

## MANDAI: BALANCING DEVELOPMENT AND NATURE

The development of Mandai Wildlife Reserve is an example of Singapore's broader challenge of balancing the use of its limited land resources with the need to also protect its nature reserves. The five-decade evolution of Mandai's wildlife attractions—from the Singapore Zoo to newer developments like the Bird Paradise and Rainforest Wild Adventure—is a journey of how leisure, education, and tourism objectives were pursued alongside environmental commitments.

This Urban Systems Study describes how inter-agency planning, public engagement with stakeholders like nature groups, and the efforts of the private sector helped to mitigate impacts on the nearby Central Catchment Nature Reserve. It also underscores the importance of collaborative, science-based approaches in achieving development goals while protecting natural ecosystems.

*"Mandai will offer a truly distinctive nature experience. It will give visitors a chance to immerse themselves in nature and wildlife in a wide variety of ways. And it will become a leading destination for nature both in Singapore and throughout the region."*

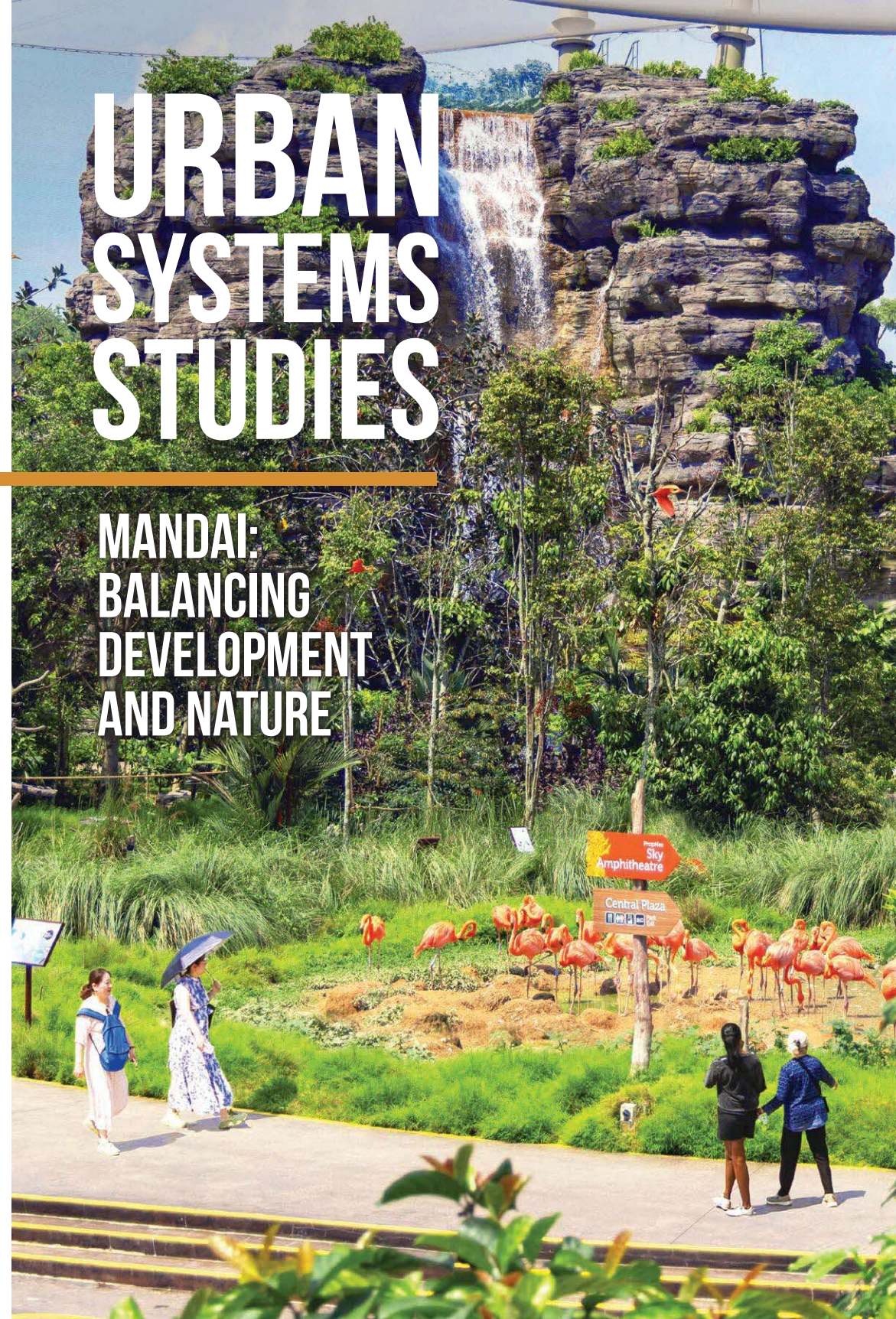
*We hope in time to come, Mandai will be a place where Singaporeans and tourists alike can get up close with nature; learn about our rich biodiversity and conservation efforts. And importantly, create many more new and fond memories here."*

Lawrence Wong, then Deputy Prime Minister and Minister for Finance<sup>1</sup>



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# MANDAI: BALANCING DEVELOPMENT AND NATURE

CENTRE for  
**LiveableCities**  
SINGAPORE

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Set up in 2008 by the Ministry of National Development and the then Ministry of the Environment and Water Resources, the Centre for Liveable Cities (CLC) has as its mission “to distil, create and share knowledge on liveable and sustainable cities”. The CLC’s work spans four main areas—Research, Capability Development, Knowledge Platforms, and Advisory. Through these activities, the CLC hopes to provide urban leaders and practitioners with the knowledge and support needed to make our cities better. For more information, please visit [www.clc.gov.sg](http://www.clc.gov.sg).

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Bird Paradise, courtesy of Mandai Wildlife Group

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## FOREWORD

For over five decades, Mandai Wildlife Group has been at the forefront of wildlife conservation and nature appreciation. This urban study chronicles the transformation of what began as Dr Kwa Soon Bee's vision for Wildlife Reserves Singapore—comprising the Singapore Zoo, Night Safari and then River Safari—into today's integrated nature and wildlife precinct.

In 2007, the Ministry of Trade and Industry and the Singapore Tourism Board identified the wildlife parks at Mandai Wildlife Reserve as having the potential to be developed into a world-class nature and wildlife themed destination, for visitors local and abroad. The rejuvenated Mandai Wildlife Reserve embodies our identity as a City in Nature, offering new eco-friendly and nature-based experiences for local and overseas visitors, and career opportunities in hospitality and animal conservation. The story revealed in these pages shows the complexity and care behind this transformation—from early conservation challenges through environmental assessments and community engagement, to innovative solutions protecting our Central Catchment Nature Reserve while creating world-class attractions.

The new developments at Mandai Wildlife Reserve continue to build on this excellent legacy, creating green public spaces for all to enjoy. These world-class attractions will draw visitors from across the globe, positioning Singapore as a premier destination for nature-based tourism while showcasing our pioneering conservation efforts to an international audience. This multi-generational project shows how tourism developments can work alongside conservation goals through careful planning and collaboration.

This story of vision, persistence and collaboration belongs to all Singaporeans and will inspire future generations to continue building a nation where nature and progress advance hand in hand.

**Melissa Ow**

Chief Executive, Singapore Tourism Board

## PREFACE

The Centre for Liveable Cities' (CLC) research in urban systems unpacks the systemic components that make up the city of Singapore, capturing knowledge not only within each of these systems, but also the threads that link these systems and how they make sense as a whole. The studies are scoped to venture deep into the key domain areas that the CLC has identified under the Liveability Framework, attempting to answer two key questions: how Singapore has transformed itself into a highly liveable city over the last six decades, and how the CLC can build on our urban development experience to create new knowledge and innovative urban solutions relevant to Singapore and other cities around the world through applied research. *Mandai: Balancing Development and Nature* is the latest publication in our Urban Systems Studies (USS) series.

The research process behind this publication involved close and rigorous engagement of our stakeholder agencies by the CLC's researchers. They also conducted oral history interviews with Singapore's urban pioneers and leaders to gain insights into development processes and distil tacit knowledge that has been gleaned from planning and implementation, as well as governance of Singapore. As a body of knowledge, the USS series—which covers aspects such as water, transport, housing, industrial infrastructure and sustainable environment—reveals not only the visible outcomes of Singapore's development, but also the importance of the other systemic structures and processes which support our urban achievements.

This USS publication describes the development of the nature-themed attractions in Mandai, from the establishment of the Singapore Zoo in 1973, to their status today as a major leisure and tourism destination that also includes the Night Safari, River Wonders, Bird Paradise and Rainforest Wild Adventure. It documents how we balanced development at Mandai with nature by leveraging on science-based mitigating measures such as the Mandai Wildlife Bridge. The book also highlights the importance of engaging and collaborating with stakeholder communities to find solutions that helped to reduce the impact of development on the wildlife in the surrounding areas.

The CLC would like to thank the Singapore Tourism Board, Mandai Wildlife Group, Urban Redevelopment Authority, National Parks Board, and all those who contributed their knowledge, expertise and time to make this publication possible. I wish you an enjoyable read.

**Hugh Lim**

Executive Director, Centre for Liveable Cities

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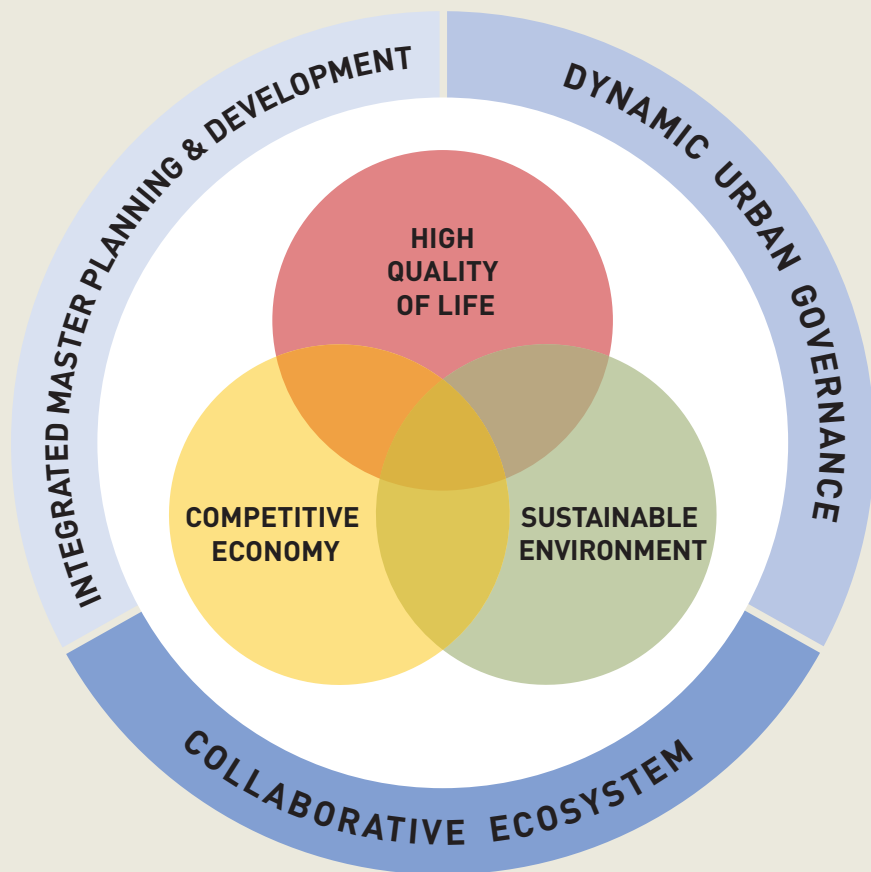
The Centre extends its sincere appreciation to Melissa Ow for contributing the Foreword. We would also like to thank Chua Yen Kheng, Cheryl Wen and Wilfred Yu from Mandai Wildlife Group, as well as former Mandai Wildlife Group staff Ong Wei Bin and Ou Guojian for their generous cooperation and support in facilitating interviews and collaborating with the Centre on the development of this publication.

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## LIVEABILITY FRAMEWORK

The Liveability Framework is derived from Singapore's urban development experience and is a useful guide for developing sustainable and liveable cities. The general principles under the three domains of Integrated Master Planning and Development, Dynamic Urban Governance, and Collaborative Ecosystem are reflected in the themes explored in this publication.



1. The Liveability Framework<sup>2</sup>

## Integrated Master Planning and Development

### Plan and Execute Effectively

The desire to build the Singapore Zoo, the first of the nature-themed attractions at Mandai, was borne out of long-term planning intentions outlined in the United Nations Urban Renewal and Development Project on Planning in Singapore of 1967, which led to Singapore's first concept plan in 1971. Even then, the Mandai area around the Central Catchment Nature Reserve (CCNR) was already planned to afford recreational opportunities for Singapore's population. This intention aligned with the plans of the Public Utilities Board (PUB) for better utilisation of the water bodies and reservoirs under its management for public recreation. This resulted in both objectives being studied and achieved together. See pages 10 and 11.

### Innovate Systematically

In due time, as the Singapore Zoo proved popular and became an important tourist attraction, the Night Safari and River Wonders attractions were also developed. Each was innovative in its own right, complementing the Singapore Zoo by adding a bigger range of experiences for visitors. This diversity of experiences on offer allowed them to not only meet the leisure, recreational and educational needs of Singaporeans, but also to become an important plank of Singapore's tourism sector, thereby adding to the vibrancy of Singapore's competitive economy. See page 43. With the newest additions of the Bird Paradise and Rainforest Wild Adventure, more than 50 years after the opening of the Singapore Zoo, the Mandai attractions continue to build upon the strengths of their predecessors.

## Dynamic Urban Governance

### Lead with Vision and Pragmatism

The nature-themed attractions at Mandai benefited from the vision of early leaders like then PUB Chairman Dr Ong Swee Law, whose team embraced the "open zoo" concept for the Singapore Zoo, which featured open enclosures that mimicked the animals' natural habitats, allowing the animals to roam freely within larger spaces than were customary for zoos at that time. See pages 19 and 20. Following this, all the attractions at Mandai were designed with the vision to improve not only the experience of visitors, but also the well-being of the birds and other animals living within them. This fostered a stronger awareness of the need to balance development in Mandai with the protection of its surrounding natural areas, as reflected in the commissioning of an Environmental Impact Assessment (EIA) for the Mandai Rejuvenation Project. It also supported a progressive deepening of the nature and conservation ethos in Singapore, as well as wider efforts to contribute more effectively to conservation in the region. See pages 104 and 105.

### Engage and Partner with the Community

With the growing awareness of the importance of nature conservation in Singapore, a concerted attempt was made to engage the public through not only the publication of the EIA for public comment, but also through deeper engagement of interested nature groups and individuals. This went beyond one-off events and evolved into a process of wider town hall-style feedback sessions, followed by small-group engagements that delved deeper into problem-solving. See pages 80 to 82.

## Collaborative Ecosystem

### Find Solutions Together

During the planning and development stages of the Mandai Rejuvenation Project, the Mandai development team worked with agencies like the National Parks Board as well as nature group representatives. They used science-based evidence to plan and execute mitigating measures during and after the development of the new nature-themed attractions. These led to several projects, such as the Mandai Wildlife Bridge, which reduced the negative impact of development on the wildlife living in and around the Mandai attractions. The bridge now serves as an ecological link for native animals to move between buffer zones that are adjacent to the CCNR on either side of Mandai Lake Road. Other innovations that were conceptualised together with nature groups included an innovative mitigation measure called the “colugo pole” that was introduced to aid Sunda colugos in crossing road gaps created by removed trees. See page 72.

### Steward Nature Conservation Efforts Both Locally and Regionally

With the importance of nature conservation now well recognised in Singapore, Mandai Nature was established in December 2020 to reflect this recognition. As a non-profit organisation that goes beyond protecting animals and habitats, Mandai Nature works to raise community support for sustainable living and promote nature-based solutions to mitigate climate change. This includes not just Singapore-based projects, but also collaboration with regional organisations such as the joint effort between Mandai Wildlife Group, Mandai Nature, the Indonesian government and Wildlife Conservation Society Indonesia Programme to breed endangered Rote Island snake-necked turtles and repopulate their natural habitat. See page 111.

# OVERVIEW

Singapore’s small physical size has always meant that there are space limitations that require a judicious balancing of competing land uses. Despite its spatial constraints, Singapore has established 24 nature areas, 4 of which are set aside as Nature Reserves under the Parks and Trees Act.

The nature-themed attractions developed at Mandai have helped to meet the leisure needs of Singaporeans while providing educational value. The Mandai attractions also serve as a major plank of Singapore’s tourism offerings, thereby supporting the nation’s economy.

While the attractions themselves are low density and support wildlife within their boundaries, their development in a location close to Singapore’s Central Catchment Nature Reserve (CCNR) was not without its challenges. For example, efforts had to be made during the development of the Singapore Zoo to ensure that waste from the zoo was responsibly managed to prevent pollution of the adjacent Upper Seletar Reservoir.

This Urban Systems Study (USS) traces the evolution of the individual attractions that have grown over five decades to make up the Mandai Wildlife Reserve, as well as the balancing of competing considerations that went into their planning and development.

The first chapter covers the development of the Singapore Zoo, Night Safari and River Wonders. Chapter 2 dives into the conception and development of the new attractions under the Mandai Rejuvenation Project, including how agencies such as the Ministry of Trade and Industry and Singapore Tourism Board conceived of new wildlife-centred experiences for local and overseas visitors. Chapters 3 and 4 outline the environmental sustainability and nature conservation considerations that had to be factored into the development of the newest attractions like the Bird Paradise and Rainforest Wild Adventure. This included the decision to conduct a public Environmental Impact Assessment, and the engagement of stakeholders such as nature groups to understand their concerns and to work together to develop effective mitigation measures that would reduce negative impacts on the CCNR and wildlife in the vicinity.

