Forest Estate, Tengah Design Studio: Ten Landscape Architectural Tactics for Managing Deforestation in a High-Density Tropical City

Text by Hwang Yun Hye and Feng Yuanqiu
Images as credited

Secondary forests in Singapore are often viewed as temporary and transitory landscapes awaiting development. Based on land use designated in the Urban Redevelopment Authority (URA) Master Plan 2014, most of the existing secondary forests, covering a total area of about 4,700 hectares, could be converted into development land uses, such as residential, commercial, institution, and reserve sites, over the next 10–15 years. These urban forests presently occupy a significant proportion of land: more than twice the total area of all parks in Singapore and close to half of all land currently dedicated to public housing.[1] They perform a number of important functions in the socio-ecological system of the city—biological, biophysical and even social-cultural. When developing forested sites, it is important to take this into account and manage long-term socio-ecological consequences.

In response to the issue of secondary forest loss, we set up and led the Forest Estate studio as part of a course module at the National University of Singapore as a platform for design instructors, students, practitioners and other professionals to collaboratively investigate a common issue. Students from the architecture and landscape architecture programmes took part in this 14-week long module which began in August 2015. In this form, the studio is "a forum for speculative ideas taken through to a degree of resolution", valuable not just as a pedagogical tool, but also as a setting for landscape architecture research.[2] The academic design studio can facilitate the generation of systemic design strategies due to its emphasis on comprehensive understanding of related theories in various fields as well as its relative independence from commercial concerns.

Tengah forest and development plan

In Tengah, a 720-hectare patch is one such secondary forest site awaiting development. Since the former *kampung* and its accompanying landscape was phased out in the 1980s, a young secondary forest has since taken over a patch of abandoned plantation land. Adjoining the 13-kilometre Tengah Nature Way, this forest patch is strategically situated between the Central Catchment Nature Reserve and the Western Catchment area. While it is currently being used as military training grounds, the fairly undisturbed greenery has become an important stopover for wildlife moving between more established nature areas. The site is also regularly utilised by some members of the community. Along the 1.7 kilometre open canal diagonally cutting through the area, people can be seen exercising, strolling, jogging, and cycling. Sporadic informal "farms", "home gardens", and agricultural remnants can also be spotted along the canal's length, a vestige of the old *kampung* life that once thrived in the area.

The forest patch is bounded by large-scale transportation infrastructure, making cross-boundary connectivity a challenge. It is also surrounded by three residential towns, Jurong, Bukit Batok, and Choa Chu Kang, which consist of high-rise Housing Development Board (HDB) flats, institutions, industrial and commercial buildings, and several new development plots. According to the 2014 URA Master Plan, the Tengah patch is

1. Overview of Tengah forest from a resident's home (Photo: Feng Yuanqiu).
2. Tengah forest canal (Photo: Feng Yuanqiu).
3. Informal farming activities in Tengah (Photo: Su Yuting).
4. A satellite image from Google Map shows the forest patch (Image: Google Maps).
5. Plans for land use development at Tengah (Image: Urban Redevelopment Authority Master Plan 2014).

expected to be developed into a new town serving mainly residential and business functions. Massive construction and earthworks are slated to begin in October 2015, and a new railway network, Jurong Region Line, will be built to serve the area.

How can we compensate for the potential socio-ecological impacts of deforestation while meeting the increasing commercial and housing demands? Should the woodland be largely conserved or could it be developed in an environmentally responsible fashion? Beyond simply preserving the site, can novel design prototypes infusing greater ecological functions and diversity into the urban context be proposed? How can design improve well-being and promote a stewardship ethic in city dwellers by bringing nature closer to everyday life? There are few clear or immediate answers to these important questions that we seek to address through the design studio.

Approaches

Four approaches to address socio-cultural and ecological concerns in developing Tengah are emphasised in this studio. Using these approaches, seven projects were produced in the studio, each addressing a specific issue. We then identified 10 landscape architectural tactics that could be further examined in real-world scenarios.

1. Site-specific design

The first quarter of the studio focused on understanding the geographical characteristics, locality and reality of the assigned sites. Students were asked to collect data and maps related to the site including landform, demographic information, history, vegetation, microclimate, built features, and future plans. They also made intensive field surveys which included on-site measurement, species identification, surveys, key informant interviews, site observation, photographic documentation, and drawings. These enabled them to layer additional information upon the site.

