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Chapter 15 NORTH SEA LANDSCAPES OF COEXISTENCE

Taneha Kuzniecow Bacchin

The South-West Delta in the Netherlands and the Thames Estuary in England both face extreme sea level rise and ecological degradation. Taneha Bacchin and her students take these conditions as an opportunity to launch a gradual revolution that redefines the land-sea edge as a productive and protective ecosystem.

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This essay presents five graduation theses from the interdisciplinary studio "Transitional Territories" offered by TU Delft's Faculty of Architecture and the Built Environment.(1) From 2017 to 2020, the studio focused on the North Sea as common ground for the mediation of multiple agents acting at the sea-land continuum. This pedagogical project employed research-by-design to map some of the controversial aspects of the North Sea as territory (e.g., the large variety of coastline habitats, management, and ownership practices) and, later, to envision different forms of co-habitation. The five selected projects illustrate a line of inquiry studied in the studio: the effects of the altered nature of the North Sea habitat and the projection of a possible/desirable synergistic approach between land-use occupation and environmental risk management. The selected projects respond to envisioned scenarios developed within the context of the studio, taking singular but related positions on the present and future state of urbanity, ecology, and climate in the North Sea geographic space.

PREMISES

As a territory, the North Sea is the product of dynamic relations between natural processes and human activities. A dense urbanised ground, it has been shaped by the—mostly divisive—relation between flows of goods, capital, data, and people, the oil, gas, and fishery industries and, most recently, climate adaptation and clean energy infrastructure.(2) The nature and materiality of its habitats, edge conditions, and the succession of its multiple layers define the North Sea as an artefactual body of water. As a relatively small geographic space, it has, throughout history, been a point of departure for global infrastructural and industrial, environmental, and geopolitical interventions. The five projects briefly presented in this essay employed chorologic and topographic analysis to examine, transform, and finally unfold the possibility of new spatial constructs and forms of habitation in a viscous mixture of land and sea.(3) All the projects consider the recalibration of edge spaces at sites exposed to extreme sea level rise and eutrophication in two specific landscapes: the South-West Delta in the Netherlands and the Thames Estuary in England. The recalibration is designed as intention and concept, using material and ecological practices to modify the relation between different forms of land use, sociocultural practices, and environmental performance. This method gave form to new infrastructures, concrete or abstract, that set some of the agents and forces present in the sea-river-land continuum in a synergistic fashion.

The examples described in this essay investigate the altered nature of the North Sea territory, taking the current pressures of extreme urbanisation, pollution, and environmental decay, coupled with future scenarios of clean energy production and accelerated sea level rise, as a design opportunity. These present-day conditions form

the base for a spatial strategy that enables a gradual revolution: the transformation of hectares of coastal and riverine borders into living ecological infrastructures. Dissolving the static edge between land and water is central to this approach, enabling spatial interventions to act as a coastal and riverine flood risk management strategy as well as enabling new forms of economy. The projects employ multiple scales and temporal programming—connecting interventions at the macro (regional) scale to nano (process) levels, and from meso (urban) to micro (architectonic) levels. As a result, the compilation of the five projects introduces the possibility of a new sea-land relation, composed by the propagation of patterns of cultivation for new industries while providing space for carbon sequestration and ecological and hydrological rehabilitation from inland areas to the sea.

STUDIO PROPOSITION: NORTH SEA ALTERED NATURE AND THE ARCHITECTURE OF EXTREMES

When projecting the long-term geography of the North Sea, some important limitations were identified in the nature of its resource space. Whether considering reduced coastal edges, depleting nutrient levels, demand for infrastructure expansion, or ecological management, each theme included a call for cooperation and synthesis between different forms of human and non-human living systems and the oceanic space. Working within critical axes ranging from moderate to extreme climate change and from local to globally influenced socioeconomic development, the studio delineated scenarios that depicted what could be defined as radical outcomes, extreme climate settings, or uncertain images of the future. Yet, somehow, as we looked closer, we began to recognise pervasive interrelations between politics, economy, ecology, and space.

To place this in context and establish the basis for a common narrative within the studio, the produced scenarios assumed that the effects of climate change are negative and vary depending in part on the cooperation of political actors and their ecological and spatial awareness. Economically, the scenarios showed that the speed of our divestment from fossil fuels, toward, for example, renewable energy systems, will depend on both shared investment and political motivation as well as the key limit or availability of extractable oil. In turn, the ecological scenarios considered driving economic factors such as fishing industry production capacities in relation to changing sea temperatures and levels—involving, for example, fish migration toward northern parts of the sea due to warming southern waters.

