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Toward a Co-Evolutionary Design for Riverfronts

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Keywords: *Co-evolution, Exaptation, Adaptation, Symbiosis, Metamorphosis*.

Abstract
The design of urban riverfronts today entails a complex set of problems regarding the evolution of operational choices. Rethinking relations between water and city requires a shift from the idea of univocal design – closed and immutable – to the open definition of a polysemic, multidimensional and a-scalar design process.
The challenge regards not only the evolution of forms, geometries and solutions but, more in general, the search for a condition of co-evolution in design that brings into play multiple actors, processes, configurations and organisations. This new process must allow the system comprising the frontier between city and water to co-evolve together with its environment through redundant responses: modifying fragility, reinforcing resistance and robustness, valorising situations of resilience and, in addition, benefiting from eventual unfavourable conditions.

Prediction and Forecasting in the Design of Urban Riverfronts

Rivers have always played a central role in the construction, transformation and even devastation of cities and territories. They configure the field of possibilities for the evolution of anthropic settlements. Set against the fascinating and fearsome image of the sea – the manifestation of the indomitable power of nature – rivers are often identified with a technical aptitude for managing hydrological dynamics to favour the growth of civilisation (fishing, agriculture, transport, commerce, energy). This dynamic equilibrium between nature and society was conserved until the fractures induced by industrial models for the intensive exploitation of the territory (Ranzo, 1996).
To anticipate the criticalities induced by unpredictable natural events and limit the vulnerabilities of settlements, actions to govern rivers have always represented a central question in urban planning. Illustrations of landscapes and maps are rife with examples emphasising the importance of riverfronts to the maintenance of urban vitality, or water regimentation works, designed to conserve the very life of a city. Design cultures have continually confronted the endless challenge represented by the control, governance and appropriate use of water, seeking to predict possible mutations in the course of a river with ever-greater precision. However, this question also raised the broader theme of the capacity of projects for watercourses to evolve and respond to changing environmental conditions. The ancient Chinese legend of “Great Yu who controlled the Waters” (c. 2205 BC) documents the search for evolutionary harmonies between humanity and water. The legend has it that “[…] after building dams, the power of obstructed flood waters only grew, overtopping these barriers. Following numerous attempts, Yu came to understand why: ‘Only obstruction is impractical; where necessary it must be done, but when it is necessary to drain, this also must be done”.
The concept of evolution recently entered the field of urban design with the spread of paradigms of environmental sustainability and the transfer of principles from the science of complexity into

projects for frontiers between buildings and nature. All the same, as in socio-political, techno-productive and economic disciplines, likewise in the field of urban and architectural design the earliest application of the concept of evolution was influenced above all by its definition – selective and competitive – based on Darwinian studies. The evolutionary process was compared to the technological-scientific progress of human societies. It was linked to the history of a single species, selected to be continually more suited to a predefined and predestined physical space (Norgaard, 1997).
This interpretation of the concept of evolution was also manifest in the programming of interventions to redesign urban riverfronts, contradicting the same objectives of sustainability that appeared to mark the starting point for new practices. This position has produced opposing results. In some cases, the nature of the river was subjugated, interpreting technological potentialities as instruments of "Darwinian selection" developed by the humankind to dominate other forms of life. Other cases sought refuge in exclusively defensive interventions, strengthening the robustness of infrastructures and the ability to resist the power of the river.
Recent studies of ecological systems have instead highlighted that evolutionary processes do not respect linear trajectories that permit a clear distinction between fragility, robustness, forms of resilience and opportunistic behaviour. Evolution is manifest together with the appearance of forms of non-passive adaptation, through processes of "exaptation" and the activation of metamorphic capacities to co-evolve with the environment, through plural and redundant responses that allow even penalising conditions to become elements of advantage (Kratochwil and Schwabe, 1999; Ceruti, 2018).
In addition, for design in fields of intervention witness to the confrontation between anthropic and natural entities, it is impossible to simply speak of changes in choices, forms, geometries and solutions. The city coexists with its natural components, which include rivers. It behaves like a complex ecosystemic organism, with processes, cycles and metabolic dynamics. Hence the necessity to search for co-evolutionary conditions that introduce multiple actors, processes, configurations and organisations, capable of modifying their structures and behaviours in response to changing contexts. However, these contexts now appear increasingly more unstable and variable due to the intensification of phenomena induced by climate change, demographic and building densification or economic recessions and, considering recent events by health emergencies.
Predicting the future appears increasingly more difficult. Instead, it is important to search for multiple levels of reactivity, delineating *pre-visions* of desirable, possible and probable futures (Caffo and Muzzonigro, 2019) through the projection of multiple design scenarios, visions and concepts (Lambertini, 2008).
Adopting the paradigm of co-evolution in the design of frontiers between cities and rivers comports two advantages. Firstly, it allows us to overcome the concept of univocal, closed, predictive and immutable design. Additionally, it can initiate a vaster reformulation of approaches, tools and solutions, favouring the passage toward the notion of design as an open process, capable of defining poly-dimensional systems of interpretations and responses that are both adaptive and flexible.

Co-Evolution for the Integrated Design of Riverfronts

Assuming a co-evolutionary approach to the design of urban riverfronts signifies incorporating elements characteristic of the reciprocal interactions and dynamics of adaptation of bio/physio-ecological systems during the decision-making and ideative process.
If we consider processes of evolution only in the Darwinian sense, we note that living species evolve as the effect of three factors: *selective* factors, which include climate conditions and processes of competition to access resources; *mutagenic* factors, which include physicochemical

agents able to modify information that serves to maintain biological functions; *recombination* factors, which constitute the casual variables of hybridisation between diverse species.

Using these three factors of evolution, the design of river systems in urban environments will tend to produce interventions of protection, maintenance and environmental restoration, limited to supporting and eventually reactivating natural cycles through compatible, defensive or reparative solutions. However, the presence of a river in an urban environment infers a complexity of immaterial relations and physical connections between urban life and the flow of time. These relations involve natural and artificial morphologies, elements of identity and society, limits and thresholds between climate, soils and human presence (Battaglini, 2020).