The concluding chapter examines the lessons learned, how restored areas and buffer areas to protect adjacent forested areas are being monitored, as well as how Mandai Wildlife Group is continuing to work towards environmental and nature conservation.

In tracing this narrative of the evolution and growth of the Mandai Wildlife Reserve, this USS seeks to exemplify how the planning and implementation of its attractions sought to maintain a fine balance between development and protecting nature. It also serves as a reminder of how important a collaborative ecosystem is in ensuring win-win outcomes and how science-based evidence can guide planning.

**Note:**

Mandai Wildlife Group has undergone corporate restructuring and name changes since the establishment of the Singapore Zoo and the Jurong Bird Park in the early 1970s. In this publication, the term "Mandai Wildlife Group" is used throughout to refer to the operator of Singapore's wildlife parks, except at points where it is historically more accurate to refer to "Mandai Park Holdings" as the holding company of Mandai Wildlife Group. Similarly, the term "Mandai Wildlife Reserve" is used to refer to the integrated destination in Mandai where all of Singapore's wildlife parks are located. Finally, individual attractions are referred to by the names by which they were known at the time of mention.

## CHAPTER 1

# TRACING THE EVOLUTION OF ZOOS IN SINGAPORE

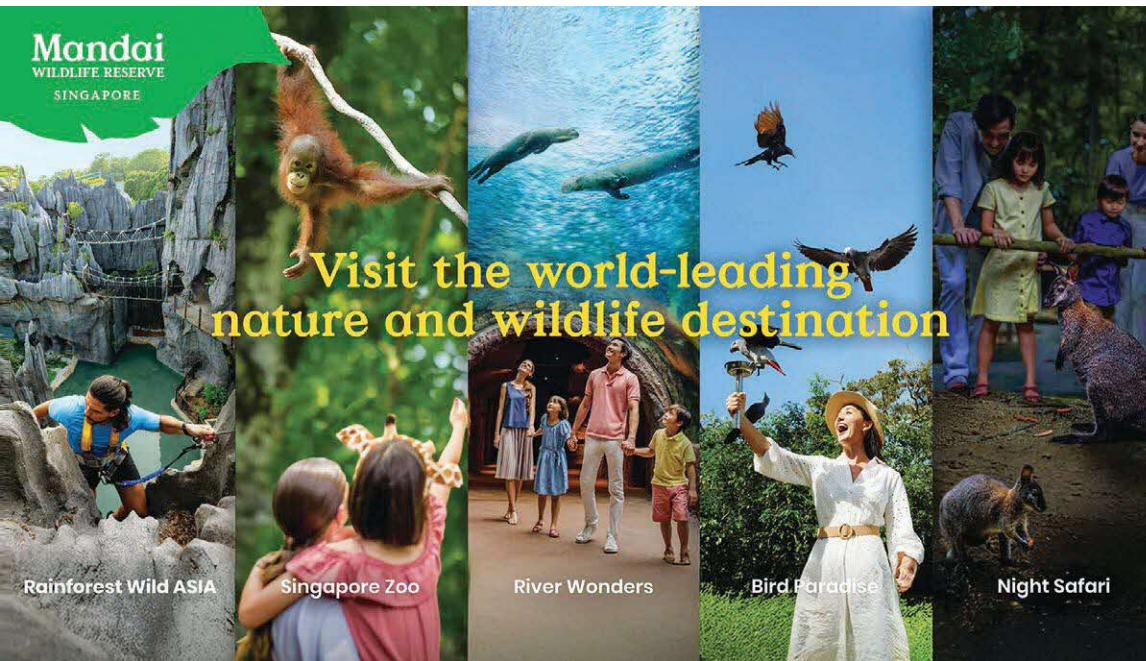
“

Singapore Zoo brings us all closer to wildlife, serving as the best possible platform to celebrate the wonders of the natural world, to explain the threats faced by so many animals in the wild, and to share what we can all do to allow people and wildlife to thrive together.

”

**MIKE BARCLAY**

Then Group Chief Executive Officer,  
Mandai Wildlife Group<sup>3</sup>



2. The Mandai Wildlife Reserve nature-themed attractions, before the renaming of Rainforest Wild to Rainforest Wild Adventure

Ask most tourists to Singapore about what attractions they like, or ask the same question of Singaporeans themselves, and it is likely that apart from the bucket list of social media “must-see” attractions like Marina Bay and Gardens by the Bay, they would speak highly of the Singapore Zoo and its sister attractions at Mandai. This would not be surprising as these are internationally known for being forward-looking and well-loved nature-themed attractions.<sup>4,5,6</sup>

What most visitors might not be aware of though, is that Singapore’s zoological parks are the products of decades of study that built upon knowledge gained from trial and error during the zoo’s early days. They may also not know that there has been an interest in wildlife in Singapore dating back to colonial times. In fact, both the founder of modern Singapore, Sir Stamford Raffles, and the first British Resident of Singapore, William Farquhar, were keen natural historians who collected and documented Southeast Asian flora and fauna during their time in Singapore and the region. This fascination has long been reflected among the public as well, with local interest continuing even after Singapore’s independence in 1965, when the population began to grow and the city became increasingly urbanised.

With Singapore often described as a “little red dot” on the world map, it is no surprise that land scarcity is a major determinant of land use planning in Singapore. Given its spatial constraints, it is crucial that Singapore carefully balances its land use choices between many competing demands to ensure that they best serve the public interest. This applies not only to conservation of native habitats, but to the land set aside for Singapore’s wildlife parks—the Singapore Zoo, Night Safari, River Wonders, Bird Paradise and Rainforest Wild Adventure.

How did Singapore balance its land use, protect the ecology of the adjacent nature reserves, and create economic value and edutainment through nature-themed attractions for both local residents and tourists?

This chapter recounts the history of zoos and wildlife parks in Singapore, both public and private, and explores the reasons behind how and why the Singapore government chose to set aside land in Mandai to develop the Singapore Zoo, despite its proximity to the Central Catchment Nature Reserve (CCNR). The chapter also discusses the land use and ecological considerations that were assessed, as well as how the “open zoo” concept took root and came to characterise all of Singapore’s subsequent nature-themed attractions.

## The First Public Zoo in Singapore

The current Singapore Zoo is in fact Singapore's second attempt at creating a public zoo. The first occurred during British colonial times, when a zoo at the Singapore Botanic Gardens was founded around 1875. Its first resident was a female two-horned Sumatran rhinoceros, gifted by the British Governor of the time, Andrew Clarke.<sup>7,8</sup>

The collection soon expanded to include a young tiger, a leopard and a sloth bear, presented by the Sultan of Terengganu and by British Colonial Resident J.W.W. Birch, along with kangaroos, emus, eagles and swans donated by the Acclimatisation Society in Melbourne. By 1877, the zoo contained a variety of animals, including orangutans, monkeys, tigers, leopards, pelicans, dingoes and foxes, housed in a total of 144 exhibits.<sup>9</sup>

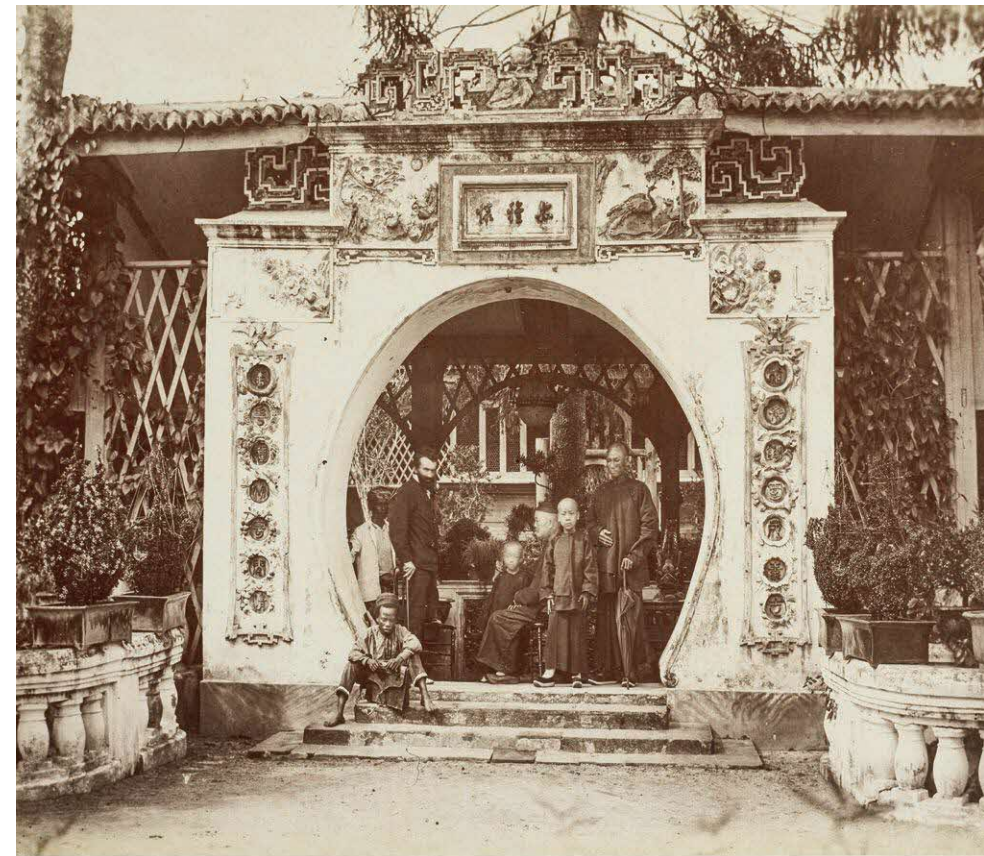
However, the influx of animals quickly overwhelmed the zoo's limited infrastructure. Over time, the zoo's budget became strained, forcing the Botanic Gardens Committee to send away the remaining large animals. In 1881, the government withdrew funding, leaving the zoo reliant solely on private contributions. Additional challenges included high animal mortality due to inadequate environmental conditions and disease outbreaks. The situation was exacerbated by trespassers who assaulted and poisoned some of the animals.<sup>10</sup> Ultimately, the zoo ceased operations in early 1905, when the last exhibit was sold due to a shortage of funds for its upkeep.<sup>11</sup>



3. The Monkey House at the zoo within the Singapore Botanic Gardens

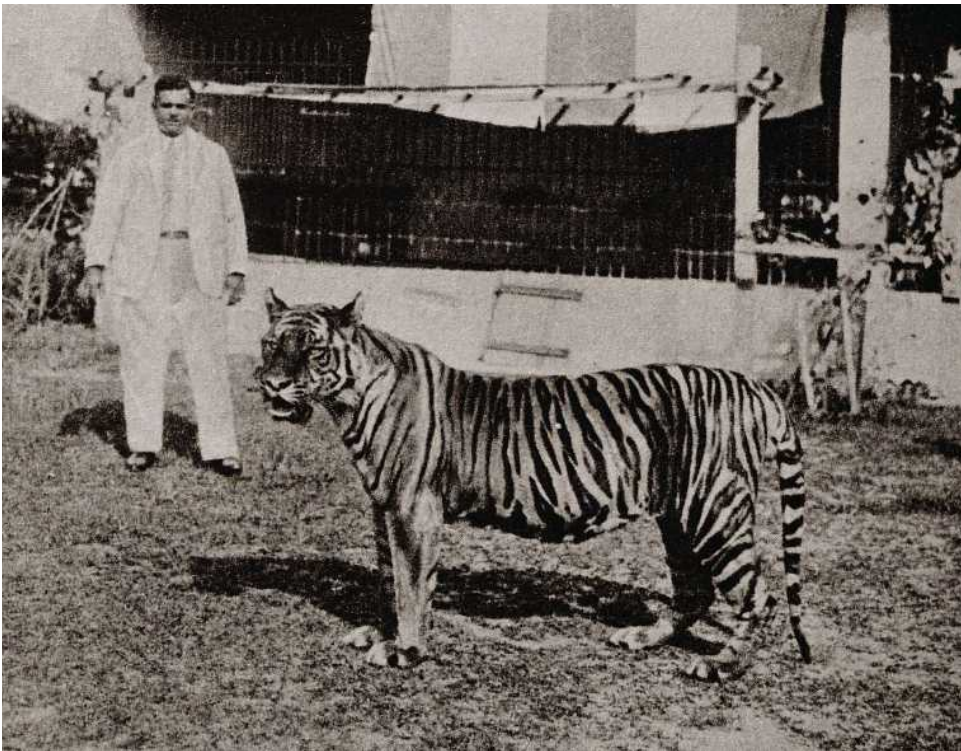
## The Advent of Private Zoos

Private zoos also played a prominent role in Singapore, driven by public fascination with wildlife and Singapore's position as a wildlife trading hub.<sup>12</sup> In the mid-1800s, well before the establishment of the zoo at the Singapore Botanic Gardens, businessman Hoo Ah Kay, also known as Whampoa, exhibited rare animals and bird species at his mansion in Whampoa Gardens. Located off Serangoon Road, in present-day Bendemeer, Whampoa's collection featured tapirs, giraffes and rhinoceroses.<sup>13</sup>



4. The Garden Pavilion at Whampoa Gardens

Several other private zoos opened and closed over the years. The next was the Punggol Zoo, founded by animal lover William Lawrence Soma Basapa in 1928. His collection boasted 2,000 birds and 200 other types of animals, including Malayan tigers, Australian cassowaries and African lions.<sup>14</sup> During the pre-war period, the zoo was a major attraction frequented by both locals and foreigners, but it was shut down by the British in 1942 in anticipation of the Japanese occupation.<sup>15</sup>



5. Mr William Lawrence Soma Basapa, who established the Punggol Zoo at 10 Mile Punggol Road, seen here with his favourite Bengal tiger, Apay

In 1954, L.F. de Jong opened a zoo in Tampines, showcasing cassowaries, tapirs, leopards, gibbons, crocodiles and snakes.<sup>16</sup> Another private zoo, the Singapore Miniature Zoo at Pasir Panjang, owned by Tong Seng Mun, opened in 1957 and housed various birds, lions, bears, a camel and a rhinoceros.<sup>17</sup> In 1963, the Chan brothers opened another zoo in Punggol, but its animals had to be auctioned off due to bankruptcy.<sup>18</sup>



6. The entrance to the Singapore Miniature Zoo in Pasir Panjang

## The Birth of the Singapore Zoo

“Many a Singaporean youth enlisted into the army as a national serviceman sees a pig for the first time in his life when he goes on military exercises in the countryside.”

—Dr Goh Keng Swee, then Deputy Prime Minister and Minister for Defence<sup>19</sup>

The Singapore Zoo and all of Singapore’s current wildlife attractions are located in Mandai, which, even now, is considered a relatively remote part of Singapore. Being right next to the CCNR and Upper Seletar Reservoir, Mandai’s wildlife attractions have always been close to nature-sensitive areas.

Since the early days of Singapore's urban planning, under the United Nations Urban Renewal and Development Project on Planning in Singapore of 1967,<sup>20</sup> which led to Singapore's first concept plan in 1971, the area around the Central Catchment had been planned to enable "a significant increase" in recreational opportunities for Singapore's population. These would include "areas for weekend recreation on a large scale", and "weekend recreational facilities which [would] be further away".<sup>21</sup>

The drive for more recreational areas aligned with plans of the Public Utilities Board (now PUB, Singapore's National Water Agency) in 1967, when it began to examine how to better utilise the water bodies and reservoirs under its management for public recreation. The agency felt that these areas were not being fully maximised because large expanses of land in the Seletar, Peirce and MacRitchie water catchment areas were closed to the public.



7. A view of the Upper Seletar Reservoir and Central Catchment Nature Reserve



8. Dr Ong Swee Law (centre), then Chairman of the PUB and Singapore Zoo, with PUB staff at his office in 1967

To study this issue, Dr Ong Swee Law, then Chairman of the PUB, formed a committee of 12 volunteers from within the PUB to assess the possibility of developing a public zoo. Dr Ong and his committee studied overseas zoos and consulted with experts before deciding that a zoo could not only open up a portion of the protected water catchment area for public use, but also complement the natural environment at the same time.<sup>22</sup> Despite environmental concerns over the risk of water pollution (discussed in more detail later in this chapter), Dr Ong presented a strong case that won endorsement from the government to proceed with the project.

Dr Ong recognised that there was a local fascination with wildlife and felt that Singaporeans would enjoy visiting a good public zoo, resulting in the conceptualisation of the Singapore Zoological Gardens in Mandai.<sup>23</sup> At the same time, since Dr Ong believed that young Singaporeans were so disconnected from nature to the extent that even domesticated animals had become a novelty, a public zoo created an opportunity for education.<sup>24</sup> In order to strike a balance between commercialism and protection of the natural environment, the zoo would contribute back to nature by raising awareness on conservation through a culture of education.