2. Ecological design

We looked to the field of urban ecology to provide guidelines and tenets for formulating design proposals. Students looked at a set of ecological urbanism concepts and their design implications proposed by Anne W. Spirn.[3] To gain an understanding of key issues in urban ecology, they also reviewed "Urban ecology: Science of cities" by Richard Forman.[4] In an early exercise, students applied their understanding of these principles and issues to the tropical city context as well as the studied area by creating maps that expose various issues in the urban ecosystem.

3. Multiscalar design

A multiscalar design approach recognises that ecosystems are nested both spatially and temporally, and design decisions made at one planning scale will impact many. Research and design considerations across multiple scales such as island-wide, neighbourhood, and landscape detail, are taken into consideration. For example,

to address issues of biodiversity, design decisions could be evaluated at the landscape scale to examine broad habitat connectivity with other large green patches. Neighbourhood and point scales were examined for more detailed considerations such as microclimate and species selection. We also explored temporal scales such as how the proposal may morph and impact the adjacent landscape over time.

4. Multifunctional design

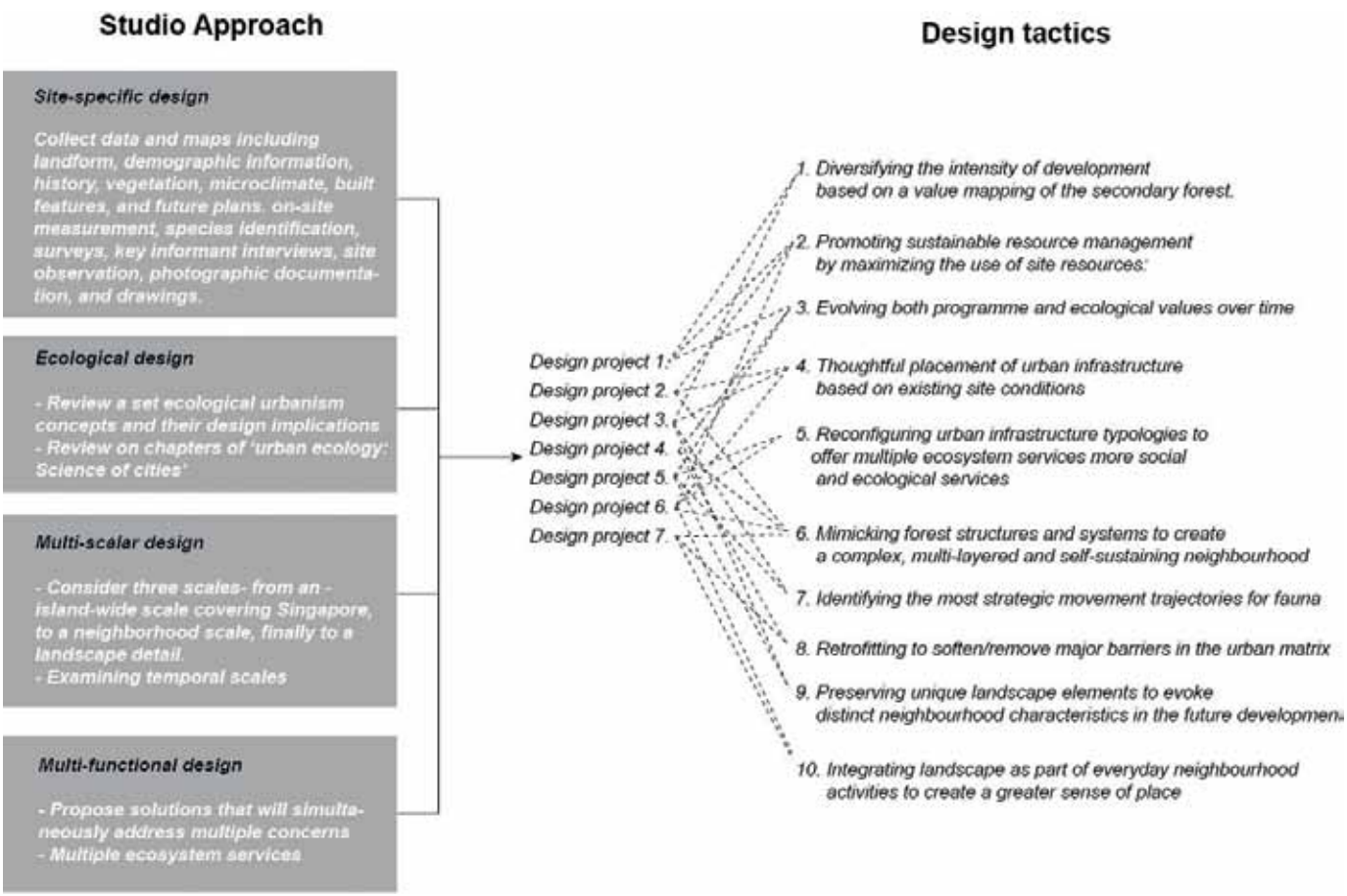
Multifunctional landscapes that have economic, cultural and ecological functions are key to achieving sustainable landscapes.[5] Students were encouraged to produce solutions that will simultaneously address multiple concerns. For instance, road infrastructure could potentially accommodate multiple ecosystem services beyond its basic function, including phytoremediation, stormwater management, microclimate amelioration, habitat provision, and socio-cultural services.