A project focused on confronting the space-time connubium between river and city cannot therefore be founded exclusively on selective, mutagenic and recombinatory evolution.

In fact, dynamics of adaptation assume a co-evolutionary character, based on the interactive reciprocity between species and environment. This observation places the design of riverfronts in a completely different relation with the city, the territory and their inhabitants. As demonstrated in the studies of Richard B. Norgaard on the relations between society and environment, the reciprocal influence between environmental factors and the social system is the founding element of co-evolutionary processes.

Development can therefore be represented as a process of the co-evolution of knowledge, values, organisations, technologies and environmental systems. From the perspective of co-evolution, culture determines the environment and the environment determines culture (Norgaard, 1994). It is evident how the interactive framework hypothesised by Norgaard implies a broader vision of the inhabited environment in which it is impossible to distinguish biotic from abiotic entities; both are indispensable to the development of the human habitat, its natural components and the communities inhabiting it (Dierna & Orlandi, 2005).

Returning to the question of the river and the relations it forms between water resources, society and technological innovations, it is legitimate to hypothesise that the paradigm of co-evolution can expand the experience of design to include more variables regarding macro- and micro-systems, not only connected with one another, but evolving together in multiple directions. Any project thus loses its predictive and directional qualities to become an uninterrupted laboratory of experimentation, with uncertain and in any case open-ended results.

The processes through which co-evolution takes form can thus also become part of an urban and technological-environmental vision of the river. In this manner, it is possible to manifest the mimesis used to develop the imitative behavioural capacities required by adaptive coexistence. Or the symbiosis that produces associative advantages for multiple species and systems, without comporting irreversible negative effects. Or, the cooperation and collaboration that delineate the fields of possibilities, but also limits on actions for developing shared strategies of survival. Finally, the metamorphoses activating processes that modify structures, organisations and languages to confront situations of unpredictability and ecosystemic emergencies.

In particular, the design of riverfronts can become an expression of a broader integrated process of investigations, proposals, policies and decisions that intervene within the socio-techno-ecological urban system. This kind of process is necessary: to resolve fragilities and to diminish vulnerabilities; to reinforce resistances and the robustness of artefacts and ecofacts; to valorise capacities for reactivity and resilience; to bring into play anti-fragilities, that is, acquiring opportunistic advantages even from eventual unfavourable conditions.

A Few Exemplary Experiences

When the principles of co-evolution are activated in the design of an urban riverfront, it is impossible to clearly distinguish between elements that belong to one scenario, strategy, programme, tactic or operational approach. The paradigm of co-evolution itself presupposes an

expanded vision of the design experience as the expression of a way of thinking and acting founded not on a set of objects and forms, but on processes in which systems of objects and their relative forms change over time, along multiple trajectories.
In this sense, strategic and programmatic aspects cannot be separated from the capacity to incorporate multiple alternative scenarios in a project, from the earliest phases of its development.
However, the paradigm of co-evolution also comports another aspect; the translation of general design elements into territorialised technical actions must acquire more tactical visions that permit variations in the structuring of interventions; this determines a multiplicity of final “configuring-actions” that can be combined with or substitute one another.
A co-evolutionary project for riverfronts thus assumes inter-systemic and a-scalar qualities. Even when searching for experiences that exemplify possible interpretations of the principles of co-evolution in an organic vision of design, it is difficult to extrapolate elements of a project intended as objects/formal entities. We must reason by components that, only through their mutual interaction, return the functionality and efficiency of design. In this situation, the heart of a project becomes the relationship that can arise between people, nature, ground and hydrological processes made possible by different means of utilising technical-building resources.
Ultimately, the co-evolution of a riverfront can emerge solely from an adequate ideative-productive activity that tends toward the construction of a “project” involving multiple scales, actors and processes; a project in which technological-environmental components establish different degrees of mutual interaction between artefacts and nature.
These interactive technological-environmental diversities can be used to identify different families of exemplary design experiences.

An initial field of experimentation comprises projects based on the use of ‘nature-based’ technologies or principles of ‘bio-mimicry’.
This is the case of works such as the *Wild Mile Project* for the Chicago riverfront, by Skidmore, Owings & Merrill, or *Sanya River Mangrove Park*, by Turenscape.
The co-evolution and adaptation of artifice-nature are supported by solutions with a low impact on the environment and pursuing two objectives. Accompanying the maintenance of natural processes linked to the motility and vitality of river ecosystems, using bio-eco-compatible, regenerable and near-zero-maintenance materials. Or, reactivating and supporting the processes that regulate and regenerate biotic resources using devices that imitate nature and its ability to evolve spontaneously.

Wild Mile Project, Chicago. This proposal for the Chicago River by SOM begins with a Community Vision. Participatory workshops with different categories of stakeholders were used to identify the riverfront’s potential to serve as a strategic-environmental and recreational asset for the entire city. The “Wild Mile Framework Vision Plan” places the reconstitution of the ‘wilderness’ of the river system front and centre to favour urban ‘wildlife’, reintegrating nature in educational, work, volunteer, leisure, sport and health-related activities. The reconciliation between urbanity-nature is defined in three environments (*Turning Basin*, *North Reach* and *South Reach*) according to five strategies: *Urban Wildlife, Expanding Public Access, Connecting People with Nature, Creating a Place for Everyone* and *Leading the World.*
The project works with the system of boundaries between land and water (ecotones) to define new green buffer zones in which to re-establish hybrid natural/artificial forms and processes (fig. 1a). Interventions on the west bank of the river focus on de-channelling the river to remove existing dams, activate processes of ‘green retrofitting’, increase landscaped edge conditions by introducing ecotones and ‘bio-matrix based’ wetlands, diversifying the mosaic of ecological habitats and defining the surfaces that offer protection against flooding (fig. 1b). On the east bank, the project introduces lightweight modular components to support human activities: floating structural

