry of Transport, Public Works and Water Management);
- nature conservation licence and an exemption under the Flora and Fauna Act (competent authority is the Ministry of Agriculture, Nature and Food Quality).

1.3 Nature conservation

An important framework for Maasvlakte 2, besides the PKB, is the required protection of the area under the European Birds and Habitats Directives. This protection was incorporated in October 2005 in the amended Nature Conservation Act 1998. The objective is to establish a European network of nature areas called Natura 2000. EU member states must contribute to its establishment by designating Natura 2000 areas and by strictly protecting certain "habitat types" and species that occur within them. The following places are relevant to the construction of Maasvlakte 2:

- the Voordelta: the land reclamation search area lies almost entirely within this Natura 2000 area. The search area for sand extraction is located outside. However, the extraction of sand may have consequences for the Voordelta, particularly as the fine silt will end up in the water during extraction of the sand. The tidal current will carry some of the fine silt to the Voordelta, which may temporarily cause the seawater to be cloudier. This may have consequences for protected species in this area;
- the Natura 2000 areas of Voornes Duin and Duinen van Goeree are in the immediate vicinity. Nature in these areas could be adversely affected by circumstances like a reduction of salt spray, i.e. sea salt that the wind carries to the dunes, which is important for protected plant species that flourish on salt spray

Figure 1.2: study area



If a project potentially has significant consequences for a Natura 2000 area, the rule is no, unless... First it must be established that the project will serve a major public interest and that no alternatives exist. If this is the case, everything reasonably possible must be done to reduce or at least mitigate the significant negative effects. For the impairment still remaining – referred to as unavoidable "significant" effects – it is mandatory to take compensatory measures so as ensure the cohesion of Natura 2000.

The public interest of Maasvlakte 2 and the lack of alternatives were demonstrated in the PKB and confirmed in a positive recommendation by the European Commission (in 2003). Consequently, the construction of Maasvlakte 2 is allowed in principle under nature conservation laws, provided that the mitigating and compensatory requirements are met. The PKB stipulates that the EIA for construction of Maasvlakte 2 must provide conclusive information about the possible mitigating measures. Additionally, the EIA must clearly state the exact nature and scale of the effects that will still remain. This will provide a basis for establishing whether compensatory measures are required and, if so, how, i.e. for which effects and on what scale. In anticipation of this the PKB has reserved spaces for the compensation that may be necessary:

- to compensate for potential significant effects in the Voordelta, the PKB has reserved in the Voordelta an area with a maximum size of 31,250 ha, which will be managed as a marine reserve[1];
- to compensate for potential significant effects in the dunes of Voorne and Goeree, space has been reserved for compensation of the beach-dune system (near Brouwersdam and dune compensation (Delfland).

[1] The 'marine reserve' is now called the 'sea bed protection area'. The name was changed because 'marine reserve' wrongly suggested that the area in question is one in which many restrictions are in place to limit human activities. The focus, however, is on protecting the sea bed and providing a haven for protected bird species. So in this report and its annexes you should read 'sea bed protection area with havens for protected bird species' wherever reference is made to 'marine reserve'.

Farther away from the land reclamation and sand extraction search areas there are the Natura 2000 areas of Solleveld & Kapitelduinen, the North Sea coastal zone and the Waddenzee. A study ("appropriate assessment") has already provided certainty that the effects of the construction and presence of Maasvlakte 2 will be negligible for these Natura 2000 areas. Consequently, the PKB makes no spatial reservations for compensatory measures for them.

1.4 Characteristics of the area

The search areas for land reclamation and sand extraction (and the surroundings) are characterised by their considerable natural dynamics, influenced by weather, tides and currents. There are also various types of human usage.

Land reclamation search area and surroundings

The land reclamation search area lies almost entirely in the Voordelta. This is a relatively shallow part of the North Sea. The water movement causes sand and fine silt(s) to be constantly in motion and part of the sand and silt is carried in a northerly direction along the coast. This influences shoreline retention and dredging in the fairway to the Port of Rotterdam: one of the world's largest and most easily reachable ports. The maintenance requirement of the present Maasvlakte is approximately 0.8 million m3 per year. Maintenance dredging (in the Eurogeul, Maasgeul and docks) averages 16 million m3 per year.

The ecological processes in the area are determined in part by the movement of the water and the transport of fine silt and sand. The area acts as a reproduction area and nursery for fish and as migratory, rest and foraging area for birds. Thanks to the wealth of seabed life the area is also important to the trawling of crustaceans and testaceans and serves as a nursery for commercially attractive fish species.

The combination of sand, sea and salty sea wind and the virtually undisturbed water regime has created on Voorne and Goeree a dune area with rare plants and animals. The area ranks among the best developed dune areas in Northwest Europe. Management measures in these dunes greatly influence the growth of dune vegetation. The natural growth of the dune vegetation into woods and brushes is currently being restricted by mowing and grazing. Consequently, open dry dunes and wet dune valleys can be retained. Management is expected to be intensified in the future and the acreage of these vegetation types will increase slightly.

The sea, beach and dunes attract a lot of recreational visitors. Many people from the Rijnmond region and far beyond go to the traditional seaside towns of Oostvoorne, Rockanje and Hook of Holland for recreation. The number of beach visitors will increase because of the growth of the population. The level of amenities will be adapted accordingly. Water recreation is also growing, particularly water sports with large craft. In response to this situation, the number of berths in the marinas at Stellendam, Hellevoetsluis and Numansdorp will increase. Amenities at Oostvoornse Meer will also be expanded.

Sand extraction area and surroundings

In the sand extraction search area the seabed lies predominantly at a depth of -20 m to -25 m relative to the NAP water level standard. Besides sandbanks at the edges of the search area there are "sand waves" on the seabed. The tops of the sand waves, oriented in northwest-southeast direction, lie at an average distance from each other of 200 to 350 m. The height difference between the tops and bottoms of the sand waves is 2 m at a distance of 10 km from the coast and 6 m at 20 km.

By nature the content of fine silt in the water of the North Sea varies considerably. Storms have a great impact because they cause a lot of fine silt to swirl up from the seabed. Generally speaking the fine silt content in the coastal zone is higher than at greater distances from the coast (more than 20 km). Higher fine silt contents mean less incidence of light in the water and by consequence the primary production (including algae) is lower.

Due to the depth of the sea at the search area and the small translucency of the North Sea water, no plants grow on the seabed. However, small invertebrates do live on the seabed. They form a source of food for various fish species, which in turn are food for fish-eating birds and mammals (seals and porpoises). The sand extraction search area forms part of a habitat and foraging area for adult fish that extends across the entire North Sea.

Eurogeul and Maasgeul, the deep entrance channels to the Port of Rotterdam, run straight across the search area. The area further includes a "traffic separation system" within which restrictions apply to the direction of navigation and changes of course. Anchorages are located at each side of Eurogeul and Maasgeul.

Besides intensive shipping there are numerous other usage functions within the search area, like fishing operations, disposal of dredged material, operational and planned pipelines/cables, oil and gas extraction, military exercises and initiatives for future offshore wind turbine parks.

Approximately 35 million m^3 of sand is currently being extracted each year in the Dutch part of the North Sea. Extraction in the search area - for maintenance dredging and sand replenishment for shoreline retention - comes to approximately 10 million m3 per year at present. The national need for sand from the North Sea is expected to increase in the coming period. A larger volume of replenishment sand will be needed due to circumstances including a rise in the sea level and more severe storms. The extraction of embankment sand will also increase.

1.5 Structure of this summary

Specialists from various areas of expertise have been working for more than two years on the environmental impact assessment (EIA). Their research results have been bundled in the main report of the EIA for Construction of Maasvlakte 2 and ten specialised annexes. All documents are downloadable from www.maasvlakte2.com.

This summary of the EIA for Construction of Maasvlakte 2 sets out the essential points of the land reclamation and sand extraction and their environmental effects. The structure of the document is:

- Land reclamation (chapter 2). Prior to the EIA there was an examination of the most functional and environment-friendly plan for land reclamation, i.e. the "cut-through" alternative". The EIA showed that a few elements of the plan can be further refined to such an extent that less sand will be required and that, by consequence, less sand will need to be extracted from the sea. Ultimately, this resulted in adoption of a Most Environment Friendly Alternative and a Preferred Alternative for land reclamation. The differences between the alternatives are small. This is because the plan for reclaiming land must in any case meet stringent requirements on account of the constraints contained in the PKB and in legislation, particularly as regards nature conservation.
- Sand extraction (chapter 3). The land reclamation plan determines how much sand will need to be extracted in the North Sea during construction of Maasvlakte 2. It comes to approximately 365 million m^3 in total. There are three main points in the determination of alternatives for sand extraction. They are (1) choice of a location where extraction will occur, (2) depth of the sand extraction pits, and (3) speed of extraction. The Most Environment Friendly Alternative and Preferred Alternative were determined based on these three points.
- Effects (chapter 4). What effects will land reclamation and sand extraction (and the combination thereof) have during and after construction? The impact assessment focused on the themes of coast & sea, environmental quality (air and sound), nature, nautical safety/accessibility, usage functions, archaeology and recreation.
- Stocktaking (chapter 5). Will the constraints in the PKB and legislation be met? What are the final conclusions of the EIA regarding construction of Maasvlakte 2?
- Next steps (chapter 6). The EIA for Construction of Maasvlakte 2 will be made available for public inspection together with the requests submitted for the required implementing decisions. The final chapter describes how the decision-making procedure will unfold.

2 LAND RECLAMATION

2.1 Result: the Cut-through Alternative

A port and industrial site for deep sea-related companies on reclaimed land in the sea requires:

- shipping access;
- sea walls that protect the inner area against flooding, and an adjacent infrastructure bundle (roads, railways, cables and pipelines);
- sites located alongside docks (with turning basins) largely surrounded by quays that are sufficiently sized for large, deep draught seagoing vessels.

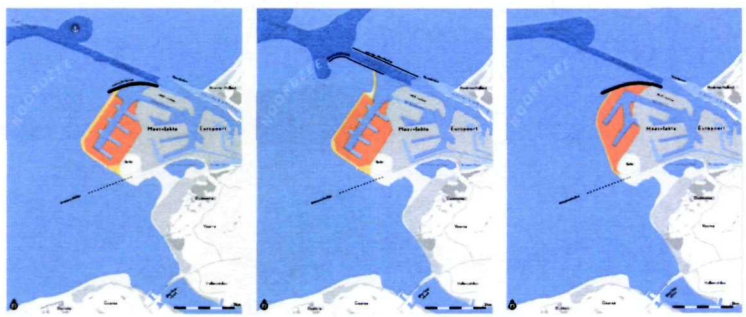
These elements can be ranked in various ways in the land reclamation plan.

From Reference Alternative (PKB) to Cut-through Alternative

The PKB, which started in 1998, detailed two reference alternatives for the land reclamation plan (figure 2.1). Each of the two alternatives has a gross size of approximately 2500 ha. In one alternative Maasvlakte 2 has its own shipping access, while in the other alternative Maasvlakte 2 will be accessible via the existing port entrance and the cut-through to be built via the existing Yangtzehaven on the existing Maasvlakte.