Tactics for Tengah forest estate

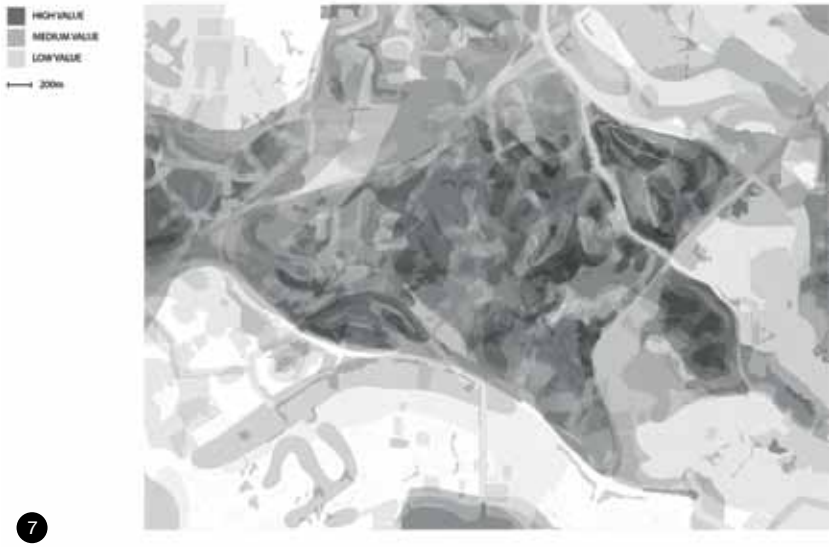
Given that the large majority of the plot has been slated for housing developments, most of the studio's projects have focused on the planning and design of residential neighbourhoods in response to the secondary forest context. Current public housing design approaches are rooted in Vitruvian ideals of architectural design, and the Housing and Development Board landscape guidelines prescribe a number of landscape design principles, neatly categorised under "community-friendly", "environmentally-friendly" and "aesthetically-pleasing".[6] In the Forest Estate studio, participants questioned these distinctions between social, ecological and aesthetic considerations and proposed a number of tactics that synthesise the trio.

1. Diversifying the intensity of development based on a value mapping of the secondary forest

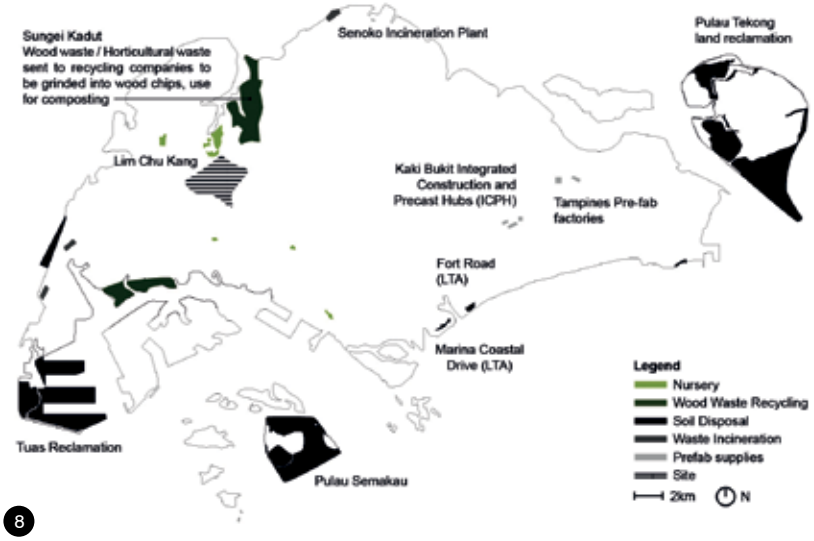
While design guidelines mention the importance of designing for context and existing conditions, in practice this is often translated to conserving mature