systems that imitate the geometric complexity of natural forms, floating paths and platforms and suspended ramps (fig. 1c) (SOM, 2019).
Sanya Mangrove Park, Sanya City. The design of *Sanya Mangrove Park*, by Turenscape, translates the desire expressed by the municipal government of Sanya City to invert the logics of urban development centred on the intensive, high-impact and deregulated used of the river system. The project aims to re-establish a dynamic equilibrium through four key factors: wind (protection against the extremes of monsoons); water (interference between monsoon marine currents and river waters); pollutants (damages to the community of mangroves); accessibility (means of accessing public water).
Design strategies adopt the principle "form follows processes" to achieve four objectives. Materials recovered *in situ* were used to model ecotonal bands constituted by watercourses and riparian habitats on different levels (fig. 2a). A network of land-water edges, with the geometry of "interlocked fingers" (fig. 2b) increases protection against ocean waves and tropical storms.
A system of terraces and hollows defines different levels of use for the riverbanks (according to variations in the level of the water), at the same time, intercepts and filters runoff from urban hardscapes (fig. 2c). Pedestrian paths respond to the morphologies of the site occupying multiple levels suspended above the water. They end at small pavilions that functions as shelters, observation decks and areas for bird watching.

A second field of experimentation includes projects dedicated to the qualification of riverfront dwelling conditions, aimed at the coexistence between processes and natural conditions of robustness in symbiosis with anthropic activities. Two examples can be considered significative: the *Bishan-Ang Mo Kio Park* in Singapore designed by Ramboll Studio Dreiseitl; the *Yangtze Riverfront Park* in Wuhan by SASAKI.
Logics of planning and designing coupled with operative technological solutions produce hybrid landscapes based on 'win-win' adaptive interactions. Naturalness and urbanity draw reciprocal benefits from co-evolution and the mutual relation between their components. Bio-ecological resources and processes increase urban quality, improving conditions of dwelling comfort at points of contact with the river (water, air, landscaping). Human activities and presence support the ecological quality of the river system (research science, monitoring, maintenance, surveillance, educational functions, eco-systemic services).

Bishan-Ang Mo Kio Park, Singapore. The example of *Bishan-Ang Mo Kio Park* in Singapore, by Ramboll Studio Dreiseitl, is exemplary of a philosophy of intervention that considers the 'downgrading' of the previous organization of the river system as an opportunity for reconfiguring the riverfront as complex field with elevated symbiotic capacities between ecological and urban functions.
The project is part of the *ABC Waters* programme aimed at transforming and re-naturalising highly artificialized bodies of water in spaces in which natural components once again dialogue with the functions and activities of the city. An existing 2.7 km-long drainage channel was substituted by a new 3.2 km-long sinuous watercourse framed by riparian environments and terraces extending across almost 62 hectares (fig. 3a).
The once uniform image of an urban park-garden, delimited by a drainage channel, was replaced by a more complex system in which the river once again flows through diversified ecosystemic habitats (fig. 3b). Terraces define multiple riparian ecosystems related to the different levels of the river using various technological-environmental solutions designed to: favour slope stability, slow runoff and mitigate soil erosion (bioengineering); drain and purify water and favour surface evo-transpiration (phytodepuration) (fig. 3c). Finally, rather than demolishing pre-existing infrastructures for channelling water, they were reintegrated as part of interventions that support recreational, sport and artistic-cultural activities.

Yangtze Riverfront Park, Wuhan. The proposal by SASAKI for *Yangtze Riverfront Park* reflects the spirit of co-evolution that characterised historic relations between Wuhan's growth and the Yangtze River. This "fluvial culture" is so strong that, after almost two centuries of industrial development, local inhabitants still visit the riverbanks in search of a direct contact with the water, even at the height of flooding. The strategy of intervention was defined together with inhabitants, civic groups and young artists. These groups actively contributed to the project by providing comments and information and through public meetings, guided tours and representations of possible visions.
The project proposes the creation of heterogeneous micro-environments that host various ecosystems (fig. 4a) (muddy floodplains, wetlands, swamps, navigable water corridors, bird watching stations).
Fluctuations in water levels transform the riverfront into a continuously evolving landscape that reflects the changing seasons. Collective spaces and recreational facilities (fig. 4b) are organised so as not to interfere with the habitats of local species and, during flooding, are temporarily returned to the river for the repopulation of aquatic animal and vegetal species. Likewise, buildings from the industrial era become part of this evolving landscape through the integration of rail lines, historic quays, trails, gardens and floating plazas (fig. 4c). At the confluence of the Yangtze and Han rivers, the Museum of the Yangtze appears almost to emerge from the river embankments.

The third field in which it is possible to define co-evolutionary conditions for the design of riverfronts involves the integration of interventions capable of modifying their functional structure and form in response to a changing context. This field includes projects such as *Yanweizhou Park* in Jinhua City, by Turenscape, and the *BIG U-Dryline* proposal for Manhattan, developed by Bjarke Ingels Group. These examples move beyond the evolutionary capacity of biological organisms; they do not explore natural mechanisms of co-evolution to imitate them using technologies, nor do they stop at the search for symbiotic conditions of coexistence between nature and artifice. The challenge is now projected toward a co-evolutionary vision based on the resilient and metamorphic capacities of design and the spaces it produces, fore-sighting changing users, flows and functions, fields of morpho-typological variation, as well as different levels of sacrifice for spatial-environmental components.

Yanweizhou Park, Jinhua City. In the project for *Yanweizhou Park,* in the heart of Jinhua, change is central to the organisation of the uses of the park and the solutions employed. The Park is situated at the confluence of the Wuyi and Yiwu rivers. This area is characterised by an elevated fragmentation of ecological and functional systems and the presence of unsightly sand quarries. The area was scarcely used, despite the presence of the Wuju Opera Theatre.
Turenscape confronted several challenges: protecting the residual riparian habitat, controlling flows of water during flooding, reintegrating pre-existing cultural infrastructures and reconnecting the fluvial landscape with various urban districts (fig. 5a).
The project defines a "dynamic concord" by activating multiple levels of resistance to adapt to monsoon flooding, to diverse flows of water and people and various temporary uses. The sand quarries were reutilised and integrated by introducing circular bio-swale systems to reconstruct riparian habitats. A system of permeable terraces covered with autochthonous vegetation offers an alternative to concrete damming works (fig. 5b); during high water levels and flooding, the site is completely under water, depositing a layer of lime vital to the continuity of ecological functions. During flooding, the sinuous bridge inspired by the Chinese tradition of the Dance of the Dragon remains the only artificial element suspended above the water and connecting different parts of the city (fig. 5c).

