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Post Rationality of a Hydraulic Civilization: An Ecological Transition for the Vietnamese Mekong Delta

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A radical project is proposed for the Vietnamese Mekong Delta, calling for the urgency to realize its Ecological Transition, as a response to the need to reverse the detrimental environmental impacts accumulated over the course of its history of agrarian colonization. The article reveals the evolution of the delta's territory, through an atlas of palimpsests regarding the delta's past transformations primarily driven by the hydraulic management of its territory. The resulting environmental degradation and obliteration of much of the Mekong Delta's ability to self-regenerate are found in large part as the consequence of the devotion of the delta's ecosystem resources to mass rice production; driven by vast irrigation infrastructural expansion. However, as an unintentional consequence of the investments made in infrastructural networks during the Green Revolution, a new value was propelled by farmers and the local community through the diversification of infrastructural uses, resulting in hybrid rururban land transformations, indicating the potential for Ecological Transition in the delta. Through the theoretical perspective of alternative ways for metropolization defined in the 'Horizontal Metropolis' and the conceptual approach developed under the 'Project of Isotropy', post-rationality of the agrarian territory is proposed through the reorganization and design of the primary canals established for irrigation after the 1986 'Doi Moi' reform period. Social-Techno-Ecological corridors are proposed to transform the currently overlooked and engineered canal settlements living in Long Xuyen Quadrangle and Can Tho province, through a resilient community-based living and cultivation paradigm based on the advancement of the traditional Vietnamese VAC (Garden-Pond-Animal) model. In addition, the Water Ecological Framework is proposed as a wider Delta Intervention whereby a series of circular water processes can take place ecologically across the territory, to promote the partial reinstatement of the Mekong's deltaic regenerative processes.

POSITIONING THE MEKONG DELTA

Located in Southeast Asia, the Mekong River spans across China, Myanmar, Laos, Thailand, and Cambodia, before ending in Vietnam. The Mekong River along with its tributaries traverses 4,900 km across these regions eventually reaching the Mekong Delta in Vietnam before flowing out into the South China Sea. Towards the Southern East Asian milieu lies the Vietnamese Mekong Delta, which begins at the intersection where the Mekong River and branches out into multiple tributaries along with the Bassac River, together forming the "Nine Dragon River Delta" at the southern capping end of Vietnam. As a watershed at the receiving end, the Delta collects the remaining stream affluence being released from upstream, after the water's flow and sedimentation have been significantly altered by geopolitical drivers upstream.

Furthermore, the Mekong Delta consists of a rather vulnerable ecosystem affected by many other factors in climate change. Numerous scientific studies have concluded dire existing impacts of climate change, Sea-Level Rise, and Anthropogenic processes on the Mekong Delta. Future projects are even more urgent, with numerous overlapping alarming claims in the increase in Sea-Level Rise, flooding, drought, land subsidence, salinity intrusion, as well as a decrease in sedimentation needed to nourish the delta's estuary and ecosystems services enabling food production. According to the Ministry of Construction, the Vietnamese government has projected that the Vietnam Mekong Delta will be sunken underwater by 2050. (Tuan, L.A. et al. 2007; Piman and Shrestha 2017; Minderhoud et al. 2018; Minderhoud et al. 2019; Minderhoud and Middelkoop 2019)

Moreover, within its regions, various administrative cities and provinces depend on agriculture as their primary economic activity. Rapid agricultural and aquacultural production by corporate industries have significantly altered the territory's natural resources, and intensive urbanization of the Delta's thirteen provincially designated urban centers has transformed the natural land cover with increasingly asphalted grounds in favor of densified urban conditions, resulting in increasingly intensified floods and polluted storm-water run-off during wet season.

DELTAIC ECOSYSTEMS PROCESSES

To appreciate the Mekong River's naturally regenerative processes, it is essential to note the dynamic flow between the Mekong River from upstream to downstream as it approaches the Mekong River Basin to the South. This dynamic flow becomes more complex as it merges with a second set of watersheds creating another relationship between the Ton Le Sap reservoir in Cambodia and the Deltaic floodplain watershed at the receiving end in the Mekong Delta. These combined densities of tributary water flow and watersheds create challenging seasonal dynamics of opposing water pulses, as shown in the map of the Greater Mekong Delta's transboundary regions of water ecosystems with the locations and extents of the pulsing watershed relationships between the Mekong River, Ton Le Sap, Cambodian reservoir, and the Mekong Delta.

figure 01 — page 28

As a lowland Delta, the Mekong's Vietnamese region is characterized as a tidal-dominant Delta, morphologically composed of the sedimentation process deposit loads coming from the upstream fluvial flow of the Mekong River. The Mekong Delta post-glacial transgression began around 6000 ±5000 yr. BP. A process of land accumulation occurred through deltaic sedimentation deposits and other processes over the centuries, resulting in the coastline extents and remaining seawards, which were established within the last 2000 years (Lap Nguyen, Ta, and Tateishi 2000). As a result, the delta is a wide and relatively flat landscape that fans out into the sea through its nine river tributaries and naturally serves as a fertile landscape for agriculture as the 'rice bowl' of Vietnam. It is also important to understand why this landscape has come to be so fertile and biodiverse, as sedimentation from upstream flows in during flooding season, releasing rich nutrients into the ground. This opposing flush and sedimentation depositing process has formed the Delta across centuries and allowed for the regeneration of its biodiverse waters and soil nutrients (Lap Nguyen, Ta, and Tateishi 2000; Goodbred and Saito 2012; Tran 2016; Thanapon Piman 2017).

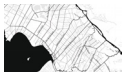
WATER INFRASTRUCTURE AS RATIONALITY FOR THE MEKONG DELTA'S TERRITORIAL CONFIGURATIONS

The following atlas series borrows the palimpsest analytical approach originally founded by André Corboz in the 1970s (Corboz 1983) . Through the generation of 'palimpsest mappings' of the historical canals that have remained up-to-date, the sequence of mappings reveals how each can be traced back historically informed by the sequence of events, to essentially building up the rationality behind the hydraulic development in the Long Xuyen Quadrangle over time.

The first canals date back to the Funan kingdom period, they were built to link the empire to temples located in the Oc Eo mountains. The main spinal canal flowed with the current of the delta's flood pulse, connecting a trade route to Cambodia in the northwest *figure 02— page 29*  . However, by the 1800s during the Nguyen Dynasty, the dredging of Vinh Te and Thoai Ha canals was constructed against the direction of natural streams, cutting right thru to strategically drain water coming from the Bassac River into the sea in the Gulf of Thailand. Rice cultivation had already been introduced as part of Vietnam's effort to enhance labor and food production. *figure 03— page 29*  Furthermore, propelled by French colonialists during the turn of the century from 1880-1930 with the introduction of steam-powered dredging machines, additions to the three original major channels were established, with the new Rach Gia and Rach-Gia Bassac canals planned as linkages between urban areas, to connect Rach Gia port city to Long Xuyen city; and multi-directional canals linking different towns. (Brocheux 1995; Biggs et al. 2009)

figure 04— page 29 

It is important to note that the former logic of the Funan kingdom canals had been wiped out in favor of appropriating land for rice cultivation by reclaiming the flood-dominant region in the flood-depressed zone. Evident that the French colonies did not initiate the alteration of the water flows, rather they merely expanded on the logic originating from the first three major channels established by adding more primary canals along the same direction to further link riverine flows to the sea. 'Floating markets' were introduced as canal-based exchange points in the 19th century well before the Cochinchina period as central trading market centers, enabling water mobility access to farmers and business people with fresh goods to sell from surrounding provinces. (Marchand, Pham, and Le 2014; Brocheux 1995; Ngo 2021)