The reference alternatives were used in the PKB to take stock of the environmental effects of the land reclamation. Initiation of the PKB procedure was followed by extensive research for the purpose of the subsequent decision-making, with a view to optimising the land reclamation plan. The principal step was the choice of a shipping access via the Yangtzehaven cut-through, because this obviates the need to build long jetties extending far into the sea, which would cause greater effects. Moreover, it was established that it was possible to reduce the gross size of the land reclamation and subsequently also improve the orientation of the sea walls. This optimisation finally resulted in the cut-through alternative.

Figure 2.1: the Reference Alternatives and the Cut-through Alternative



reference plan I | reference plan II | cut-through variant

Cut-through Alternative: minimal space utilisation, optimum orientation of sea walls.

Figure 2.1 shows the main differences between the Reference Alternatives and the Cut-through Alternative:

- Space utilisation. With some measuring and fitting it is possible to organise the land reclamation in such a way that all required elements fit into a well thought-out plan with a gross size of approximately 2000 ha. Compared with the Reference Alternatives, this will save 500 ha of space in the Voordelta, without impairing the functionality of Maasvlakte 2. This was achieved mainly by optimising the public areas, i.e. roads, railways, pipelines, docks, turning basins and so on;
- Orientation of sea walls. Compared with the Reference Alternatives, the sea walls in the Cut-through Alternative are in a position far better suited to the direction of the water current along the Dutch coast. The effects on coast, sea and marine nature will consequently be smaller. Thanks to the curved shape of the sea walls, the flow pattern is also favourable for nautical safety and accessibility of the Port of Rotterdam to shipping. Moreover, the Cut-through Alternative will not have any adverse effects on the protected dunes of Voorne and Goeree.

Nature conservation laws require minimisation of the effects on protected areas. The Cut-through Alternative meets this requirement because it is the most environment-friendly basic plan for land reclamation. After all, it is not possible to achieve anything more compact than a gross size of approximately 2000 ha, i.e. a further reduction of the space utilised in the Voordelta. The same applies to a different orientation of the sea walls with fewer effects on the coast, sea and nature in protected areas

2.2 Phased construction

Phasing as a strategy for controlling risks

The PKB states that Maasvlakte 2 will be built in phases, step by step. Additionally, the PKB stipulates that the EIA must detail the phasing for the inner area and for the sea walls, respectively. The guiding principle is the purpose of phasing. The PKB says: "Phased construction is a strategy for consciously dealing with uncertainties. Keeping a watch on the actual development will avoid unoccupied sites, delay impairment of nature values for as long as possible and make adjustment possible." In other words, phasing is not a goal in its own right, but a means for controlling risks concerning market developments and effects on protected nature.

An important consideration for the detailing of the phasing options is that the uncertainties and ensuing risks have decreased significantly since the start of the PKB procedure in 1998:

- Nature. Compared with the PKB Reference Alternatives, the Cut-through Alternative will have fewer effects on coast and marine nature. What's more, the effects have been studied more extensively and in greater detail in the EIA and the "appropriate assessment" for the subsequent decisions. As the Cut-through Alternative will have fewer effects, fewer compensatory measures will be required;
- Market. It has been established that a great demand exists for sites for deep sea-related activity in the Rotterdam port area. There is no longer a risk of unoccupied sites, i.e. constructed sites for which there is ultimately no demand. Consequently, it is realistic to base the ultimate land reclamation on the Cut-through Alternative, with 1000 ha of allocable land. Given market developments there is no need to make allowance for a final situation where Maasvlakte 2 would be smaller than the maximum allowed for allocable sites stated in the PKB.

Phased construction of inner area

The final situation, with 1000 ha of allocable land, does not automatically necessitate building the inner area in one go. The opposite is true. In line with the PKB it has been decided to construct the inner area in phases, based on current insights into market demand. The first approximately 600 ha of allocable sites will be built in the 2008-2013 period, the remaining approximately 400 ha in the period thereafter. This will stagger the investments over a longer period and temper the effects in the 2008-2013 period. The phasing of the inner area will for example delay some of the sand extraction (approximately 20%) in the North Sea - and the resulting effects on nature and the environment - until after 2013.

Practical constraints for phasing of the sea walls

Phased construction of the outer contour means there will be an interim step prior to expansion towards the final situation. The interim step is subject to three practical constraints:

- The interim step must be independently usable as a port and industrial site and must therefore have a shipping access, sea walls with an adjacent infrastructure bundle and docks surrounded by quays with the necessary sites alongside;
- The interim step must be a stepping-stone for expansion towards the final situation. This means the shipping access and quays must immediately be built at their final positions. The same applies to part of the hard sea walls that will be necessary in the first phase. The technical complexity, the adverse environmental effects, the use already being made of the sites and the high costs involved make it unfeasible to dismantle these elements a few years later and reconstruct them elsewhere in the immediate vicinity;
- The interim step must lead to an acceptable flow pattern, i.e. with nautical safety and accessibility at least as good as in the present situation.

Within these constraints, there will be, in addition to the sites, the following elements that can be varied in the phasing:

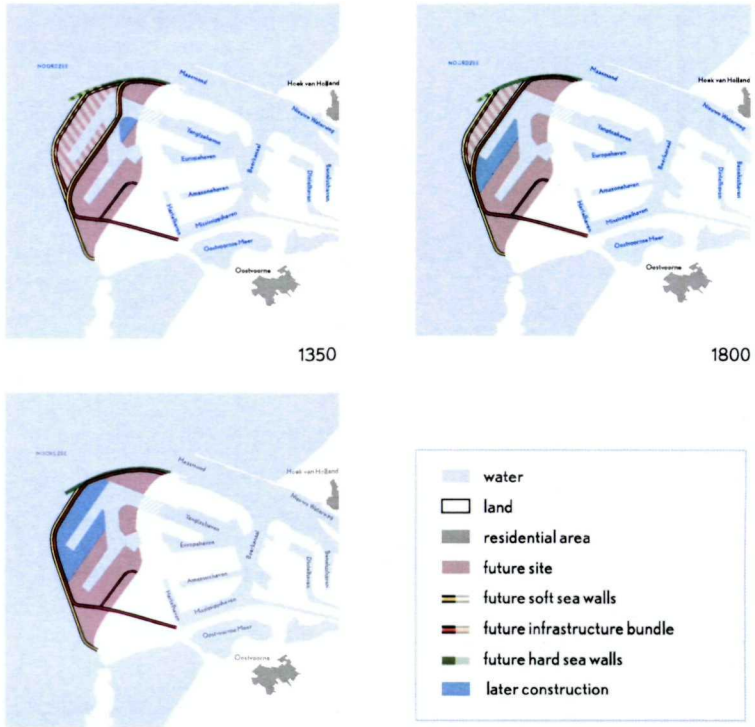
- the soft sea walls and the infrastructure bundle: the phasing will provide for these elements first to be placed at temporary positions and for some of them to be moved to their final positions during expansion towards the final situation;
- the western part of the hard sea walls: if there is phasing this element will not be constructed until the time of expansion towards the final situation.

Three variants for phasing sea walls

The environmental impact assessment (EIA) looked at three variants (figure 2.2). The names given to them indicate the gross space utilisation in hectares:

- 1350 variant. With this variant, the gross space utilisation, after completion of the first phase, will be the smallest. The 1350 variant suffices with one inlet port. The soft sea walls will be folded as tightly as possible to this port. In total there is more than 550 ha net allocable land. This is enough to absorb market demand for five to six years. But this also means that expansion towards the final situation will start almost immediately after completion of the first phase, namely around 2014, because otherwise the required extra sites will not be ready on time to keep in step effectively with market developments. Figure 2.2 shows that with this variant the sea walls will not be streamlined, so that there will be an abrupt transition between the hard and soft sea walls. This will cause a degree of irregular currents that will inconvenience shipping. The nautical safety and accessibility preconditions can only be satisfied by means of additional measures on the sea side of the sea walls. The most logical temporary solution is the construction of an underwater dam that will better guide the current. But the utilisation of space and its environmental effects will largely negate the benefit of phasing;
- 1800 variant. With this variant, the second inlet port of the final situation will also be constructed, again with soft sea walls folded as tightly as possible against it. With 850 ha net allocable land, this variant will last longer as an interim step. Expansion towards the final situation will start around 2023, i.e. about 10 years after completion of the first phase;
- 2000 variant. With this variant, the sea walls will immediately be placed at their final positions. They will not need to be moved to arrive later at 1000 ha net allocable land.

Figure 2.2: variants for phasing of the sea walls



Comparison of nature effects

Space utilisation: postponement with the 1350 and 1800 variants

Maasvlakte 2 will result in direct space utilisation through the covering of the seabed in the protected Voordelta. Due to the flow pattern along the sea walls, an erosion pit will gradually form on the seabed, resulting in indirect space utilisation. If the pit becomes deeper than 20 m below the water level standard (NAP), it will count as loss of protected nature under the Nature Conservation Act, because the acreage will be taken from the protected acreage above NAP –20 m.

However, a difference is that where land reclamation occurs, the seabed will be lost permanently for nature purposes, while the erosion pit will have no adverse effects for the vast majority of protected species. There will be a disadvantage only for ducks (particularly the Black Sea Duck) because when gathering food they do not usually dive deeper than 20 m. A second difference is that it is possible to intervene technically in the erosion pit, for example by inserting gravel locally and thus delaying or stopping the erosion process.

After Maasvlakte 2 has been completely built, the direct space utilisation will be equally large and the size of the ultimate erosion pit will be roughly the same. As regards direct space utilisation, the 1350 variant will initially yield a saving of approximately 650 ha. However, a large part of this will be lost due to the additional measures necessary to obtain a sufficiently acceptable flow pattern. For the remaining hectares, the postponement of space utilisation will be short, because after completion of the first phase a start will be made on further expansion almost immediately (around 2014). The temporary saving in the 1800 variant is smaller, approximately 200 ha, but those hectares will remain in use longer. After all, the expansion from the 1800 variant to the final situation will begin around 2023.

Disturbance of marine nature: 5 years with the 2000 variant, 9 years with the other variants

The 2000 variant will disturb the local marine nature because of construction work in the 2008-2013 period. The remaining work after 2013 to complete the inner area will take place within the sea walls and not at open sea. The two other variants will lead between 2008 and 2013 to the same degree of disturbance of the marine nature, but there will be a second disturbance period of roughly four years at the time of further expansion towards the final situation. The nature developed on the underwater bank of the reclaimed land will be covered with sand and with phased construction will have to develop twice.

Sand extraction: almost no difference

There is virtually no difference in the quantity of sand that must be extracted (or in its effects on nature), at least not in the period when sand extraction will be most intensive. For all variants it will be necessary between 2008 and 2013 to extract just as much sand at sea to construct the sea walls and sites.

Possibilities for adjustments.

One of the considerations for a phased approach is that it keeps open the possibility for making adjustments if the nature effects turn out to be greater or different than forecast in the study, or if the compensatory measures fail to produce the required improvement of quality. An important matter is the spatial reservations made in the PKB for compensatory measures.