The BIG U, New York. While designed in the wake of Hurricane Sandy to protect Lower Manhattan, the *BIG U* by Bjarke Ingels Group completely redefines the relationship between New York and the waters of the Hudson and East rivers. Presented during the "Rebuild By Design" competition, this vision included a participatory process that allowed local communities to express and share their needs and requests for collective uses of the site. The proposal produced a system of simultaneously protective, social and environmental infrastructures that modify the form and functions of the area. The *Westside* becomes a raised park that integrates seaside gardens with protective-draining functions, collective facilities, pedestrian/bicycle paths and flood barriers. In the *Lower* district a vast green infrastructure wraps and transforms existing volumes into a berm that progressively rises up toward the east (*Harbor Berm*) (fig. 6a), including the Coast Guard building reimagined as an aquarium from which to observe changes in the water level. For the *Eastside*, the theme of protection is defined in diverse variants: as integrated system of berms, bridges and ramps covered by vegetation (*bridging berm*) (fig. 6b); as system of folding barriers, positioned beneath road infrastructures that close during storms or open up to host exhibition pavilions, a winter market, areas for sport, performances and recreational activities (fig. 6c) (BIG, 2020).

Co-evolution can also come into play in the design of riverfronts where relations between river and city have been fully compromised. In this field, we find a fourth possible way toward co-evolution in design. Here, instead of restoring a naturalness that has already been lost, projects completely reinvent immaterial relations and physical connections between water and the city.
This vision includes the *Parque Rìo Manzanares* in Madrid, designed by West 8 with Burgos & Garrido, Porras & La Casta and Rubio & Álvarez-Sala, or the project for *Cheonggyecheon* river park, in Seoul. The paradigm of co-evolution is interpreted in its extreme meanings. Critical issues, weaknesses and negative impacts generated by incorrect policies in the past become founding elements for integrally redefining relations between spaces, processes and functions in an anti-fragile manner, involving design, river and city.

Parque Rìo Manzanares, Madrid. This project returns a river to the city after a lengthy absence induced when it was cut by the M-30 motorway running parallel to the riverbed. Between 2003 and 2007 local government decided to bury the road. The competition organised to reimagine the surfaces reclaimed following this work was won by the team comprised of West 8 and MRIO (Burgos & Garrido + Porras La Casta + Rubio & Álvarez-Sala) (fig. 7a).
Instead of restoring a false nature overlapping infrastructural works, the project weaves a network of different green and blue spaces, dotted by works of architecture, pavilions and bridges (Franchini & Arana, 2011).
The *master plan* included interventions to reintegrate the river within the urban scenario, define a set of green spaces for the city, reorganise flows of urban mobility and accessibility and improve the environmental quality of peripheral and central areas. Linear and areal boulevards, gardens and parks overlap and integrate the underground road network and riverbed that once again plays a leading role in life of the city (fig. 7b).
The project re-established a continuity of spaces, environments and flows. Primarily natural materials were used to construct a landscape that, while markedly artificial, nonetheless manages to combine environmental biodiversity with the techno-diversities of the city (fig. 7c).

Cheonggyecheon river park, Seoul. The project designed to reactivate the *Cheonggyecheon* is the result of a lengthy process of transformations started in 1918, the year works began to partially cover the river to resolve health and flooding issues. The river was completely covered between 1958 and 1961 and later concealed by the construction of a motorway in 1971. The restoration project was developed by a team consisting of Cheongsuk Engineering, Saman Engineering and Dongmyung Engineering, the landscape architects SeoAhn Total Landscape, under the supervision of the Seoul Metropolitan Government. The project re-established an approximately 3.6 mile (5.8 km) ecological-river corridor, reconnecting the restored riverbanks, inserting pedestrian, vehicular and bicycle bridges. The flow of the river was increased by intercepting waters from the Han River; riparian habitats and wetlands were recreated using natural materials

(fig. 8a). All without negating pre-existing infrastructures, integrated within the reconfiguration of the river (fig. 8b) (Robinson & Myvonwynn, 2011).
While the project different sectors that are markedly artificial, the challenge of this environmental restoration led to a further level of co-evolution (fig. 8c) between *Cheonggyecheon* and Seoul, also demonstrating how the use of technological resources is in some cases necessary to re-orient urban quality, beginning with the negative acts of the past.