Direct anthropogenic impacts encompass the disturbance of nutrient balance, marine pollution, and resource depletion. At the same time, indirect anthropogenic impacts—predominantly through climate change (sea level and temperature rise)—account for shifts

within the North Sea's biotopes and habitats, as previously explained. With these impacts intensifying at an unprecedented pace and the outcomes being largely unknown, any projections remain speculative. However, it is evident that negative feedback loops are beginning to dominate the ecosystems of the North Sea and adjacent bodies of water.

Finally, the studio explored the spatial implications of an extreme sea level rise on coastal areas. The extreme scenario of a global mean sea level rise 15 mm yr–1 (10–20 mm yr–1, likely range) and global temperature rise of 1.5 degrees Celsius acts as a warning for North Sea coastal countries.(4) The North Sea and its adjoining bodies of water constitute one of the major forces of climate issues in the region. The maps identified the Dutch coastline and the Thames Estuary as the most vulnerable areas, showing the spatial delineation of the projected flooding extent and the socioeconomic defence types currently in place. Taking other factors into consideration such as sea level rise and the North Sea currents, the projected changes point to coastal erosion and adhesion, affecting not only the coastline, but also patterns in urbanised cities. The southern coastline between England, France, Belgium, and the Netherlands is in a constant state of change, while the northern area of Scotland and Norway are the most stable areas, experiencing minimal impact, even with the projected sea level rise.

The extremity of change demands that actors take a collaborative approach, responding to earth forces and the microenvironments of each region; differentiating between the British Isles and the coastal regions of Belgium, the Netherlands, Germany, Denmark, and Norway. The shift toward cross-national collaboration and microclimate responsiveness maintains the possibility of addressing a number of different issues within the territory.

Overall, regardless of the chosen projection, the studio argued that the rapid increase and instability of earth forces, such as sea level rise, must inform a change of perception, intention, and practice—one that works with, rather than against the new state (of extremes). The following five projects illustrate ways in which this change can potentially be implemented.

RESTORING SYSTEMIC PROXIMITIES: TOWARD THE RE-TERRITORIALISATION OF THE DUTCH RIVIERENLAND, South-West Delta, the Netherlands (Isabel Recubenis Sanchis)(5)

Uncertain and extreme climate events challenge a particular territoriality that is reliant on the control of groundwater and river dynamics within urbanised Deltas.(6) In the Netherlands and particularly in the Dutch river area (Rivierenland in Dutch), new adaptive approaches to spatial planning and hydraulic engineering have already resulted in "Room for the River", a national planning