The next palimpsest map reveals how almost all the originally excavated canals have remained up to date; as either maintained or upgraded since the French colonies left after 1954. During the war in 1965, additional canals completed the river-to-sea drainage logic evolving the territory into a system of canals forming a "comb-like" pattern, with main canals feeding from the Bassac River and releasing waters into the Ha Tien – Rach Gia main canal which serves to collect water flows along the coast to be released into the sea. *figure 05— page 29*  During the 1975 reunification period, reform policies were put in place, and the Rice-based farming system development state was established shortly after (Nguyen Duy Can et al. 2007). With nearly all primary canals put in place, the total territorial cultivation shift from traditional farming of transplanting and floating rice practices into monocultural rice production had been completed, whereby high-yielding rice varieties had raised rice production from single to double crops annually. As the primary canals became more networked with additional second ary canals, farming-scale irrigation systems were implemented. *figure 06— page 29*  By 1984, the primary canals had become subdivided by canals added in between their spans. The intensified 'comb-like' system developed smaller watershed compartments, artificially controlling flood waters in favor of an irrigation system. Completing the anthropogenic transformation of the delta into a "Delta Machine" (Biggs et al. 2009) or a hydro-techno-managerial state, composed of gridded and compartmentalized agricultural field. With all of the infrastructure investment made to bolster rice production, canals expanded rapidly to over 2.5 million hectares by 1995, nearly doubling the amount built in 1975 (Ducourtieux et al. 2018). The gridded state of the delta evolved complete with subsystems of sluice gates, elevated dikes, and pumping stations. This augmentation of the irrigation system not only gave way to the intensification of rice production to meet national food security, but it also exceeded the production quota with a massive surplus propelled by competition in global exports.

Additional layers to the the palimpsest map up to the 1990s, show how the original roads were upgraded as highway grades along the old canals providing linkages between urban centers to town centers across the provinces. Most significantly, a new response to water infrastructural investments emerged, revealed through land change activities across the rururban fabric. For example, as dikes were raised or constructed, new

access to subsequent road infrastructure was leveraged as protected properties within access to economic activities, resulting in the thickening of linear settlement (shown in dashed lines) along roads and the subsequent expansion of urban towns.

In addition, large-scale gridded masterplans, and block-scale developments had spontaneously emerged at given intersections across the entire fabric (shown in orange), in response to access to national road networks, as another layer of gridded blocks over the water and road network. This development reveals a new value propelled by the local population challenging the water infrastructural investment built, essentially adding a new layer of economic activities on top of the agricultural fields.

figure 07— page 29

First, the palimpsest atlas reveals how the development of the canal and subsequent road infrastructure has propelled rururban growth across urban towns. Over time, the original nodal towns established at the intersection between canal channels expanded via linear development, that have sprawled across the main water and mobility networks. These linear networks are activated by work-live activities that have thickened the fabric. This new kind of rururban growth was defined in France in the 60s and 70s as rururbanization (Barcelloni and Viganò 2022), whereby urban flight explosion into the countryside resulted in response against the formal urban policy, and villagers built their own homes densifying the countryside.

Analogous to rururbanization in Europe, Terry McGee identified the 'Desakota' or 'city – village,' phenomenon in South Asia during his further studies, revisiting South East Asia's urban fringe to reassess the challenges of Mega urbanization (1991). Desakota is a phenomenon whereby the extended built area located between the agrarian landscape is driven by activity flow as

"Distinctive areas of agricultural and non-agricultural activity… emerging adjacent to and between urban cores, which are a direct response to pre-existing conditions, time-space collapse, economic change, technological developments, and labor force change occurring in a different manner and mix from the operation of these factors in the Western industrialized countries in the nineteenth and early twentieth centuries" (Ginsburg et al. 1991)

Alternatively, the palimpsest atlas reveals the mechanisms led by hydro-technologically and managerially driven policy, that has radically altered the delta transforming its territory against the laws of nature. Despite the first influences or traces of canals set in place during the Nguyen Dynasty and the French Cochinchina period, the rapid progression of historical events that most influenced the territorial changes occurred after the war ended in 1975 when global knowledge in technological and managerial ingenuity and foreign investments became widespread after the 1986 reform period. By the late 1990s and early 2000s, canals became more mechanized due to reactions to natural disasters in flooding and interest in intensifying rice production. Processes once in tune with the cycles of the monsoon's wet and dry seasonal patterns were superseded for more predictable albeit less sustainable practices in flood protection and revenue in monocultural rice varieties dependent on water management coordination of mechanisms including irrigation channels, sluice gates, pumping stations and dikes.

Overall, the palimpsest maps show the progression of territorial transformations made through the zoning of different water control mechanisms and subsequent responses: From the alignment of the first canals to the artificially devised watershed management system developed through added water channels and mechanisms, and over this system, rururban growth activities and the market response deploying large-scale project blocks.

POST-RATIONALIZATION OF THE DELTA'S WATER INFRASTRUCTURE

The delta's history of water territorial rationalization driven by its hydraulic regime and subsequent local interactions responding to the water infrastructure, has anthropogenically altered the Mekong Delta's ecosystem. The modern delta's hydraulic management rationality was set against the law of nature, resulting in the destruction and gradual obliteration of the delta's ecosystems composed of forests, mangroves, wetlands, and fauna habitats living in the former floodplains. Unpredictably, despite investments made in the agricultural sector, the rice industry's effectiveness in production has also suffered the consequences of anthropogenic impacts due to decreased fertility from environmentally contaminated waters and degraded soils—putting into question the Mekong Delta's complete devotion to intensified rice production in over 60% of its territory.

In the 1970s, worldwide capitalism thrived under the global urbanization strategy as part of the Urban Transition, which accelerated large-scale corporate manufacturing and industrialization for national economic growth and modernized living standards around the world. However, rapid urbanization resulted in the spatial dominance of centralized city areas to the periphery and rising income inequality, underemployment, and deteriorated material conditions in the countryside (Friedmann 2005). Moreover, it essentially resulted in territorial fragmentation politically and socioeconomically with the subsequent degradation of natural resources. However, Vietnam is still catching up in the Urban Transition for rapid industrialization concerning other Asian countries like China, Malaysia, Thailand, and India. Nevertheless, this serves as an opportunity to rethink this rapid Urban Transition under the contemporary environmental crisis of Climate Change and the planetary limits highlighted by Planetary Urbanization and the resulting State of the Anthropocene (Neil Brenner and Christian Schmid 2017; Kelly 2020).

Driven by rapid urbanization and industrialization aims, the concept of the Urban Transition in Vietnam has resulted in spatial dominance, income inequality, and environmental degradation (Friedmann 2005). However, Vietnam's slower pace in the Urban Transition presents an opportunity to rethink development under the context of the contemporary environmental crisis. The current urbanization challenges faced by compact cities in the Mekong Delta include water pollution, flooding, groundwater depletion, and other vulnerabilities to adverse climate changes. These challenges highlight the need for a shift towards more sustainable and resilient development approaches.

However, it is encouraging to discover that the delta's territory exhibits a new value propelled by its rururban population, one characterized by peri-hybridization of the urban-rural milieu driven by 'Desakota' land-

use changes accompanied by increased economic activities and growth. These activities challenge the traditional water infrastructural investments made during the Green Revolution and present alternative rationalities for development evoking the need for the multi-functional use of the irrigation system.