Open Co-Evolution

In our current situation of climatic-environmental, socioeconomic and technological-cultural change, the necessity to confront the design of riverfronts according to co-evolutionary principles emerges with growing clarity.
The examples presented, in no way an exhaustive representation of the panorama of design experiments underway, reveal some fundamental elements for reconfiguring a new framework of relations between city and river through design. In particular, the rational management of water cycles, an attention toward the landscape, the centrality of contributions from the ecological and geological sciences, inevitable connections with urban, spatial and economic planning, the relevance of technological-environmental and architectural professions.
In the end, there is a need for a substantial change in how we approach design to incorporate the randomness and unpredictability of future events and consider strategic, tactical and operative aspects (Duffy & Jefferies, 2011). At the same time, it is equally important to foresight a gradual implementation of interventions in order to reactivate, maintain, adapt, develop and reinvent the reactive, productive and sustainable capacities of the entire river-city-society system with respect to the multiple fields and timeframes of design.
In strategic terms, the co-evolution of design can no longer be ensured solely through a univocal proposal for the long-term, exclusively predictive of restorations or innovative transformations decided once and for all. Strategic design scenarios must already include the evolution of equilibriums between city and water. They must consider the dynamics of transformation of the city-river system and the modification of contextual factors (climate, meteorology, geology, settlement), allowing for the eventual possibility of extreme weather events (overflowing, flooding, slope instability, landslides). Strategic scenarios must also explore: the presence or absence of hydraulic works (reclamations, channels, protective infrastructures); the eventual disconnections that may arise between territorial transformation policies and projects; the behaviours and needs of inhabitants; the hydrogeological-environmental and settlement-infrastructural conditions; the individual and collective practices of using water spaces and resources.
Likewise, for tactical aspects, a co-evolutionary project for riverfronts cannot be limited to facilitating interventions for the temporary transformation of spaces, offering illusory responses to initiatives lacking a bottom-up approach. The tactical dimensions of co-evolution must be an expression of multiple visions that unite and establish a dialogue between the design skills of experts and their spontaneous counterparts, making recourse to intermediate enabling technologies involving above all the interstitial components of the city-river system. Tactical co-evolution thus protects not only the system of water and infrastructural constructions (containment, retention, drainage, disposal, recycling, barriers). It becomes a specifical designing level on: the void spaces that define ecotonal boundaries and edges between city and water (stands of trees, uncultivated/unproductive lands, open spaces); the systems of mobility and uses related to settlement/productive activities and linked to the presence and cycles of water.
Finally, the operative dimension of interventions is also subject to substantial repercussions when we adopt a co-evolutionary approach to design. It is in this field that works involving the city-river system manifest the capacity to activate and maintain co-evolutionary dynamics of between artifice and nature. By configuring multiple timeframes, layouts, modalities and dimensions of correlation

between environmental resources and the city, the technological-environmental components of a project act in general: to adapt (buffer zones, neo-ecotopes with filtering functions) and reinforce (retention basins, embankments, lamination/flooding tanks); to establish ecological reconnections (wetlands, naturalistic floodplains, riparian corridors, bands and stands of vegetation) or functional links (riverbed maintenance works, accumulation, recovery, distribution and drainage of water); to re-naturalise (reconstitution of lowland/hygrophilic woodlands and natural drainage) or to reinvent artificial forms (reclamation and recovery of contaminated and residual areas, phytodepuration, water plazas, floating spaces and paths).

It is thus clear that a co-evolutionary approach to the design of riverfronts excludes the possibility to modify only the single components of the river, city or territory. A true co-evolution of design can emerge solely through the integrated improvement of the entire system of settlement and its economic, operative, behavioural, organisational and cultural qualities.

In this perspective, the river-city system is destined to become a polysemic, multidimensional and a-scalar system resulting from a design process whose priority is to establish dynamic and changing connections between multiple fields and levels of intervention.

In the framework of urban, landscape, architectural and technological-environmental design, a similar process can only be continuative and open.

Bibliographical references

Battaglini, E (2020), “Il Fiume tra simbolizzazione dello spazio e fruibilità del territorio”, in Nuvolati, G. (Ed.) *Enciclopedia Sociologica dei Luoghi*, Vol.2, Ledizioni, Milano, IT.

BIG Team (2020), *The BIG “U”. Rebuild by design. Promoting Resilience Post-Sandy Through Innovative Planning, Design, & Programming*, Bjarke Ingels Group, New York, USA. Accessed on 23.07.2020: http://www.rebuildbydesign.org/data/files/675.pdf.

Caffo, L. & Muzzonigro, A. (2019), *Costruire futuri. Migrazioni, città, immaginazioni*, Bompiani, Firenze, IT.

Ceruti, M. (2018), *Il tempo della complessità*, Raffaello Cortina Editore, Milano, IT.

Dierna, S. and Orlandi, F. (2005), *Buone pratiche per il quartiere ecologico*, Alinea Editrice, Firenze, IT.

Franchini, T. & Arana, J. (2011), “The Mega-Blue-Green Network: Madrid River Project”, 47th ISOCARP Congress, Wuhan, PR China, 24-28 October 2011, ISOCARP.net accessed on 23.07.2020: http://www.isocarp.net/Data/case_studies/1872.pdf.

Jefferies C. & Duffy A. (2011), *The SWITCH Transition Manual. Managing Water for the City of the Future*, University of Abertay, Dundee, UK.

Kratochwil, A. & Schwabe, A. (1999), “Evoluzione, coevoluzione e biodiversità”, in AA.VV. *Frontiere della vita,* Istituto della enciclopedia italiana Treccani, Vol. IV, Roma, IT, pp. 385-405.

Lambertini, A. (2008), “A conversation between Giampaolo Proni e Raffaella Trocchianesi”, *Rivista*, January-June 2008, pp. 49-60.

Norgaard, R.B. (1994), *Development Betrayed: The End of Progress and a Coevolutionary Revisioning of the Future*, Routledge, London, UK.

Norgaard, R.B. (1997), “A coevolutionary environmental sociology”, in Redclift, M.R. & Woodgate, G. (Eds.) *The International Handbook of Environmental Sociology,* Edward Elgar, Cheltenham, UK, pp. 158-168.

Ranzo, P. (1996), “La civiltà delle acque”, in Ranzo, P., a cura di, *La civiltà delle acque. Le tecnologie ambientali per il recupero dei bacini idrografici*, Giannini, Napoli, IT, pp. 9-14.

Robinson, A. & Myvonwynn H. (2011), “Cheonggyecheon Stream Restoration Project” in *Landscape Performance Series*, Landscape Architecture Foundation, https://doi.org/10.31353/cs0140.

Skidmore, Owings & Merrill (2019), *Wild Mile Framework Vision*, City of Chicago Department of Planning and Development, June 2019.