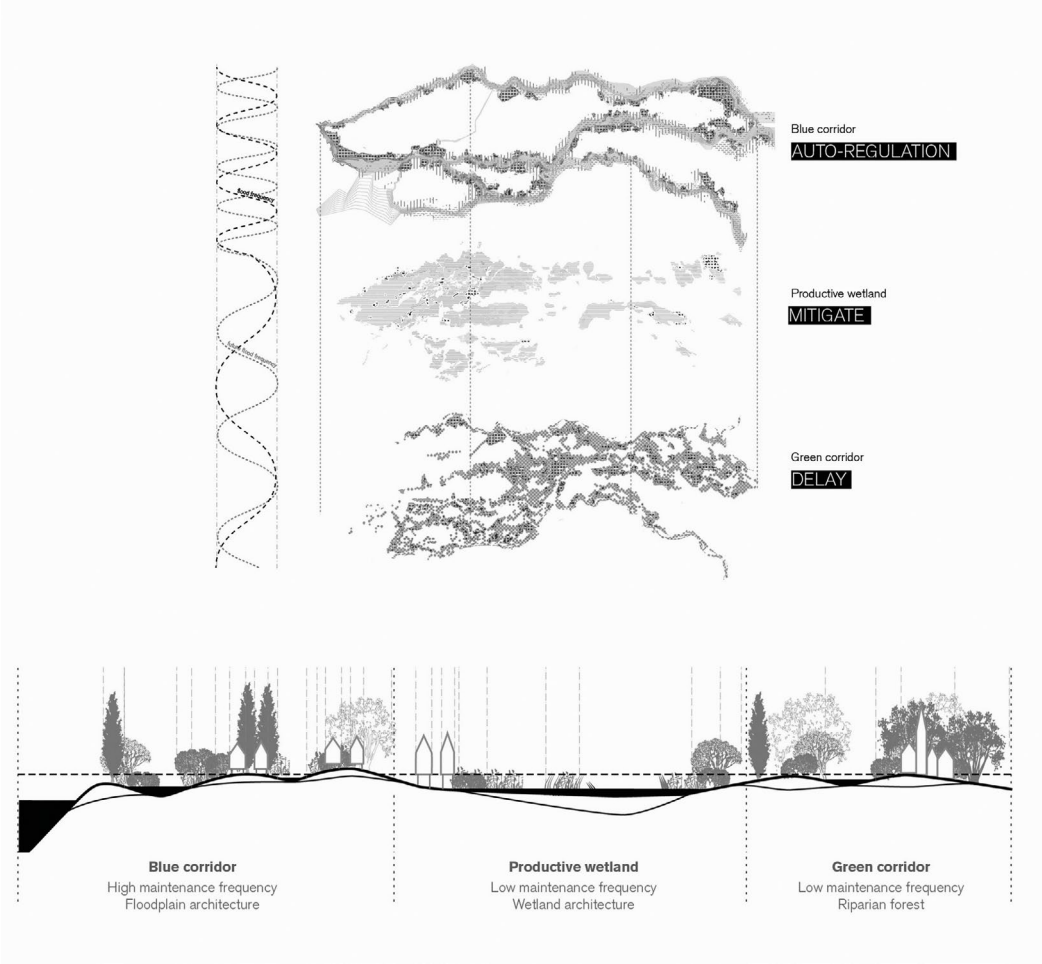

Fig. 1
Macro-Framework: Extreme-discharge function. Three geomorphological conditions with a type and frequency of flood disturbance and specific extreme discharge function: auto-regulation (blue/ river corridor), mitigation (wetlands), delay (green/ coarse-grained soil corridors). (Isabel Recubenis Sanchis, TU Delft 2020)

policy project that gives more space for the river while improving the spatial qualities of affected areas.(7) However, there is still a need to go beyond the physical, cultural, and programmatic separation in flood management between active areas—assigned to embanked rivers—and passive areas—assigned to the urbanised territory. The definition of these dualities in the Dutch territory not only feeds a model based on flood vulnerability—working under certain levels of river discharge—but it also leaves a fragmented landscape.

Aiming to embrace climatic uncertainty and river discharge extremes within highly urbanised floodplains, this project proposes a process-based approach to planning and a design based on radical connectivity throughout the Dutch Rivierenland watershed, where every part of the urbanised territory plays a role in the active management of floods and ecosystem restoration [Fig. 1]. The approach guides a specific spatial transformation consisting of a new topography of repurposed flood channels and depressed areas strategically distributed throughout the urbanised catchment and

the cultivation of a green infrastructure of agroforestry patches as riparian corridors. The decentralisation and dispersion of the flood and green network throughout the entire regional matrix upscales the space for groundwater and river dynamics by downscaling flood-related spatial interventions.(8) This model opens the possibility for a local management of flood events and regenerates the forested land cover of the watershed, all of which delays and reduces the hydrograph peak during extreme discharges, reducing the likelihood of flood-related disasters.(9)

The main outcome of the thesis is a process-based planning and design framework for the hybridisation of the territory by increasing ecological densities and buffer capacities, which upscales the green and blue infrastructure per land management unit—the plot—and functional layer as a result. The framework guides a transformational pathway where the synergetic coupling of functions is activated locally by landowners, triggering the cultural appropriation of the proposal. The project is positioned within an emerging urban paradigm, one that redefines the act of urbanisation as an act of reterritorialisation, where occupation is aligned with the ecology and shifting climatic frequencies of the particular territory.(10)

Extreme climatic events require that land be managed differently in order to restore and maintain the soil capacity to delay, store, and discharge water. The thesis explores the idea of performative land units by restoring the proximity to the river and the subsequent —economic, flood management and land regeneration— opportunities.(11)

CULTIVATED ECOLOGIES: OPERATIONAL LANDSCAPES OF MATERIAL PRODUCTION AS FLOOD-RELATED RISK INFRASTRUCTURE, Greater Thames Estuary, South-East England, UK (Sarantis Georgiou)(12)

This thesis elaborates on a theoretical, epistemological, and design research framework for the possibility of an operative synthesis of, on the one hand, climate-related risk management (flood exposure from sea level rise and coastal/tidal flooding, fluvial flooding, and/or pluvial flooding) and, on the other, the planning and design of operational landscapes of material production, as a means for sustainable ecological development.