6



7



8

TYPICAL DEVELOPMENT	PROPOSED DEVELOPMENT
Excavated Soil	Excavated Soil (1m deep)
13,120,528 m3	**4,876,965** m3
Required Fill	Required Fill (Building Footprint)
21,915,464 m3	**1,609,398** m3
Additional Soil/Fill (Deficit)	Soil to be Reused (Surplus)
8,794,936 m3	**3,267,569** m3
GREEN	GREEN
Untouched Trees	Untouched Trees
0 trees	**12,530** trees
Removed Trees	Removed & Thinned Trees
38,839 trees	**13,154** trees
Planted Urban Trees	Planted Urban Trees
5,490 trees	**8,065** trees
Total Trees Lost	Total Trees Gained
30,774 trees	**38,839** trees
Planted Forest Trees	Planted Forest Trees
2,575 trees	**13,154** trees

9

6. The development process of design tactics from studio approaches, associated research activities, and design projects.
7. A value mapping of Tengah created by a process of overlaying. Darker areas indicate areas of higher value (Image: Pearlyn Chang Mei Fen and Wang Chao Chao).
8. Resource maps indicating inputs and outputs (Image: Pearlyn Chang Mei Fen and Wang Chao Chao).
9. A quantitative comparison between typical and proposed developments (Image: Pearlyn Chang Mei Fen and Wang Chao Chao)

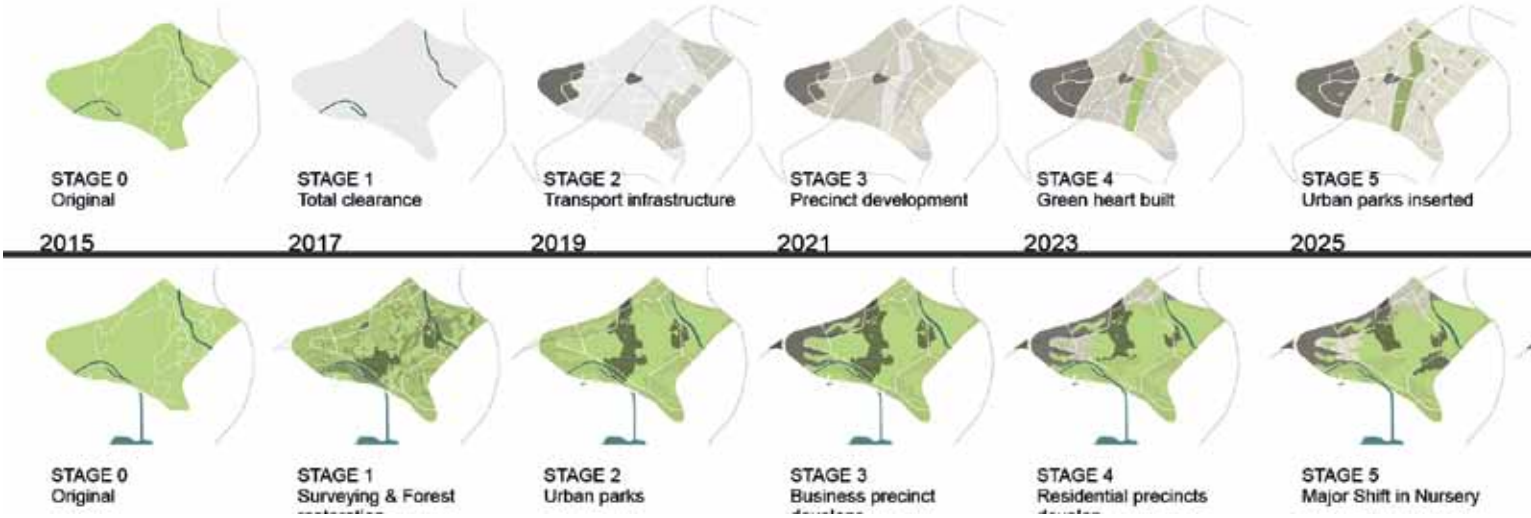
tree specimens. We suggest that more in-depth study and understanding of context is needed when developing secondary forest sites. In the Forest Estate studio, detailed mappings of habitat types, canopy cover, water bodies, topography and relationships with the surrounding urban green spaces were created and overlaid to identify areas of high value. Accordingly, the intensity of urban developments were planned and adjusted based on the information (see Image 7).

