SCHORERPOLDER: A NATURAL FILTER

[N & P REDUCTION]

1. INTRODUCTION

The agricultural land of Schorerpolder is bound to be transformed and connected to the sea as nature compensation by the North Sea Port to mitigate the impact that the expansion of the port could have (HZ, 2018). With the creation of a nature-based engineering solution comes several regulating ecosystem services. This new connection to the Western Scheldt will become low dynamic estuarine nature that serves as a natural filter to purify water focusing on nitrogen and phosphorus retention and reduction. Another benefit for society provided by the new intertidal zone is its function as a natural buffer to the surrounding environment, which serves as a better flood protection. Finally, as wetlands are very productive ecosystems biodiversity will also increase.

NUTRIENT CYCLES

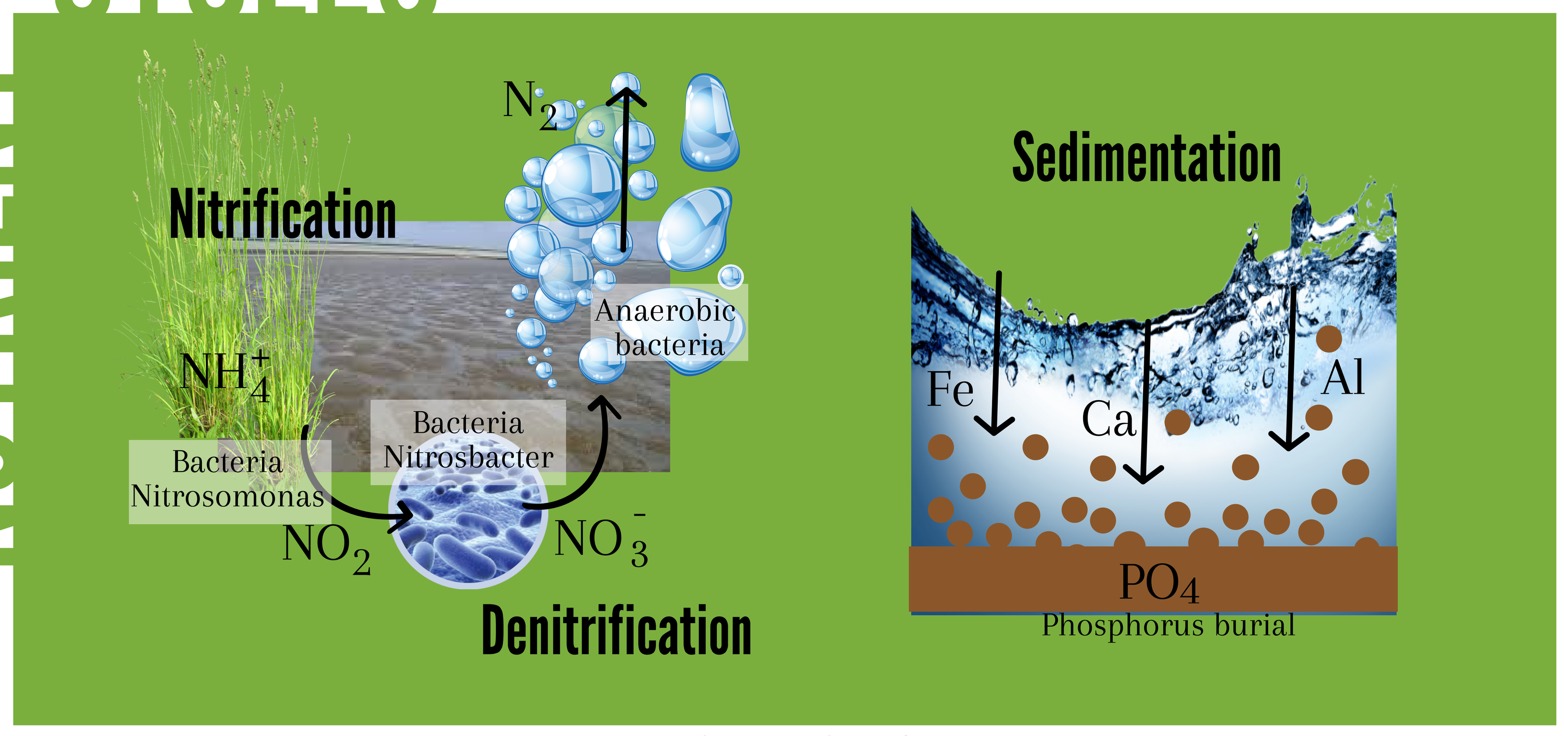


Figure 1. Nutrient cycles

2. METHOD

- Location based concentration levels of N, P and NO3 taken from Rijkwaterstraat (2018).
- Admitted standards for water quality from the Water Framework Directive (van der Molen et al., 2006).
- Comparison between the two values observed in the location near Schorerpolder and the standard values to determine if they exceeded.
- Water purification capacity.
  - P (sedimentation): calculated using available area and the average sedimentation rates. [1, 2 & 5 cm/yr]
  - N (denitrification): values taken from TIDE report. (Liekens et at, 2013)
- Shadow prices obtained from the result table in the Ecology & Society scientific magazine (Boerema et al, 2016).
  - Average denitrification data in intertidal areas in the Scheldt estuary measured in kg (N) per hectare per year provided in the table.
  - Value then multiplied by the area in the Schorerpolder to get a net flux.
  - Result multiplied by the average shadow price, which reflects the economic value of the process and set in the same table.
- The same method was then used for the phosphorus burial shadow price using sedimentation rates.
- Two main factors taken into account in the decision matrix for ranking: sedimentation and erosion.