Contemporary practices of managing ecological, environmental and climatic risk rely heavily on a "mitigation" approach, where the imperative is the restoration of a prior "natural" order or the spatial planning of the next waves of development and urbanisation according to the evaluation of the internal logic of natural processes. However, this line of thinking severely hinders the possibility of a creative and proactive reorganization of human processes of material production precisely because it presupposes a "nature-society rift."(13) Similarly, the negative externalities associated with the extensive and

intensive operationalisation of vast terrestrial terrains are viewed as singular phenomena to be addressed in situ and not as opportunities to fundamentally reconceptualise contemporary planetary urbanisation.(14)

This work is built on the premise that to properly address climate-related risk, one has to also address unsustainable patterns of material production and the physical and functional organisation of urbanisation. In contrast to the predominant approach of placing the emphasis on the "city", and following the development of the concepts of "concentrated" and "extended urbanisation" through the construction of gradients of "agglomeration" and "operational landscapes,"(15)(16)(17) this thesis attempts the opposite: by shifting the analytical centrality from agglomerations to the operational landscapes that sustain them, we are able to formulate an urbanisation hypothesis that addresses the requirements of the latter not as externalities of the former (thus hindering the capacity of the framework to be adequately socio-ecologically sustainable) but as the fundamental elements of the planning and design of the urban fabric. The thesis suggests that integrating within the urbanised landscape biophysical processes and ecosystem functions, which are central to the performance of operational landscapes, would offer climate-related benefits.

Assuming that this integration is an act of construction of the urban landscape which also partakes in its economic activities, this work reformulates Henri Lefebvre's opening statement in "*The Urban Revolution*": "society has been completely urbanised", as follows: "the urban has been completely operationalised," and attempts to elaborate on the coming-into-being of this reality: the project of the cultivation of the urban.(18) The proposal discusses the possibility that "agglomeration landscapes" become hybridised with "operational landscapes," meaning that contemporary cities and urban regions renounce their sole correspondence with the secondary and tertiary sectors of the economy and, in turn, take on the role of encompassing primary (i.e., material) production as well. The design and planning framework establishes the ways in which different compositions of forest plots, croplands and / or pastures could be adapted within existing urban areas and result in a landscape structure that performs for water-sensitivity. The geomorphology, geology, surface hydrography, and hydrology of the landscape influence water-regulation and flood-risk management, as well as the structure of the open space and the land-use/land-cover types.(19) Part of the ecological region of the Greater Thames Estuary that is most exposed to different forms of flooding is used as a case study, here referred to as the "border interface zone." The analysis considers the current landscape composition, the land-use/land-cover class types that exhibit the greatest potential for transformation and their relation to water-regulation and flood-risk management. The design proposes

suitable crop species and organises the crops in such a way as to provide water-sensitive performance as flood- risk infrastructure [Fig. 2, p. 265]. Existing spaces are reconfigured internally as well as receiving patches of forestry, cropland and/or pasture. These spaces become "cultivated landscape ecologies," contributing to a new landscape image.(20)

RE-NATURED ECONOMY: FROM POLLUTANTS TO PRODUCTIVE LANDSCAPES, South-West Delta, the Netherlands (Aikaterina Myserli)(21)

In light of climate change, it is clear that as a result of ecosystem derangement and the debasement of local economies in the name of globalisation and free trade, capitalism has almost exhausted its source of nourishment: nature. Cities seem to be more connected to the planetary system of production and trade than to their surrounding context.

To place humanity within natural processes and to define humans as custodians of nature's ecological heritage, are interventions well-discussed in the fields of urban, landscape, and environmental theory, however there are still challenges regarding their implementation. The question is: which new ecologies of the Anthropocene could transform negative outputs of our current economic model (pollutants, waste flows) into inputs of new productive landscapes?