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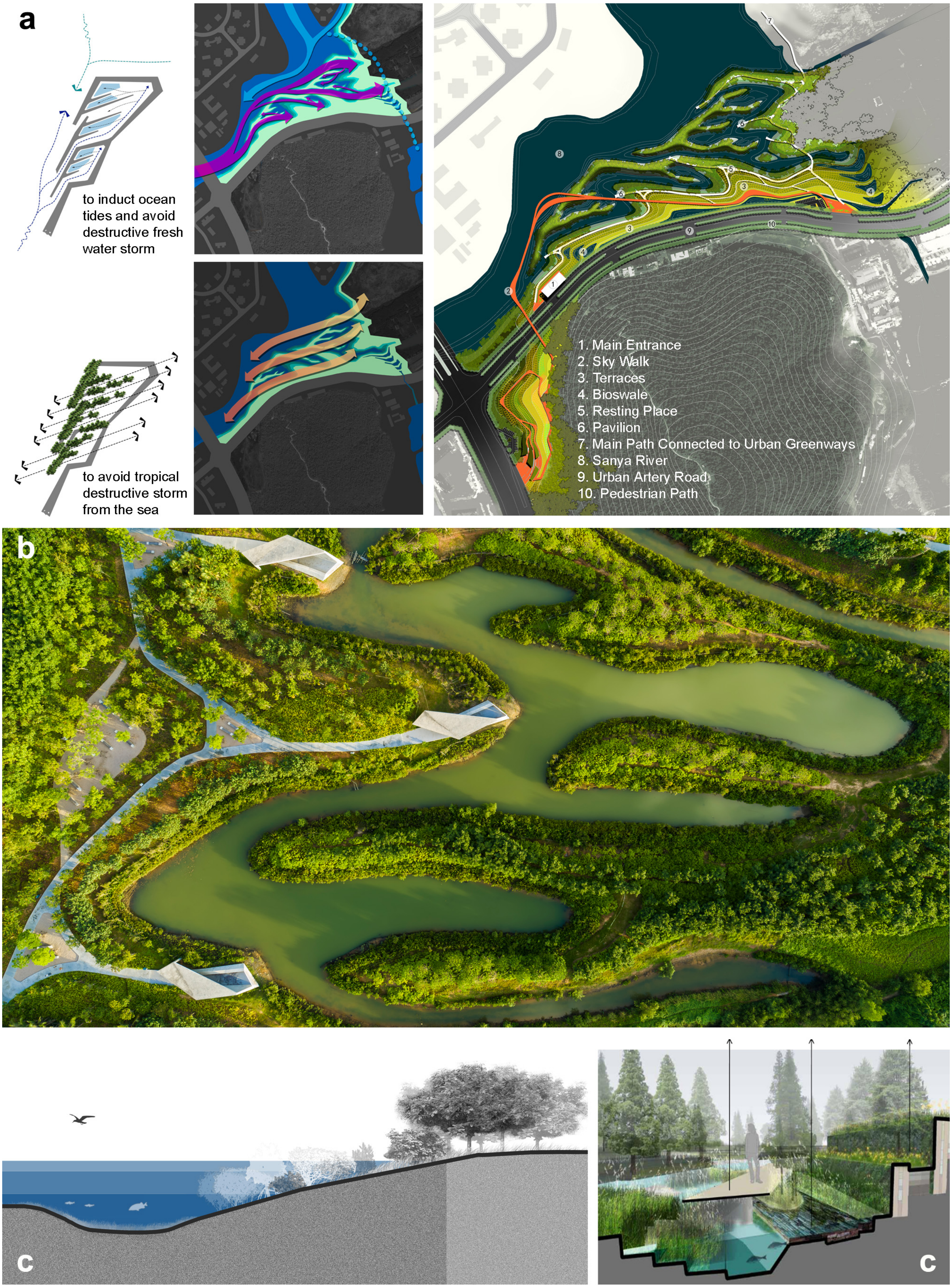
(Fig. 1) *Wild Mile Project,* Chicago. Project by Skidmore, Owings & Merrill.
1a. *Conceptual vision* for *The Turning Basin* area; 1b. *Conceptual vision* for the *North Reach* area; 1c. Proposal for the redefinition of Hobbie St. Cove east riverbank (*South Reach* area).
Source: courtesy of Skidmore, Owings & Merrill and Urban Rivers.