Dr Ong's efforts led the planning committee to eventually give the green light to proceed with the development of the zoo, and in 1969, the Singapore Zoological Gardens, a public limited company founded with S\$5 million in capital, was authorised by the government.<sup>25</sup> The Singapore Zoological Gardens, more commonly known as the Singapore Zoo, was officially opened on 28 June 1973 by then Deputy Prime Minister Dr Goh Keng Swee, who noted that there was widespread love for animals in Singapore, judging from the number of pets being kept.<sup>26</sup>

The newly opened Singapore Zoo proved to be a hit with both foreign and local visitors. By June 1974, it was reported that more than 850,000 people had visited the zoo, with its millionth visitor expected in October 1974.<sup>27</sup>



9. Dr Goh Keng Swee, then Deputy Prime Minister and Minister for Defence, shaking hands with Susie, an orangutan, during the official opening of the Singapore Zoological Gardens on 27 June 1973; the others pictured in the photograph are, from left to right, Dr Ong Swee Law, Executive Chairman of the Zoo; Mr Alagappasamy s/o Chelliyah, specialist primates keeper; Dr Yeoh Ghim Seng, Speaker of Parliament; Mr Vijaya Kumar Pillai, zookeeper; and Miss Lee Hei Yin, Secretary of the Zoo

## Building the Singapore Zoo While Protecting the Integrity of the Water in the Central Catchment Nature Reserve

One of the key challenges that the PUB faced in its efforts to implement the Singapore Zoo at Mandai was the site's location next to the CCNR and Upper Seletar Reservoir, which were not only considered to be an ecologically important and sensitive area, but also part of Singapore's main water catchment.

The main concern was that the development of the Singapore Zoo could result in water pollution at the Upper Seletar Reservoir, which was one of the few local water resources that Singapore had after its separation from Malaysia.<sup>28</sup> In addition, the waste generated by the animals was a paramount concern of Singapore's founding Prime Minister, Lee Kuan Yew, who recalled in a 1993 interview that the zoo was next to "a reservoir for drinking water", and that he was "obsessed with water" at the time. However, he noted that the PUB's engineers managed to facilitate the implementation of the zoo while ensuring clean water, and in that achievement, Mr Lee saw a broader lesson for Singapore, that "Nothing comes naturally...Behind it is engineering, careful planning."<sup>29</sup>



10. Locations of the Singapore Zoo, Night Safari, River Wonders and a planned area for future attractions



11. The location of the Mandai Wildlife attractions, right next to the Upper Seletar Reservoir and Central Catchment Nature Reserve

To ensure that waste from the zoo was properly managed to prevent pollution of the neighbouring Upper Seletar Reservoir, the opening of the zoo in 1973 was accompanied by anti-pollution measures implemented by the PUB. These cost approximately S\$1.75 million and included infrastructure like deep stormwater drains encircling the entire zoo, an on-site treatment plant that treated all the waste from the zoo’s animal quarters and enclosures, as well as public toilets. The zoo authorities also took steps to minimise the risk of communicable diseases by distributing water from a central source directly to all enclosures.<sup>30</sup>

The efforts made to protect the surrounding environment continue today. Wastewater generated by the wildlife parks is now treated at two new wastewater recycling plants that use membrane technology and phytoremediation to recycle it into high-quality water suitable for non-potable uses in the parks. In addition, wastewater from the manatees’ tank is cycled through a bio-bed filter instead of being directly discharged. The water is further improved through the use of specially grown pandan and wetland plants which remove contaminants. This entire process keeps the water in the manatee habitat clean while recycling around 30,000 m<sup>3</sup> of water, resulting in annual water savings of 50%.<sup>31</sup>

The two new wastewater recycling plants, which became fully operational in 2023, won the distinction prize in the Water Reuse Project of the Year category at the 2023 Global Water Awards, and are expected to support 21% of Mandai Wildlife Reserve’s water needs in the long term.<sup>32</sup>

## Nature Education and Conservation

From the outset, the economic and financial sustainability of the Singapore Zoo had been accompanied by nature education and conservation as a core part of its mission. Dr Ong, who had been made the Chairman of the Singapore Zoological Gardens, stated at the zoo's opening that his plan was to work with the Ministry of Education to implement educational facilities, hold lectures and tours, as well as build a library on wildlife.<sup>33</sup> He also told the press that “we intend to encourage a greater awareness of the part played by animals in the ecological balance of life and the efforts of conservationists to prevent their extinction”.<sup>34</sup>

By ensuring that the Singapore Zoo would go beyond being just a wildlife leisure attraction to also pursue a wildlife conservation agenda, Dr Ong was in the 1970s perpetuating a long-standing pursuit of environmental sustainability and conservation in Singapore that had begun as early as the late 19th century, during the British colonial times.

For example, following a magistrate's inquiry that discovered that as many as 20,000 birds of brilliant plumage had been captured by a single individual within a 6-month period in 1883, and were later exported, the Wild Birds Protection Ordinance was passed in 1884, and birds became the first type of wildlife in Singapore to be protected from unlicensed killing, wounding or taking.<sup>35</sup>

Among other nature conservation initiatives, subsequent legislation by both the British authorities and the Singapore government led to the Nature Reserves Ordinance, which came into force in 1951.<sup>36</sup> The law aimed to protect and preserve flora and fauna in the nature reserves, and to provide opportunities for their study and research within the natural environment in which they live. The ordinance evolved into the Nature Reserves Act in 1985, which was repealed and replaced by the National Parks Act in 1990.<sup>37</sup>

As part of its own educational outreach efforts, the zoo created interpretive signs for the animal exhibits that complemented the surrounding natural environment, and leveraged animal presentations as a platform to raise conservation awareness.<sup>38</sup> For example, the primate presentations emphasised the amount of rainforest habitats destroyed during the span of each performance, ending with a message to save rainforests, while the sea lion presentation conveyed the importance of reducing the use of plastic bags to save marine animals.



12. Interpretive signs at animal exhibits to educate visitors about animal welfare and wildlife conservation



13. A sea lion presentation

More recently, Mandai Wildlife Group (MWG) and Mandai Nature<sup>39</sup> joined Singapore's National Species Action Plan, led by the National Parks Board (NParks) and Nature Society Singapore (NSS), to guide conservation efforts for the local straw-headed bulbul population,<sup>40</sup> a species commonly trapped for the songbird trade.



14. The straw-headed bulbul, a globally critically endangered songbird, also native to Singapore

Alfred Chia, veteran birdwatcher and adviser to the NSS bird group, noted that the species was almost extirpated in places like Myanmar and Thailand, and was nearly extinct in parts of Indonesia, such as Java and Sumatra. Mr Chia also mentioned that, "Unfortunately, straw-headed bulbuls are really hard to breed in captivity. Mandai Wildlife Group is one of the few zoological institutions in the world that [has] successfully bred the birds in captivity."<sup>41</sup>

Moreover, as the straw-headed bulbul is no longer allowed to be trapped in Singapore, unlike in other countries in the region, the Mandai precinct now hosts about 5% of its global population, and the Action Plan aims to ensure that this species continues to thrive in the Mandai Wildlife Reserve, as well as in wider Singapore and its remaining range in Southeast Asia.<sup>42</sup>

## The Open Zoo Concept

One of the unique features of the Singapore Zoo is its open zoo concept, which stems from a desire to feature more open exhibits that mimic the animals' natural habitats, allowing the animals to roam within spaces that are larger than the conventional barred cages that characterise traditional zoos.<sup>43</sup>

One of the main appeals of the open concept was the camouflaging of barriers with landscaping and foliage to create a more immersive experience for visitors, such that they would feel closer to the animals and develop empathy for them, thereby strengthening the impact of the zoo's conservation message.<sup>44</sup>



15. The open zoo concept at the Singapore Zoo, featuring minimal use of cages in favour of more open and naturalistic enclosures

The open zoo concept was first considered by the committee headed by the PUB's Dr Ong, after they had visited various well-regarded zoos around the world, including those in San Diego, Basel, London and Frankfurt.<sup>45</sup> The open zoo design of the Singapore Zoo was particularly inspired by the Dehiwala Zoo in Sri Lanka and its minimal use of barred cages. Indeed, the committee was so impressed that the director of the Dehiwala Zoo, Lyn de Alwis, was appointed as the consultant of the Singapore Zoo.<sup>46</sup>

Today, elements of the open zoo concept characterise all of MWG's zoological attractions, including the Bird Paradise and Rainforest Wild Adventure, which have continued the tradition of eschewing cages, instead recreating as well as possible the animals' natural habitats. The exhibits provide more space for the animals to roam or fly, while also allowing visitors to better understand the context of the natural habitats within which the animal species live in the wild.

For a city-state like Singapore whose residents generally live in high-density urban environments, a visit to the zoo and its sister attractions can help to foster a connection to nature, as the PUB's Dr Ong foresaw. Their importance as "a bridge between an all-encompassing anthropogenic environment and green spaces or naturalistic settings supporting other living organisms is clear."<sup>47</sup>

Indeed, apart from Singapore's Mandai wildlife parks, the open zoo concept has progressively become more accepted internationally, with more zoos embracing designs that "unzoo" the zoo, to show birds and other animals in naturalistic habitats, rather than as caged animals within a confined park.<sup>48</sup>

Following the success of the Singapore Zoo, and with confidence that the impact on the water catchment areas could be managed, the open zoo design concept was applied to the subsequent wildlife attractions at Mandai.

## JURONG BIRD PARK, A UNIQUE ATTRACTION SET UP IN AN INDUSTRIAL ESTATE

Although it was arguably less well-known than the Singapore Zoo, the Jurong Bird Park was in fact Singapore's first animal-oriented attraction to be created post-independence. It opened on 3 January 1971, more than two years before the zoo at Mandai. Even then, it was a trailblazer, making its entrance as Asia's largest bird park, home to more than 7,000 birds across 350 species. Among other superlatives, it was also home to what was billed as the "world's highest man-made waterfall", with more than 30 m<sup>3</sup> of water "thundering down from a height of over [30 m] every minute".<sup>49</sup>

The story of the Jurong Bird Park's genesis is an interesting one, and like many of Singapore's earlier developments, it was the brainchild of then Minister for Finance Dr Goh Keng Swee in the late 1960s. He said the idea first occurred to him in September 1967 in Rio de Janeiro, Brazil, when he visited the Rio Aviary on a free moment during a World Bank meeting. The following year, Dr Goh visited the aviary in Bangkok, which convinced him that it would be a good idea to set up a bird park in Singapore.<sup>50</sup>



16. Then Minister for Defence Dr Goh Keng Swee (centre) at the opening of the Jurong Bird Park, 1971; Mr Woon Wah Siang, the park's chairman and managing director, is on the far right

As to why the Jurong Bird Park was sited in an industrial estate, Dr Goh had been touring the estate and remarked that “there were some islands, some area along the Jurong River which was not used, covered with bush or undergrowth. So I said it’s a good idea to make it beautiful”.<sup>51</sup>

When the Jurong Bird Park was built in the heart of Jurong New Town in 1971, Singapore’s founding Prime Minister Lee Kuan Yew alluded to its location in the Jurong industrial estate as an indicator of Singapore’s clean air. Mr Lee emphasised that “without strict anti-pollution standards, the birds from the world over could not have thrived as they are doing”. Greening was also introduced in the Jurong industrial estate, requiring all factories to landscape their grounds and plant trees before they could commence operations.<sup>52</sup>

One of the early challenges faced by the bird park was that it had to have a significant bird collection in order to attract visitors. Since the endeavour was started from scratch, the park’s pioneer chairman and managing director, Woon Wah Siang, pursued many different channels in order to find enough birds to fill the park. He was reported to have said, “I attended every National Day cocktail party just to ask for birds.”<sup>53</sup>

Beyond attending cocktail parties, Woon also approached ambassadors and foreign dignitaries in Singapore for help. He penned a 10-page letter to the British High Commissioner, Arthur de la Mare, listing over 350 bird species and seeking assistance in obtaining these birds from the United Kingdom.

Even after the birds had been sourced and acquired, there were issues in keeping them safe. In September 1969, a cassowary, two peacocks and a pair of storks were brazenly stolen. Fortunately, the cassowary attracted so much attention at the shop where it had been put on sale that the police managed to recover the bird.<sup>54</sup>

In addition, it was found that during the earlier stages of the Jurong Bird Park’s construction, its waterfall became muddy when it rained. The issue was resolved with the installation of a filtration plant near the waterfall that was “capable of filtering and cleaning the water so that what thunders down is crystal clear”.<sup>55</sup>



17. Dr Goh Keng Swee touring the Jurong Bird Park during its opening in 1971, with the park’s signature man-made waterfall in the background

Despite these challenges, the Jurong Bird Park was a hit when it opened, drawing 37,493 visitors in its first 15 days alone. By the end of 1971, it had welcomed 645,743 visitors. It was also reported to be the biggest aviary in the world at the time, sprawling over 0.20 m<sup>2</sup>, with many of its birds gifted to the park by 12 countries, 40 private collectors and 7 zoos.<sup>56</sup>

In 1993, the Jurong Bird Park attracted 1,549,595 visitors, with slightly more than 1 million being tourists.<sup>57</sup> By the time of its 50th anniversary in 2021, the Jurong Bird Park had hosted 30 million visitors.<sup>58</sup>

In 2000, the Jurong Bird Park, which had been run separately from the Singapore Zoo and Night Safari, joined its sister animal-themed attractions in Mandai through a corporate merger under Wildlife Reserves Singapore, allowing them to pool their resources and marketing.<sup>59</sup>

It was announced in September 2014 by Prime Minister Lee Hsien Loong that the Jurong Bird Park would physically join its sibling attractions and be relocated to Mandai, where the Singapore Zoo, Night Safari and River Safari (now River Wonders) were located as part of the plan to transform Mandai into a precinct of nature-themed attractions for education and recreation.<sup>60</sup>

The Jurong Bird Park was closed to visitors for good on 3 January 2023, the 52nd anniversary of its opening, after having welcomed 41 million visitors since 1971. The park's legacy lives on in the new Bird Paradise attraction, which now houses the birds from the Jurong Bird Park. Most would agree that the former bird park connected "Singaporeans and international visitors with the amazing world of birds and nature while making great strides in avian care, research and conservation".<sup>61</sup>



18. A scene from the final days of the Jurong Bird Park

## Leisure Industry Opportunities Plan

After the completion of the Singapore Zoo, by 1991, the Urban Redevelopment Authority (URA) and the Singapore Economic Development Board (EDB) had drawn up a layer plan of the Concept Plan 1991, called the Leisure Industry Opportunities Plan, which aimed to identify potential sites for development with the objective of setting up world-class leisure attractions.<sup>62</sup>

The URA and EDB worked to consider how more leisure facilities in Singapore could be strategically planned for, including theme parks like "an Asian Epcot Centre", marinas and thematic attractions to further complement existing ones like the Singapore Zoo.

According to Mr Michael Koh, then head of urban planning at the URA, the idea was to create a "necklace of attractions" around Singapore to not only deepen leisure opportunities for Singaporeans, but also to attract foreign investment and extend tourist stays in Singapore. He added that the plan considered the safeguarding of the land at Mandai for possible future leisure and thematic attractions.<sup>63</sup>

The plan for an integrated nature and wildlife destination aligned with the vision of the late Dr Kwa Soon Bee, who, apart from his important role as the Permanent Secretary for Health, was a visionary who held the wildlife parks to the highest standards.

He was the Chairman of Jurong Bird Park and oversaw the formation of Wildlife Reserves Singapore, which, by 2014, encompassed the Singapore Zoo, Night Safari and River Safari.<sup>64</sup>

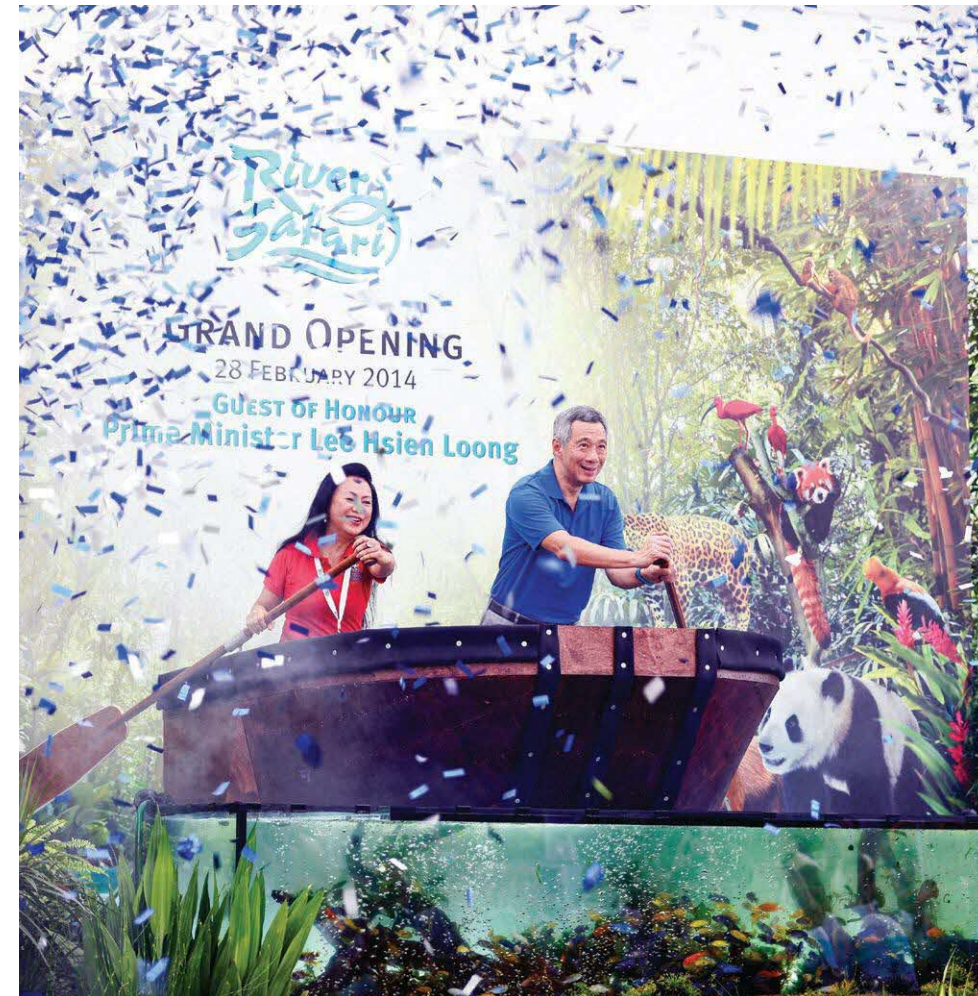
The Night Safari, which officially opened on 26 May 1994, was then the first of its kind in the world, allowing visitors to observe animals in nocturnal and naturalistic settings, including free-ranging herbivores at night.