2. Promoting sustainable resource management by maximising the use of site resources

Typical development practices of ignoring the secondary forest context not only results in various ecological impacts, but also generate large amounts of waste material. Instead, the existing forest could be regarded as a resource for development. Top soil, for example, is highly valuable in tropical environments and should be collected to be reused. Apart from conserving mature trees, valuable young trees could be retained in on-site nurseries for replanting. Woody plant materials could also be retained on site to be used for various outdoor structures and furniture (see Images 8 and 9).

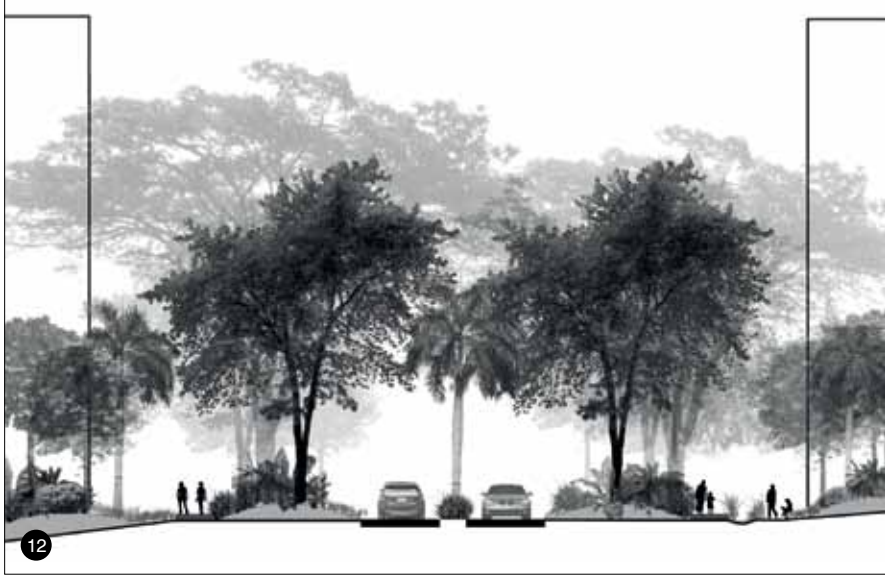
3. Evolving both programme and ecological values over time

As opposed to the total and immediate replacement of site and programme when demands arise, projects in Forest Estate propose a well-orchestrated evolution of land use change which simultaneously allows the landscapes to mature and grow in ecological value over time. Interim uses of secondary