Thus, the hybrid land transformations and economic activities propelled by farmers and local communities indicate the potential for an Ecological Transition in the delta. This transition involves integrating urban and natural processes between humans and non-humans, promoting new social-ecological processes in the territory. The potential for these peri-urban, rururban territories to take on the new Ecological Transition could offer a more resilient approach to the alterations that have been pushed locally by reinforcing the transition initiated by the local population, albeit with more beneficial consequences in climate change resilience.

THE DELTA AS A HORIZONTAL METROPOLIS

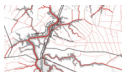
As a response to the observations made regarding the urban-rural push towards peri-urban hybridization, the research hypothesizes on observing the delta from the concepts and phenomena found in the Horizontal Metropolis discourse, as a suitable perspective for the delta's territories and a relevant approach towards climate resilience in the Mekong Delta's urbanization future.

The research's theoretical perspective is based on the conceptual and contextual definitions derived from territorial observations generated and a suitable theoretical discourse highlighted based on the findings of palimpsest research. The phenomena found have been highlighted across worldwide metropolises and peripheral territories. An alternative way of metropolitanization has been observed through the concepts developed by the gaze of the Horizontal Metropolis, derived by Bernardo Secchi and Paola Viganò across explorations of Brussel's regions (1990-2014), which evolved as a discourse of common cases found worldwide. Taking on the challenges posed by Infinite Suburbia and Planetary Urbanization (Neil Brenner and Christian Schmid 2017; Berger and Kotkin 2018), the Horizontal Metropolis addresses how infinite urbanization expansion has taken on diffused and isotropic territorial characteristics, often supported by autonomous spatial capital and or natural processes.

Preceding the discourse, the idea of the Citta Diffusa claims that the European metropolitan city is characterized by self-organizing processes across dispersed or diffused living territories. Discovered in Italy; Citta Diffusa was founded by Indovina in 1990 and further investigated by Secchi and Viganò, whereby once dispersed territories were found to be transformed by centralized urbanization. A call for a diffused project paradigm has been established as a solution to the environmental challenges; for example, the Project of Isotropy calls on the relationship between water ecologies and spatial design strategies in territories extensively infrastructured in the long term (Viganò et al. 2016). As such, the project for the Mekong Delta centers on the hypothesis that applied across the Mekong's territorial organization, the concept of Isotropy could catalyze resilient delta transformation.

The lamination of multifunctional constructs found in the delta's palimpsest maps, in parallel to, and across the canals, resulting from informal rururban economic activities, have created different states of hierarchy, producing various orders of access, uneven centralities, and fragmented landscapes, essentially polluting or obliterating the natural water ecosystems. In addition, uneven geopolitical processes in hydraulic and urban planning projects have further fragmented states of nature, which includes the lack of water management coordination between large provincial scale canals and water irrigation infrastructure and district-to-local scale canals.

figure 08— page 30



Consequently, the Mekong Delta's urban-rural territory has become fragmented by spaces controlled by hierarchical order, driven by relationships to mobility access and activities along industrial, and commercial corridors. Over time, water management planning coupled with the thickening of linear settlement activities has created uneven access and water resource distribution, disturbing the natural water-ecosystems processes. In addition, densification has resulted in urbanization challenges such as urban floods due to low capacity drainage and water pollution due to a lack of water-sewage management.

The challenges posed by the Mekong Delta's conditions under the umbrella of not only climate change and the State of the Anthropocene but the challenges posed by the delta's disturbed water ecosystems due to geopolitical processes, all become subject to a radical project based on the figure of discourse posed by the Horizontal Metropolis: To answer the challenges between the disconnected, diffused and clashing mixed territories resulting from processes of technological modernization, the centralization of urbanized planning as well as the decentralization of production—privatization, globalization, and corporation. Under the Horizontal Metropolis, the region's future extended metropolis can act as an agency of transformation of horizontality and metropolis, as a radical project, whereby non-hierarchical horizontal processes and relations between water nature and human urbanization can be (re)introduced (Barcelloni Corte 2019) across the delta's extended post water techno-managerial territory.

Since the modernization of water and mobility networks has imposed hierarchical structures across the delta's natural landscape, consequently threatening its water ecosystems, a radical project must be envisioned for the Mekong Delta, under the Project of Isotropy. Under the Isotropic concept, diffused water networks across the landscape act as a kind of "sponge," or permeable natural surface whereby water could be diffused in all directions and natural processes could proceed—as a counter critique to the asphalted state of the modernized contemporary planning model centered on automobiles (Viganò et al. 2016). The challenge includes how to regenerate the original isotropic qualities of the delta's ecosystem, as a post-rationalization of these infrastructures which cannot be overlooked, to transform them into another kind of nature characterized by the social-ecological interrelationship between water and technology—as new Social-Techno-Ecologies.

The Project of Isotropy serves as the approach to reframing water challenges under a project scope, one adaptive to living within water and saline environments, one that equalizes the currently fragmented geopolitical territories through an added scale of habitability and a framework of integrated interrelationships across socio-ecological processes.

AN ECOLOGICAL TRANSITION: SOCIAL TECHNO ECOLOGIES

As a gridded water machine, the development of the Mekong's agrarian territory has yielded modular dimensions, ideal conditions for the deployment of prototypical projects; however, to be developed based on contextual conditions to directly respond to the delta's environmental challenges at the local level as a post rationality to the vast kilometers on-end of systematic canalization networks. As engineered canal structures, they are proposed to be reframed to break down the industrial planning set by the agrarian regime, into ecologically viable and livable spaces through continuous interrelationships between nature and the built, to foster a sense of place in the urban-rural milieu. Thus, a radical project, ecological diversification is proposed to evolve the existing canals into 'Social-Techno-Ecological' corridors, by transforming the currently engineered water channels into ecological continuities across the delta's territory to incorporate processes conducive to ecological resilience, biodiversity, and multifunctional cohabitation spaces between humans and nonhumans alike.

Strategically, 500 meters shall be planned as a 'flexible' zone along each side of the canals to make up a total of 1 km corridor space, to be reorganized as spaces for inhabitation, gardening, recreation, and farming. These Social-Techno-Ecological corridors are envisioned conceptually as a dedicated multifunctional space to foster the paradigm of "making room for the river;" whereby different water spaces could be appropriated during the wet season and cultivated based on different freshwater bodies, re-naturalized water bodies by wetlands, mangroves, and forests, to regenerate water, soils and ecological spaces.

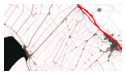
For example, ecological approaches are envisioned to bring back traditional floating rice practices, via cultivating the ecologically agricultural farming village unit. Through historical and local knowledge of the farming community system, the VAC system (Vuong- garden Ao- pond Chuong- animal stable) could further evolve as a sustainable approach—this Vietnamese traditional living model integrating the kitchen garden with farm animals and pond, could be brought into the contemporary discourse of circular living systems (Ueda 1996; Nguyen 1996; Nhan et al. 2005). Hence, the project aims to free up water space along the canals to create a new habitable relationship between water nature, habitat space, and the delta's wet and dry seasons. As a planning mechanism, existing dikes shall be transformed by incrementally depoldering parts, to release water spaces into the agrarian landscape, embodied as natural water spaces and as productive spaces incorporated within the new VAC farming processes.