To compensate for utilised space, the PKB provides for creating a marine reserve of 31,250 ha (within a search area of approximately 40,000 ha) in the Voordelta. This matter has been set down in detail in the Designation Order pursuant to the Nature Conservation Act and the Voordelta Management Plan, based on the effects of the Preferred Alternative for the reclamation of land. The management plan will be updated once every six years. It states the measures that in the marine reserve will compensate for the negative effects on protected nature caused by Maasvlakte 2 so that on balance there is no loss of nature.

An extensive monitoring programme will identify the actual effects of constructing Maasvlakte 2, while monitoring will also enable determination of the effectiveness of the measures in the marine reserve. If the effects of construction are found to be greater than forecast in the EIA, and/or if the effectiveness of the measures in the marine reserve fall short of expectations, there will be a possibility to intensify nature compensation by taking additional measures. The management plan for the marine reserve offers sufficient flexibility and legal assurances for the practicability of such adjustments. This creates a safety net, so to speak. The actual space utilisation for the Cut-through Alternative is smaller than in the PKB Reference Alternatives and will result in a compensatable marine reserve size of 25,000 ha (instead of 31,250 ha). This will not result in utilisation of the entire search area of approximately 40,000 ha that the PKB states as a search area for the marine reserve. Of this search area approximately 5,000 ha is unsuitable for compensation (for example because of different habitat type), but there will still be approximately 10,000 ha of potentially usable "residual space". Therefore, quantitative adjustment of the marine reserve will also be possible.

Another relevant matter is that the PKB reserves more space for dune compensation than is necessary according to the conducted research. The research established that the Cut-through Alternative will not have any effects on morphological developments in the mouth of Haringvliet. That means that there will be no adverse effect on the salt spray and consequently no adverse effect on the dunes at Voorne and Goeree. An important consideration for phasing was to delay the effects on the dunes.

Now the construction and presence of Maasvlakte 2 do not appear to have any effects on the dunes, this reason for the space reserved in the PKB for the beach-dune system compensation and for dune compensation no longer exists.Compensation for the beach-dune system is no longer necessary and the dune compensation will take place only, and on a far smaller scale, because of the effects of use of Maasvlakte 2 (air pollution). This means possibilities will exist for dealing to some extent with unexpected disappointing effects of the construction and presence of the reclaimed land by intensifying the dune compensation.

The relatively largest uncertainty concerns the development of the erosion pit (speed, ultimate size below NAP -20 m). But with the erosion pit it will be possible - in equal measure in all variants - to keep a close watch on its actual development and fill it with gravel to stop the erosion process if occasioned by the nature effects.

None of the three examined variants will block the possibility to compensate later on for any disappointing effects on protected nature by making an additional effort. In that respect there is simply no difference, on the one hand because the effect will occur in all cases, on the other because in all cases there will be sufficient scope for enlarging the nature compensation. Perhaps even more important is the small likelihood of unexpected setbacks in each of the three variants. For example, there is hardly any uncertainty about the effects on nature of the direct space utilisation of the reclaimed land. The potential effects of disturbance caused by construction work have been identified as well as possible, based on a worst case scenario. The extent to which the worst case materialises remains to be seen. But on this point there is no difference in the 2008-2013 period between the three variants: in all cases work will take place in the same way and at the same intensity.

Negligible effects for the North Sea coastal zone and Waddenzee

The examination of the effects of Maasvlakte 2 on the North Sea coastal zone and the Waddenzee has already led to the conclusion that the effects on the protected habitats and species there will be negligible. This has eliminated the original uncertainty that was an important consideration regarding phasing.

Taking stock of effects and nature risks

There are no differences as regards sand extraction and its effects. The same applies to the possibilities for additional compensatory measures in the event of unexpected setbacks. There will be differences with the postponement of space utilisation and disturbance, but they will lead to other choices. Phased construction of the sea walls (1350 and 1800 variants) will postpone space utilisation, but there will then be two disturbance periods (with a longer total duration) instead of one. The picture is exactly opposite for the variant where the sea walls will immediately be placed in their final position (2000 variant). From the point of view of effects on protected nature there is no clearly preferable variant. Therefore, none of the variants automatically qualifies as a baseline for the Most Environment Friendly Alternative for land reclamation.

Nautical and business aspects, and environmental effects

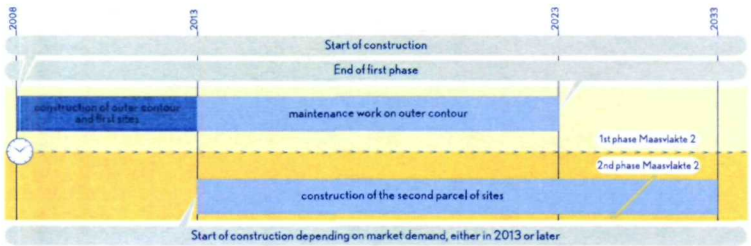
During the step from the PKB Reference Alternatives to the Cut-through Alternative the orientation of the sea walls was adjusted so as to create an optimum flow pattern. The 1350 variant will disturb the flow pattern so much as to create an unacceptable situation for nautical safety and accessibility and will necessitate additional measures (temporary underwater dam). But if the sea walls are immediately placed in their final position, it will immediately create the optimum flow pattern of the final situation. Therefore, the 2000 variant is preferable from a nautical point of view.

From a business point of view and environmentally a preference also exists for the 2000 variant (use of raw materials and energy, and emissions during construction), especially now market developments show that reclaimed land with 1000 ha of allocable sites is a realistic final situation. This will avoid disinvestments, extra environmental effects and practical limitations for using the port due to the need quickly to dismantle some of the soft sea walls and the infrastructure bundle if there is phasing.

Conclusion

Given the nature effects and controllability of risks, a phased construction of the sea walls will not produce any added value. For nautical, business and environmental reasons, however, it is clearly preferable not to phase the building of the sea walls. Therefore, the ultimate choice is to build the sea walls immediately at the final position. The inner area will be built in phases in step with the development of market demand. The timeline in figure 2.3 show this chosen method of phasing.

Figure 2.3: timeline for constructing Maasvlakte 2



2.3 Variants for four building blocks of the plan

Sand savings as a guiding principle

The final plan for the land reclamation must be compatible with the PKB and satisfy constraints embedded in legislation, i.e. minimal effects on nature and air quality, limit values for noise, recreational possibilities equivalent to those that currently exist, careful treatment of archaeological values, no inconvenience for shipping and no reduction of accessibility or safety. As a basic plan for the land reclamation the Cut-through Alternative meets these requirements optimally.

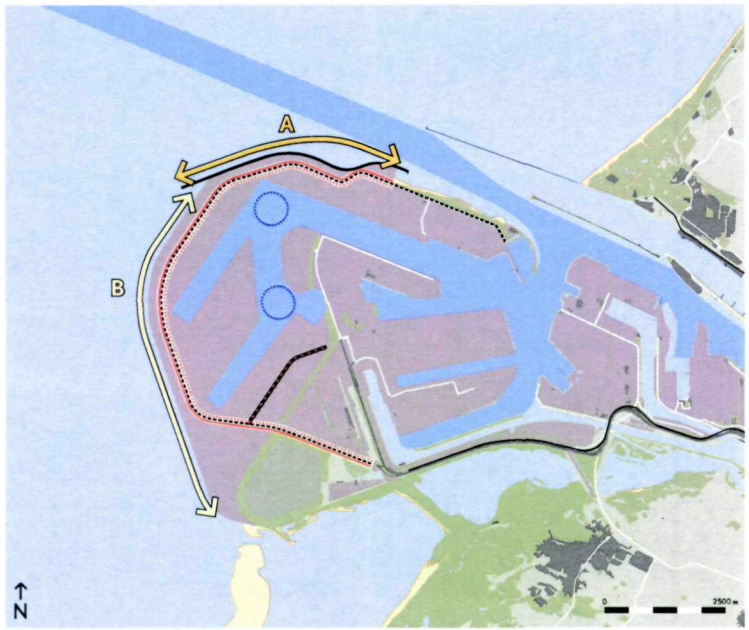
The environmental impact assessment for construction of Maasvlakte 2 showed that supplementary optimisations are achievable only by detailing specific building blocks of the land reclamation in such a way that as little sand as possible needs to be extracted at sea. The benefits will then be twofold: the effects of sand extraction on nature and the environment will be as small as possible, while the costs of sand extraction - and thus the total costs for building Maasvlakte 2 - will be lower.

No variants for construction work and equipment

The environmental impact assessment examined the possibilities that exist to ensure that work on constructing the reclaimed land takes place as smoothly as possible, with as little environmental impact as possible. The contractor who will carry out the work will be required to do so using an approach and equipment that satisfy legal requirements. The research conducted established that no significant positive contribution can be expected from supplementary measures for these activities. Therefore, it is neither necessary nor meaningful to set down specific supplementary requirements for the actual performance of the work and the use of equipment.

Figure 2.4 shows the Cut-through Alternative again, but now in greater detail. There are four building blocks of this plan where it is possible to make savings on the amount of sand required.

Figure 2.4: the Cut-through Alternative



main infrastructure bundle
shortcut route
turning basins
A hard sea walls
B soft sea walls

1) The hard sea walls: 'gull variant'

The sections of the sea walls on the northern side of Maasvlakte 2 will be provided with a hard covering of quarry stone, concrete blocks or interlocking top layer elements. During construction the fullest possible use will be made of material freed up during the dismantling of the sea walls of the present Maasvlakte. The definitive implementation method will be chosen during the tendering procedure.

Figure 2.4 shows that the hard sea walls connect with the sea walls of the present Maasvlakte via a twist. This is the "gull variant", so-called because the line of the hard sea walls resembles a flying gull. In earlier plans, the hard sea walls ran in a straight line to the existing sea walls. In the gull variant, the hard sea walls are shorter, i.e. approximately 3 km instead of approximately 4 km. Consequently, less building materials will be necessary. In terms of the quantity of sand that must be obtained from the North Sea, the gull variant produces a saving of approximately 8 million m3. Compared with the original plan without a twist, the gull variant has no disadvantages for the flow pattern in the fairway.

2) Soft sea walls: coarser sand

Maasvlakte 2 will have dune-like soft sea walls - with a beach on the sea side - of approximately 8 km. In the plan it was originally assumed that for the construction of the soft sea walls sand would be used with an average grain diameter of 285 micrometres. By using even coarser sand, the soft sea walls can be slimmed down and it will mean less sand has to be extracted at sea. This will produce a saving of up to 10 million m3 during construction.

3) Height of sites: NAP +5.0 m as a basic site height

The hard and soft sea walls will be sufficiently high and robust to rule out breaching of the sea walls if there is an extreme storm surge and the spilling over of an undesirably large amount of water. However, the inner area of Maasvlakte 2 may nevertheless flood - not via the sea walls, but via the ports. The height of the sites in the inner area will determine the scale of the flooding risk.

The Maasvlakte 2 sites will be unembanked. If the defences around an embanked polder give way, the polder will flood. Maasvlakte 2 is not a polder, and the maximum effect of an extreme storm surge is that the sites will temporarily be under water via the port entrance and shipping access. It is of paramount importance to ensure the water never rises to a level that poses a threat to life, creates a risk of the spreading of hazardous substances or causes some other environmental damage.