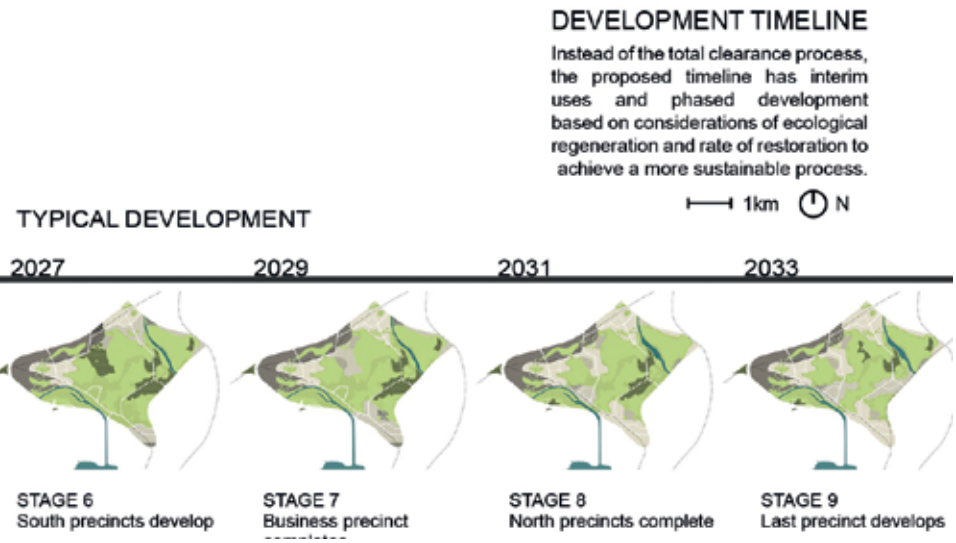
10

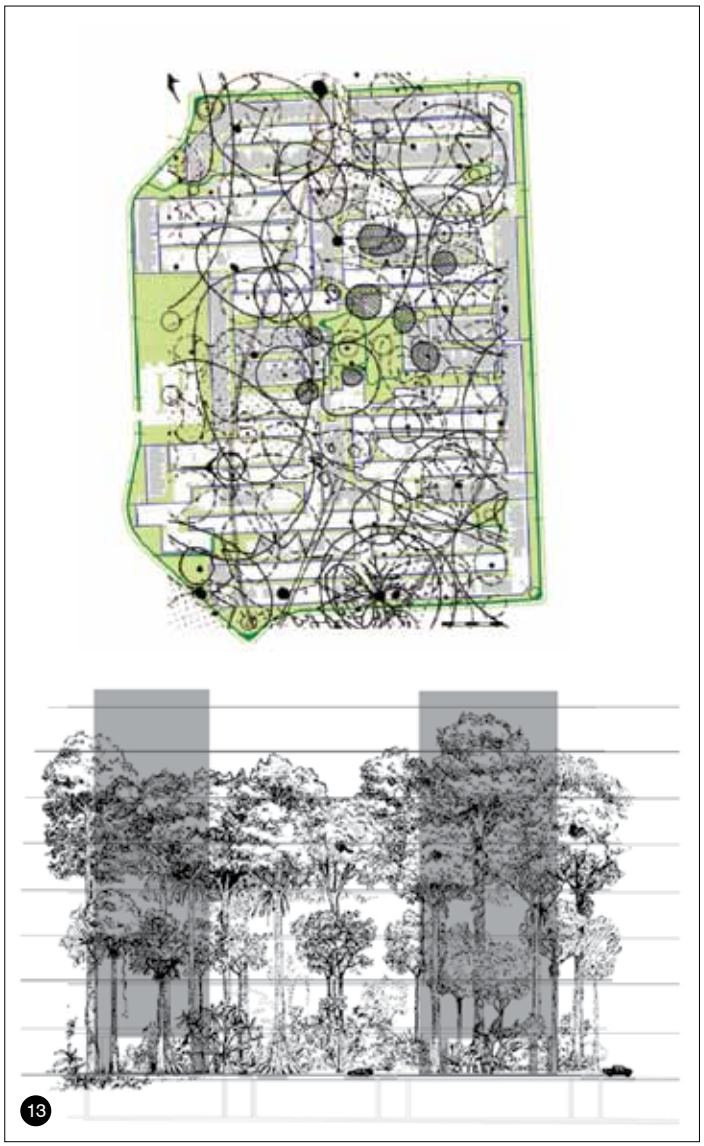
11



12

10. A development phasing plan from stage 0 to 9 over a period of 30 years (Image: Pearlyn Chang Mei Fen and Wang Chao Chao).
11. A mapping of pedestrian movement through the HDB estate. The map facilitates the reconfiguration of human and fauna movements (Image: Wang Yu Qian and Liu Yu).
12. Drawings of alternative road typologies to ameliorate the urban heat island effect (Image: Chen Wei and Tan Wenbin).
13. A conceptual sketch of a precinct modelled after a forest (Image: Amanda J. C. and Amanda D. W.).




13

forest sites as plant nurseries and nature parks offer recreational space for residents living nearby and builds a closer relationship between urban residents and the adjoining forest (see Image 10).