From the start, the Night Safari proved wildly popular with not only local visitors but tourists as well. Just a month after its opening, an “overwhelming response” led the Night Safari to suspend advance ticket sales and appeal to visitors to avoid coming on Saturday nights.<sup>65</sup>

The third major wildlife attraction is the 0.12-km<sup>2</sup> River Safari (now River Wonders), which opened on 28 February 2014. Built at a cost of S\$160 million, it was Asia’s first and only river-themed wildlife park, housing the world’s largest freshwater aquarium at the time, along with 6,000 animals from 200 species. The park was inspired by freshwater habitats around the world, including seasonally flooded forests of the Amazon, Yangtze, Ganges, Nile and Mekong rivers.<sup>66</sup>



19. Grand opening of the Night Safari by then Prime Minister Goh Chok Tong on 26 May 1994



20. Grand opening of the River Safari (now River Wonders) by then Prime Minister Lee Hsien Loong on 28 February 2014

Brazilian tapirs, South American jaguars and manatees called River Wonders home, and its freshwater exhibits showcased threatened and exotic species like the Mekong giant catfish, electric eel and giant freshwater stingray. Attesting to the popularity of these animals with the public, the attraction hosted over a million visitors in its opening year, exceeding the number of guests the Singapore Zoo and Night Safari welcomed in their inaugural years.<sup>67</sup>

## GRAND OPENINGS OF THE NIGHT SAFARI AND RIVER SAFARI

### Night Safari

Twenty-one years after the opening of the Singapore Zoo, the Night Safari opened on 26 May 1994. This was the world's first nocturnal wildlife park and it aimed to showcase the behaviours of nocturnal tropical mammals at night.<sup>68,69</sup> The park boasted 100 species of animals, such as the Asian lion, Indian wolf and tiger, of which 43 species are endangered,<sup>70</sup> and operated from 7:30 p.m. to midnight.<sup>71</sup> The Night Safari cost S\$60 million to develop, totalled about 0.40 km<sup>2</sup>—almost twice the size of the Singapore Zoo—and was built upon the open zoo concept that had proven to be a success.<sup>72</sup>

Lyn de Alwis, who also designed the Singapore Zoo, first conceived the idea of a night safari in 1988, when the PUB enquired about the yet-undeveloped area in Mandai.<sup>73</sup> He felt that if nocturnal animals could be shown out in the open with a certain amount of lighting, people would get a much better understanding of how animals behaved at night.<sup>74</sup> This was a groundbreaking idea as conventional zoos had always struggled with exhibiting tropical mammals that were largely nocturnal.<sup>75</sup>



21. The entrance gate to the Night Safari, the world's first nocturnal wildlife zoo



22. Visitors on a tram in the Night Safari

The park was first drawn up when the PUB approached the then Executive Director of the zoo, Bernard Harrison, about an undeveloped area nearby in 1988. Other plans were suggested for the land such as golf courses, fruit plantations, recreational facilities and a large day safari, but eventually the zoo's management decided to continue with the night safari idea that Lyn de Alwis had suggested.<sup>76</sup> The Night Safari took seven years to conceive and develop, and after it proved to be an immediate success in its first year, five more trams had to be ordered to add to the existing fleet of nine trams.<sup>77</sup> By 2014, the Night Safari was hosting approximately 1.1 million visitors annually.<sup>78</sup>



23. The manatee exhibit in the Amazon Flooded Forest section of the River Wonders

### River Safari

The River Safari had its soft launch on 3 April 2013, and by the official opening of the park 10 months later on 28 February 2014, it had attracted more than a million visitors.<sup>79</sup> After regrouping of the zoo management and rebranding of its attractions, the River Safari was renamed River Wonders in 2021.<sup>80</sup>

It was Asia's first river-themed zoo when it opened, and spanning 0.12 km<sup>2</sup>, it was and remains dedicated to creating greater awareness about river life, freshwater ecosystems and their inhabitants. River Wonders houses the world's largest freshwater aquarium and one of the most extensive collections of freshwater animals, with over 11,000 land and aquatic animals representing 260 species.

The conceptualisation of the park as an addition to the Singapore Zoo and the Night Safari started around 2007. The flooded forests of the Amazon inspired Cham Tud Yinn, an exhibit designer, to come up with the idea of a river park.<sup>81</sup> Its exhibits were planned to showcase riverine systems from around the world.

The development of the park was announced in 2009 and construction began in 2010.<sup>82</sup> Special care was taken to minimise the project's impact on the surrounding flora and fauna, and a green corridor was created to preserve the biodiversity of the Mandai area. Construction of the development was also designed to protect and preserve the endangered and mature trees within the compound.<sup>83</sup>

The Singapore Zoo, Night Safari and River Wonders owe their success to their ability to overcome early challenges, and to the enlightened and judicious land use decisions that enabled them to grow into the well-regarded wildlife attractions that they are today. Their development arc also demonstrates the tensions that Singapore's government navigated in the balance between economic value extraction, nature and ecological protection, and provision of an attractive leisure destination that deepens Singaporeans' understanding of the importance of nature and wildlife.

The balancing of these competing forces will be further explored in the upcoming chapters, which discuss how government agencies such as the Singapore Tourism Board, together with Temasek and MWG, had to balance the economic imperatives underlying the expansion of the wildlife attractions under the Mandai Rejuvenation Project, while continuing to safeguard the ecological integrity of the surrounding CCNR and water catchment areas.



## CHAPTER 2

# CONTINUING TO REFRESH, RENEW AND REBRAND

“

We embrace the Government's vision to further develop Mandai into a nature destination for recreation, education, and conservation. This fits in with the three wildlife attractions that Wildlife Reserves Singapore already operates in the area. Our proposal seeks to build carefully and thoughtfully on this wildlife heritage in Mandai for present and future generations.

”

**DILHAN PILLAY SANDRASEGARA**

Then Head,  
Enterprise Development Group, Temasek<sup>84</sup>



24. The Karsts section of Rainforest Wild Adventure West

The Singapore Zoo, Night Safari, River Wonders and Bird Paradise have been lauded as world-class attractions,<sup>85</sup> and while Singaporeans may be familiar with the attractions themselves, there is a fascinating backstory on how they all came to be collectively housed at their current location in Mandai, adjacent to Singapore’s Central Catchment Nature Reserve (CCNR). This was a journey that was planned over several years by the Singapore Tourism Board (STB), Temasek, Mandai Wildlife Group—then known as Wildlife Reserves Singapore (WRS)—and their many partners.

According to Mr Khoo Teng Chye, who was Chief Executive Officer of the PUB, Singapore’s National Water Agency, from 2003 to 2011, “I probably heard about the idea first from CEO of STB, Mr Lim Neo Chian. The idea came about from the search for a new site for the Jurong Bird Park which was being relocated. The idea of creating a wildlife reserve centred around the Singapore Zoo, Night Safari and River Safari was floated by [the Ministry of Trade and Industry (MTI)].”<sup>86</sup>

Mr Khoo added, “It made a lot of sense as these were already some of the most popular visitor attractions in Singapore for both locals and visitors. Adding the bird park on the nearby land and relocating some of the less popular uses like the Mandai Orchid Garden would help to keep this valuable and sensitive area next to the CCNR as a good buffer against intensive urbanisation like housing.”<sup>87</sup>

The Urban Redevelopment Authority (URA) supported the MTI’s objectives by identifying alternative sites for the existing uses at Mandai to facilitate the STB’s incoming tourism developments. The intention to “transform Mandai into one of Asia’s must-visit nature destinations” was subsequently reflected in the URA’s 2008 Draft Master Plan proposals for the North Region.



25. Publicity materials for the North Region in the URA’s 2008 Draft Master Plan proposals

The makeover and expansion of the precinct was announced in January 2015, with the MTI committing that the redevelopment would be “led by the STB and Temasek” and that the partnership would help in realising the government’s vision for the Mandai nature-themed attractions to be world class. Temasek shared a vision to see the new Mandai as a naturalistic haven for Singaporeans and visitors to “enjoy nature in a fun and inspiring way”.<sup>88</sup> The government also reiterated their belief that it was important to carry out the rejuvenation of Mandai in an “environmentally sustainable and sensitive manner”, and to this end, Mandai Park Holdings (MPH) committed to commissioning a comprehensive Environmental Impact Assessment (EIA) for the project.<sup>89</sup>

The vision outlined by the STB and Temasek was eventually fulfilled with the opening of the Bird Paradise in May 2023,<sup>90</sup> Rainforest Wild Asia (now known as Rainforest Wild Adventure West) in March 2025 and Mandai Rainforest Resort by Banyan Tree in April 2025.<sup>91</sup> This chapter tells the story of that deliberate process, charting how the Mandai vision was ultimately realised through sustained partnership, thoughtful planning and a shared commitment to environmental stewardship.

## The Consolidation of Singapore’s Wildlife Attractions and Development of the River Wonders

Behind the project is an origin story and precursor event that arguably set the stage for the Mandai Wildlife Reserve’s current incarnation. In August 2000, it was announced that the Singapore Zoo and Night Safari, along with the Jurong Bird Park, would be consolidated under a single parent family with the formation of WRS.

The parks were restructured to match regional competition from Disneyland in Hong Kong and Japan’s Universal Studios.<sup>92</sup> By offering a more diverse range of experiences, it was also expected that the attractions in Mandai could move further towards achieving corporate financial sustainability.<sup>93</sup>

Mr Poh Chi Chuan, Executive Director, Experience Development Group, Exhibitions & Conferences at the STB, recalled that while the STB had always been supportive of Mandai’s nature-based attractions as they were certainly a draw for tourists, its involvement in Mandai deepened when the Jurong Bird Park was merged into WRS. The merger also allowed optimisation of common corporate functions within WRS and provided an impetus for more STB support in areas such as grants and marketing.<sup>94</sup>

Physically, the Singapore Zoo had also undergone significant renovations. In March 2006, for instance, the zoo opened a S\$3.6 million, 1,600-m<sup>2</sup> Wildlife Healthcare and Research Centre to treat animals and ensure the highest quality of animal care, with then President S R Nathan as the Guest of Honour.<sup>95</sup> To improve animal health, the centre was equipped with a new ultrasound machine that would better detect pregnancies and internal ailments, along with three different wards for small mammals, reptiles and larger mammals.<sup>96</sup> Two months later, a free-ranging orangutan exhibit—the first in the world—was created using tall trees, thick branches, foliage and vines to replicate a naturalistic environment.<sup>97,98</sup>



26. The Wildlife Healthcare and Research Centre

The creation of the research centre was part of WRS's and its predecessor's longstanding efforts to inculcate animal welfare and environmental conservation and sustainability. This had been part of Singapore's wildlife attractions' core ethos from the beginning, when Dr Ong Swee Law highlighted the efforts of conservationists in preventing animal extinctions at the opening of the Singapore Zoo.<sup>99</sup>

## ANIMAL WELFARE AND CONSERVATION AS A CORE MANDAI ETHOS

Apart from the Singapore Zoo's Wildlife Healthcare and Research Centre, an avian hospital was built at the Jurong Bird Park in 2006—the first of its kind in the Asia-Pacific region.<sup>100</sup> The hospital, outfitted with state-of-the-art technology, enhanced the park's research capabilities in avian medicine and surgery.<sup>101</sup> The Jurong Bird Park's oriental pied hornbill project, conducted in collaboration with the National Parks Board (NParks) and the Nanyang Technological University, also led to a world-first, with the 24-hour recording of nest interiors by infrared cameras to observe the nesting behaviours of captive and wild hornbills at the Jurong Bird Park and Pulau Ubin. This project's efforts to link in-situ and ex-situ research were recognised when it won the IV International Symposium on Breeding Birds in Captivity Conservation Award in Toronto, Canada.<sup>102</sup>

When the Jurong Bird Park celebrated its 50th anniversary in 2021, the public got another peek at the park's commitment to animal welfare, with *The Straits Times* offering a behind-the-scenes profile of how the Jurong Bird Park Avian Hospital takes care of its ageing penguin residents, and more broadly how its veterinarians, nurses and technicians ensure the health and well-being of the park's 3,500 birds across 400 species.<sup>103</sup>



27. Behind the scenes at the Jurong Bird Park Avian Hospital



28. Cotton-top tamarins at the Singapore Zoo

By 2007, more than 180 animals had been born in the Singapore Zoo and the Night Safari under the parks' captive breeding programme; of the species represented, 14% were endangered in the wild. In that year, the zoo saw a host of primate births, with three proboscis monkeys, two douc langurs, one Bornean orangutan, one lion-tailed macaque and four cotton-top tamarins being born—all of which were on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. The zoo was also the only zoological institution to successfully breed the douc langur outside its home range countries of Vietnam and Laos.<sup>104</sup>

In 2009, wildlife conservation got another boost when WRS established the Wildlife Reserves Singapore Conservation Fund (WRSCF) with the mandate of being an independent fund to conserve threatened native species. Conceived as an independent charity, it drew together a team of specialists from various related organisations, focusing on native animal conservation efforts and climate change-related issues.<sup>105</sup>

From the start, the WRSCF worked to increase its reach and efficacy by collaborating with like-minded partners. In January 2010, it signed an agreement with the New York-based Wildlife Conservation Society,<sup>106</sup> and its Singapore affiliate, on field conservation and public education to protect biodiversity in the face of global climate change and human encroachment.<sup>107</sup>

By 2015, the WRSCF had funded 20 local conservation and research projects, including on the Sunda pangolin, Singapore freshwater crab and banded leaf langur. It had by then also supported 20 regional projects for 24 threatened species, including the orangutan, Asian elephant and Tonkin snub-nosed monkey.<sup>108</sup>

In 2018, more than 700 animals from across 131 species were born at the 4 parks under the WRS. Among the newborns were 35 species listed as threatened under the IUCN. This included the successful breeding of the endangered Santa Cruz ground dove under human care at the Jurong Bird Park, with 12 chicks born. The birth of the Santa Cruz ground doves made the park the first zoological institution in the world to successfully breed this bird species, which is classified as endangered on the IUCN Red List.<sup>109,110</sup>



29. One of the Santa Cruz ground dove chicks that successfully hatched in Jurong Bird Park on 31 December 2018, a first for the wildlife park



30. Then President Halimah Yacob receiving a copy of *Wildlife Matters* from Ms Claire Chiang, then Chairperson of the WRSCF; the book was launched to celebrate the 10th anniversary of the WRSCF, the first conservation fund of its kind dedicated to Singapore's wildlife

By August 2019, when the WRSCF celebrated its 10th anniversary, it had established three National Species Conservation Action Plans—for the Raffles banded langur, Singapore freshwater crab and Sunda pangolin—disbursed over S\$2 million to support more than 40 projects covering a range of native species and habitats, empowered over 40 researchers, and shared its conservation message with over 100,000 individuals through 70 workshops, symposia, and community engagement and education programmes.<sup>111</sup>

By 2007, major plans were afoot to rejuvenate Mandai as a new nature destination, and on 20 November that year, the MTI announced that WRS had drawn up a five-year S\$70 million masterplan to add new facilities to the Singapore Zoo and Night Safari as part of the government's Tourism 2015 plan to grow tourism into a key pillar of Singapore's economy.<sup>112</sup>

The announcement included the news that WRS was conceptualising an attraction that would "recreate exotic river environments and allow visitors to explore and learn about endangered freshwater flora and fauna in natural habitats".<sup>113</sup> This new attraction would eventually become the River Safari, which opened on 28 February 2014<sup>114</sup> and was later renamed River Wonders in October 2021.<sup>115</sup>



31. Visitors immersed in a River Wonders' boat ride experience

## The Evolution of Mandai's Wildlife Attractions Towards the Mandai Rejuvenation Project

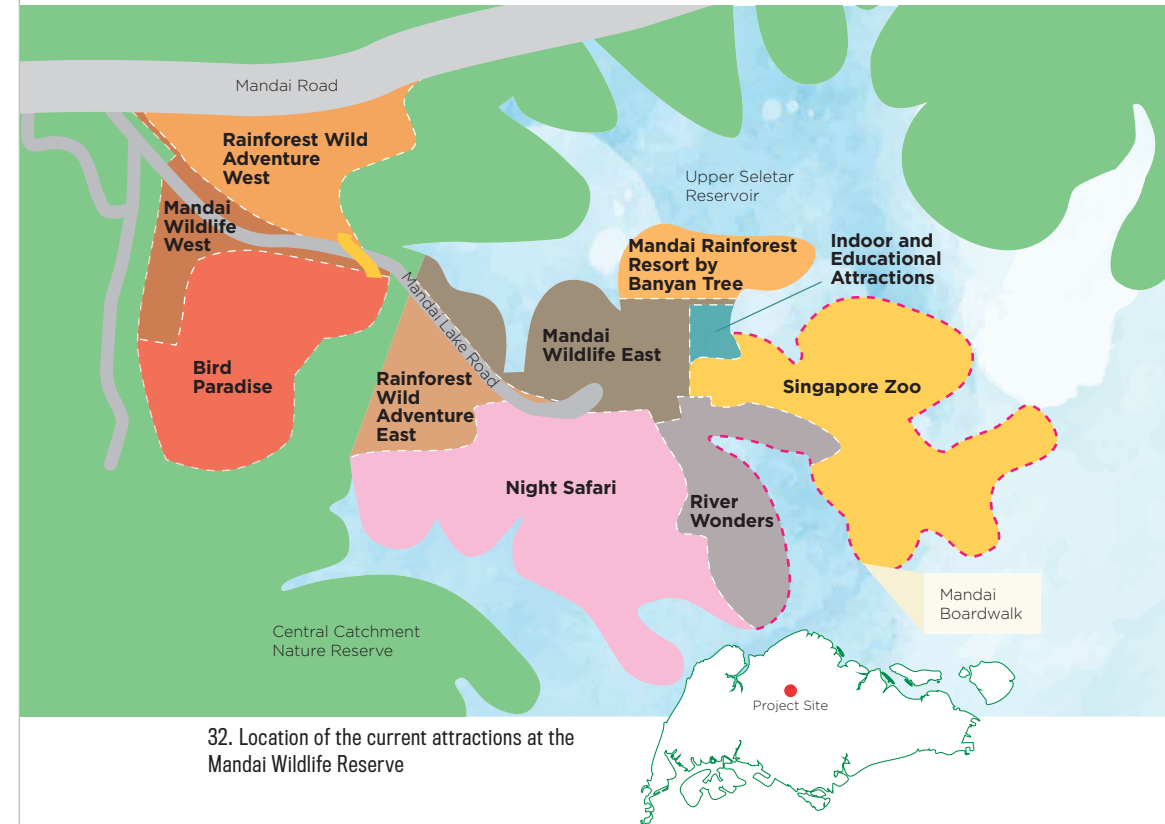
"I think the team in Mandai wanted to do it differently. They wanted to investigate whether it would be of interest if we were to showcase animals around water bodies, where humans and animals interact, then using that as a canvas to tell a story about the importance of preserving our water bodies."