The plan provides (after the "settling" of the filled sand) for a basic site height of NAP +5.0 m for the part of the inner area of Maasvlakte 2 where container and distribution sites have been planned. With an extreme storm surge, a maximum of 50 cm of water may come on to the site with an overshoot probability of 1/10,000 per year. For chemical sites the additional site height on top of the basic level will be determined by means of an analysis of the risk of the spreading of hazardous substances and environmental damage. The road that forms part of the infrastructure bundle will be free of high water in such situations, because the height of NAP +5.5 m will be applied for the entire infrastructure bundle. Until 2050 the overshoot probability of being flooded (by a maximum of 50 cm) will be limited to 1/10,000 per year. For the period of 50 years after 2050, additional measures will be taken, if necessary, to maintain the flooding overshoot probability of 1/10,000 per year and limit the environmental risk posed by chemical companies.

All in all, it is responsible to base safety against flooding on the specific features and functions of Maasvlakte 2 and to determine the site height accordingly. Applying a basic site height of NAP +5.0 m will produce a saving of approximately 12 million m3 of sand compared with the original plan where the integral height was NAP +6.0 m.

4) Internal extraction: maximum deepening of the docks and turning basins

A hard requirement is that the fairway must be at least 20 m deep. A smaller depth will make the inner area inaccessible to large, deep draught seagoing vessels.

Sand will be freed up during construction of the ports and turning basins. The same applies to the Yangtzehaven cut-through. This sand will be used for construction of Maasvlakte 2. The yield of this "internal extraction" can be increased by deepening the ports and turning basins by more than the minimum required depth of 20 m. Technical preconditions for doing this, however, are that the manoeuvrability of vessels must not be reduced and that it must still be possible to build stable quays. Within these constrains the internal extraction yield may nevertheless be greater than originally assumed. In the best case scenario it will produce an extra saving of 9 million m3.

Use of secondary building materials and raw materials

A variety of work performed in the Rijnmond region –like land decontamination - results in materials becoming free for use. If there is no other efficient purpose for which such materials can be used, they are considered superfluous and may in principle be used for the construction of Maasvlakte 2. However, their use may be subject to legal or building requirements. This does not concern very large quantities compared with the total necessary for Maasvlakte 2. What makes the use of these "secondary building materials and raw materials" attractive is that surpluses that get in the way elsewhere can be used up. In the best case scenario it will be possible to achieve a saving of approximately 5 million m^3, including the sand reclaimed from the dredged material for the Slufter.

2.4 Most Environment Friendly Alternative and Preferred Alternative

The Most Environment Friendly Alternative for land reclamation is based on the Cut-through Alternative. The Most Environment Friendly Alternative calls for the inner area to be built in phases and for the sea walls immediately to be placed in their final position. All savings variants examined in the environmental impact assessment form part of the Most Environment Friendly Alternative:

- the gull variant for the hard sea walls;
- use of coarser sand in the soft sea walls;
- a basic site height of NAP +5.0 m;
- maximum deepening of the docks and turning basins;
- use of secondary building materials and raw materials from the Rijnmond region.

The Preferred Alternative, on which applications for licences will be based, is almost identical to the Most Environment Friendly Alternative. To some extent this is simply a practical consequence of the small amount of latitude the constraints embedded in the PKB and the legislation leave for a Preferred Alternative that differs markedly from a Most Environment Friendly Alternative. The main reason for including the savings variants in the Preferred Alternative is that environmental and business benefits will also be attainable at the same time. The only exception is use of secondary building materials and raw materials freed up elsewhere in the region. This saving has been applied "passively" in the Preferred Alternative.

3 SAND EXTRACTION

3.1 Method

The environmental impact assessment determined the effects of different sand extraction scenarios. A sand extraction scenario was compiled for the Most Environment Friendly Alternative and for the Preferred Alternative on this basis.

Three questions play a key role as regards sand extraction:

1. Location: nearby or farther away?
2. Arrangement of sand extraction pits: how deep?
3. Execution: at what speed?

The land reclamation plan will determine how much sand will be necessary to build Maasvlakte 2. A small proportion will be obtained through internal sand extraction, during deepening of the ports and turning basins and cutting through Yangtzehaven. Most of the sand extraction will take place in the North Sea.

How do you extract sand at sea?

Extracting. As with major land reclamation projects elsewhere in the world, the sand will be extracted at sea by means of Trailing Suction Hopper Dredgers. While slowly sailing, these large sand extraction vessels suck up a sand/water mixture from the seabed and store it in their hold. As a lot of water comes up with the sand, the hold quickly fills up, but initially with an insufficient load. By continuing to suction for a while and letting the superfluous water drain away via the "overflow" the hold slowly fills up with sand. The superfluous water also takes some of the suctioned fine sediment with it back into the sea. This is mainly small sand particles that immediately sink again in the immediate vicinity. Only the silt particles (smaller than 63 micrometres) continue to float in the water and spread out across a larger area. On average the losses that occur during extraction on account of overflow come to approximately 15%.

Dumping. Once the hold contains a sufficient load, the vessel sails to the dumping location where it will empty its load. Allowance is generally made for a loss of 7% during dumping. This is the percentage that was applied in the calculations for Maasvlakte 2, but in practice for this specific project the dumping losses will be considerably less. During dumping the larger part of the sand immediately goes to the targeted place. A fraction of the sand that will be placed on the inside of the sea walls will initially flow away and sink farther along, but will eventually end up in the right place.

3.2 Sand extraction challenge: extracting the required volume at sea

The table below shows how much sand will be necessary to construct the reclaimed land, maintain the coast and compensate for dunes at Delfland. The yield of internal extraction must be deducted from this volume. Rounded off the remaining volume comes to approximately 290 million m3.

Required for Maasvlakte 2 project:	
- building of reclaimed land:	332 million m³
- sand for shoreline retention of Maasvlakte 2 for 10 years:	12 million m³
- sand for compensating for dunes at Delfland:	6 million m³
Total requirement:	350 million m³
Minus: yield from internal extraction (docks, cut-through)	approx 60 million m³
Difference: total volume needed from the North Sea (rounded off):	290 million m³

The volume of sand extracted at sea that will ultimately be used effectively is smaller than the total volume of extracted sand. This is because losses occur during extraction (approximately 15% on average) and when tipping the sand (up to 7%). Also see the notes in the sidebar in section 3.1.

The sand will be extracted in step with the phased construction of the reclaimed land. The sea walls will account for the largest proportion of the total volume of required sand (60%). The remaining 40% will be used to construct the sites of the inner area; the first part (20% of the total) will be used in phase 1, the remaining part (also 20%) in the following phase, i.e. the period after 2013. As construction of the sea walls and the first half of the sites will occur in the 2008-2013 period, the extraction of sand will be most intensive in this phase, i.e. 80% of the total.

The figures stated above are summarised below in a table which has also been used as a basis for applying for the earth removal licence:

Net volume required in phase 1 (2008-2013), including 10 years of maintenance and dune compensation	230 million m³	
Gross sand extraction requirement in phase 1 (2008-2013): net volume required + losses during extraction and dumping		290 million m³
Net volume required in phase 2 (after 2013)	60 million m³	
Gross sand extraction requirement in phase 2 (after 2013): net volume required + losses during extraction and dumping		75 million m³
Total volume required in phases 1 and 2	290 million m³	
Total gross sand extraction requirement in phases 1 and 2: net volume required + losses during extraction and dumping		365 million m³

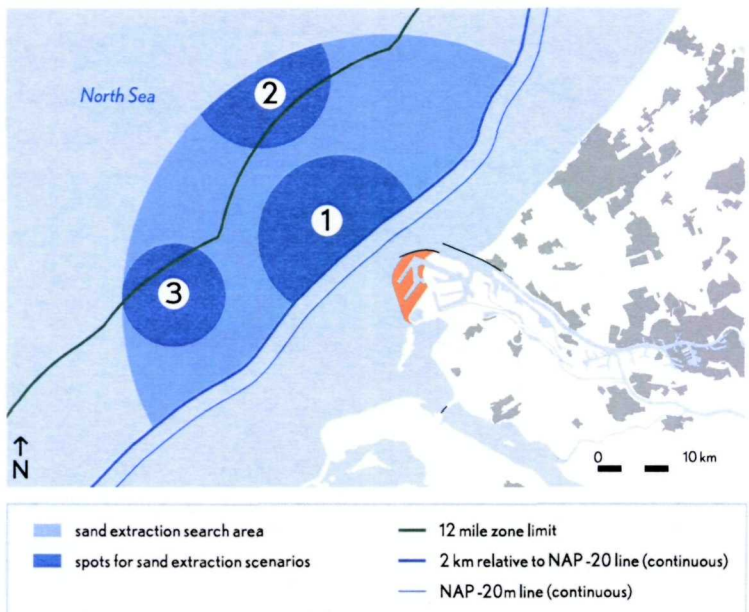
3.3 Location

Within the sand extraction search area (approximately 1,000 km2), there are a few distinct areas used for purposes incompatible with large-scale sand extraction, such as locations for mineral mining and dredged material disposal, oil and gas platforms, a military exercise area, cable and pipe lines and the Euro-Maasgeul. The remaining space, approximately 900 km2, is still considerably larger than the space needed for the sand extraction pits. This means choices may be made.

The environmental impact assessment examined three alternative locations, in the form of "spots" (figure 3.1):

- Spot 1: as close as possible to Maasvlakte 2. Extracting nearby will keep the overall environmental burden (energy consumption, emissions) as small as possible and is advantageous as regards transport costs.
- Spot 2: far away from the Voordelta. This spot is located on the edge of the search area. It is situated in such a way that it is farthest away from the protected Voordelta.
- Spot 3: concrete and masonry sand. At this sport there are likely to be locally at greater depths extractable layers of coarse sand. Removing the top covering layer through sand extraction for Maasvlakte 2 will loosen up the coarse sand. It could then be extracted in the future as a supply of concrete and masonry sand.

Figure 3.1: the three spots



These three spots are representative of the entire search area. Therefore, they are a good reflection of the possible choices, and of the bandwidth of the environmental effects of sand extraction, insofar as decisive for the choice of extraction location.

3.4 Arranging the sand extraction pits

Extraction depth: up to 20 m below the seabed

The extraction depth is the most important variable for arranging the sand extraction pits. The present depth for extracting sand in the North Sea is 2 m below the seabed at most. The large volume required for Maasvlakte 2 makes it desirable to consider greater extraction depths, down to a maximum of 20 m below the seabed.

In terms of environmental burden (energy consumption, emissions), the extraction depth is not a decisive factor, but it does determine the nature effects as regards the utilisation of space. Sand extraction will cause the disappearance of the locally present seabed life and complete recovery is likely to take two to four years.