The Dutch-Flemish Delta is used as the test bed for a new projective ecology. Pollutants causing eutrophication (nitrogen, phosphorus, CO2, algae) are captured in order to facilitate processes that generate value (food production, energy) and trigger a shift in economy that will both reshape the deltaic landscape as well as set the foundations for a bio-based future economy. At the core of this proposal lies the transformation of underperforming crops (mainly produced via arable farming, grasslands, and flower production) into algae crops in enclosed tubular systems that do not require fresh water but contribute to wastewater treatment and convert discharged nutrients into valuable [bio]products [Fig. 3, p. 266]. Traditional agriculture uses vast quantities of fresh potable water and releases phosphorus and nitrogen into the water through the extensive use of fertilisers. In addition to enclosed algal systems, the proposal investigates the creation of new wetlands by re-flooding polders with high saline soil and non-profitable crops; establishing macroalgae ponds in their place. These ponds may function as a model of filtration "layers" for agricultural and industrial discharges that would reduce the level of pollutants in the water and could bring back benthic and pelagic species that are currently forced to migrate.

A system where pollutants are subverted into resources requires, on the one hand, the transformation of local industrial systems from linear to circular (closed loops of flows, semi-open systems) and a new material economy (circular systems that generate value out of pollutants and a market for renewable resources) on the other. It is

noteworthy that in order to project a vision and develop an efficient strategic framework for such a shift in economy, it is crucial to understand and work with the relationships between large-scale regional strategies and more detailed, local design solutions. In this case, the temporal dimension is of utmost importance; fossil fuel depletion is a reality and a shift in economy toward renewable sources will take place in the years to come, therefore pollution reduction means pollutants may not provide sufficient input for a bio-based economy in the future. The proposed hypothesis is therefore a transition in time, an intermediate stage toward sustainable economic development. In the end, as pollution becomes historical, nature becomes a landscape of flows and fluids that co-exist and co-evolve.

REVERSED RISK: PROTECTIVE PRODUCTIVE CYCLE BASED ON TIDAL FORCES IN ESTUARINE TERRITORIES, Thames Estuary, England (Alexandra Farmazon)(22)

With more than 80 percent of Thames River banks transformed into concrete storm walls and the Thames Barrier in place since the 1970s, the dynamic tidal force is persistently causing storm surge flooding and flash floods throughout London's dense urban areas.(23) This makes the UK coastline a priority North Sea area—both in terms of event frequency and of prospective impact. Despite this urgency, the UK Environment Agency's funding for maintaining flood assets has fallen by 14 percent nationally. Recent investigations undertaken by the *Financial Times* quote John Pettigrew: "It is important that the UK is seen as a place that is attractive to inward investment. In terms of the energy sector, a lot of infrastructure needs to be built in the UK over the next few years. Post-Brexit, it is important that it is coming in."(24) While funding for the energy sector is increasing, the UK's flood defense plans are inadequate and lagging behind in investment.(25) As a consequence and if inundated, the Greater Thames Estuary region, currently containing 1 million properties, would suffer direct damage of at least £ 97.8 billion at 2003 prices.(26) Surely, the increased investment on the energy sector is justified as the North Sea is facing an era of fossil fuel depletion and overpriced electrical energy urgently demands a transition to clean, renewable sources. The UK is a leading power with the most extensive Exclusive Economic Zone coverage in the North Sea, including several fossil fuel extraction platforms that are currently being transformed into energy farms. This opens the opportunity to research and design productive landscapes triggered by coastal dynamics as a possible paradigm for energy futures. Therefore, this thesis proposes a spatial strategy that integrates coastal risk management and energy production with new ecosystems and land-use typologies.

Already, in shifting the focus of energy production to the maritime territories that engage in exchanges with the land, we are implicitly discussing coastal flood strategies. From a theoretical and practice point of view, there would be a clear interdependence between the hydrodynamics of the territorial sea and the adaptive coastal response to risk. However, the UK planning system regards these issues as separate entities, under separate departments, directly subordinated to Her Majesty The Queen. From the central government level, to the regional, county, and village level, flood risk and energy efficiency are managed separately under the Department for Business, Energy and Industrial Strategy (BEIS) and the Department for Environment, Food and Rural Affairs (DEFRA), while spatial planning is addressed through the Department for Communities and Local Government (DCLG), thus making any communication difficult if not impossible.