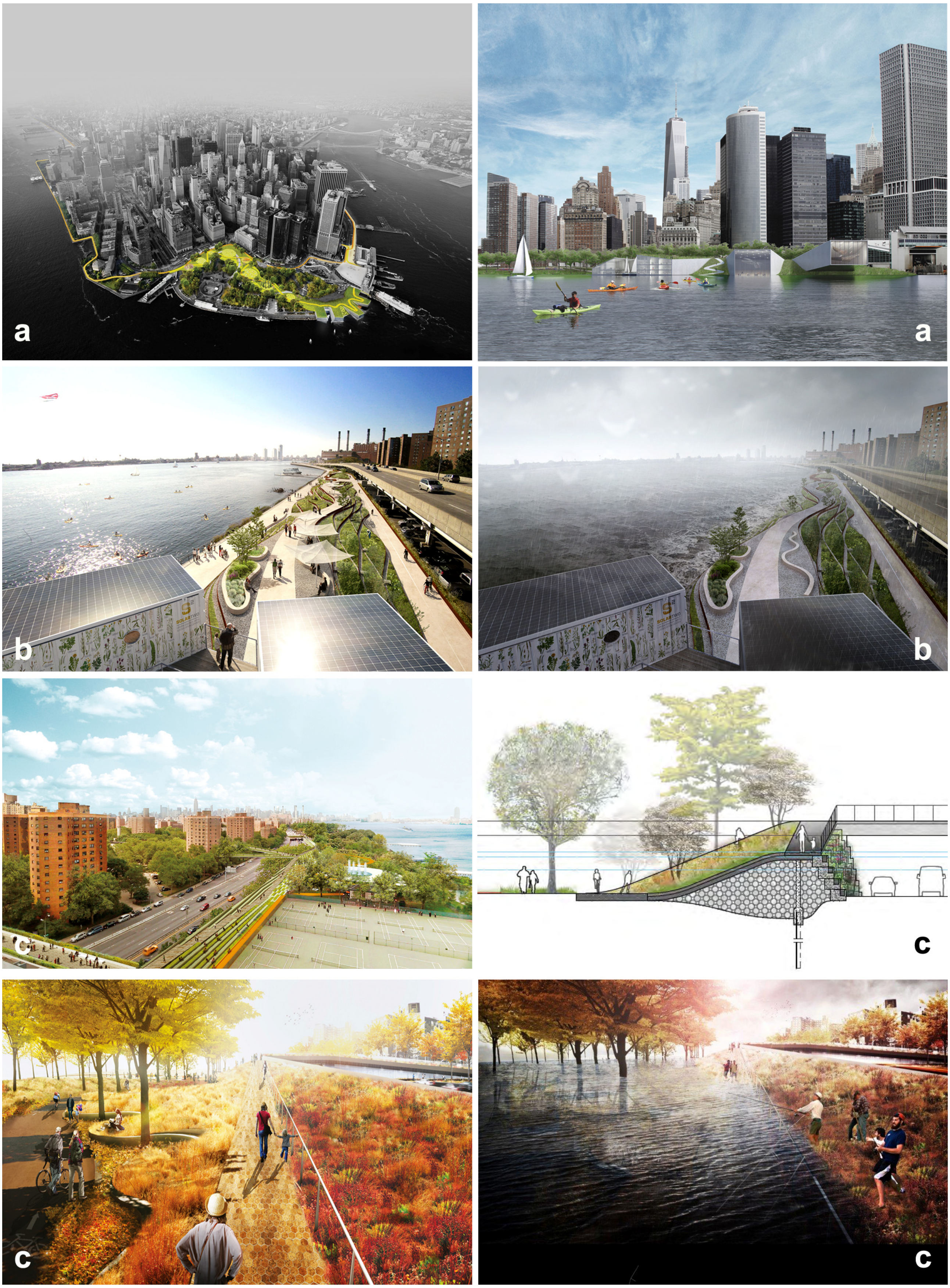


(Fig. 2) *Sanya Mangrove Park*, Sanya City. Project by Turenscape.
2a. Design diagrams for the "*form follows processes*" principles and *master-plan*; 2b. The land-water boundaries network and its "*inter-locked fingers*" geometry; 2c. Examples of different ecotone typologies.
Source: courtesy of Kongjian Yu, Turenscape.

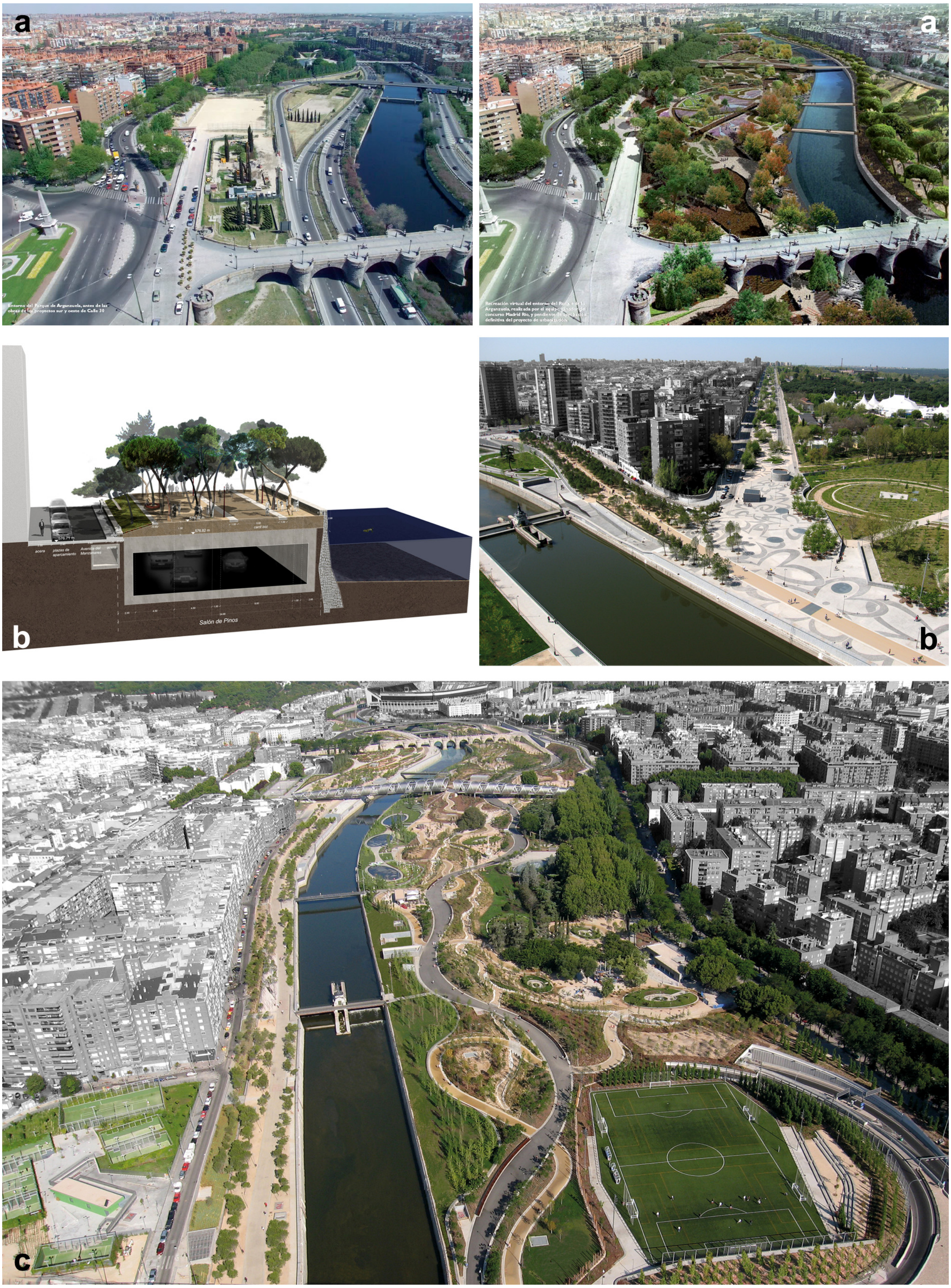
(Fig. 3) *Bishan-Ang Mo Kio Park*, Singapore. Project by Ramboll Studio Dreiseitl.
3a. The project area before and after interventions; 3b. Different river habitats along the project area;
3c. Technic-functional process diagram of the river terracing.
Source: Atelier Dreiseitl.