—Poh Chi Chuan, Executive Director,  
Experience Development Group,  
Exhibitions & Conferences, Singapore Tourism Board<sup>116</sup>

In November 2007, then Minister of State for Trade and Industry S Iswaran gave the first inkling of the STB's plans to introduce the new cluster of attractions that would be known as the Mandai Rejuvenation Project. This ultimately culminated in the creation of Mandai's newest Bird Paradise and Rainforest Wild Adventure attractions.

He noted that the plans for Mandai as a new nature destination were still in their infancy, as the STB and WRS would have to conduct a feasibility study to assess how a new attraction in the area could complement the Singapore Zoo and Night Safari. Hence, the STB was working with other government agencies like the URA and NParks to identify a site of over 0.30 km<sup>2</sup> called the "fourth gate" in Mandai that could be developed for new nature-themed experiences within a tropical setting.

When completed, it was envisaged that the Mandai Wildlife Reserve would become entrenched as a unique nature destination with its own identity, distinct from other already recognisable precincts in Singapore like Marina Bay, Sentosa and Orchard Road.<sup>117</sup>



32. Location of the current attractions at the Mandai Wildlife Reserve

The development plan would come to be known as the Mandai Rejuvenation Project, and in due time, the new attractions would be progressively integrated into the larger land use and leisure plans for the surrounding region. See Chapter 5.

In the run-up to the creation of the Bird Paradise and Rainforest Wild Adventure, WRS itself would undergo a major corporate rebranding in October 2021, when it was renamed and assumed a new identity as Mandai Wildlife Group.<sup>118</sup> But long before that, things were brewing as Temasek and the STB worked hard with WRS and their many public stakeholders to flesh out and give life to the vision of the new wildlife attractions at Mandai.

## How It Came Together: Collaboration Between the STB and Temasek

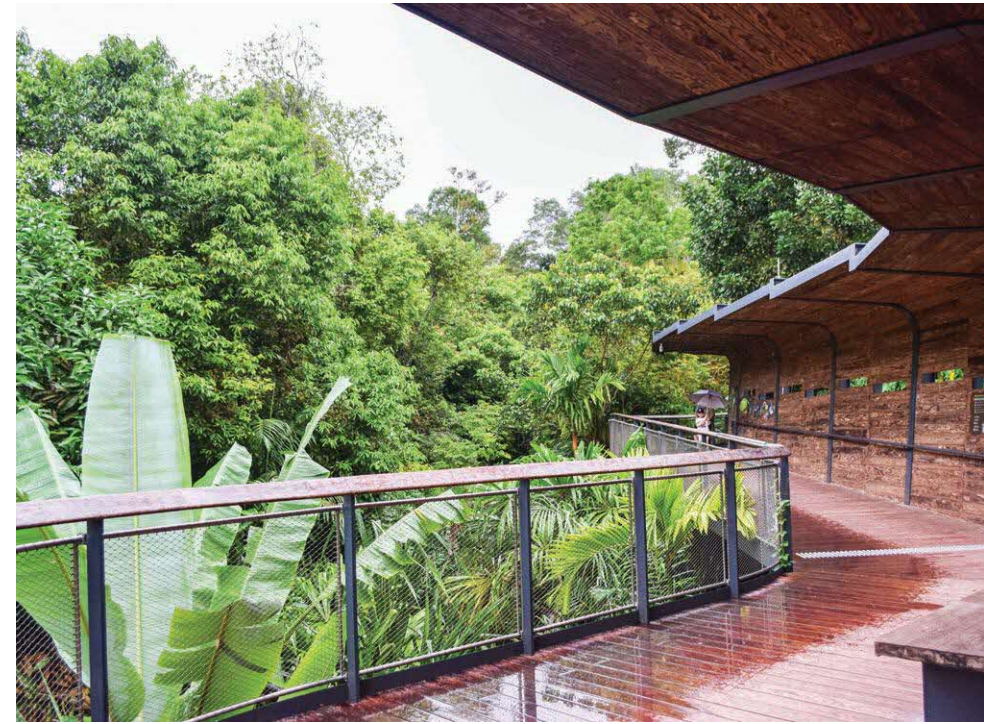
*By Generations, For Generations: Fifty Years of Temasek as Told by the People Who Shaped It*,<sup>119</sup> a book commemorating Temasek's 50th Anniversary, revealed that in 2007, the STB had put up two plots of land for tender, with the aim of developing a “fourth gate” at Mandai alongside the Singapore Zoo, Night Safari and River Safari.

However, when there were no bidders, in 2010, Temasek responded to the STB's invitation to explore concepts for Mandai. The site to be developed was outside the nature reserves and included the former Mandai Orchid Garden and an abandoned village, which were both along the way to the WRS attractions existing at the time.<sup>120</sup>

Indeed, the redevelopment of Mandai became one of the largest projects undertaken by Temasek's Enterprise Development Group, which was set up in 2013 to identify and develop promising enterprises that “had the potential to be global, regional or domestic champions”.<sup>121</sup>

As to why Temasek had decided to get involved, Mr Dilhan Pillay Sandrasegara, CEO of Temasek, explained that the Mandai Wildlife Reserve fulfilled all three roles for Temasek that had been laid out in the 2012 Temasek Charter—to be an investor and shareholder, a forward-looking institution, and a trusted steward.<sup>122</sup> He noted, “People can say, ‘Oh, what returns will you get?’ Yes, you may not make as much in returns as you would investing in [a multinational corporation]. But more importantly, though, we have something that everyone will remember”. Temasek's involvement in Mandai's redevelopment also demonstrated its principle of incorporating sustainability into its projects.<sup>123</sup>

For Ms Neo Gim Huay, then a Director with Temasek's Consumer & Real Estate Investment team, Project Mandai, which became known as the Mandai Rejuvenation Project, stirred childhood memories of Sunday drives past the Singapore Zoo en route to her grandparents' home. She also recognised its ambition as “a partnership with the [STB] to transform the [1.26-km<sup>2</sup>] Mandai precinct into a nature-based destination attraction” that would “integrate the Singapore Zoo, Night Safari, River Safari and Jurong Bird Park—all operated by MPH—into an immersive wildlife and rainforest experience, where visitors could learn about and engage in conservation efforts.”<sup>124</sup>



33. A platform that gives visitors a close-up view of the treetop canopy at Rainforest Wild Adventure West

Thus, Ms Neo saw in the Mandai Rejuvenation Project an opportunity to demonstrate how the Rainforest Wild Adventure attraction could help promote nature conservation through education: “We planned to tell the stories of the rainforest and introduce the world's first zoo in the air. Visitors can enjoy the multi-layered habitats, from treetop to the canopy to the forest floor and to an underground cavern. They will be able to explore and enjoy the richness of the rainforest and through this, we hope to inspire everyone to play a part in nature conservation”.<sup>125</sup>

Ultimately, Ms Neo's deep personal connection to the Mandai area inspired her to volunteer to lead the project. She spent the next four years at its helm, “turning bold ideas into actionable plans, and ensuring the development built on the rich heritage of the zoo and its natural surroundings.”<sup>126</sup>

## TEMASEK'S NEO GIM HUAY ON HER ROLE IN STEERING THE MANDAI REJUVENATION PROJECT

### Finding Common Ground

Ms Neo Gim Huay joined Temasek in 2012, drawn by its unique approach to stewardship. “That combination of rigorous financial discipline and long-term strategic impetus was what attracted me,” she explained.<sup>127</sup>

She first worked with Temasek while at the Ministry of Finance, Temasek’s shareholder, and had a front-row seat to the firm’s commitment to stewardship and active ownership of its portfolio companies. When the opportunity to join Temasek arose some years later, she didn’t hesitate.

While she initially worked on several large-scale real estate projects, the complexity of the Mandai Rejuvenation Project—the reason why commercial developers were unwilling to take it on—meant it soon became her primary focus. “It wasn’t a typical urban development project,” she remembered. “We had to understand and address the concerns of various stakeholders, while pioneering ideas and solutions in line with the project’s ambitions to build a ‘zoo of the future’, supporting and promoting wildlife conservation beyond Singapore, in the region and globally.”<sup>128</sup>



34. Ms Neo Gim Huay, now Managing Director and Member of the Managing Board of the World Economic Forum

Alongside building a compelling business case that would pass muster with Temasek’s Investment Committee, it was critical to address the concerns raised by environmental groups. These included the need to minimise the impact on local wildlife and ensure animals could safely navigate the area. “We had difficult conversations, and found ways to build trust and bridge the gaps,” said Ms Neo, who joined the board of MPH, established to oversee the project, about two years in.<sup>129</sup>

MPH also commissioned a comprehensive EIA, undertaken with guidance from the NParks and drawing on international best practices. An Environmental Advisory Panel, comprising local biodiversity and sustainability experts, was convened to guide the implementation of the EIA’s recommendations through the project’s environmental management and monitoring efforts.<sup>130</sup>

Ms Neo also recounted that she encouraged Mandai’s conservation efforts by learning from overseas counterparts like the Bronx Zoo and the San Diego Zoo, which had done “signature work in conservation”.<sup>131</sup>

The team also found ways to protect water bodies in the area and reached out to partners across the business ecosystem to implement sustainable cooling and waste management systems. “The ambition is for the Mandai development to be the first carbon-neutral precinct in Singapore, and a sustainability-accredited destination in itself,” Ms Neo said.

The consultative approach helped create common ground, and build trust and confidence on every front, added Ms Neo, who handed over the day-to-day management of the project to MPH as it entered its execution phase in 2018. She remained on its board until she left Temasek in 2021.<sup>132</sup>

Reflecting on her time with the Mandai Rejuvenation Project, she felt that “it’s important for a city, society to continue to have big dreams, to have visions. And to have hope and meaning for the future. So, for me, it is the process that is as important as the product, to be able to build a team, to be able to work and engage with all the stakeholders, whether these are nature groups, whether these are government stakeholders, these are experts from around the world whom we’ve tapped—many of these experts found a lot of meaning, interest, and inspiration in working with us. I think, this is what we need continually to do as a society”.<sup>133</sup>

### A Model for Stewardship

Ms Neo's years on the Mandai Rejuvenation Project left a lasting impression, both on her career and Temasek's approach to sustainability. It illustrated the potential for how sustainability and commercial viability could be jointly pursued and achieved.

The insights, experiences and networks she gained helped inform her later role as Temasek's first Managing Director for Sustainability, where she led initiatives such as Ecosperity, and drove Temasek's efforts in emissions reduction, impact investing and sustainability solutions. These efforts reflected Temasek's broader push to be a pathfinder, bringing together diverse stakeholders and the larger ecosystem to propel the sustainability journey forward.<sup>134</sup>

Reflecting on the firm's culture of embracing change and opportunity, she said, "Temasek's first instinct is not to say no. Its first instinct is to take a step back and say, 'Is this meaningful? How do we make it work?'"<sup>135</sup>

Now Managing Director and Member of the Managing Board at the World Economic Forum, Ms Neo mentioned that she takes pride in how the vision articulated a decade ago has been translated into reality: "The founders of our first wildlife attractions were entrepreneurial, bold, and ambitious," she said. "I feel privileged and humbled by the opportunity to be part of the team carrying that spirit forward."<sup>136</sup>

To gather ideas and explore possibilities, Temasek consulted the relevant government agencies, nature experts, leading institutions, academics and other potential partners. In response to consumer surveys that pointed to strong public interest in nature attractions, study trips were also undertaken to understand best practices and experiences of various nature attractions around the world. Based on these initial inputs, Temasek subsequently proposed a concept that integrated the designated site with the current WRS attractions.<sup>137</sup>

As planning for Mandai's redevelopment proceeded apace, one of the ideas considered was whether to relocate the Jurong Bird Park, and on 4 September 2014, then Prime Minister Lee Hsien Loong made the official announcement that the Jurong Bird Park could be re-located to Mandai by noting that, "the Bird Park is all by itself down in Jurong. Why not move it to where the zoo is?"<sup>138</sup>

Prime Minister Lee also gave a preview of the scale of Mandai's redevelopment by revealing that the government was considering using the available space outside of the protected CCNR and surmised, "If you can extend the zoo to those parts, I think it'll be very interesting". When asked if the waterfall at the Jurong Bird Park—a signature feature of the park—would be moved as well, he gave a sense of how the government was planning for an ambitious successor to the attraction, replying that "I think we have something in mind which is even more spectacular than the waterfall."<sup>139</sup>



35. Conceptual design of one of the aviaries at the Bird Paradise

To ensure that the Mandai Rejuvenation Project would be built and run in an environmentally sustainable manner, merely planning and designing the parks well would not be sufficient for success. It would be necessary and desirable to build collaborative partnerships with key stakeholders—both within and between interested government agencies—and public interest groups. Indeed, it was clear when the Mandai Rejuvenation Project was announced that Singapore’s nature and environmental groups were deeply concerned about the potential impact that the Mandai Rejuvenation Project would have on the neighbouring CCNR.

This is the focus of the next chapter, which describes not only the EIA process, but also the evolution of how stakeholders were engaged throughout this process and how their feedback was incorporated into the design and construction of the upcoming wildlife attractions.

## CHAPTER 3

# BALANCING DEVELOPMENT WITH ENVIRONMENTAL CONCERNS

“

We are very excited by the concepts that are beginning to take shape in Mandai. We are committed to conserving and nurturing Singapore’s natural heritage, so that it can be enjoyed and loved by generations to come.

”

**S DHANABALAN**  
Then Chairman,  
Mandai Wildlife Group<sup>140</sup>

As early as 2007, after the Ministry of Trade and Industry (MTI) announced plans to introduce a new cluster of attractions that would ultimately culminate in Mandai's newer nature-themed parks, there was increased discourse around biodiversity concerns, highlighting the need for a balance between tourism development and environmental conservation. After all, Mandai's proximity to the Central Catchment Nature Reserve (CCNR), and its geography as a crucial wildlife corridor, meant that the potential ecological impact of any sort of development plan needed careful consideration.