In response to these conditions, this project aims to bring these separated fields together through a new coherent, integrated approach linking flood risk and energy transition pressure. It proposes a strategy for production in estuarine waters, requiring a control body that involves all implicated departments and ensures the coordination of vision, policy, and investment. The project looks beyond the 2030 effective lifespan of the Thames Barrier and explores an alternative system of hybrid infrastructure that can reverse the flood risk factor toward a profitable tidal energy source, creating a protection/production cycle, simultaneously defending and "fuelling" the city, as well as retrieving its original investment [Fig. 4, p. 267]. Practically, understanding the value of natural forces, paired with adaptive capacity patterns builds a gradient of spatial and performance suitability. This creates a system of critical intervention areas directly supporting and conserving their anthropic activity within the urban system. A coherent spatial assessment framework is proposed, which results in identification of critical locations and a paired governance implementation model. The following design approach then zooms to a system where a restrictive, regeneration urban area is transformed into natural protected landscapes. As a result, the protective infrastructure boosts the regional economy by promoting an agricultural transition to aquaculture and an energy self-sufficient urban district.

A NON-STRAIGHTFORWARD ARCHIPELAGO,
South-West Delta, the Netherlands (Neil Moncrieff)

As Erle C. Ellis has suggested, "In the Anthropocene, there is no possibility of removing human influence from ecosystems: anthropogenic transformation of the terrestrial biosphere is essentially complete and permanent."(27) Ellis also claims that few remaining natural systems demonstrate no human impact and it is at the junctions between natural and urban systems where the impact