(Fig. 4) *Yangtze Riverfront Park*, Wuhan. Project by Sasaki.
4a. The ecological corridor structure configures heterogenous micro-environments; 4b. Spaces and infrastructures are integrated in the river habitat according to the variable levels of water; 4c. The river landscape changes with the intensity of the floods. Source: courtesy of Sasaki.

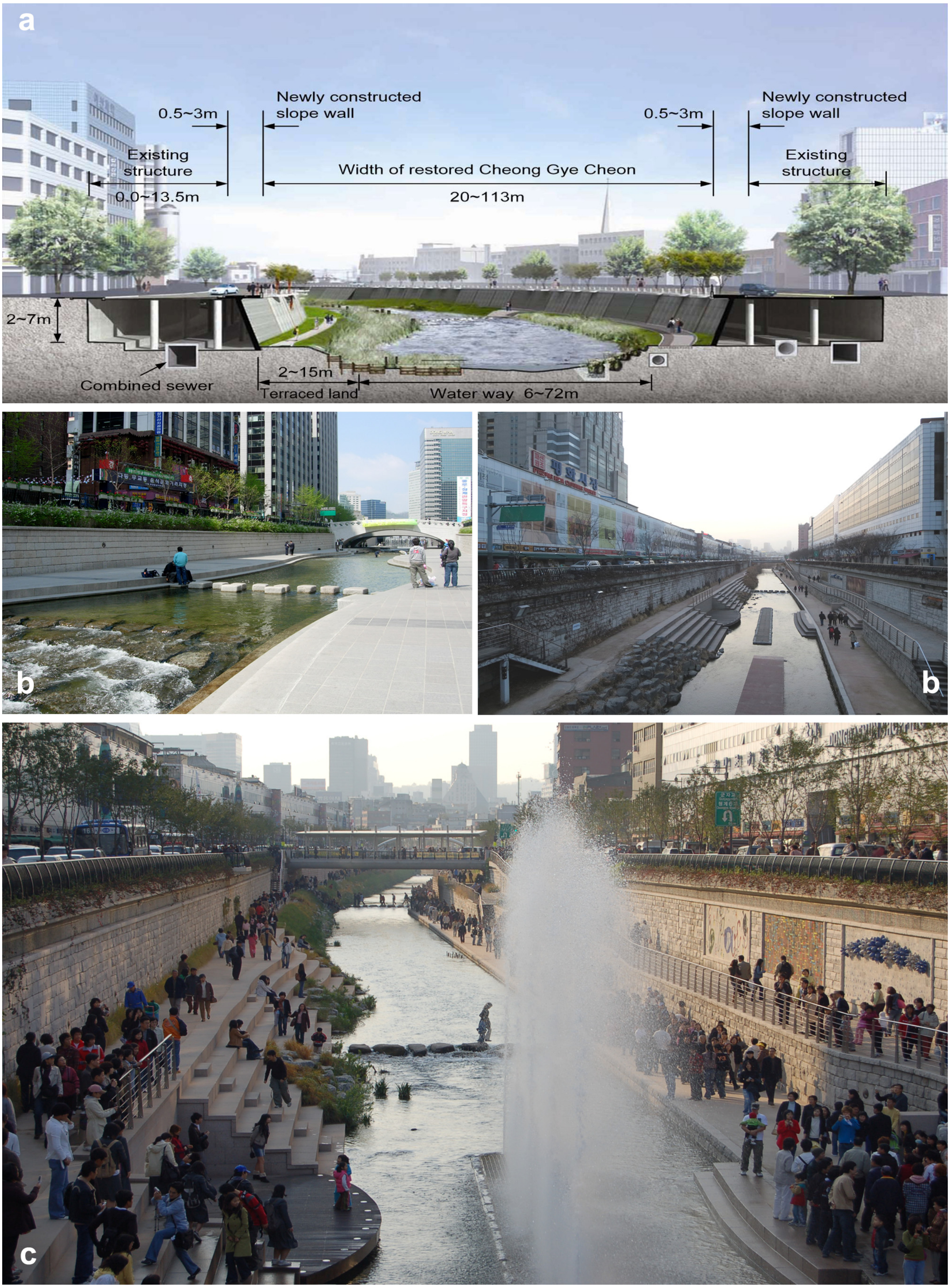
(Fig. 5) *Yanweizhou Park,* Jinhua City. Project by Turenscape.
5a. Connecting pedestrian paths between urban districts; 5b. Examples of different river terracing;
5c. The confluence between Wuyi e Yiwu rivers before and after the flooding season.
Source: courtesy of Kongjian Yu, Turenscape.



(Fig. 6) *BIG-U*, New York. Project by Bjarke Ingels Group.
6a. General view of project with the *Harbor Berm* 6b; The *Stuyvesant Cove Park* riverfront during dry and flood phases;
6c. The *Bridging Berm*: aerial view, cross-section type and two visions during the dry and flood seasons.
Source: courtesy of Bjarke Ingels Group.



(Fig. 7) *Parque Rìo Manzanares*, Madrid. Project: by West 8 + Burgos & Garrido + Porras & La Casta + Rubio & Álvarez-Sala. 7a. The project area before and after the interventions; 7b. Cross-section along the M-30 highway with *Salón de Pinos* park areas and connection with the *Avenida de Portugal*; 7c. Aerial view on *Arganzuela Park* areas. Source: Municipality of Madrid, courtesy of West 8.



(Fig. 8) *Cheong Gye Che,* Seoul. Project by Cheongsuk Eng., Saman Eng. e Dongmyung Eng. + SeoAhn Total Landscape. 8a. Cross-section of the river restoration project; 8b; The restored riverbed between building and infrastructural pre-existences; 8c. A new co-evolutive season for the story of *Cheong Gye Che* river.
Sources: Wikimedia Commons, Seoul Metropolitan Government.

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