Figure 3.2: extraction depth (number of metres below the sea level) relative to the utilisation of space (acreage in km2) of sand extraction

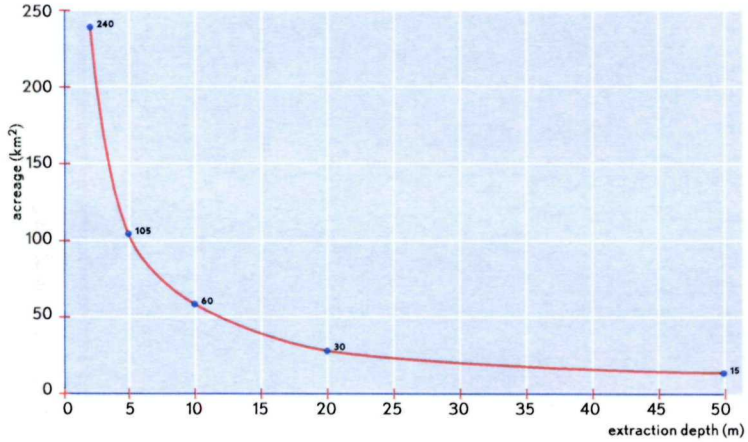


Figure 3.2 shows the relationship between the extraction depth and the size of the disturbed area of seabed. With extraction at 2 m below the seabed, the sand extraction would extend over a surface area of approximately 240 km2. Extraction 10 m below the seabed will reduce the surface area to 60 km2. Figure 3.2 shows that the greatest space utilisation saving will be achieved just with the step from 2 m to 10 m below the seabed. With extraction down to 20 m below the seabed, the utilisation of space would decrease still further, i.e. to 30 km2. At such an extraction depth, there will certainly be no ecological risks, such as unfavourable oxygen conditions in the pits that will remain in the seabed after sand extraction.

The availability of equipment also plays a role as regards extraction depth, however. In the search area, the water is 20 to 25 m deep. An extraction depth of, say, 20 m below the seabed would mean the pit would be 40 to 45 m below the water level. A distance of that kind is bridgeable only by Trailing Suction Hopper Dredgers, which, in addition to an on board pump, have an "underwater pump". Trailing Suction Hopper Dredgers of that kind are scarce. At extraction depths of 10 to 15 m below the seabed, the availability of equipment (Trailing Suction Hopper Dredgers without an underwater pump) is not a limiting factor in principle.

Shape, orientation and slope

In terms of nature effects and environmental burden, it does not matter what shape the sand extraction pits have horizontally and how they are oriented in relation to the current. However, there are some constraints of a technical, morphological (erosion) and nautical (effects on the current) nature for shape and orientation. These constraints will be observed.

The steepness of the pit slope has no environmental consequences, but nature effects do play a role. A workable situation is a pit slope not steeper than 1:7 and not milder than 1:10. A slope of 1:7 eliminates the risk of absence of oxygen along the edge of the pit. A pit slope milder than 1:10 is not an obvious choice because the space utilisation of the pits will increase, albeit to a limited extent.

3.5 Performance of work

Trailing Suction Hopper Dredgers

Trailing Suction Hopper Dredgers (TSHDs) will be used between 2008 and 2013. The number of TSHDs in use will not exceed 15 at any time. A smaller number will suffice for the extraction of the remaining 20% in the period after 2013. The definitive choice of vessels to be deployed will be made in the tendering procedure.

Rate of extraction

A variable for the performance of the work is the speed of extraction. The extraction speed depends on several factors:

- amount of equipment used;
- weather conditions: gales and also after-swells of the seawater;
- progress of construction of the hard sea walls, which will provide protection for the sand to be put in elsewhere.

The minimum extraction speed required to complete the first phase on time is an average of 60 million m3 per year. Based on a realistic assumption of the use of the fleet of dredgers, the maximum achievable extraction speed will be 150 million m3 per year. To obtain a complete picture of the effects of extraction speed, an interim variant with an extraction speed averaging 100 million m3 per year was examined, in addition to the aforementioned extremes.

The extraction speed is not a decisive factor in the total environmental burden, i.e. whether there is a shorter peak at a higher speed, or a more even distribution over a longer period at a lower speed. Calculated over the entire extraction period, however, the energy consumption and emissions will be the same.

There are possibly differences as regards nature effects, but it is not possible to designate a clearly best choice. The extraction speed makes no difference to the total volume of fine silt that will end up in the sea through overflow during extraction. The current will carry some of this fine silt to the Voordelta. The fine silt concentration in the seawater in the Voordelta is an important consideration, because high fine silt concentrations can reduce the supply of food for locally foraging birds (see section 4.4).

However, the weather conditions will be the dominating factor for the actual fine silt concentration at any one time. In a calm year, with few storms, the fine silt content is naturally low. In a stormy year, the fine silt content will be many times higher. Against the background of these natural fluctuations, the supply of fine silt as a result of sand extraction will make a relatively modest extra contribution - and not more than that, as the research has established. The extraction speed determines when and to what extent this extra contribution will occur:

- at a higher speed there a peak in the increase of the fine silt concentration in the Voordelta will occur sooner, but the extra contribution the sand extraction makes to the fine silt concentration will also decrease faster;
- a lower extraction speed will distribute the increase of the fine silt concentration caused by sand extraction more over time and the peaks in the supply will level out somewhat.

At the maximum achievable extraction speed, the number of years with highly intensive extraction will be the smallest, so there will be the smallest likelihood of the peak coincidentally coinciding with a stormy year. With a low extraction speed, the extra supply of fine silt caused by sand extraction will make a smaller contribution to the total fine silt content in the Voordelta, but there will be an increased probability - because extraction takes longer – of the extra contribution occurring in an unfavourable year (with storms). In other words:

- an extraction speed of 150 m3 per year produces a smaller probability of a greater effect;
- an extraction speed of 60 million m3 per year produces a greater probability of a smaller effect;
- an extraction speed of 100 million m3 per year falls in between the bandwidth extremes in terms of probability and effect.

Alternative sand extraction methods not possible

A large land reclamation project like Maasvlakte 2, whereby the sand has to be obtained relatively far out at sea, can only be carried out by using large trailing suction hopper dredgers. The ideal way of limiting the environmental effects of sand extraction with these vessels effectively is by making well- founded decisions regarding the location, extraction depth and extraction rate, in conjunction with technical measures designed to minimise the adverse effects of overflow. With the present state-of-the-art there are no practicable alternative sand extraction methods with less environmental impact for the volumes required for Maasvlakte 2.

3.6 Most Environment Friendly Alternative and Preferred Alternative

The table below sets against each other the Most Environment Friendly Alternative and the Preferred Alternative for sand extraction. The table focuses on the core matters of (1) location, (2) depth of the pits and (3) extraction speed. The choices in the Most Environment Friendly Alternative and Preferred Alternative are based on the results of the environmental impact survey, as set out in greater detail in chapter 4 of this summary. It is necessary in the notes beneath the table to deal with some matters ahead of that chapter.

	Most Environment Friendly Alternative	Preferred Alternative
Location	Spot 1: close to Maasvlakte 2	Spot 1: close to Maasvlakte 2
Pit depths	20 metres below the seabed	On average at least 10 to at most 20 metres below the seabed
Extraction rate	At most 150 million m^3 per year	At most 150 million m^3 per year

Location

An important observation in the study is that sand extraction for Maasvlakte 2 will not have any significant effects on protected nature values in and around the Voordelta, even if extraction occurs in spot 1, i.e. near Maasvlakte 2. The fine silt carried to the Voordelta - and the related nature effects - will be greater than in the case of extraction in the more distant spot 2, however. But even in the worst case scenario, the effects will be limited and of a temporary nature. On completion of the work there will be complete recovery and the potential fluctuations in the populations will be smaller than the natural fluctuations. This effect will not obstruct sustainable development of the natural populations.

For the determination of the Most Environment Friendly Alternative, the potential limitations of the environmental burden (energy consumption, emissions) are important considerations, in addition to the effects on the protected nature values. A significant extra effort will be necessary to comply with legislation in this field, such as laws covering air quality and climate. The extra fuel consumption for extraction in spot 2 is estimated at 75 million litres in the first phase. Another relevant matter is that situating extraction in spot 1 is the only possibility for reducing the totality of energy consumption and emissions caused by sand extraction; it cannot be achieved through choices for the depth and speed of extraction.

Based on the foregoing, extraction in spot 1 has been adopted as the point of departure for the Most Environment Friendly Alternative. In the Preferred Alternative, extraction at spot 1 is also preferable, for the same reasons as stated above and on account of a substantial saving on transport costs. The additional costs of extraction in spot 2 are estimated at €160 million.

Concrete and masonry sand

The effects of extraction in spot 3 on the Voordelta will be at least in the same order of magnitude as in spot 1, while emissions and costs will increase substantially because of the longer sailing distance. Therefore, there is no reason why the project initiator should choose this option. In spot 1 there are likely to be dispersed occurrences of concrete and masonry sand. These will not be "disturbed" during dredging, but they will be freed up so that they are available

Depth of pits

Space utilisation will be minimised at a maximum extraction depth of 20 m below the seabed. Therefore, the Most Environment Friendly Alternative assumes that for all pits the extraction depth will be 20 m below the seabed.

The Preferred Alternative uses for the extraction depth a bandwidth averaging at least 10 m and at most 20 m below the seabed. An important consideration is that the sufficient availability of equipment poses a problem if there is an obligatory extraction depth of 20 m. Based on ecological considerations (limitation of space utilised for sand extraction), an average extraction depth of a least 10 m below the seabed has been chosen. The only exception is the occurrence of concrete and masonry sand at a few places in spot 1.

Speed of extraction

It has been established that speed will depend mainly on weather conditions:

- whether the temporary carrying of fine silt to the Voordelta will cause nature effects due to the sand extraction;
- and, if so, how large those effects will be.

As mentioned earlier, a higher extraction speed means a smaller probability of a larger effect, while a lower extraction speed means a greater probability of a smaller effect. But regardless of how high or low the extraction speed is, the temporary extra supply of fine silt will not lead in any of the cases – at no time whatsoever or for any species - to a point being reached where the sand extraction can be considered a cause of significant effects on nature values in the Voordelta.

With that in mind there is no added value to managing according to speed of extraction. This also means that, ecologically, there is no reason to include specific extraction speed conditions in the Most Environment Friendly Alternative. Therefore, the extraction speed will be determined by the possibilities the project offers during its implementation, i.e. the maximum deployable fleet of dredgers, weather conditions and progress in constructing the hard sea walls. The speed determined according to these factors will be at most 150 million m3 a year. This figure is the point of departure both in the Most Environment Friendly Alternative and in the Preferred Alternative.

4 EFFECTS

4.1 Working method

The description of effects in this chapter shows mainly the differences between a situation where Maasvlakte 2 will not be constructed (autonomous development) and a situation where it will be constructed. Chapters 2 and 3 show that the differences between the Most Environment Friendly Alternative and the Preferred Alternative are so small that they cannot usually be expressed in differences in effects.

The effects of the construction work, including sand extraction, will clearly be the greatest in the 2008-2013 period. Construction of the remaining part of the inner area and remaining 20% of sand extraction will take place after 2013. By then all effects of construction work will be significantly less.

In the presence phase, only the reclaimed land itself will still cause effects. The use made of the reclaimed land (companies, traffic) will also have environmental consequences, but they are described in the EIA for the Zoning of Maasvlakte 2. Potential forms of a cumulation of effects – one on top of the other - of the construction and use of Maasvlakte 2 are discussed at the end of this chapter.