4. Thoughtful placement of urban infrastructure based on existing site conditions

Large scale infrastructure such as roads and drainage systems are critical to the functioning of modern cities, though their environmental impacts are often immense. The form and location of these infrastructural elements within the site should thus be carefully considered. For example, projects in Forest Estate planned and organised roads in reference to the topography of the site to minimise drastic changes to terrain and hydrology.

5. Reconfiguring urban infrastructure typologies to offer more social and ecological services

Apart from thoughtful placement, urban infrastructure typologies could be rethought to become more multifunctional. Through the use of alterative spatial configurations, planting palettes and programming, projects in Forest Estate presented new road and canal typologies that offered recreational space, heat mitigation and water treatment belts, fauna movement corridors, and improved pedestrian accessibility (see Images 11 and 12).

6. Mimicking forest structures and systems to create a multi-layered and self-sustaining neighbourhood

Drawing from the structure and functions of the tropical forest, schemes in Forest Estate sought to create comfortable urban microclimate, increase biodiversity benefits, provide urban water treatment services, and promote more positive human-wildlife relationships. One project did this by strategically increasing flora heterogeneity and density in the residential neighbourhood's planted areas and open spaces. This was done through careful studies of the plants' functional traits and creating planting compositions that were informed by cultural and ethnobotanical values (see Image 13).

14. A three-dimensional sketch that shows the placement of urban green spaces which create strategic movement trajectories to soften urban barriers (Image: Wu Yu-Chen and Pu Wenjun).
15. A mapping of unique landscape features and elements in Tengah (Image: Zhang Qingqing and Su Yuting).
16. Designers can develop a sense of place by integrating everyday life in the residential neighbourhood with the landscape (Image: Zhang Qingqing and Su Yuting).

7. Identifying the most strategic movement trajectories for fauna

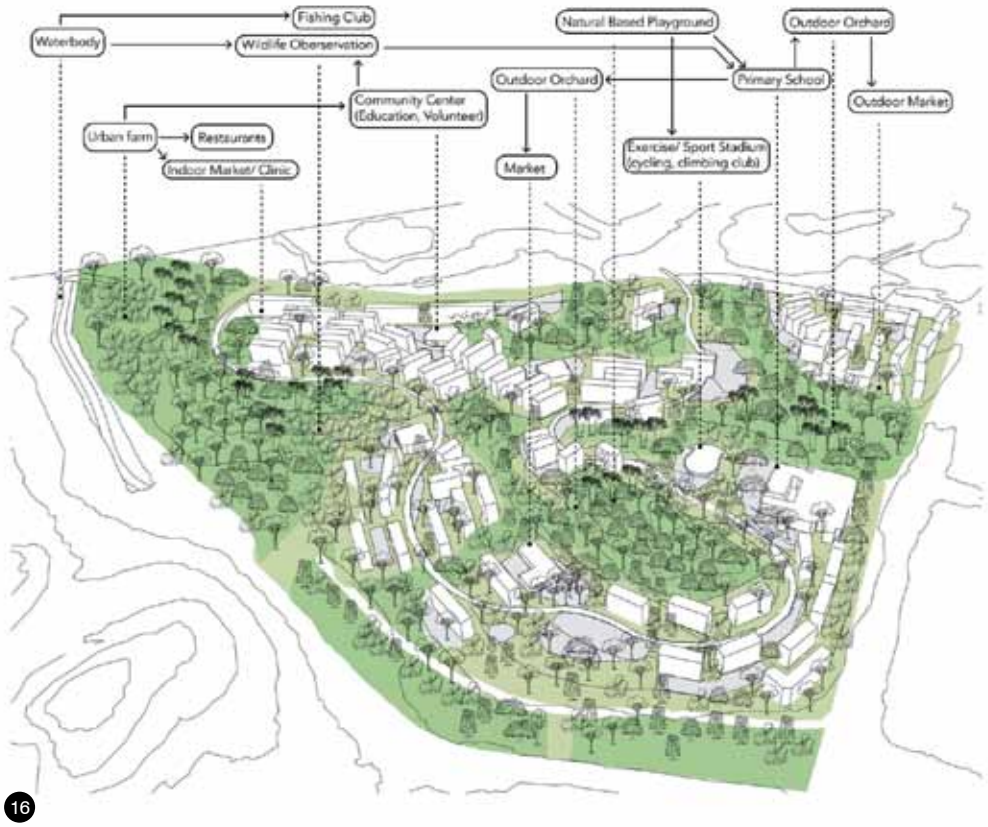
The patchwork replacement of urban green spaces with hardscape and urban infrastructure inevitably results in the fragmentation of the landscape, and reduces connectivity for various fauna species. Where development has already left major green areas disconnected, strategic movement trajectories through the development could be identified for specific ecological guilds. Based on available space, current usage, and disruptiveness of existing urban barriers, designers can determine which species may be served through various potential movement corridors (see Image 14).