NUTRIENT CONCENTRATION IN THE SCHELDT

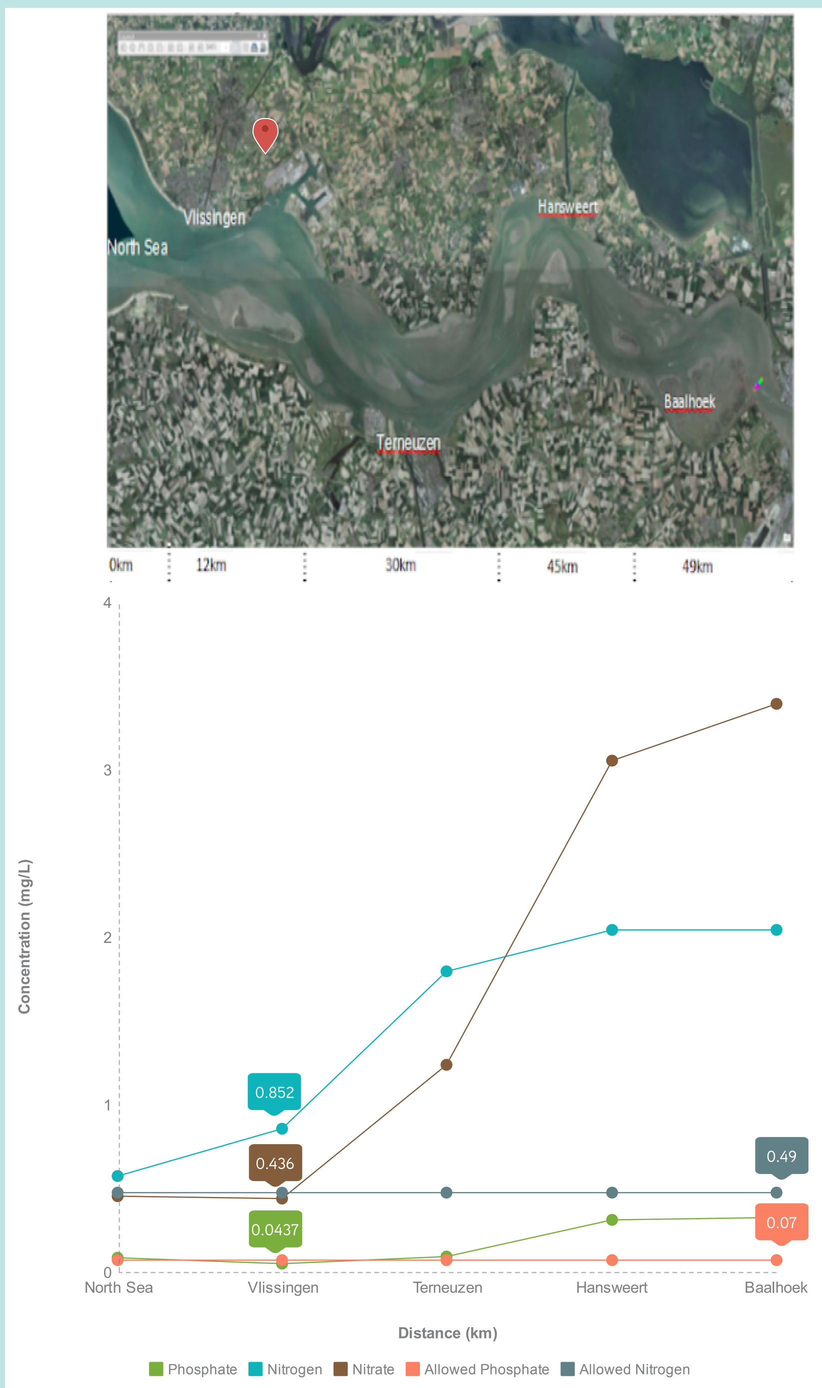


Figure 2. Distance vs Nutrient concentration

ECONOMIC VALUE

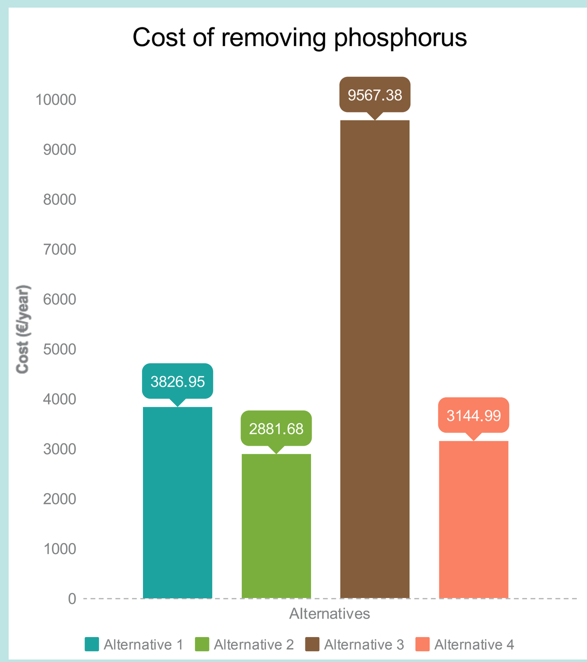


Figure 3. Shadow prices for phosphorus burial

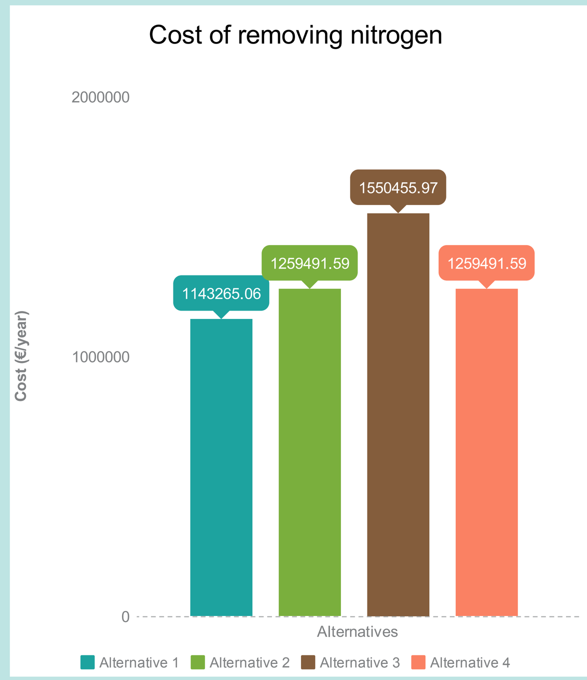


Figure 4. Shadow prices for denitrification

3. RESULTS

In *Figure 2* the nutrient concentration levels of phosphate, nitrogen and nitrate are shown along the Scheldt estuary. Near Vlissingen, where the Schorerpolder is located (marked in map) the phosphate levels are below standards but the nitrogen levels almost double the standard. However in Baalhoek both are higher. It was observed that for the last 20 years the concentration levels only have small variations while staying in a constant range.

In *Figure 3 and 4* the economic value of phosphorus burial and denitrification is stated, this can be explained as the cost of treating water to remove or reduce N and P.