4.2 Coast and sea

Construction and presence of Maasvlakte 2 will have various consequences for the physical characteristics of the coast and sea area (including the seabed) and for the processes that occur there, such as the current and the transport of sand and fine silt. Some of these effects are particularly relevant because they can affect nature. Additionally, there are effects that will have maintenance consequences, i.e. shoreline retention and dredging maintenance. Coast and sea aspects unaffected by Maasvlakte 2 have been disregarded, such as protection against flooding in the surrounding area, because neither land reclamation nor sand extraction will have any influence on these aspects.

Effects of land reclamation in the presence phase that will have a knock-on effect on nature

Various species and habitats in the Voordelta are protected under the Nature Conservation Act. The largest protected habitat type in the Voordelta is easily habitat type 1110, "Sandbanks slightly covered by sea water all the time", with the seabed at a depth of NAP 0 to -20 m. Maasvlakte 2 will cause a loss of acreage of habitat type 1110:

- direct space utilisation on 1110 acreage will be approximately 2000 ha, the gross size of the reclaimed land;
- the presence of the reclaimed land means the speed of the current seawards from the reclaimed land will increase here and there. The current will carry with it sand from the seabed. To the west of the sea walls this will create an erosion pit. The number of hectares over which the pit will be deeper than NAP -20 m at a particular time will also count as a loss of 1110 acreage. After ten years the part of the erosion pit below NAP -20 m will have a maximum size of approximately 470 ha.

The presence of the reclaimed land will not only change the current near Maasvlakte 2, but also farther away. This will have minor consequences for the carrying of fine silt along the coast. Along the Dutch coast the fine silt concentrations will decrease, while slightly farther out to sea they will increase.

Since the closing off of Haringvliet in 1970, Haringvlietmond (the Haringvliet entrance) has gradually become shallower. This process will continue for many years yet. Consequently, the salt spray at Voorne and Goeree will decrease. Land reclamation will slow down the ongoing shallowing of Haringvlietmond. As a result, the salt spray at Voorne and Goeree will decrease less fast than in the situation without Maasvlakte 2.

	Present situation and autonomous development	Situation with Maasvlakte 2
Direct space utilisation	Not applicable	Approx. 2,000 ha
Size of erosion pit below NAP -20 metresAP	Not applicable	At most 470 ha after ten years
Fine silt carried along the coast in the presence phase	No changes	Decreasing fine silt concentrations along the coast, slight increase farther out to sea.
Haringvlietmond and salt spray at Voorne and Goeree	Ongoing shallowing of Haringvlietmond, ongoing reduction of salt spray	Slowing down of shallowing of Haringvlietmond, slowing down of reduction of salt spray

Effects of sand extraction in the construction phase that will have a knock-on effect on nature

The most important effect - in the light of the knock-on effect on nature - is that the extraction of sand will release fine silt. The fine silt will spread with the tidal current both to the south and north and will join the fine silt that is naturally present. In the Voordelta the concentration of fine silt will increase. At a higher fine silt concentration, the water will become cloudier. Section 4.4 explains the nature effects this might cause. The natural variation in fine silt concentration is exceptionally large anyway: after severe storms in the winter, the water is far cloudier than during a slightly longer period with very calm weather in summer, because of the fine silt swirled up from the seabed. Typical values for the annual average fine silt concentration in the Voordelta are 20-30 mg/litre near the coast and 5-10 mg/litre farther out to sea. The increase in the annual average fine silt concentration in the Voordelta caused by sand extraction will reach at most approximately 6 mg/litre in 2010. During stormy periods the fine silt concentration will rise to 100 mg/litre.

	Present situation and autonomous development	Situation with Maasvlakte 2
Annual average fine silt concentration in Voordelta near coast	20-30 mg/l	Temporary annual average increase of 6 mg/litre in 2010 (maximum effect)

Shoreline retention and maintenance dredging

Along a large section of the Dutch coast it is necessary to replenish sand periodically to stop the coastline from receding. This is called shoreline retention. Maasvlakte 2 will have consequences for shoreline retention only at the location of the land reclamation and not for coastal sections in the vicinity (Delfland, Voorne, Goeree) or farther away. At the existing Maasvlakte and Slufter, an average of 0.8 million m3 of sand per year is currently being provided. As a result of Maasvlakte 2 this will increase to approximately 1.2 million m3 per year.
Compared with present maintenance dredging, the maintenance dredging in the construction phase will increase. On account of the construction of the soft sea walls and the sand extraction, more fine sediment will temporarily enter coast and sea system. Some will sink in the Maasgeul and farther on in the Maas entrance and in the existing docks. In the present situation and in the autonomous development, the maintenance dredging here comes to 16 million m3 per year. This will increase by approximately 45% in the 2008-2013 period and then decrease again.

The volume of maintenance dredging in the presence phase will remain virtually the same. In the period after 2013, the sea walls will shift the current outwards, so less fine sediment will sink in the Maas entrance and in the docks. Therefore, less dredging will be necessary there compared with the present situation. Against this, however, more sand than at present will enter the Maasgeul after 2013. This is because just in front of the reclaimed land sand from the soft sea walls and from the seabed will wash away to the Maasgeul through waves and currents. In the presence phase (after 2013) there will therefore be two opposing mechanisms that cancel each other out: less sedimentation in the Maas entrance and docks, more accretion in the Maasgeul.

	Present situation and autonomous development	Situation with Maasvlakte 2
Shoreline retention for Maasvlakte: Maintenance (replenishments) in million m^3 per year	0,8	1.2 (increase of 50%, with bandwidth of 50%)
Maintenance dredging in construction phase (2008-2013) in million m^3 per year	16,0	23.4 (increase of 45%, with bandwidth of 50%)
Maintenance dredging in presence phase in million m^3 per year	16,0	14.8 – 16.5 (bandwidth -1.2 +0.5 million)

4.3 Environmental quality

Air quality

Fuel consumed by equipment will cause emissions of substances that will affect air quality. For the air quality on land, the emissions near or on the reclaimed land will be the most significant. The Trailing Suction Hopper Dredgers (TSHDs) will make the greatest contribution when sailing near the coast and/or dumping sand at the land reclamation site, followed by suction-cutter dredgers that deepen the port basin and create the Yangtzehaven cut-through.

The Air Quality Decree names relevant substances and specifies limit values for maximum permissible concentrations in the air. Particularly important in the Rijnmond region are the concentrations of NO2 (carbon dioxide), SO2 (sulphur dioxide) and PM10 (particulate matter). These concentrations are already high, particularly those of carbon dioxide and particulate matter. This prompts the question of what extra contribution the construction of Maasvlakte 2 will make in relation to the background concentrations. This matter was examined using model calculations for three reference points, i.e. Hook of Holland, existing Maasvlakte and Voornes Duin.

The construction work will produce an increase of carbon dioxide and sulphur dioxide, but the standard will not be exceeded. The average annual concentration of particulate matter is satisfactory at present and will continue to meet the standard in the autonomous development and if Maasvlakte 2 is constructed. There is a second standard that applies to particulate matter, i.e. a concentration higher than 50 µg/m3 may occur not more than 35 days per calendar year. The most recent data and model calculations show that this 24-hour standard will come close to being reached – 33 days - in the specific case of Hook of Holland in the autonomous development (2010). At an extraction rate of 150 million m3 per year, there will for two to three years be an increase by one day (to 34 days) in the calculated number of overshoot days at this reference point. Even then, however, the standard will not be exceeded.

The table below shows the calculated concentrations at Hook of Holland. It can be seen that construction of Maasvlakte 2 will not cause violation of the relevant air quality standards. The same conclusions apply to the other two reference points.

Hook of Holland	Standard	Situation in 2010 without construction of Maasvlakte 2	Situation in 2010 with construction of Maasvlakte 2	Increase	Compliance with standard
Annual average NO_2 concentration	40 µg/m³	22,5 µg/m³	24,3 µg/m³	+1,8 µg/m³ (+8,0 %)	Yes
Annual average SO_2 concentration	20 µg/m³	3,9 µg/m³	4,7 µg/m³	+0,8 µg/m³ (+20,5%)	Yes
Annual average PM_{10} concentration	40 µg/m³	28,80 µg/m³	28,93 µg/m³	+0,13 µg/m³ (+0.45%)	Yes
Number of days with daily average concentration higher than 50 µg/m³	35 days	33 days	34 days	+1 day	Yes

Noise

A distinction can be made between underwater noise and air noise (i.e. noise above the water). Dredgers are the main source of underwater noise, but it was found during the study that the noise level below water does not rise to disturbance level.

The dredging fleet and above all the equipment used to reclaim land will be the determinants of air noise. The total noise load will not exceed the standards stipulated in the Noise Nuisance Act at any time during construction of Maasvlakte 2. The calculated noise contours will remain sufficiently far away from the residential areas situated closest to the reclaimed land (Hook of Holland) and from designated quiet areas in the region.

4.4 Nature

In the construction phase, the temporary increase of the fine silt concentration in the Voordelta will be particularly important, even though it will not cause any significant nature effects. In the presence phase, the space utilised by the reclaimed land will be the dominant factor. It will have significant effects for one protected habitat type and three protected bird species. These effects are unavoidable because it is not possible to achieve any further reduction of space utilisation. The marine reserve will compensate for these effects.

Construction: disturbance and impairment of seabed life

Sand extraction and construction work for land reclamation will cause disturbance because of noise (below and above water) and the use of equipment, which may frighten off shy species. This disturbance may temporarily cause them to avoid the area in the immediate vicinity of the source of the disturbance. Many protected species have a large action radius, however, and within the large Voordelta there are ample alternative locations. Therefore, the temporary effect on the living and foraging area of protected species (birds, mammals and fish) will be slight. Permanent effects will not occur.

A local and temporary effect of sand extraction will be the impairment of seabed life. With an extraction depth up to 20 m below the seabed, there will be no obstructions for recolonisation. Complete recovery is likely to take two to four years.

Construction: nature effects caused by increased fine silt concentration

At an extraction speed not exceeding 150 million m3 per year, the fine silt concentration in the Voordelta will for a few years be higher than the normal annual average concentration. The study examined what effects this temporary increase may have for all protected nature values in the Voordelta. For the protected habitat types (seabed, flats and salt marshes) there will be no consequences: the same applies to by far most protected species. There is a chance that effects may occur for three species of shellfish-eating ducks (eider, Black Sea duck and scaup) and two species of fish-eating birds (common tern and sandwich tern).

Chain from intervention to effect for shellfish-eating ducks and fish-eating birds

The ***eider***, ***scaup*** and ***Black Sea duck*** are present each winter in the Voordelta. The annual variations in numbers are large particularly in the case of the Black Sea duck. This is partly due to the major fluctuations in the availability of their food in the Voordelta and elsewhere along the Dutch and Belgian coast. Therefore, the Voordelta is an important *potential* foraging area for this species in the winter.The chain from intervention (temporary increase of fine silt concentration) to possible effect (probability of a temporary reduction of the population) consists of the following links for these shellfish-eating ducks. A higher fine silt concentration makes the water cloudier and reduces incidence of light. This slightly slows the growth of algae, food for shellfish and shellfish larvae. A particularly important matter in relation to shellfish is that the peak in algae growth, the "spring blossom", can occur one or two weeks later than usual because of the reduced incidence. This can create a situation where at a certain time there are numerous shellfish larvae that have just come out floating in the water, while the spring blossom – on which the larvae rely for their nutrition – has not yet started. This produces a mismatch: the peak in the demand for food of the shellfish larvae will be out of sync with the supply of food. The shellfish larvae will then grow more slowly and by the time they settle on the seabed they will be smaller than in a situation without a mismatch. It is assumed that this delay in growth cannot be made good. Growth will further be restricted because with an increased fine silt concentration there will relatively speaking be more uneatable fine silt and fewer eatable algae in the water. The shellfish that live on the sea bed and filter some of their food out of the water will therefore grow less quickly. The potential consequence of this mechanism is that the meat weight of the shellfish in autumn will be lighter, and that by consequence there will be less food available for the eider, scaup and Black Sea duck.