STRATEGIC OPERATIONS

The project strategizes on re-appropriating parts of the comb-like structure of canals, however, it would be too challenging to involve the ones initially established by the French colonial period, since they have evolved into densely inhabited canal settlement areas over time, activated by the intensification of water and land infrastructure which have attracted multiple flows between industrial and commercial activities. Hence, the original canals, exhibiting thickened activities, as shown in dashed lines, shall be omitted from the transition.

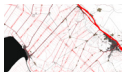
Instead, subdividing canals added, in between the ‘comb’ lines established after the 1986 'Doi Moi' reform, still serve predominantly as irrigation systems, to promote intensified agricultural fields in the Long Xuyen Quadrangle region; as such they remain sparsely inhabited. Valorizing the ecological potentials of these highly engineered yet lightly settled canals, the project strategizes on transforming them into Social-Techno-Ecological corridors, as part of the diversification initiative to foster an Ecological Transition in the delta. Composed of versatile multifunctional land types, these new water corridors shall foster water-based communities with spaces for work, live, and leisure.

figure 09— page 31



The proposed 'Social-Techno-Ecological corridors' serve as a place where natural and artificial processes could coexist between water ecosystems and cohabitants. Whereas the economic activities existing along the historical canals could resume, a phasing of new activities based on new water spaces shall prevail to take shape along subdividing canals, as the agency for generating new interrelationships, as a new attractive place for cohabitation. (Wilcox et al. 2019) Once implemented across the network system of canals, these corridors shall expand to create a continuity of landscape ecologies for multi-specie inhabitants across the territory. This growth is envisioned as evolving into patches of diverse pockets directed across corridors to regenerate all the different kinds of life throughout the Mekong Delta and reinstate its countryside with peri-urban ecosystem relationships. As such, the canal-based communities shall benefit from rururban social-ecological dynamics and regain a sense of empowerment, well-being, and belonging, as a resilient territory valorized for its abilities to cope with climate change impacts and generate ecological values in the delta.

figure 10— page 31



The sectional transformative process of the engineered canal structures shows a set of alterations made, from the existing conditions to the proposed prototypical Social-Techno- Ecological corridors. The existing primary canals range approximately 20 to 40 meters in width with elevated embankments protected by dikes, from 1.5 to 2.5 meters in height; many of which are typically doubled-up as road networks. Homes typically line these roads through privately built ramp access; in this case, the house is built on an elevated concrete platform with a light ramp access to the road. Orchards are cultivated alongside the property plots and intensified agriculture spans the rest of the field, up to 14 kilometers beyond.

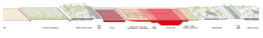
Proposed as a stepped water terrace system at 1-meter escalations, the new water space is achieved by depoldering parts of the dike off both

sides of the canal, opening up a new kind of space for different water ecosystems to enter. In response to the increasing pattern of aquacultural ponds that have sprung up mainly along diked roads since 2008, a prototypical water pond used for water retention or as a fishery is proposed in the scenario, right adjacent to the lowered portion of the new canal system. As such, the pond utilizes water directly from the canal, enabling the deltaic water inundation and filtration process to take place and provide essential nutrients (image b). figure 7 page 00

figure 11— page 32 

As a result, the widened 1 km Social-Techno-Ecological corridors are created with a variation of 10 to 40 meters in width of different water bodies along the canal, significantly expanding the original waterline inland. Additionally, the proposed dwellings are set back with water gardens lined up along the new waterline. A new diked road system planned to set the conditions for generating a polder town, is proposed setback up to 60 meters inland; which allows for the provision of habitable land within access to road infrastructure and different possible land cultivation patterns between the agricultural fields beyond.

The axon view of the transect illustrates the state of water transformation, showing different gradients of spaces from bodies of waterscapes to garden landscapes. The differences in water levels carve out different areas of wildlife habitats, consisting of fauna, flora, and fish species. Here the flow of the deltaic waters plays a role in the ecologies that shall form along the edges of the new waterline, and a natural landscape composed of multi-species adaptive to different water bodies including marshes and mangroves. In contrast, the network of irrigation channels is upgraded with filtration systems, to better support various cultivation system patterns of permaculture.

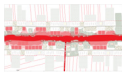
figure 12— page 32 

Thus, in adapting to the impact of climate change and sea-level rise, rising water levels are no longer problematic, since the cultivation pattern could be switched. For instance, when the water level is high, it fills the ponds for aquaculture harvesting, when it lowers different floating rice practices could be supported and once it recedes, the soil could be treated to plant crops. More importantly, the Vietnamese cultural heritage of canal-based living could be preserved, however, upgraded within access to collective facilities, housing communities, and public services in soft infrastructure such as collective gardens and different water filtration and retention systems.

As part of the Ecological Transition, the Social-Techno-Ecological corridors paradigm offers thickened moments composed of multi-layered types of open spaces that laminate the canal, creating a system of integrated mosaics whereby ecosystem processes and cohabitation could take place. As such, a diffused urbanization pattern is shown as self-sufficiently supported by the ecosystem services made available. Spanning as a landscape transect reaching from the waters into the fields, each community unit consists of about 4 to 6 households sharing a 30 by 70-meter plot, accompanied by hundreds of meters of farmland extents, composed of local animal farms, orchard, fruit trees, vegetation, and other

horticulture and aquaculture usages. Homes directly facing the waters are protected on raised beds and new dikes which fluctuate before connecting back into the existing dike alignment right adjacent to the canal, running along a span of the proposed setbacks which may range anywhere from 10 to 60 meters back, depending on the existing conditions.

figure 13— page 32



With the replenishing sedimentation processes made possible by the partial reinstatement of flood waters into new water spaces, the shared community gardens benefit from fertile soil to cultivate food from nutrient resources. The new community-wide Social-Techno-Ecological corridor serves as an experimental ground whereby organic methods in permaculture, horticulture, and other innovations could be explored through a second VAC generational approach, well supported by equipment allocated within collective structures (in yellow). The cultivated fields bolster current practices of extended orchards and annual perennials, through more circular approaches in organic farming, to harness resilient practices. With the vision of inverting the current paradigm centered on the agricultural fields, by introducing more multifunctional options in landscape more resilient than mono-cultural rice practices, via the extension of different plantations into the fields beyond. The incremental elongation of biodiverse plots across the agricultural field serves as a strategy to, in the long run, phase the delta's homogenous territory into an ecologically connected patchwork of landscapes, that would support different lifeforms and promote biodiversity through ecosystem continuity.

MEKONG DELTAIC INTERVENTIONS: WATER ECOSYSTEMS FRAMEWORK

To fully realize the Ecological Transition, Deltaic Interventions are introduced as a wider framework interconnected to the Social-Techno-Ecological corridors at the regional scale. These interventions shall ensure that the process of delta regeneration and provision of ecosystem services can take place from the watershed scale across the water ecosystems. This regional scale scenario is proposed to be implemented through the integration of a proposed system and subsystem: Delta interventions propose a wider system of 'Water Ecosystems Framework' to be planned and organized across the delta's region and in contextual relationship with Social-Techno-Ecological corridors applied as a subsystem.