Some key environmental concerns raised during this time were the risk of escaped animals from the proposed nature-themed attractions, increased traffic congestion, and noise and light pollution.<sup>141</sup> The Nature Society Singapore (NSS) made the observation that even though the proposed new developments were not going to be built within the CCNR, their sites were located in an important ecological buffer zone and any further developments could upset the fragile ecosystem of the adjacent nature reserve.<sup>142</sup>

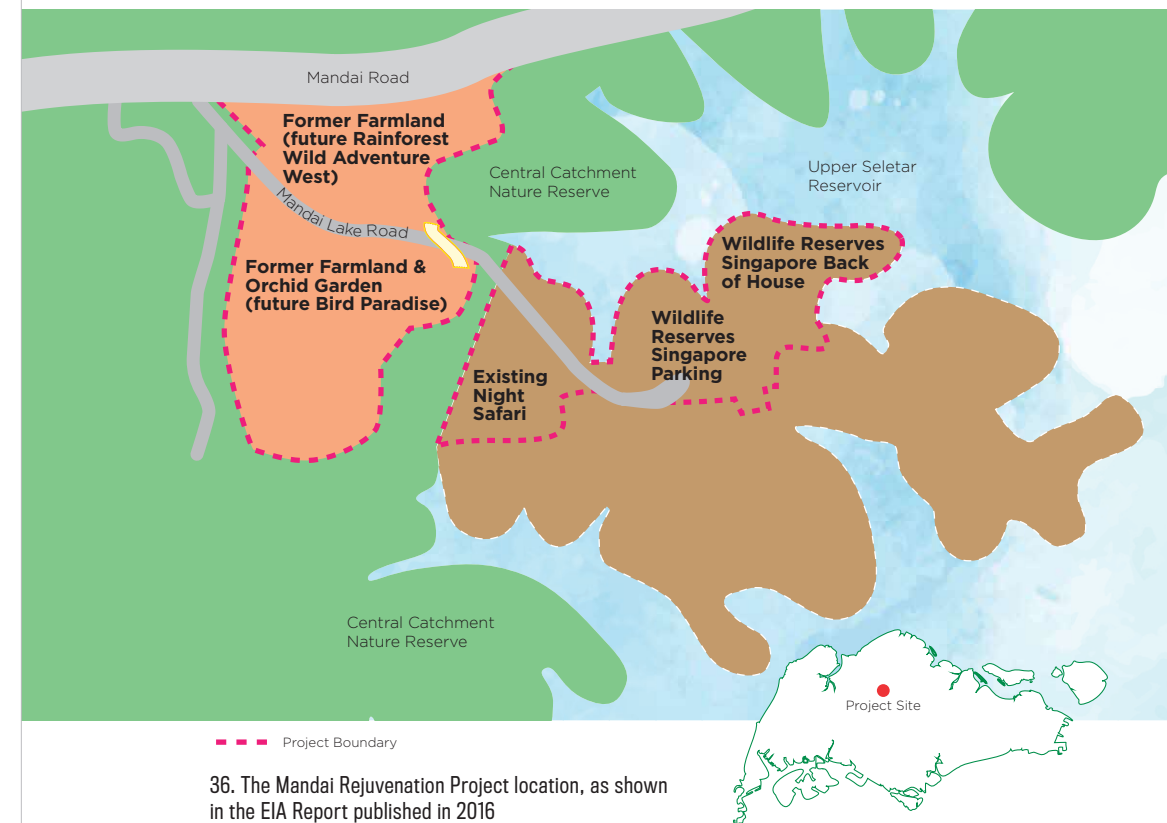
Following the early feedback in 2007 from the NSS, the press published letters of concern by members of the public suggesting that there should be an Environmental Impact Assessment (EIA)<sup>143</sup> for the developments in Mandai and that this should be made public.<sup>144</sup>

It was important to address these concerns, and in December 2007, the Singapore Tourism Board (STB) publicly committed that the development would have to factor in mitigating measures from the outset to minimise any impact on the ecological balance of the area, and demonstrate that care would be taken to ensure that the developments were in line with environmental preservation aims.<sup>145</sup>

This chapter explores how these early concerns, calls for transparency and commitments to environmental stewardship shaped the approach to Mandai's redevelopment.

## The EIA for the Mandai Rejuvenation Project

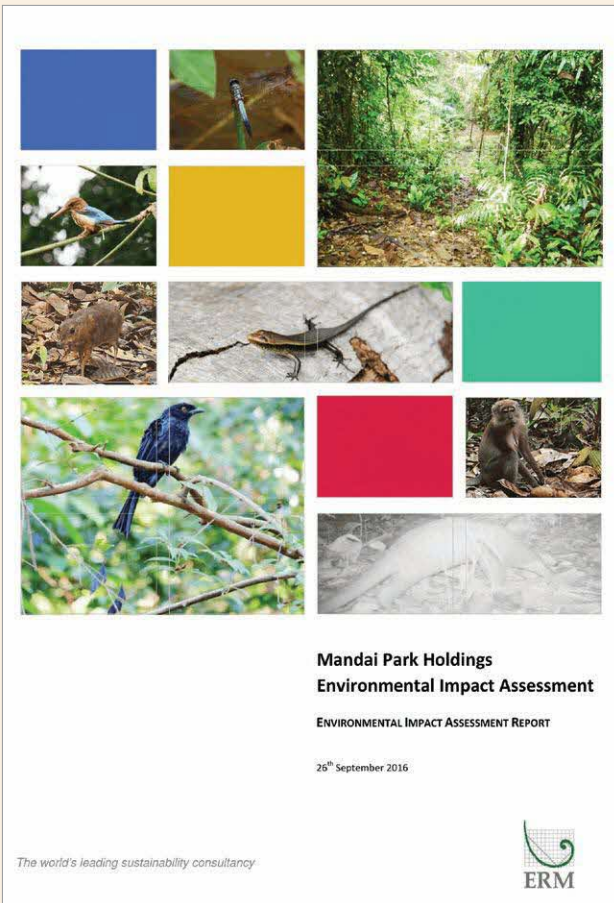
To ensure that environmental concerns were addressed, Mandai Park Holdings (MPH) commissioned an EIA<sup>146</sup> that encompassed nearly 0.64 km<sup>2</sup> of land. This included the land west of the Singapore Zoo, the two project development parcels that would eventually become the Bird Paradise and Rainforest Wild Adventure attractions, as well as "back of house" areas. The EIA was carried out before construction began; it detailed the potential environmental impacts on surrounding areas and proposed mitigation measures to minimise these impacts on biodiversity and the environment.<sup>147</sup>



36. The Mandai Rejuvenation Project location, as shown in the EIA Report published in 2016

## THE EIA FRAMEWORK IN SINGAPORE

Singapore’s EIA Framework has evolved over the last few decades as an administrative practice involving planning controls and inter-agency coordination, rather than through a single statutory intervention. Its development was driven by project-specific experiences and increasing public expectations for greater transparency, accountability and rigour in addressing environmental and biodiversity impacts of development. MPH’s EIA Report, published in 2016, was one of a series of EIAs that have been commissioned<sup>148</sup> to determine and mitigate the potential impacts of any new development on the environment.

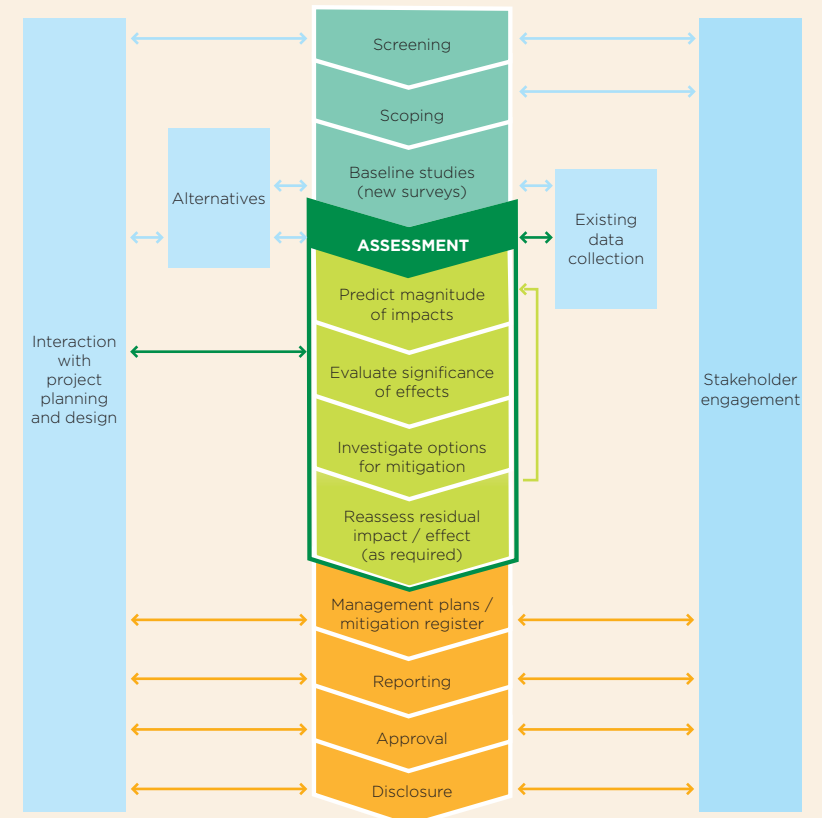


37. The cover of the MPH EIA Report<sup>149</sup>

In general, development projects in Singapore are required to undergo a thorough evaluation process that addresses their potential impacts on traffic, public health, cultural heritage and the environment.<sup>150</sup> In addition, development projects that are close to sensitive nature areas are subject to greater scrutiny and may require more detailed environmental studies.

The findings of all environmental studies are carefully considered in the planning evaluation process in order to determine the extent of potential impacts, and the adequacy of proposed mitigation measures, before a project is allowed to proceed.<sup>151</sup>

A separate Environmental Management and Monitoring Plan (EMMP) is formulated after an environmental study. The EMMP guides the implementation of the proposed mitigation measures and sets out clear commitments from the entity taking the action regarding how those impacts will be avoided, minimised, managed, remedied and/or compensated for, so that they are environmentally acceptable.<sup>152</sup>



38. A diagram on the impact assessment process, adapted with inputs from NParks and based on the EIA for Mandai Development, Scoping Report

### Milestones in the Development of Singapore's EIA Framework

<b>1950s to 1970s</b>	Environmental considerations prior to formal EIAs are addressed through statutory protection and institutional oversight. This includes the Nature Reserves Ordinance (1951) and the establishment of the Nature Reserves Board in 1970s. <sup>153</sup>
<b>1960s to 1980s</b>	Most commercial and public housing projects in Singapore focus primarily on ensuring geotechnical safety; in-depth environmental assessments are generally not conducted during this period. <sup>154,155</sup>
<b>1990s to early 2000s</b>	The formation of the National Parks Board (NParks) in 1990 strengthens environmental governance capacity. The Singapore Green Plan, launched in 1993, introduces nature conservation into national policy. The Urban Redevelopment Authority identifies "Nature Areas" requiring consultation for nearby development, which is formalised under the Parks and Waterbodies Plan in 2002. Developments in the early 2000s, including the Malaysia-Singapore land reclamation issue, <sup>156</sup> highlight the limitations of ad hoc approaches and inform subsequent efforts to strengthen environmental assessment processes. The Singapore government recognises the intrinsic value of conserving the natural biodiversity of this highly urbanised tropical island. <sup>157</sup>
<b>2008</b>	An administrative EIA framework is finalised, integrating environmental consultation and studies into the statutory land-use planning and development control process.
<b>2017</b>	Then Second Minister for National Development Desmond Lee shares in his inaugural media interview that the government wants to strengthen the EIA process, improving it based on lessons learnt from earlier projects. <sup>158</sup>

<b>2020</b>	Four enhancements to the EIA framework are announced by the Ministry of National Development. These are to: <ul style="list-style-type: none"> <li>• increase the rigour of environmental studies through a set of Biodiversity Impact Assessment (BIA) Guidelines, to provide developers and industry professionals greater clarity on how to assess the impact of development works on biodiversity;</li> <li>• strengthen the enforcement regime for implementation of mitigation measures and monitoring plans, through the amended Wildlife Act;</li> <li>• build up local expertise on ecological matters; and</li> <li>• make all environmental study reports publicly available, unless there are specific reasons to maintain confidentiality such as security considerations.</li> </ul>
<b>2022</b>	EIA consultancy management is centralised under NParks to enhance methodological consistency, reduce conflicts of interest and strengthen national stewardship over biodiversity data. This approach is piloted for new Housing & Development Board and JTC Corporation development projects requiring EIAs starting from early 2023. <sup>159</sup>
<b>2024</b>	NParks publishes enhanced BIA guidelines, in consultation with environmental consultants, nature groups and academics, to provide clarity on how to apply revised survey methods, manage lighting during night works and implement wildlife management measures. Agencies continue to review the EIA framework to strengthen it, and to ensure its relevance.

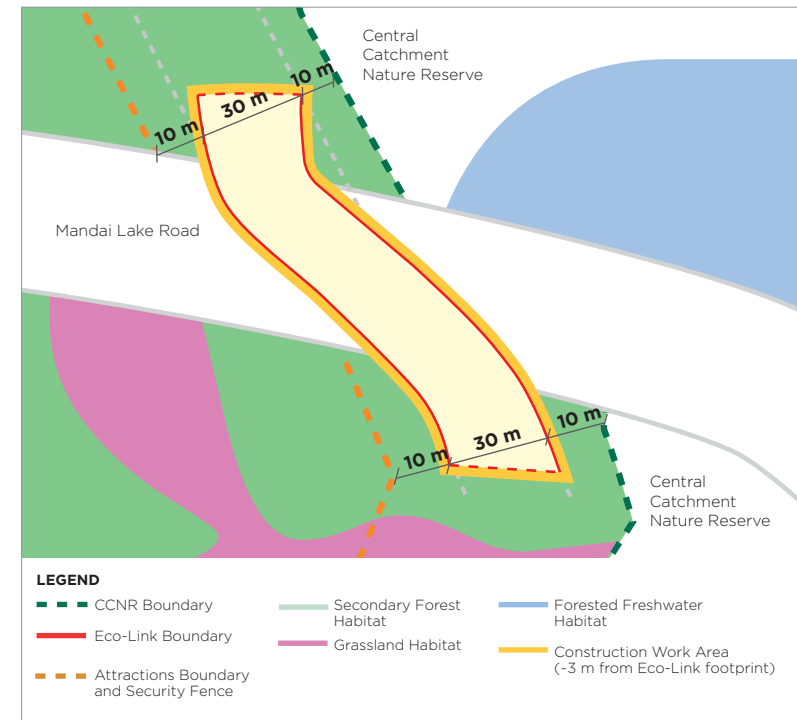
Mr S Dhanabalan, then Chairman of MPH, made the decision to make the Mandai EIA publicly available for comment.<sup>160</sup> Professor Peter Ng, then head of the Lee Kong Chian Natural History Museum, recalled that when Mr Dhanabalan mentioned his intention to make the EIA public, he had explained to Mr Dhanabalan that there could be intense public interest and discussion. Professor Ng recalled that Mr Dhanabalan's position was that "this is the right way to do things. The world has changed; we have to do it this way. And we will deal with the consequences as they come."<sup>161</sup>

MWG's then Deputy Chief Executive Officer of Development, Leong Yue Kheong, recalled a similar sentiment, that making the EIA public "helped our moral ground" as it demonstrated that "we're not hiding [anything]". In fact, he recalled that at the time, agencies regarded EIAs as internal documents and were unsure of the impact of a publicly shared EIA.<sup>162</sup>

The EIA was made public on 26 July 2016, and the STB announced that it had been gazetted for public consultation until 22 August 2016.<sup>163</sup> Mike Barclay, then GCEO of MPH, reiterated at the time that one of the reasons the EIA was commissioned was that MWG was "committed to being a responsible steward for nature" and wanted to make "a conscious effort to conduct the EIA at the concept stage of the project to allow key mitigation measures to be built into the design of the new Mandai precinct".<sup>164</sup> This was done early in the planning and design processes, "to bring on board feedback and comments at a very early stage to inform our master-planning".<sup>165</sup>

The nearly 400-page report was compiled by international consultancy firm Environmental Resources Management with input from stakeholders and local academics, including the National University of Singapore, which provided technical advice and oversight, led by Professors Peter Ng and Leo Tan from the Lee Kong Chian Natural History Museum.<sup>166</sup>

A key finding of the EIA was that the majority of potential environmental impacts associated with the development could be reduced with appropriate mitigation measures.<sup>167</sup> One of the key recommendations was to accelerate development of the Mandai Wildlife Bridge to mitigate the impact of construction of the new Bird Paradise and Rainforest Wild Adventure nature-themed attractions on wildlife. The bridge would serve as an ecological link between the buffer zones adjacent to the CCNR on either side of Mandai Lake Road. It would be planted with native trees and shrubs to simulate a natural forest and act as a safe passage for native animals.<sup>168</sup>



39. The conceptual design for the Mandai Wildlife Bridge in the EIA Report

The EIA recommendations elicited mixed responses from nature group representatives. Mr Subaraj Rajathurai, a wildlife consultant, noted then that the eco-bridge would help minimise traffic accidents involving wildlife, a key concern of nature lovers. However, he also felt that MPH could still look into more "green connections" to help animals "safely move from one area to another with minimum risk". Mr Subaraj also pointed out that while there would be narrow buffer zones, measuring 45 to 50 m wide—where no construction or human activity would take place—there still needed to be "sufficient landscape and greenery to play a part in animals' foraging and moving".<sup>169</sup>



40. The Mandai Wildlife Bridge was built in December 2019 to link forest patches next to the Central Catchment Nature Reserve

Former Member of Parliament Louis Ng, then CEO of the Animal Concerns Research and Education Society (ACRES), noted that the consultations with nature groups during the EIA process were collaborative and “involved local experts, people who really understood the animals. We were thankful for that”.<sup>170</sup>

The 140-m-long Mandai Wildlife Bridge officially opened in December 2019. It was the second major eco-bridge to be built in Singapore, following the success of the 62-m-long Eco-Link@BKE, which had opened in 2013 over the Bukit Timah Expressway (BKE) to connect the Bukit Timah Nature Reserve and CCNR.<sup>171</sup> As with the Eco-Link@BKE, the Mandai Wildlife Bridge allowed animals to cross safely between two forest patches,<sup>172</sup> enabling them to forage further afield for food and expand their genetic pool by finding mates from different locations.<sup>173</sup>

In addition to the building of the Mandai Wildlife Bridge, the findings of the EIA led to the incorporation of further measures into the detailed design of the new parks which would reduce environmental impacts according to a mitigation hierarchy of “avoid, minimise, manage, and compensate”.<sup>174</sup> These included the measures and outcomes listed in the table on the next page.