A reduction of the translucency because the water is cloudier when there are higher fine silt concentrations may also have temporary consequences for the ***common tern*** and the ***sandwich tern***, especially in the breeding season. If the water close to the coast becomes so cloudy that they find it more difficult to see their prey fish, these birds that hunt by sight, may have to fly farther to get their food. In the breeding season, this may be at the expense of the success of breeding and thus the size of the population. This is based on a worst case scenario, however, because there are indications that prey fish come closer to the water surface if they believe they are less visible. This matter was not taken into account in calculating the maximum effect, however.

It is expressible in a figure what the maximum potential effect will be for the eider, scaup and Black Sea duck if the concurrence of circumstances described in the sidebar produces the worst case scenario for each link in the chain. Given the multiplicity of relevant factors, however, there is an equally great chance that the effect of increased fine silt concentrations will ultimately be zero. The table below therefore explicitly shows for the eider, scaup and Black Sea duck a bandwidth between no effect and maximum effect. The table also shows the maximum potential effect (worst case) for the common tern and sandwich tern. The maximum percentages given also include the – relatively modest – impact of disturbance to the cormorant, Black Sea duck and sandwich tern caused by sand extraction vessels during construction.

Potential effects on population in Voordelta	Situation in 2009-2011 without sand extraction for Maasvlakte 2	Situation in 2009-2011 with sand extraction for Maasvlakte 2
Eider	No effect.	Reduction: 0% to at most 6.4 %
Scaup	No effect.	Reduction: 0% to at most 5.0 %
Black Sea duck	No effect.	Reduction: 0% to at most 7.1 %
Common tern	No effect.	Reduction: at most 0.9 %
Sandwich tern	No effect.	Reduction: at most 0.9 %

The maximum potential effect was assessed as "not significant" for each of the five species. The most important consideration is that a temporary effect is concerned, one that will not cause a structural, permanent reduction of the population. The maximum reduction is also substantially less than the natural fluctuations that occur in the size of the populations.

Presence: four significant effects caused by space utilisation

The presence of the reclaimed land will have four significant effects for the protected nature values in the Voordelta for which compensatory measures are mandatory. In line with nature conservation laws allowance was made, when assessing "significance" and determining the compensatory requirement, for other developments and projects in the Voordelta and also for the environmental effects of use of Maasvlakte 2 (commercial activities, traffic).

The first significant effect is the loss of acreage of protected habitat type 1110, "Sandbanks slightly covered by sea water all the time", with the seabed at a depth of NAP 0 to -20 m. The reclaimed land will take up approximately 2,000 ha; the size of the part of the erosion pit below NAP -20 m will have increased after 10 years to approximately 470 ha. In total, almost 2,500 ha of 1110 acreage will be lost. This represents a reduction of 2.8% of the total acreage of this habitat type in the Voordelta. Other projects and developments in the Voordelta and the use of Maasvlakte 2 will not increase this loss any further. The principal reason for considering a 2.8% reduction a "significant effect" is that the seabed covering will be permanent and irreversible because of the reclaimed land. It will be possible to take additional measures only at the erosion pit to slow or stop the erosion process.

The maximum potential effect for the Black Sea duck is that 3.1% of the potential foraging area will be lost (in winter). This is due mainly to the presence of the reclaimed land. Use of Maasvlakte 2 will make a modest extra contribution (0.3%). Other developments and projects in the Voordelta will not play a role. This is a significant effect: although sea ducks are certainly not present in large numbers in the Voordelta every year, if it does occur it will be because they really need the Voordelta in the winter concerned as a foraging area. In such a situation there will be no fallback alternatives.

Maasvlakte 2 will reduce the living and foraging area of the common tern, so the size of the population in the Voordelta will decrease by at most 5.9% in relation to the average population size in recent years. Other developments and projects in the Voordelta will not increase this effect. This is a permanent effect, so it is considered "significant".

For the sandwich tern, the total effect on population size was calculated as a reduction of 3.7% in the Voordelta. Maasvlakte 2, including its use, will make a 1.7% contribution to this figure. The sandwich tern forages at sea in summer. Recreation in the Voordelta is likely to become more intensive in summer, thus increasing the disturbance of sandwich terns (a contribution of 2% to the total). A cumulative reduction of the population by 3.7% can be considered a significant effect, because the sandwich tern is an endangered species in the Netherlands, the total European population is vulnerable, and the calculated effect is largely of a permanent nature.

The presence of the reclaimed land will not have any significant effects on any other protected species in the Voordelta, and the same applies to the other protected habitat types like flats and salt marshes. The "significance limit" will not be exceeded for any of these protected nature values even when the effects of use of Maasvlakte 2 and other developments and projects in the Voordelta are added (cumulation) to the effects of the presence of Maasvlakte 2.

Compensation

The four significant effects described above require compensatory measures. The compensation will be provided by creating a marine reserve in the Voordelta, together with a management plan. The point of departure for sizing the marine reserve is that it must be at least 10 times as large as the ultimate loss of 1110 acreage. Ten times the maximum loss of 2,500 ha of 1110 acreage works out to compensation of 25,000 ha. The PKB has made a spatial reservation for the marine reserve of 31,250 ha, within a search area of approximately 40,000 ha. Within the search area, approximately 5,000 ha is unsuitable for compensation (because of a different habitat type, for example), but there will still be approximately 10,000 ha of potentially usable "residual space". Moreover, when the Voordelta management plan is next updated, there will be possibilities for intensifying nature-related management activities. It is unlikely that this will prove necessary, but it is important to note that it can be done if it must be done.

Maasvlakte 2 will not have any adverse effects for the protected nature areas of Voornes Duin and Duinen van Goeree. The construction work will not cause any disturbance at these places. Optimising the plan (the step from the PKB Reference Alternatives to the Cut-through Alternative) means the presence of the reclaimed land will not have any adverse effects on nature in the two dune areas. This is worth noting because earlier - during stocktaking of the environmental effects of the PKB Reference Alternatives - an expectation existed that Maasvlakte 2 would accelerate the reduction of the salt spray at Voorne and Goeree. In point of fact, the Cut-through Alternative will actually slow down the reduction of salt spray.

This means that compensatory measures for the beach-dune system and dunes, for which the PKB has also reserved space, will no longer be necessary on account of the effects of the construction and presence of Maasvlakte 2. The space reserved for the beach-dune system compensation will definitely not need to be used. Compensation for the dunes remains a requirement, but for an entirely different reason that at the time of the PKB procedure was not sufficiently recognised. Air pollution as a result of use of Maasvlakte 2 (particularly emissions by the increasing amount of shipping) may lead to significant effects on nature values in the dunes. The compensation requirement for this is less than the dune compensation estimated in the PKB, however, so there will still be "residual space" for the dune compensation.

4.5 Nautical safety and accessibility

Nautical safety for shipping to and from the Rotterdam port will be retained at its present high level:

- In the construction phase there will be usage rules for dredgers and other vessels to ensure that safety is not jeopardised and that regular shipping will not be inconvenienced by the construction work.
- As regards external (nautical) safety, there will be no effects in the construction phase, either at sea or in the port, on the localised risk and group risk. External (nautical) safety in the usage phase was factored into the EIA for the Zoning of Maasvlakte 2.
- In the presence phase, the current in the Maasgeul will be better than it is at present. The maximum speed of the current across the Maasgeul and the change of the cross-current speed over a certain distance ("cross-current gradient") will decrease. Maasvlakte 2 will be constructed in a way that at least retains the current characteristics of the current flow in the construction phase.
- The Port of Rotterdam Authority is at present working on a set of measures to keep future accessibility and safety up to standard and improve it still further where possible. The consequences of extra shipping as soon as Maasvlakte 2 goes into use will be incorporated into the set of measures. The set of measures cover such matters as optimisation of the control of shipping and adjustments to the port infrastructure, like alterations to a number of landing stages and an existing berth in Yangtzehaven, and the widening of the curve to Beerkanaal (excavation of part of Papegaaienbek or Kop van de Beer).
- A nodal analysis was performed to identify the effects on hinterland links (inland shipping). In combination with the EIA for Zoning (traffic and transport), it has been concluded that the presence of Maasvlakte 2 will have no effects on the hinterland links.
- Research into the sailing times of shipping, by means of a simulation model, showed there will only be a slight increase in the turnaround time for vessels that have the present Maasvlakte as their destination.

4.6 Other effects

Usage functions

The reclaimed land will take up a small area where fishing currently takes place. This concerns mainly fishing by means of smaller vessels, like cotters, which have Stellendam as their home port. During the extraction of sand there will be some fishing restrictions because it will not be possible to fish at the location of the sand extraction pits.

In the construction phase separate measures will be taken to safeguard the cooling water function. The construction and presence of the reclaimed land and the extraction of sand will not have any consequences for any other usage functions.

Archaeology

At the place of the reclaimed land there are archaeological values from different eras at different depths in the seabed, varying from traces of hunting and fishing that occurred here when the area was a brackish water lagoon (from 8000 to 6500 BC) to the wreck of the Danish steamship Cornelia Maersk that sunk in 1942.

Possible archaeological values were identified using existing information and some additionally obtained information. The seabed study that will precede extraction will have to provide a greater insight into this matter. Known locations will be avoided, unless they occur in planned fairways or at the place of the hard sea walls. Special work procedures will be drawn up to avoid impairing archaeological values as far as possible.

Shared used by recreational visitors

A precondition is that recreational possibilities in the presence phase may not be less than they are at present. This precondition will be amply met, because there will be more beach, at least as many beach entrances and equivalent water sport possibilities. Maasvlakte 2 will not have any consequences for local beaches.

Sand extraction in the construction phase will not affect the quality of swimming water or recreation. However, work on the land reclamation will clearly have consequences. The present beach along the existing Maasvlakte will be closed off and the new beach along the soft sea walls of Maasvlakte 2 will not be opened until permitted by the construction work on the outside of the soft sea walls.

4.7 Cumulation

When determining the cumulative effects between construction and use of Maasvlakte 2, the year 2015 was chosen as a calibration point, on the one hand because it ties in with the planning period of 10 years in the zoning plan, and on the other because in 2015 construction will be in progress while companies will already be operational. Traffic and transport streams will still be limited because only a small surface area will already be in use as port and industry sites in 2015. Additionally, a large part of the construction work will have been finished by 2015. Similarly, the contribution of road traffic resulting from construction work will have few effects and will remain within the bandwidth. Moreover, the cumulative effects for all other matters will not exceed the permissible effects within the environmental space determined in the EIA for the Zoning of Maasvlakte 2. The cumulative effects on nature will also remain within the prescribed constraints (see section 4.4).