To revive decades of biodiversity loss, the Mekong deltaic interventions regard the "Water Ecosystems Framework" as a broader operation to reinstate the regenerative processes of the Delta. This framework addresses the challenges of floodwater and stormwater run-off and subsequent pesticide and fertilizer-based pollution, which is compounded by CO2 emissions across increasing traffic from dense urban areas. Deltaic interventions span from the northwest to southeast through a series of water flows to create the Water Ecosystems Framework, which traverses across the canals transversally, to better manage water flows via different levels of water retention and filtration processes, and "making room for the river" by reinstating part of the delta's natural flood pulses within designated floodplains.

figure 14— page 33

Thus, this framework allows for reinstating the natural floodplains in Long Xuyen Quadrangle, with the ability to deliberately flood large portions of the current irrigation system as a means of water retention, filtration, and soil cleansing, subsequently depolluting the water and the soils through controlled flood management, replenishing essential sediments and nutrients on the ground. For instance, new pockets of flood waters can be preserved within planned water basins connected to the ecological corridor framework by filling in water compartments between the canals.

figure 15— page 34

As a result, the flood pulse cleansing process is envisaged to be reintroduced by promoting a more cyclical water collection, retention and filtration system. This process is planned to revitalize the Delta's regenerative process via a well-coordinated, planned, and designated system of techno water flows interlinked between systems and subsystems. Combined with the transformed canal structures as water ecological corridors, this larger framework is envisaged to reduce water pollution and gradually recover the degraded soils, regenerating the delta's natural ecosystems.

The workings between the framework's larger flood water retention and cycling processes and the mesoscale canal water's filtration and cultivation subsystem of Social-Techno-Ecological corridors would create a resilient social-ecological system better aligned to deltaic processes, to in turn yield a wider variety of ecosystem services. As such, the Mekong Delta's future of biodiverse water ecosystems shall play a critical role in ensuring the future resilience of its territories and multi-species inhabitants.

figure 16— page 35

CONCLUDING REMARKS

The proposition for an Ecological Transition in the Mekong Delta touches upon many of the research findings revealed through the palimpsest mapping over time, territorially post-rationalizing the use of water and road infrastructure through an ecological regeneration of existing canals by "making room for the river." As a post-rationality of the use of the canals, the proposed technologically disposed yet naturally emerging canal structures turned Social-Techno-Ecological corridors further integrated by the 'Water Ecological Framework' opens up a new circular water process, whereby the Delta's seasonal water flows could slowly be recuperated into the ecosystem, fostering new water relationships between open spaces, ecosystems, and social-ecological processes.

The Water Ecosystems Framework shall serve to facilitate the cycles of the wet and dry seasons, whereby flood waters and stormwater could be collected across retention and filtration systems as well as restored into the groundwater aquifer or recycled back into the delta's water cycle. Moreover,

the Socio-Techno-Ecological corridors address the community-level interrelationships supporting different water flows and water bodies to facilitate different water-based farming processes from one subsystem to another, bolstering the need for socioeconomic generation through a wide variety of approaches in cultivation patterns. Overall, the long-term consequence of the Vietnamese Mekong Delta's proposition for an Ecological Transition is envisioned to be communicated and transferred through the regional water framework, however, implemented at the local farming unit scale across the canals. Incremental steps taken to depolder parts of the diked canal system to reclaim water and ecological systems shall challenge the currently linear processes in agriculture production through ecosystem thinking, which adopts a more circular and mixed approach to address the Delta's broader complex dynamics.

The project envisions that the decision-making process could be fostered to address the urgent need to post-rationalize the Delta's hydraulic state by producing a different kind of "space" between humans and nonhumans as a mutually beneficial and neutralizing agency in the currently uneven geopolitical conditions. The new canal-based communities are proposed to embark on the Ecological Transition as new water Socio-Techno-Ecological corridor societies, offering the local farmers and their families multiple opportunities for living, working, and recreation, to support a healthy lifestyle in touch with nature and harmony with the Delta's natural water processes.

The hope is that Vietnam would recognize this diversified canal living-based model and the wider water network system, as an asset offering valuable climate resilient qualities, that seek environmental adaptation by addressing the wicked problems of our time. And that the current imposition of the Mekong Delta deemed as a provider of ecosystem services functioning primarily to fill the agricultural demands of the Nation and beyond, would gradually be superseded by the more pressing ecosystem services the Delta could provide: Resilience against not just the impact of climate change and sea-level rise but the anthropogenic effects of the built environment. By offering cyclic ecosystem qualities to promote biodiversity and an array of possible social ecologies with a variety of socio-economic and ecological values. As a diffused water civilization challenging the compact city model, one that would better sustain the local ruruban population while building new knowledge regarding the territory's ecosystems capacity. The project shall contribute to more local processes by rethinking the currently linear production models with more circular water ecosystem processes. All these activities shall be promoted through the Ecological Transition, with the vision to mutually benefit humans and nonhumans living in the Mekong Delta.

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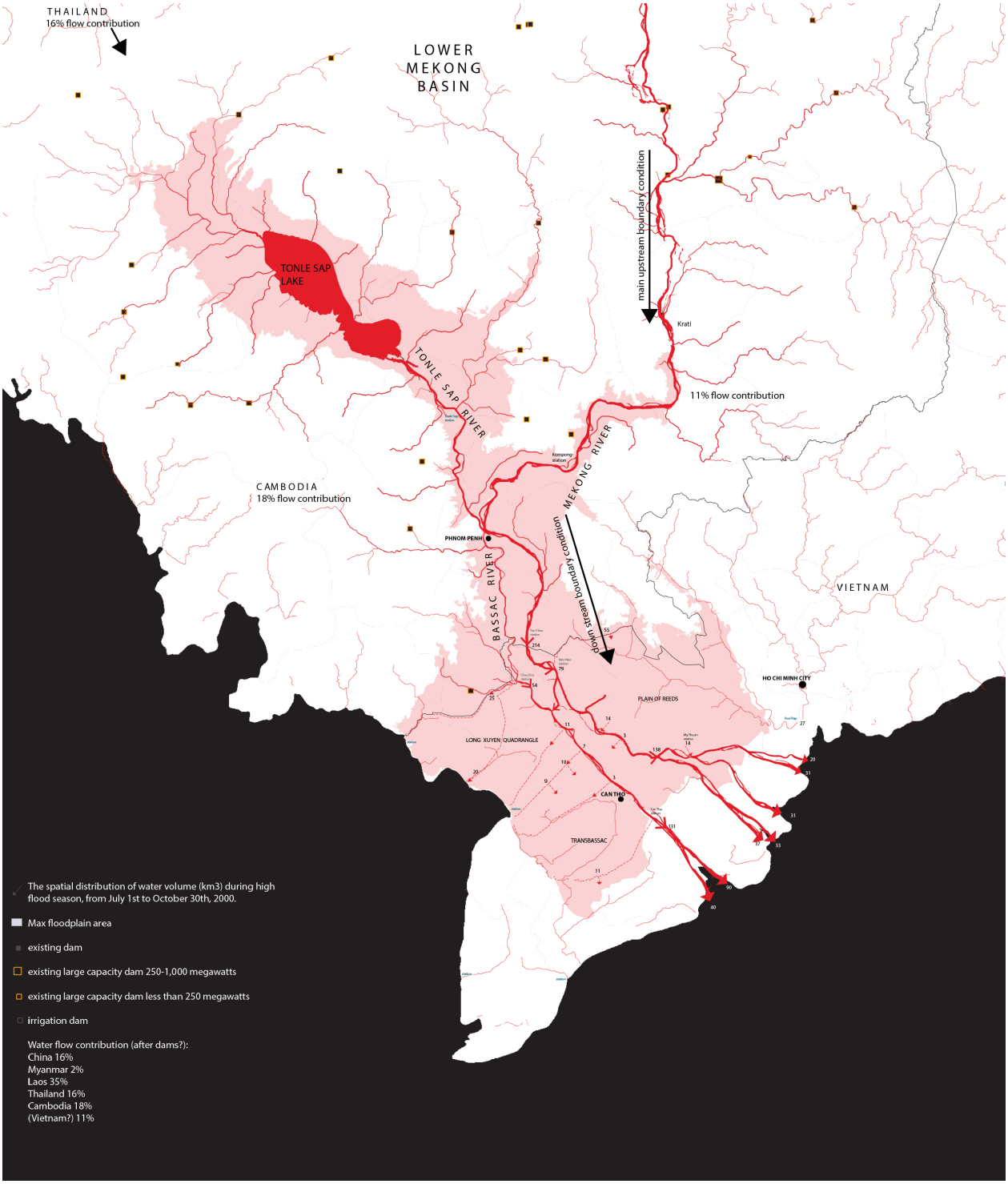