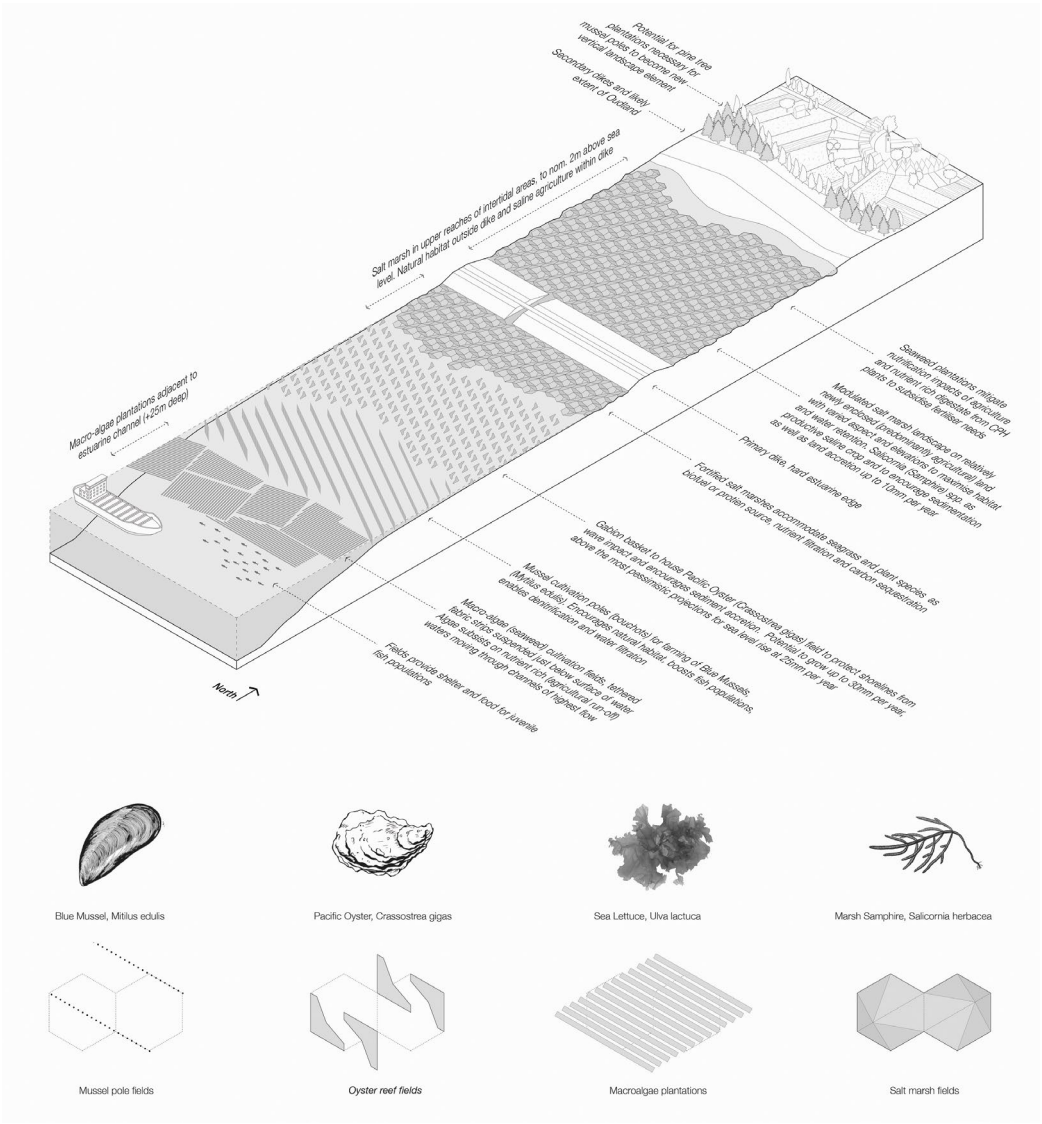

Fig. 5
New spatial typologies at Oosterschelde (Neil Moncrieff, TU Delft 2020)

of, for example, habitat degradation, pollution, or resource over-exploitation, as well as the complex series of interactions between culture and landscape are most apparent.(28) As neither system holds sway, this is also where local interventions might have the broadest impact: both in terms of the cultural changes exerted on the environment and the psychological and behavioural impacts that these environments exert over the occupying communities.

The Dutch relationship to landscape is particular and the physical construction and ordering of the landscape in response to the ever-present threat of inundation has had as much impact on the cultural psyche as it has on the deltaic groundplane. The question is whether the elements that come together to compose the unique

visual and cultural character of the Dutch landscape might be replicable, or at least employed again in different ways, to address today's environmental and existential threats. What might be a contemporary estuarine equivalent of the traditional patterned, agricultural, and infrastructural polder landscapes?

A possible consequence of the contemporary re-evaluation of Dutch flood and water management strategies could be a return to more naturalistic estuarine conditions within the South-West Delta. This has the potential to re-animate natural systems and habitats as well as bolster cultural connections to, and across, this landscape. But how could this re-naturalisation benefit the urban landscapes and economies that negotiate the transition between one of Europe's densest urban, industrial, and logistics corridors from Brussels and Antwerp to Rotterdam, and the equally congested territory of the southern portion of the North Sea? Could a new spatial typology of designed ecologies (nature-based solutions) prompt a re-orientation of both natural and urban ecosystems within the delta toward greater social, economic, and ecological efficiency and resilience? Can alternative spatial organisation driven by an alternative notion of flood protection, productive landscape infrastructure and a new land-use transitional delta logic respond to different tidal forces over time?

This project suggests four new ecosystems and land-use typologies, namely mussel pole cultivation fields, oyster reef installations, macroalgae (seaweed) plantations and salt marsh meadows. The design and spatial arrangement of these ecosystems is driven by their Oosterschelde context, conforming to a new, shared spatial grid, in turn defined by the individual productive and/or locational requirements of the ecosystems themselves [Fig. 5].

These new typologies should improve environmental, biodiversity, and habitat values as well as reorient the delta flood defence and water management systems, moving away from hard, engineered measures (as typified by the Deltaworks) toward softer, more naturalistic infrastructures that are able to keep up with sea level rise. This designed deployment of ecosystem engineering measures also aims to be of economic, cultural, and social benefit, with strong spatial characteristics that could foster community, visual, and economic connections to the new landscape. The system could expand and close functional and systemic loops (e.g., carbon, nutrient, and productive cycles) as well as facilitate the broader intellectual, logistics, and cooperative networks required to distribute biomass, local power or heat, and new seafood products.

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[Fig. 2] Based on “"Ordnance Survey: OS Open Data." 2019. Accessed 08.04.20 https://www.ordnancesurvey.co.uk/opendatadownload/products.html. Rural Payments Agency. 2018. Crop Map of England: Product Specification - v.2018.2; Ordnance Survey: OS Open Data.” 2019. Crop Map of England (CROME) 2018.