4. DISCUSSION/CONCLUSION

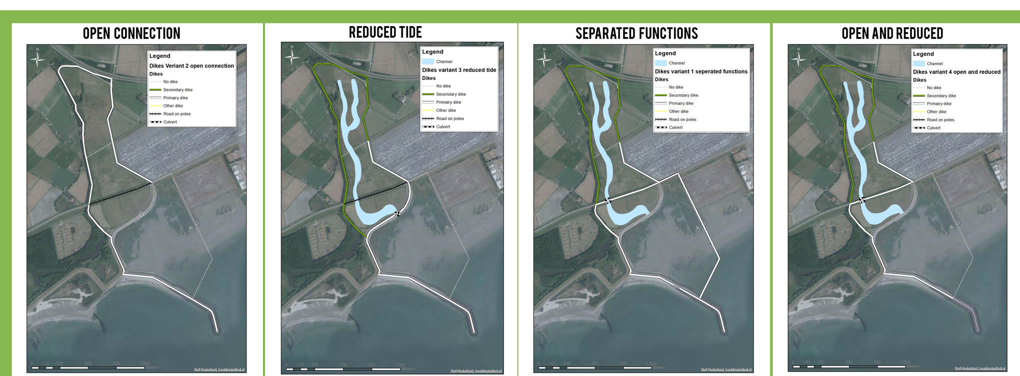
For phosphorus reduction, sedimentation is a key factor for the burial of the nutrient. Sediment has to settle and with it phosphorus is buried, reducing the concentration in water. Erosion plays a role as well because when it is present the sediments are disturbed and the phosphorus is once again released. For denitrification anaerobic conditions are vital, which are present in the channel and the intertidal area at high tide. Most of the denitrification process is made by anaerobic bacteria releasing nitrogen into the atmosphere in its gas state, this condition is met mostly in the channel. While the economic value of denitrification is close to one another for each alternative, phosphorus burial shows a bigger difference having the greatest benefit for alternative 3. However, the values are much smaller than denitrification which means less impact on the economic earnings.

The third alternative (separated functions) has all the previous requirements and the economic value for denitrification is slightly higher than the other alternatives which makes it the best option.

We would like to propose a new research question: Would this project be better suited for a location further in the Western Scheldt estuary?

⬆ High
\- Intermediate
⬇ Low

✓ Occurs
✗ Does not occur



		OPEN CONNECTION	REDUCED TIDE	SEPARATED FUNCTIONS	OPEN AND REDUCED
CONDITIONS	Sedimentation [m^3/yr]	21,260.84	16,009.31	53,152.09	17,472.18
	Erosion	⬆	-	⬇	-
	Anaerobic conditions	✗	✓	✓	✓
AREA	Channel [ha]	0	10.1	10.1	10.1
	Mudflat [ha]	106.3	80.1	96.2	96.2
	Marsh [ha]	0	16.1	0	0
PROCESSES	Phosphorus Burial	-	-	✓	-
	Denitrification	✗	✓	✓	✓
RANKING		④	③	①	②

Figure 6. Decision matrix

ALTERNATIVE 3

BEST SOLUTION

STAKEHOLDERS

REFERENCES

1. Rijkswaterstaat. (2018). *Waterinfo*. June 8th, 2018, Retrieved from https://waterinfo.rws.nl/#!/nav/index/
2. Van der Molen, D., Boers,P., & Evers, N. (2006). *KRW-normen voor algemene fysisch-chemische kwaliteitselementen in natuurlijke wateren.* Platform. Retrieved from https://library.wur.nl/ebooks/hydrotheek/1832218.pdf
3. Boerema, A., Geerts, L., Oosterlee, L., Temmerman, S., & Meire, P. (2016). Ecosystem service delivery in restoration projects: the effect of ecological succession on the benefits of tidal marsh restoration. *Ecology and Society, 21(2).* http://dx.doi.org/10.5751/ES-08372-210210
4. Liekens, I., Broekx, S. & De Nocker, I. (2013). Manual for the valuation of ecosystem services in estuaries. Retrieved from http://www.tide-toolbox.eu/pdf/reports/TIDE_ManualValuationEcosystemServicesEstuaries.pdf
5. HZ University of Applied Sciences. (2018). Jointly understanding and validating the system and challenges. Project en portfolio. Retrieved from-https://www.projectenportfolio.nl/wiki/index.php/LC_00447#The_area
6. Mudflat image used in Figure 1 retrieved from https://www.jstor.org/stable/10.1086/652991?seq=1#page_scan_tab_contents
7. Mudflat in results retrieved from https://www.roughguides.com/destinations/europe/netherlands/things-miss/#/A0NRWB-1680x1050.jpg

Ximena Correa, Lorenzo Somai, Mellie den Toonder, Pamela Morales, Leonardo Gemelli

UNIVERSITY OF APPLIED SCIENCES HZ

DELTA ACADEMY