01

01 The map shows the shared watershed system and spatial distribution of water volume based on the percentage flow from each country during high flood season, collected in the transboundary watershed region between the lower part of Cambodia and the upper central Mekong Delta alluvial plain; and the distribution of existing dams (in black squares) which impact the final distribution of water flow. (Nguyen, 2023)

02

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02 Possibly during the Funan kingdom period, the map shows how multi-directional canals connected the kingdom to temples and the Oc Eo mountains, with the central water spine directly linking to Cambodia. (Source: The Management Board of Oc Eo Cultural Sites, visit 2022) (Nguyen, 2023)

03 First canals dredged during the Nguyen Dynasty period over the swamp landscape: Vinh Té canal (1817), Thoai Ha Canal (1818), and Bao Dinh Canal (1818) (Nguyen, 2023)

04 Palimpsest of 1930 original canals whose traces have remained up-to-date. (Nguyen, 2023)

05 1975 Palimpsest map of the study area. (Nguyen, 2023)

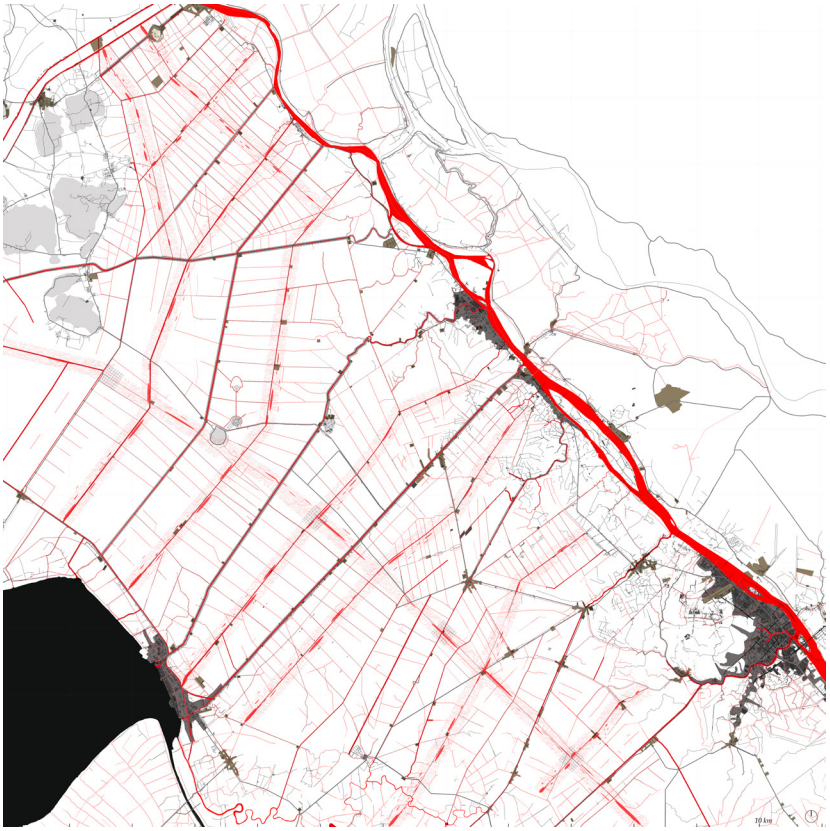
06 Palimpsest mapping up to 1990 showing the primary canals remaining from the French Colonial period and the added primary canals, completing the 'comb-like' pattern. (Nguyen, 2023)

07 Palimpsest map up to the 90s showing the intensified growth of linear development and the spontaneous development of large-scale master plans. (Nguyen, 2023)

08

08 Palimpsest map showing the disturbance in the formerly isotropic water system whereby a lamination of multifunctional constructs has resulted from infrastructural investments made in water and road networks (Nguyen, 2023)

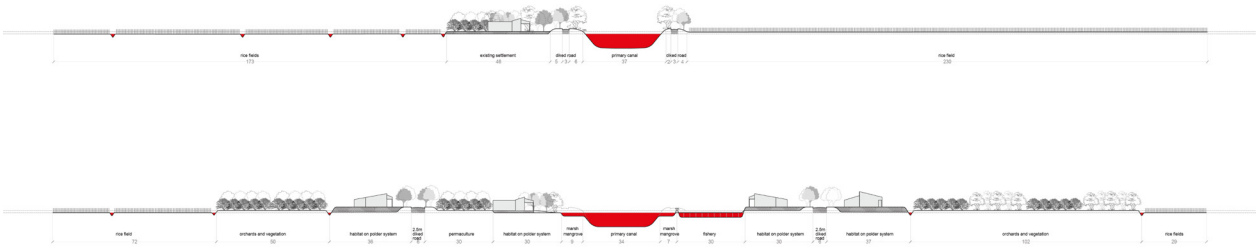
09



10

09 Map showing current conditions of the regional study area, particularly noting the relationship between the currently densified linear areas along the historically dredged canals and the low-density subdividing canals added in the 80s, which completes the 'comb-like' irrigation structure linking the Bassac River to the Gulf of Thailand sea (Nguyen, 2023)

10 Proposed Urban design framework with 1km wide Weak Structure as canal-based Social Techno Ecological corridors. (Nguyen, 2023)



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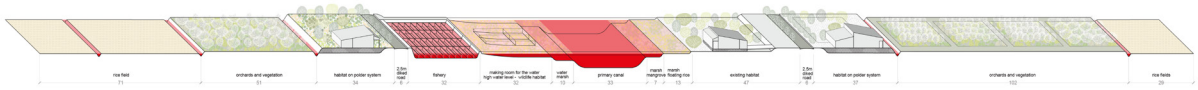