Identified Potential Impacts	EIA's Recommended Mitigation Measures
Potential loss of mature trees and biodiversity if the Bird Paradise was developed on ecologically sensitive land <sup>175</sup>	<b>Relocation of Parks</b> The locations of the Bird Paradise and Rainforest Wild Adventure West were to be swapped. Rainforest Wild Adventure West was to be built on the land parcel north of Mandai Lake Road to better protect the existing forest as the mature trees could be integrated into the park's design, while Bird Paradise would be located on less ecologically sensitive land in the southern part of the development area. <sup>176</sup>
Disturbance and disruption to critically endangered flora and fauna during and after the construction process <sup>177</sup>	<b>Land Zoning for Low-Impact Activities</b> Buffers and setbacks were to be established to protect sensitive natural areas, including development-free 45- to 50-m-wide buffers between the CCNR and Bird Paradise and Rainforest Wild Adventure West. A 25-m setback was also to be applied within the Rainforest Wild Adventure East adjacent to the CCNR, while the Mandai Rainforest Resort by Banyan Tree was to provide a 15-m setback from the reservoir edge. <sup>178,179</sup>
Habitat destruction and disturbance to wildlife by visitors to the Mandai development <sup>180</sup>	<b>Site Access Restrictions</b> Decentralised arrival plazas were to be built in the western and eastern parts of the development to divert a significant proportion of visitors away from sensitive areas near the nature reserves. <sup>181</sup>
Potential impact on the primary and secondary forest along the edge of the reservoir <sup>182</sup>	<b>Modifying the Boardwalk System</b> The publicly accessible boardwalks were to be modified to avoid areas of high biodiversity value and maintain the movement of wildlife along the reservoir's edge. <sup>183</sup>

41. A selection of the EIA's recommended mitigation measures to reduce negative environmental impacts



42. An illustration from the EIA Report showing the locations of the CCNR, proposed retained forest patches, adjacent buffers and setback areas<sup>184</sup>

From the beginning of construction through to the operational stages of the Mandai development, the EIA Report recommended that the mitigation measures be implemented through an EMMP. Besides consolidation of the mitigation measures, the EMMP also set out the organisational arrangements, roles and responsibilities for their implementation. These included measures elaborated in supporting documents such as the Wildlife Protection Plan and Forest Restoration Plan.<sup>185</sup>

The EIA also recommended integrating operational protocols to reduce the likelihood of animals escaping and prevent introducing invasive species to adjacent areas.<sup>186</sup> Throughout the project's lifespan, the EIA emphasised training all onsite workers to educate them about the ecological sensitivities of the project area and ensure compliance with environmental controls.<sup>187</sup>

The EMMP provided a structured framework for implementing these mitigation measures across the different stages of the project, with monitoring, reporting and auditing requirements to assess their effectiveness. It also required these measures to be reviewed and updated periodically to ensure alignment with detailed designs, construction activities and operational plans as the project progressed.

To build upon the initial mitigation measures, at the end of the formal month-long public consultation period of the EIA and further consultation with nature groups and relevant agencies, MWG announced on 10 October 2016 a revised EIA Report to guide the detailed development plans for the Mandai Rejuvenation Project.

The enhanced mitigation measures included an iterative process involving technical agencies and nature groups to improve the Mandai Wildlife Bridge design, including the best location to place the bridge. In addition, to further aid ecological connectivity, a forested strip that would run through the upcoming Bird Paradise site would be maintained as a passageway for wild native birds and arboreal mammals. To protect a freshwater stream, the building footprint for the West Arrival Node was also shifted 10 m away.<sup>188</sup>



43. The site for the Bird Paradise was swapped with that of the Rainforest Wild Adventure West to reduce the potential loss of mature trees and biodiversity

## Formation of the Environmental Advisory Panel

“Mandai Park Holdings is committed to developing a destination that celebrates Singapore’s natural heritage and seeks to preserve it for generations to come. The EAP will assure adherence to the environmental protection measures envisaged in the EMMP.”

—Mr S Dhanabalan, then Chairman of Mandai Park Holdings,<sup>189</sup>  
now known as Mandai Wildlife Group

To support the EIA’s recommendations and implementation of mitigation measures, MPH established an Environmental Advisory Panel (EAP) that would report to its board. The EAP would include independent subject matter experts from the scientific community, academia, nature groups and the private sector, and was tasked with providing advice on effective implementation of the EMMP during the detailed design, construction and operations phases of the project.<sup>190</sup>

The members of the EAP were announced on 1 November 2016, with Professor Peter Ng as its Chairman. He was joined by Professor Ng Soon Chye, Advisory Council Member of the NSS; Dr Shawn Lum, senior lecturer at the Nanyang Technological University Asian School of the Environment and former head of the NSS; and Mr Tai Lee Siang, Chair of the World Green Building Council at the time.<sup>191</sup>

When appointed, Professor Peter Ng explained that the EAP members would “guide development plans to achieve good environmental stewardship” and that it was “critically important that the conservation needs for the project site as well as adjacent areas [were] addressed.”<sup>192</sup>

In a separate interview, Professor Ng gave credit for the formation of the EAP to Mr S Dhanabalan, then Chairman of MPH, who had assured him when he was asked to chair the EAP that he would take seriously any environmental issues that the EAP deemed important to raise.<sup>193</sup>

Mr Dhanabalan had also given Professor Ng freedom to choose the rest of the EAP members, as long as he was certain that they were the right people to do the job. Professor Ng recalled that this commitment “gave me a certain assurance that we can do the right thing.” He added, “Since Mr Dhana[balan] assured me of that, I was pretty sure it could be done... and once I agreed to do the job, I started to find a few other members to join me”.<sup>194</sup>



44. Members of the EAP in March 2020: Prof Erwin Viray (back row, 1st from left), Dr Shawn Lum (back row, 2nd from left), Prof Ng Soon Chye (back row, 3rd from left), Er Lim Peng Hong (back row, 8th from left) and Prof Peter Ng (back row, 9th from left), with MWG staff including then GCEO Mike Barclay (front row, 2nd from left), then DCEO of Development Leong Yue Kheong (front row, 3rd from left) and DCEO and Chief Life Sciences Officer, Dr Cheng Wen-Haur (back row, 6th from left)

MPH’s then Deputy CEO of Development, Mr Leong Yue Kheong, felt that Mr Dhanabalan had shown “strategic foresight” in establishing the EAP, which he described as providing objective oversight and acting as a moderating influence throughout the development project.<sup>195</sup>

The EAP periodically reviewed the environmental management and mitigating measures across the Mandai project’s design, construction and operations phases, advised the board of MPH on environmental management, and regularly monitored the effectiveness of the mitigation measures.<sup>196</sup>



45. The Mandai Rainforest Resort by Banyan Tree, which was developed as an eco-friendly resort within the project area

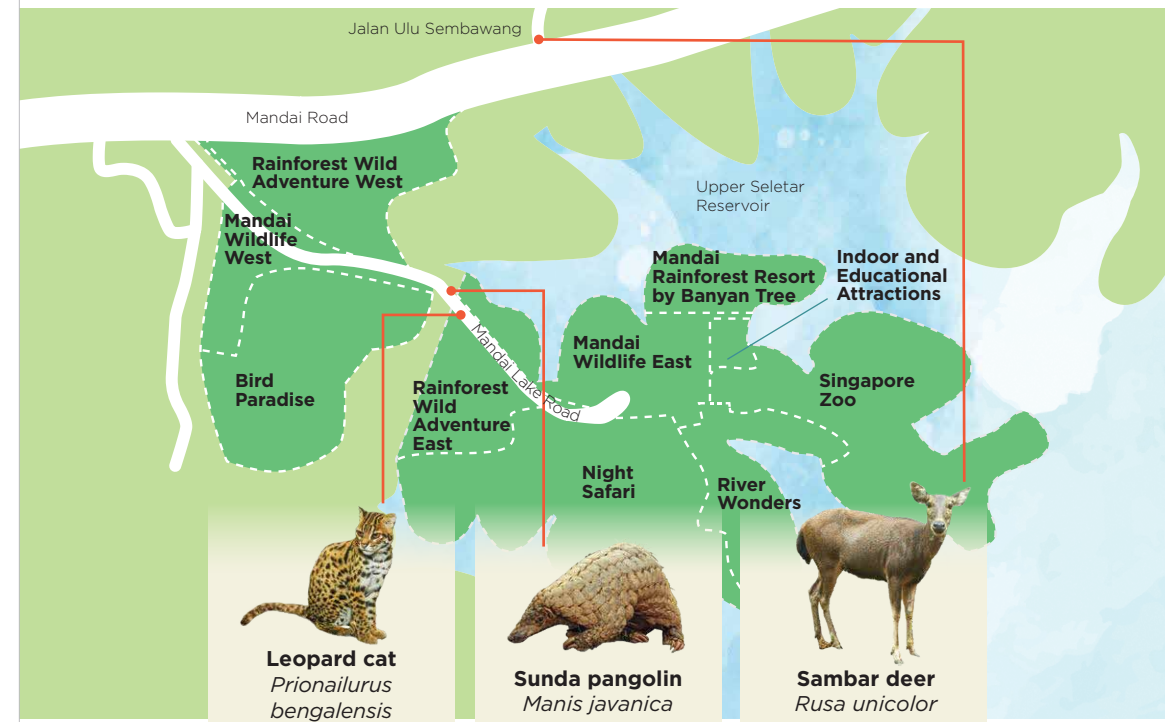
During this period, the EAP also provided expert inputs in the areas of design and sustainable operations for a proposed eco-friendly resort. Some of the sustainable practices implemented as a result were the protection of flora of conservation value, and the maintenance of a 15-m-wide strip of vegetation along the edge of the Upper Seletar Reservoir to conserve sensitive habitats and wildlife connectivity.<sup>197</sup>

Beyond its role in supporting sustainable development, the EAP also advised MPH on its environmental research agenda. In 2019, it endorsed a two-year insect survey to provide information on the insect diversity present in the buffer zones, setbacks and retained forests within the Mandai project area. The findings helped to identify potential issues and inform solutions relating to undesirable carriers of parasites and diseases, invasive species, and species reintroduction. Another two-year project investigated the influence of the developments in the Mandai district on the movement of the Sunda colugo, which aided efforts to protect the species.<sup>198</sup>

## Further Efforts to Improve Environmental Governance

To address concerns about possible noise impacts during construction and the operations of the new nature-themed attractions, MPH committed to avoiding night-time construction works. In addition, long-term noise monitoring was implemented at the fringe of the CCNR to ensure that night-time noise levels within the reserve during the project's operations phase were similar to pre-development levels.<sup>199</sup>

A key concern of the nature groups and members of the public was the number of roadkill incidents involving wildlife during the construction of the new nature-themed attractions. These included a Sunda pangolin in a road accident along Mandai Lake Road in September 2017, and a leopard cat that was found dead along the same stretch of road in February 2018.<sup>200</sup> On 3 February 2018, a sambar deer was fatally struck by a vehicle on Mandai Road.<sup>201</sup> Later that year, on 18 December, another deer was killed in a motorcycle accident along Mandai Road towards Mandai Avenue.<sup>202</sup>



46. Endangered animals that were involved in roadkill incidents from 2017 to 2018<sup>203</sup>

Environmental groups attributed these incidents in part to habitat disruption associated with ongoing development activities in the area. Dr Ho Hua Chew, then Vice-Chairman of the Conservation Committee at the NSS, observed that the clearing of regenerated secondary forest had contributed to the fragmentation of existing vegetation, increasing the likelihood of wildlife moving out of their usual habitats. “Coupled with construction work there, animals may venture out onto the roads in an attempt to reach another patch of forest,” he said.<sup>204</sup>

In response to public concern, and after further consultation with nature groups and local wildlife experts, MPH implemented several mitigation measures aimed at reducing the chances of roadkill incidents. These included traffic calming measures to reduce vehicle-animal collisions. For example, speed limits were reduced to between 20 and 40 km/h, and speed humps, radar panels and regulating strips were installed along Mandai Lake Road. Wildlife crossing signs and road markers were also placed along key points, including car park entrances, to alert motorists to possible animal movement.<sup>205</sup>

## FACILITATING ANIMAL CROSSINGS ALONG MANDAI LAKE ROAD

To support wildlife movement across Mandai Lake Road and reduce the risk of wildlife-vehicle collisions, a suite of temporary and permanent measures was implemented during the construction phase of the Mandai Rejuvenation Project. These included the early delivery of the Mandai Wildlife Bridge, which reconnected forest patches on either side of Mandai Lake Road.

A 50-m-long rope bridge was built above the road to facilitate safe crossings for tree-dwelling animals such as squirrels and monkeys. A 30-m-wide temporary ground crossing was provided to support wildlife movement while the Mandai Wildlife Bridge was being constructed. To minimise disturbance and risks at this location, nearby bus stops were removed, and sections of Mandai Lake Road were temporarily closed at night.<sup>206</sup>



47. One of the rope bridges at Mandai that was built to help arboreal animals such as monkeys cross the road safely

In consultation with local wildlife experts like Mr Norman Lim, an innovative mitigation measure called the “colugo pole” was introduced to aid Sunda colugos in crossing road gaps created by removed trees.<sup>207</sup> The placement of these poles was based on identifying existing trees that colugos could still reach and locating canopy gaps that disrupted their glide paths. The poles were wrapped in rope to mimic tree bark and provide suitable landing surfaces. They were constructed using recycled lampposts and represent a novel, species-specific mitigation measure tailored to the gliding behaviour of the Sunda colugo.<sup>208,209,210</sup>



48. A tall pole, designed to mimic a tree trunk, allowing a colugo (near the top) to move as it would in a forested area<sup>211</sup>

Monitoring observations indicated that nocturnal colugos did use the poles to cross Mandai Lake Road. As Mr Lim noted, “Roads are an obstacle to colugos, and the poles were designed to allow them to leap from tree to tree”.<sup>212</sup>

Additional operational measures were implemented to reduce wildlife exposure to traffic. This included the installation of continuous hoarding along Mandai Lake Road from late 2018 to deter animals from entering the road during construction, the extension of approximately 300 m of fencing along the forest road interface to deter animals from approaching Mandai Road, and the nightly closure of Mandai Lake Road between 1:30 and 6:00 a.m. to safeguard nocturnal animals.<sup>213</sup> Roadside fencing was also installed along Mandai Lake Road and a section of Mandai Road to guide wildlife towards designated crossing points. This reduced the likelihood of animals straying onto the road.<sup>214</sup>

Traffic calming measures, such as speed humps, regulatory signs and regulatory displays, were put in place along Mandai Lake Road to limit speeds to between 20 and 40 km/h. Wildlife crossing signs and road markings were also installed to alert motorists.<sup>215</sup>

Active roadkill monitoring was also carried out, with dedicated personnel, including a wildlife management officer, conducting daily checks from Monday to Friday along the roads to document incidents and communicate mitigation strategies to contractors.<sup>216,217</sup>

Dr Lee Hui Mien, then Vice President of Sustainable Solutions at the Mandai Park Development, noted that the interventions had yielded positive results. “We have observed a significant number of animals using the ropeway and other safety features,” she said, highlighting the effectiveness of cross-sector collaboration among planners, researchers, conservationists and authorities.<sup>218</sup>

Despite the completion of the Mandai Wildlife Bridge and implementation of other mitigation measures, roadkill incidents were not fully eliminated. Between January 2020 and December 2021, seven additional roadkill incidents were recorded along Mandai Lake Road and within 500 m of the project boundary on Mandai Road. The affected species included a Sunda pangolin, a Malayan colugo, a long-tailed macaque, a wild boar and a red-tailed pipe snake.<sup>219</sup>

However, the overall frequency of roadkill incidents involving larger mammals was noticeably reduced, suggesting the importance of maintaining perimeter fencing and other operational measures to minimise risks to wildlife.

Finally, in response to concerns about the spread of non-native species and diseases to the CCNR, daily recording and tracking of the birds and other animals within the new Bird Paradise and Rainforest Wild Adventure attractions were implemented to enable timely recovery and corrective actions if any of them escaped. Robust biosecurity and disease management procedures were also developed and implemented in consultation with the relevant regulatory agencies to minimise the risk of disease transmission.<sup>220</sup>

## Reflections on the EIA and Mitigation Measures

Even with the changes made to the initial development plans in response to the EIA's findings, Professor Leo Tan acknowledged that some degree of environmental impact from human activity would be inevitable. But he noted the need to anticipate, manage and mitigate it responsibly during the development.<sup>221</sup>

Professor Tan's comments were echoed by Dr Shawn Lum, then head of the NSS, who said that "while there is 'no magic wand' to compensate for habitat loss, the developers could look into various ways of designing the attractions, such as sinking down the aviaries to prevent trees from being impeded by large structures, and to allow wild birds to still roost in undisturbed canopies".<sup>222</sup>

Dr Lum added, "In the risk assessment, we can list each of the risks one by one, the results of those impacts, the likelihood of these things happening, and then you can work on a more ecologically sound mitigation...That becomes a starting point to address these issues more realistically".<sup>223</sup>

The EIA's initial risk assessments and the immediate mitigating measures recommended were not the end of the story but were the starting point for further discussions between MPH and its entities, the nature groups, and other stakeholders on how to improve mitigation efforts during the construction phase of the Mandai Rejuvenation Project.

This process of engagement during the development and construction phases was mediated by the Mandai EAP. The next chapter will delve into how the collaborative ecosystem surrounding the Mandai Rejuvenation Project evolved in terms of stakeholder engagement and changes in the format and scope of that engagement and consultation.