Another important matter is whether cumulation will occur with other projects. Other projects were identified and examined for that purpose. The conclusion is that none of the projects will produce a cumulative effect. So by consequence this also applies to eye-catching projects like a revised opening hours regime at the Haringvliet locks, sand extraction at sea for other projects and the strengthening of "Weak Links" in the coastal defences. Similarly, no work or projects are expected to occur that will cumulate locally on the effects of construction on air quality.

4.8 Knowledge gaps and monitoring

Following the research there are no knowledge gaps to prevent further decision-making. The alternatives have sufficiently crystallised out to serve as a good point of departure for forecasting effects. The land reclamation plan has been worked out in detail and there is sufficient clarity about how the construction work (including the sand extraction) will take place. The final choices for performing some work will be made later when contracting out the work to a contractor. Wherever the precise working method may influence the effects, an "upper limit" approach was adopted. This means the maximum effects were defined. The likelihood of the effects being greater in reality can be deemed nonexistent.

The best available methods and techniques were used to forecast effects. Especially for the effects on the coast and sea and on nature, various workshops were held with experts to check the research results. Wherever model calculations identified a bandwidth in the forecast effects:

- either the maximum effect (worst case) was taken as a baseline, also when defining the nature effects, mindful of the precautionary principle;
- or the expected value was defined with explicit statement of the bandwidth in question.

Applying an upper limit for the uncertainties means that any knowledge gaps do not stand in the way of further decision-making. At the same time, the use of an upper limit makes clear where there are gaps in knowledge, i.e. precisely at those places where the expectation is more favourable than the baseline, but the available knowledge is insufficient to validate this sufficiently. These knowledge gaps concern mainly the effects of construction work on coast and sea aspects and their translation into effects on nature.

The actual effects of construction and presence of Maasvlakte 2 will be studied in an extensive monitoring and evaluation programme. This ties in partly with existing regular monitoring, but sub-studies specifically focused on Maasvlakte 2 will also be carried out. Field research and baseline measurements - which are necessary for systematic monitoring - were started in autumn 2004 and some will continue until the start of construction work, and also after completion of construction, so as to monitor and evaluate the effects of the presence of Maasvlakte 2. Monitoring includes the effectiveness of the measures in the marine reserve.

5 STOCKTAKING

Stocktaking is possible now there is a complete picture of the alternatives. For that purpose, we will return to the point that started this summary: the PKB. Is the plan for the Maasvlakte 2 construction project the best way of fulfilling the ambitions formulated in the PKB? And are the alternatives and effects compatible with the constraints stated in the PKB?

The PKB contains 17 "fundamentally important decisions" that define the intended result and constraints. The "fundamentally important decisions" will not be dealt with individually below, but have been grouped into three clusters called land reclamation, sand extraction and nature.

5.1 Land reclamation

The intended result is reclaimed land that will be used by deep sea-related companies, with a maximum of 1,000 ha net allocable land, located within a search area with borders specified in the PKB. The land reclamation plan completely meets this requirement. The method ultimately chosen for phasing construction is also in line with the objective and planning of the phasing contained in the PKB. The inner area will be built in phases, the sea walls will immediately be placed in the final position: phased construction of the sea walls provides no added value ecologically, and is clearly more disadvantageous from the point of view of other relevant matters.

A precondition is that the present high level of accessibility and safety for shipping must at least be maintained. The plan is geared to meeting this condition: the port infrastructure of the inner area meets the requirements, and through the shape of the sea walls there will be an improved current in the Maasgeul compared with the present situation. Regulations for performance of construction work and usage rules for dredgers and other vessels will ensure that accessibility and safety in the construction phase will at least match the current level.

The negative environmental effects of the final plan may not exceed the environmental effects of the two PKB Reference Alternatives. In that respect, the Cut-through alternative is an important result: it is more compact than the Reference Alternatives and the sea walls are oriented more favourably. The effects on coast and sea and on nature will thus be smaller. Similarly, the final plan is in every respect better than the Reference Alternatives with regard to other environmental effects.

Air quality

"Air quality" has become a major item of attention in spatial projects in recent years, particularly in projects in areas where the limit values for maximum permissible concentrations are already close to being violated. Air quality is not mentioned as a separate subject in the Key Planning Decision (PKB), but a great effort was made in the environmental impact assessments for the construction and zoning of Maasvlakte 2 to keep or get the effects within the standards. It ultimately proved possible to carry out the construction work in such a way that there will be no violations of air quality standards.

5.2 Sand extraction

Sand will be extracted within the search area demarcated in the PKB for sand extraction. The possibilities mentioned in the PKB for the mitigating measures were examined and applied to a far-reaching extent. As regards examination of the remaining non-significant nature effects, the mitigation of effects for the grey environment also played a role. The final result is that the sand extraction can be carried out with limited non-significant temporary effects, without any permanent effect, on the strictly protected nature values, while the effects on air quality and other emissions by the dredgers will be limited.

The PKB further mentions a number of implementation aspects that the EIA must address: choice of location, extraction depth, working methods and a possible combination with future extraction of concrete and masonry sand. All of these aspects have been addressed in the EIA for Construction of Maasvlakte 2. This has resulted in a Most Environment Friendly Alternative and a Preferred Alternative for the extraction of sand, with a validation of the choices for all relevant implementation aspects.

5.3 Nature

This summary makes clear that nature played a very important role in the EIA, both in the development of the alternatives and in the research into the effects. Perhaps the most illustrative of what this ultimately produced is the compensatory requirement. The PKB makes spatial reservations for three compensation projects, but it follows also from the PKB that there is a best-effort obligation actively to look for ways of limiting the effects on protected nature, so that ultimately there will be a compensation requirement that is as small as possible. The achieved result is that, based on the construction of Maasvlakte 2, there will be no need at all for compensatory measures for the dune-beach system or for dunes. The marine reserve will be necessary, however, to compensate for the unavoidable significant effects resulting from the utilisation of space for the land reclamation. The compensation requirement that the marine reserve must absorb is significantly less than the reservation made for it in the PKB, however. The reserved space left over thus provides a possibility to reverse any disappointing effects resulting from the land reclamation and/or the disappointing effectiveness of measures in the marine reserve.

5.4 Conclusion

The above justifies the conclusion that it has indeed proved possible to pursue the ambitions contained in the PKB in the best possible way. All constraints contained in the PKB and constraints embedded in important legal frameworks (nature, air) will be met. And as there are no knowledge gaps to obstruct decision-making - see the conclusion at the end of chapter 4 - it is now possible to move on to the implementing decisions.

6 NEXT STEPS

The course of the procedures

Two EIAs were carried out under the responsibility of the Port of Rotterdam Authority, the initiator of the Maasvlakte 2 project. They are the EIA for Construction of Maasvlakte 2 and the EIA for the Zoning of Maasvlakte 2. Both environmental impact assessments will be made available for public inspection at the same time, together with various other documents, i.e. the requests for the required implementing decisions for land reclamation and sand extraction, a preliminary zoning plan for Maasvlakte 2 and the Appropriate Assessment of the effects of construction and use on the protected Natura 2000 areas.

Figure 6.1: Diagrammatic representation of the project and the environmental impact assessments in relation to decision-making

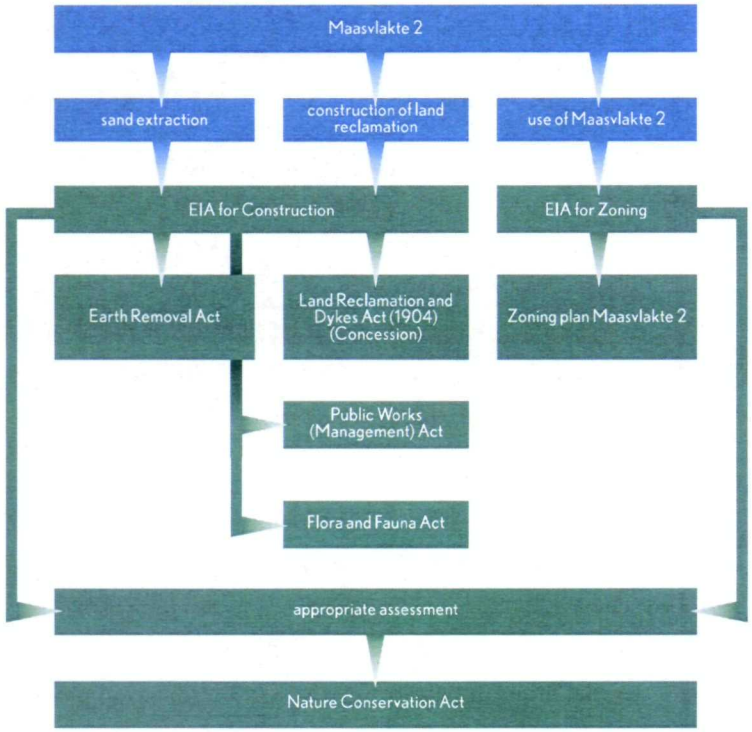


Figure 6.1 is a diagrammatic representation of the decision-making procedures that will be followed. The plan is to let decision-making on construction (land reclamation and sand extraction) run in synch with the decision-making on zoning (the zoning plan that will serve as a spatial guideline for activities on Maasvlakte 2). The various decision-making authorities will harmonise the decisions that are taken.

There will first be a six-week consultative period. At the same time, there will be consultation at governmental level. During the consultative period, anybody may respond to the documents open for inspection. This may be done in writing or orally, at hearings that will be held towards the end of the consultative period at various places in the region. Advertisements and the website www.maasvlakte2.com provide practical information about the consultation round, such as where documents can be inspected, how to respond, where and when the hearings will be held and so on.

All written responses of the consultation round and the minutes of the hearings will be forwarded to the Environmental Impact Assessment Committee. The experts of this independent committee will examine whether the information in the EIAs is correct and complete: do the documents contain sufficient information to be able to weigh up environmental interests properly during decision-making? The EIA Committee will present its opinion in an "expert recommendation" submitted to the decision-making authorities.

The decision-making authorities will then come into play. They will factor into their decision-making the information contained in the EIAs, the responses during the consultation round, outcomes of the governmental consultations and the expert recommendation of the EIA Committee. For decision-making on the construction of Maasvlakte 2, the Minister of Transport, Public Works and Water Management is the competent authority for the land reclamation concession, the licence under Public Works (Management) Act and the earth removal licence. The Minister of Agriculture, Nature and Food Quality is the competent authority for the licence under the Nature Conservation Act and the exemption under the Flora and Fauna Act. The draft decisions of the two ministers will be made available for public inspection. Afterwards, the definitive decision-making will take place. It will be possible to appeal against decisions to the Administrative Jurisdiction Division of the Council of State.

Planning

The objective is to complete all decision-making procedures definitively towards the end of 2007. During 2007 the tendering procedure will also be completed, resulting in a contract with the contractor who will carry out the work.

The start of construction is planned for 2008. The planning of the work was explained earlier in this summary of the EIA for Construction of Maasvlakte 2: the first phase of construction will be dominated by building the sea walls and the first sites of the inner area. From 2013, the first companies can be operational on Maasvlakte 2. In the second phase, after 2013, the remaining sites will be built and gradually put into service.