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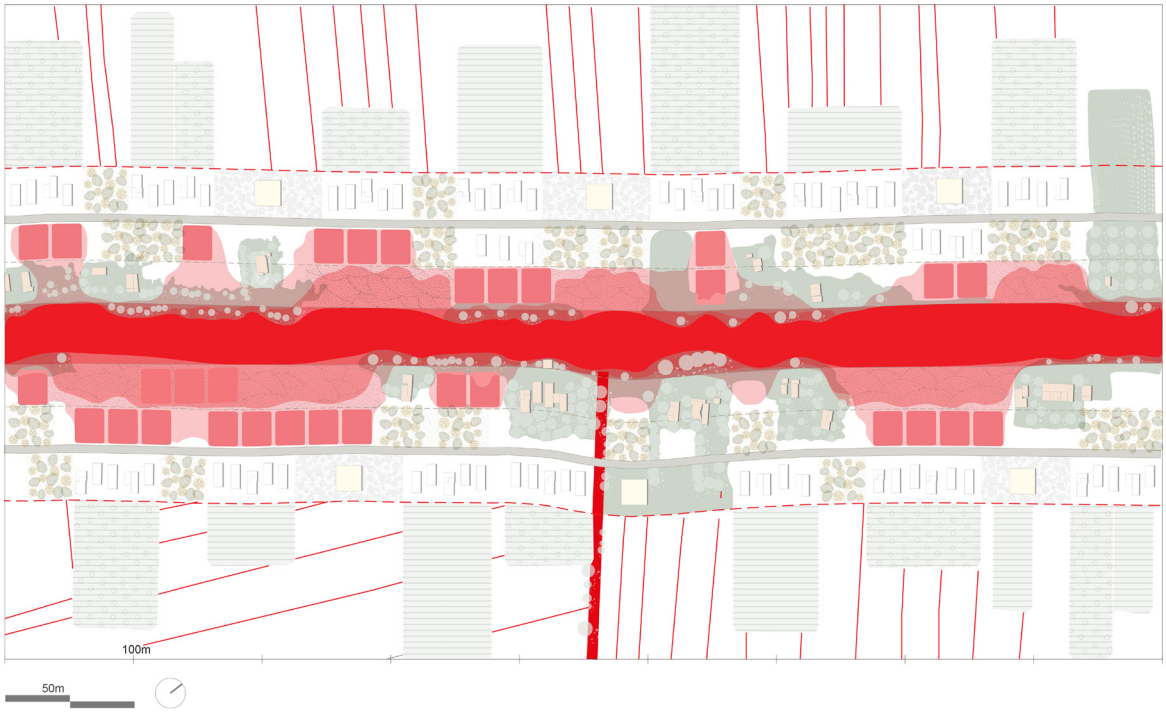
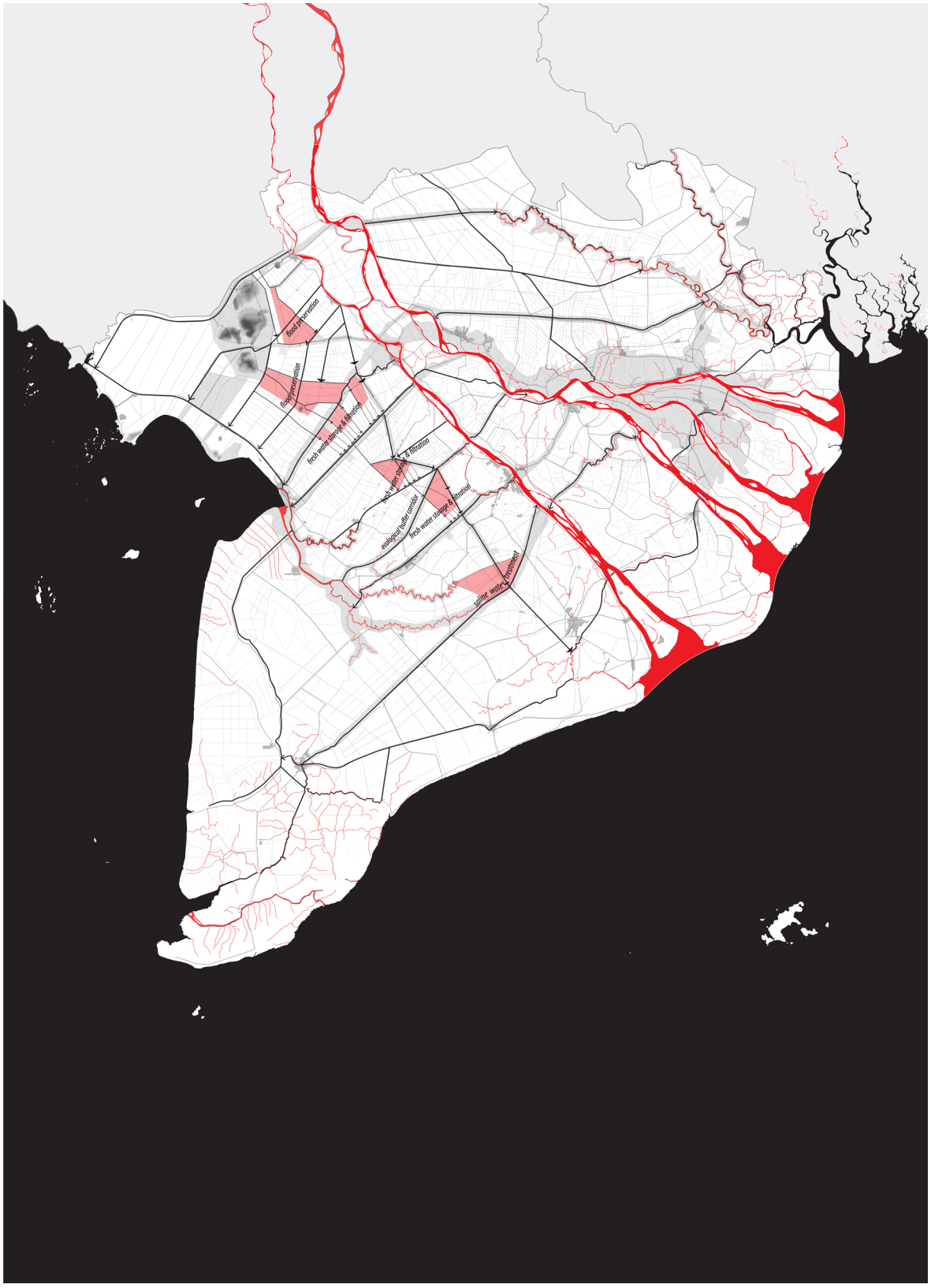


13

11 Sections of the existing and proposed ecological corridor scenario: a) existingconditions of canal and diked roads, b) proposed new ecological section whereby the canal is extended through stepped terraces shaping relationships between land and water bodies (Nguyen, 2023)