8. Retrofitting to soften or remove major barriers in the urban matrix

Major barriers preventing wildlife movement in the urban matrix such as roads and tall buildings can be retrofitted to create a less hostile environment for fauna. For instance, vertical greening techniques, beyond their decorative role, has potential to soften these major urban barriers. In urban green spaces, increased planting density and alternative maintenance regimes could also make human-managed spaces more welcoming to the city's non-human denisens.

9. Preserving unique landscape elements to evoke distinct neighbourhood characteristics in the future development

Secondary forests, though sometimes dismissed as "wastelands" and "wild growth", are valuable as a unique landscape type that is now rapidly being replaced with hardscape and highly managed greenery, which have been criticised as being monotonous and generic. Detailed surveys of the secondary forest unveils a number of distinct landscape elements—from tree covered hills and natural streams to patches of old durian orchards intermixed with pioneering forest species. By preserving these landscape elements in the future development, a distinctive neighbourhood could be created without using contrived designs (see Image 15).



16

10. Integrating landscape as part of everyday neighbourhood activities to create a greater sense of place

The "placelessness" of modern cities is a problem often commented upon by intellectuals from various disciplines. Yet, creating a sense of place is a tall order that cannot be instantly achieved through design. Instead, the Forest Estate studio approaches the issue by aiming to closely integrate the visible landscape with everyday activities in the neighbourhood by identifying unique synergies between existent landscape features and programmes such as a market with a former fruit orchard or a school near a more biodiverse patch. By designing to provide opportunities for unique and positive landscape experiences to take place, designers can facilitate the development of a strong sense of place by leveraging on the landscape qualities of the secondary forest (see Image 16).

Conclusion

We hope that these proposed tactics expand the range of design approaches currently available in practice. The tactics also incite greater professional discourse on the potential leadership role landscape architects can play in the management of deforestation in a high-density tropical city. Ideas generated by the academic studio have to be developed and modified in the context of economic and political realities, and tested in an iterative and adaptive process of implementation and post-implementation monitoring. As development encroaches further into urban green spaces all over the island, a set of design tactics and guidelines that closely address the secondary forest context is imperative in managing the social and ecological consequences of their continued loss.

References

1 Tan, P. Y., Feng, Y., & Hwang, Y. H., "Deforestation in a Tropical Compact City Part A: Understanding its Socio-ecological Impacts", Journal of Smart and Sustainable Built Environment (Accepted), 2015.

2 Helen Armstrong, "Design studios as research: an emerging paradigm for landscape architecture," *Landscape Review 5* (1999), 5–25.

3 Anne W. Spirn, Ecological Urbanism: A Framework for the Design of Resilient Cities, 2011, Retrieved from http://www.annewhistonspirn.com/pdf/Spirn-EcoUrbanism-2012.pdf.

4 Richard Forman, "Urban ecology: Science of cities," (New York: Cambridge University Press, 2014).

5 Sarah T. Lovell and John R. Taylor, "Supplying urban ecosystem services through multifunctional green infrastructure in the United States," Landscape Ecology 28 (2013), 1447–1463, doi:10.1007/s10980-013-9912-y.

6 Housing and Development Board, "HDB Landscape Guide," (Singapore: Housing and Development Board, 2013).

Acknowledgements

Much of the work here was done by the student participants in the Forest Estate, Tengah studio. Year 4 students: Chang Mei Fen Pearlyn, Chen Jumin, Chen Wei, Liu Yu, Pu Wenjun, Qian Xuanyu, Su Yuting, Tan Wenbin, Wang Yuqian, and Zhang Qingqing. Year 3 students: Amanda Dwiyani Widodo, Amanda Jennifer Chandra, Chia Ming Kuang, Neo Jasmine, Nur Afiqah Bte Agus, Wang ChaoChao, and Wu Yu-Chen.