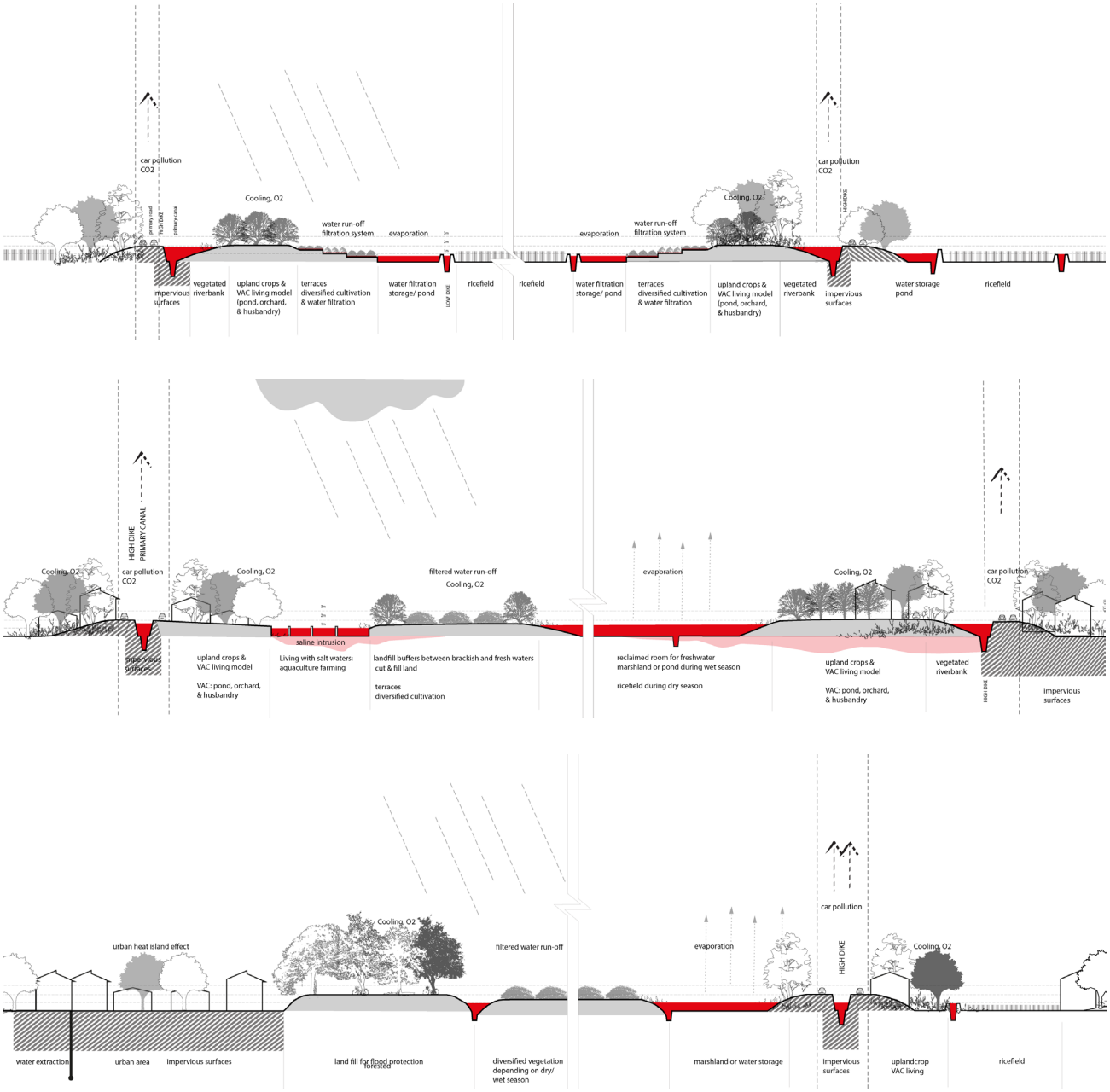
12 Axon illustrating the transect across the canal's proposed transformation, cultivating different types of water spaces for fauna and flora and various water-landbased cultivation practices by the surrounding community (Nguyen, 2023)

13 Map showing the proposed ecological corridors scenario as a diffused urbanization pattern supported by different water bodies of ecosystem services, based on the three different water lines (0m, 1m, 2m) resulting from different seasonal flooding patterns. (Nguyen, 2023)



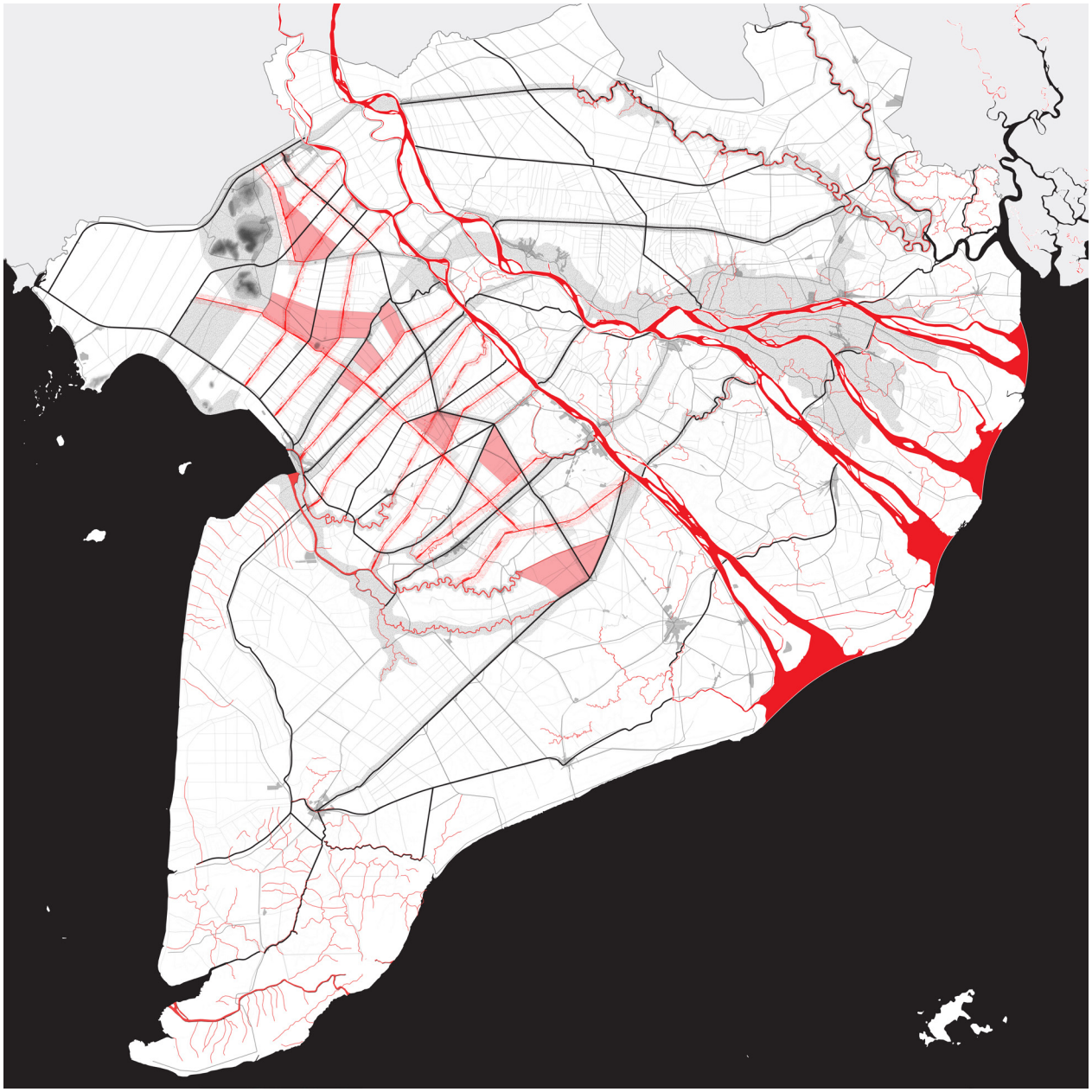
14

14 Map of proposed Socio-Techno-Ecological water corridors, as an urban design framework fostering ecological water management. (Nguyen, 2023)



15

15 Sections showing how the ecological water framework could improve the water ecosystems, a) stepped terraces are proposed as water run-off filtration systems, b) water is reclaimed in retention ponds, and aquaculture cultivation is proposed between buffering poldered landscapes to reduce saline intrusion, c) water retention areas are enabled by poldered raised orchard beds, to foster biodiversity by cultivating wetlands, reducing environmental contamination. (Nguyen, 2023)



16

16 Map of proposed integrated urban design structure across scales, between Social-Ecological corridors and the water ecological framework. (Nguyen, 2023)

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