## CHAPTER 4

# ENGAGING STAKEHOLDERS AND COLLABORATING FOR PROBLEM SOLVING

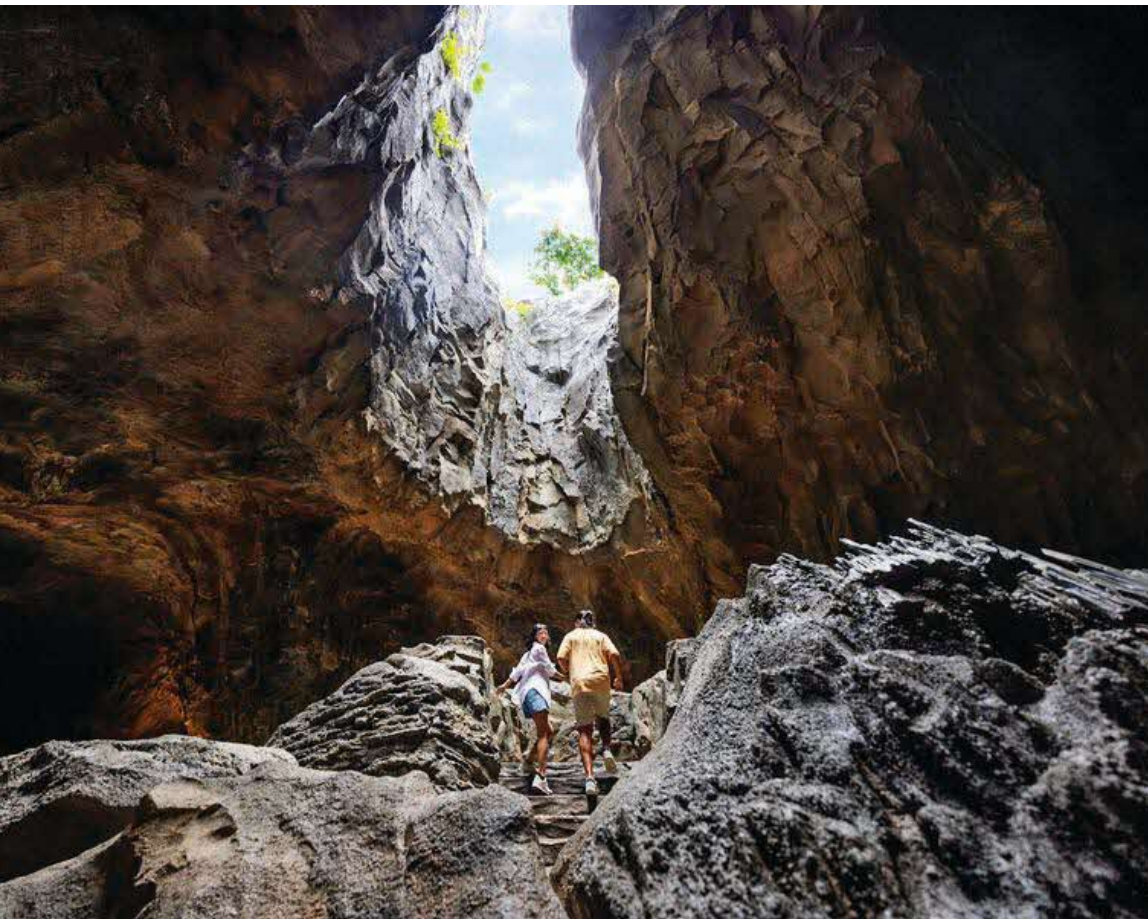
“

Sure we have different views. But we agree we want to do something that is good for Singapore. And if we agree on that, then we can workshop ideas in a really powerful way.

”

**AARON MANIAM**

Then Director, Industry Division,  
Ministry of Trade and Industry<sup>224</sup>



49. The Oculus at Rainforest Wild Adventure West

The rejuvenation of the Mandai precinct took place in a highly sensitive environmental context, given its immediate proximity to the Central Catchment Nature Reserve (CCNR), one of Singapore's most important and intact forest ecosystems. The scale of the new nature-themed attractions therefore raised early questions about how development could proceed alongside the protection of surrounding forests and native wildlife. From the outset, there was a recognition that the project would need to contend with competing priorities related to conservation, land use and long-term sustainability.

To better understand and manage these challenges, an Environmental Impact Assessment (EIA) was conducted during the planning stages of the Mandai Rejuvenation Project. The EIA sought to identify biodiversity-sensitive areas, assess potential impacts arising from construction and operations, and recommend mitigation measures to reduce impacts to the surrounding natural environment. These measures would later inform decisions relating not only to physical design and construction practices, but also to how the project was governed and implemented over time.

While technical studies such as the EIA provided an important foundation, the development project unfolded within a broader social and institutional landscape involving government agencies, Mandai Wildlife Group (MWG), nature groups and members of the public. Engagement with the stakeholders evolved over several years, beginning with a period of heightened concern and scepticism, then shifting towards more structured dialogue and collaboration.

This chapter examines how that engagement process developed, the tensions that emerged, and the ways in which sustained interaction contributed to more workable outcomes for managing trade-offs between development and conservation.

### Initial Concerns with Mandai's Expansion and Redevelopment

Following the announcement on 1 June 2016 of the two new wildlife parks that would eventually become the Bird Paradise and Rainforest Wild Adventure, Dr Ho Hua Chew, then chair of the Nature Society Singapore (NSS)'s conservation sub-committee, who with other nature experts had been in talks with Mandai Park Holdings (MPH) since redevelopment plans were first revealed, said he was concerned because these would not be in "ecological harmony" with the CCNR<sup>225</sup> and would have possible adverse impacts on local wildlife in the area.<sup>226</sup>

The planned bird park, which MPH had touted as having one of the world's largest collections of birds, would require more fences than planned and pose problems for local wildlife movement.<sup>227</sup> Dr Ho reiterated his concerns after the EIA was released publicly on 26 July 2016, stating that it was "most disappointing" that the Bird Park would be relocated to Mandai.<sup>228</sup>

To underscore its concerns, the NSS subsequently released a position paper on 2 September 2016 which detailed specific, technical objections to the development plans, as well as detailed critiques on habitat loss, fragmentation, wildlife movement and edge effects. This illustrated that while engagement with nature groups did occur, significant ecological disagreements remained, including over the extent of habitat loss, fragmentation, wildlife movement and edge effects.<sup>229</sup>

However, other nature experts such as Mr Joseph Koh, an authority on spiders, were less critical of the engagement process during the assessment. He said, “It was not a token consultation, not just a one-way traffic [flow]”, and that “while we did not get everything we wanted, we were glad that we were given an opportunity to be briefed in advance and were not presented with a fait accompli”.<sup>230</sup>

### Engagement as an Evolving Process: Recognising the Need to Share Information and Build Trust

In the face of some of the more critical nature group responses to the re-development of Mandai’s nature-themed attractions, a key question arose on how to reconcile different perspectives on development, conservation and protection of the area’s natural heritage—particularly given Singapore’s high density and scarcity of land as a city-state.

Mr Aaron Maniam, who had been involved in the Mandai Rejuvenation Project as Director, Industry Division, in the Ministry of Trade and Industry (MTI) between 2014 and 2017, characterised the tension as arising from two equally important priorities: the developing agencies’ and MPH’s focus on efficiently and expeditiously completing the new attractions by the publicly announced deadline, and the nature group representatives’ deeply held concerns over the potential of negative impacts to the flora and fauna of the adjacent CCNR.<sup>231</sup> He noted that such a tension was not surprising, as the various entities had different and defensible starting points. But subsequently, it was important for stakeholders to “slowly find ways to converge into the zone of possible agreements”.<sup>232</sup>

Mr Maniam also felt that some amount of healthy tension was useful, as the need to both cater to stipulated deadlines and address conservation concerns kept the developing agencies disciplined and innovative in generating solutions to mitigate the impacts of development on the surrounding nature areas. He noted that as the Mandai Rejuvenation Project was a type of conservation tourism, it demonstrated a practical and efficient “Singapore style” of solution-finding.<sup>233</sup>

As the nature groups were informed of both the importance of the new nature-themed attractions, and what was being done to mitigate their impacts, trust and social capital were eventually established between the different stakeholders.<sup>234</sup>

In the case of the developments in Mandai, long-time NSS member and nature advocate Mr Tony O’Dempsey, who at the outset viewed them as “an inappropriate land use”, nonetheless recognised value in the lessons that came from the solutions developed to aid wildlife. For example, the colugo poles that were successfully put into practice to help colugos safely move across roads in Mandai were then applied more widely to aid nature conservation efforts elsewhere in Singapore.<sup>235</sup>

However, it took time to build the strong mutual respect and collaborative ecosystem needed for MWG, government agencies, nature groups, and interested members of the public to work together to air their concerns and effectively iron out their respective differences.

Professor Peter Ng, then Chair of Mandai’s Environmental Advisory Panel (EAP), recalled that the first few years of public engagement between the various stakeholders were fraught with tension. He said that initially, nature groups and academics had deep concerns and fears over the welfare of the local biodiversity in the area. He recalled that some had even asked the established Singapore Zoo to move out of Mandai.<sup>236</sup>

## The Importance of Relationship-Building and Meaningful Dialogue

A major factor that helped to allay the deeply held concerns of the nature groups was the building of relationships and trust. For agencies such as the MTI and Singapore Tourism Board (STB), their role was primarily to broker compromises and collaboration, and to find practical ways to move ahead. The aim was to deliver the project and its broader benefits, while managing effects on the natural environment.<sup>237</sup>

The underlying approach adopted by the various agencies was to make the point that the interests of the different stakeholders were not zero-sum games and mutually exclusive. Hence, while the tensions had to be openly acknowledged, there was a subsequent opportunity for stakeholders to work together creatively and mutually support each other.<sup>238</sup> As such, there was a need for the agencies to form alignments on policy, land use and nature conservation issues. There were many instances where the representatives of the various parties needed to reconcile their differing perspectives to reach workable solutions.<sup>239</sup>

As Mr Maniam also noted, the various parties recognised that while there were differing points of view between the agencies and the nature groups, ultimately, “we all agreed that we want to do something that is going to be good for Singapore. And if we could agree on that, then we can sit together and workshop creative solutions.”<sup>240</sup>

At the outset, the engagement process involved town hall-like meetings with a broad spectrum of nature groups and academics from a variety of conservation and sustainability disciplines. When the town hall-type meetings had served to allow the airing of concerns from a broad array of nature groups and other stakeholders, the mode of public engagement transitioned to smaller focus group engagements in 2020. These working groups brought together Mandai’s development and management teams with nature group representatives and subject-matter experts who could address specific impacts of development on the natural environment and wildlife.

Professor Ng explained that because the development was complex and involved issues for which there were no clear answers, it was important to be transparent and fact-based. He noted that issues were resolved through the small working groups mostly by arriving at balanced compromises.<sup>241</sup>



50. A meeting in 2019 with members of the nature community to discuss design elements of the Mandai Rejuvenation Project

The transition to small working groups had the advantage of enabling more fine-grained mitigation measures through greater specialisation and technical depth. Each working group dealt exclusively with one aspect of impact management, with groups dedicated to addressing issues like roadkill, noise levels and wildlife connectivity, such as for the colugos, among many others.<sup>242</sup> Mr O’Dempsey explained that more technical data and detailed information could be shared within the smaller groups, compared to the more emotive town hall-like meetings, and that this made for more effective problem solving.<sup>243</sup>

For Mr Maniam, at the end of the day, it boiled down to relationship and trust building. He noted that:

“People need to feel that they are engaged in the process. If you just announce results and outcomes right from the outset, people feel like ‘Okay, I wasn’t involved deeply and didn’t have a part in shaping this outcome.’ But if you involve them, through things like a briefing beforehand and sharing relevant project materials, that helps to establish mutual regard, and to build trust in the process. Many little things like that eventually added up in the case of Mandai.”<sup>244</sup>

### Problem Solving at Mandai

On the ground, the teams that were charged with executing the Mandai Rejuvenation Project, which included Mandai’s own development and construction staff and engineers, the EIA consultants and more, faced their own challenges in delivering the project.

Professor Ng said that the development team had been unhappy when there were constraints imposed on them due to the need for measures to mitigate the environmental impact. The necessity of reconciling competing demands and concerns led to the EAP feeling caught in the middle, to the point that Professor Ng recalled, “I did complain to Mr Dhana[balan] a few times. I’m caught between the devil and the deep blue sea!”<sup>245</sup>

However, Professor Ng recalled that Mr Dhanabalan had argued that working out differences with the nature groups was important if Mandai wanted to do things the right way. He also credited Mr Dhanabalan for his willingness to help resolve differences, including agreeing to attend the engagement sessions with nature groups if the EAP felt his presence necessary.<sup>246</sup>

For former National Parks Board officer Mr Adrian Loo, who was then involved in the public engagement efforts as Director of the National Biodiversity Centre’s Terrestrial Branch, the discussions reconciling different concerns needed to be science-based to be effective, as they helped to mitigate the inherent emotiveness of the issues. He noted that:

“The important thing [is] that you have to be very sound ecologically...the science becomes stronger when you have a lot of information. That’s why ground truthing, like [doing] a lot of camera trap work, bio-diversity surveys...was important.”<sup>247</sup>



51. Nature community stakeholders during a visit to the West Node construction site in 2017

During construction works, MWG took necessary steps to mitigate potential impacts to surrounding biodiversity, given the area’s proximity to dense forest inhabited by wildlife. For example, it was imperative to ensure that personnel working at the construction site were prepared to respond appropriately should animals enter the work areas, so as to protect both animals and workers.

Biodiversity awareness training was mandated for all on-site workers, regardless of their role. The training focused on helping workers recognise wildlife like the king cobra, Sunda colugo and Sunda pangolin, as well as their conservation significance,<sup>248</sup> and the importance of adhering strictly to site boundaries. Workers were prohibited from handling wildlife and were required to follow established response protocols, which involved stopping work where necessary and alerting trained specialists to manage any animal-related situations on-site.<sup>249,250</sup>

### General Environmental Management



Main contractors were required to maintain dedicated on-site environmental personnel to oversee implementation of EMMP requirements.



Food consumption and waste management on site were controlled to avoid attracting wildlife, with appropriate facilities and waste handling measures provided.

### Construction Timing and Noise Management



Construction activities were generally confined to 8 a.m. to 6 p.m. to reduce disturbance to wildlife, with any night works subject to approval, additional controls and mitigation measures.



Noise-intensive activities were managed in accordance with regulatory requirements and were not permitted during approved outdoor night works.

### Lighting Management



Construction lighting was designed to be downward-facing and directed at work areas, with light spill towards the CCNR and sensitive areas minimised.



Lighting levels were kept to the minimum required to meet safety requirements for workers under the Ministry of Manpower guidelines.

### Plant and Animal Protection



Tree Protection Zones were established to protect retained trees of ecological or conservation value, with arborists engaged to monitor and advise on tree health during construction works.



When wildlife was encountered, site personnel followed an established wildlife protection protocol, which involved engaging trained specialists to manage the situation.



While the wildlife bridge was being constructed, a temporary ground crossing was maintained.



Daily wildlife inspections were conducted prior to the start of works.

52. Key constraints on construction activities implemented to mitigate impacts on the surrounding natural environment, based on the EIA and EMMP<sup>251</sup>

## Monitoring of Development Works for the Mandai Rejuvenation Project

Once the mitigation measures for the project were agreed upon, it fell to MWG's then Deputy Chief Executive Officer of Development Mr Leong Yue Kheong to ensure that they were properly implemented on the ground.<sup>252</sup>

Mr Leong recalled that when he joined the project team in 2017, it was clear to him that the nature community was predominantly not in favour of the redevelopment, and that relationship building was crucial: "We spent a lot of time building trust, communicating, being transparent with the nature community. I invited them one by one to have lunch almost on a monthly basis, to understand one-on-one what their concerns were".<sup>253</sup>

It was also explained by Mr Leong that additional costs were incurred to implement the mitigation measures recommended in the Environmental Management and Monitoring Plan (EMMP), demonstrating Mandai's commitment to environmental sustainability. On other aspects of construction work, Mr Leong noted that ensuring noise and light control would require changing some types of equipment, such as piling machines and standard hammer punch machines, because the noise was too loud. This was in addition to restricting night hours construction.<sup>254</sup>

Mr Leong also noted that Mandai's development team had, at one stage, bought up an entire available market supply of high quality wildlife-friendly erosion control blankets—a measure taken to reduce the risk of wildlife becoming entrapped in standard erosion control materials. Daily removal of food waste was also mandated across construction sites to deter wildlife from entering the site. This contributed to the Mandai project being regarded as arguably one of the cleanest construction sites in Singapore.<sup>255</sup>

Additionally, Mr Leong emphasised that the contractors had to be educated on the importance of meeting the obligations required by the EIA during construction, and that they had to make adjustments based on suggestions that arose from the nature groups. To that end, all the major contractors were required to have an environmental management team on board, including ecologists and arborists, and every batch of contractors and subcontractors within all work sites had to be trained in animal recognition and identification. Mandai's development team also audited the construction works, and implemented penalties and disincentives, including withholding payment, when necessary.<sup>256</sup>

Mr Leong observed that as construction progressed, and engagement with stakeholders deepened, trust was established. He said:

“I think there was learning on both sides. The [nature groups] learnt to reframe their [requests] to be more realistic. And we also learnt to share upfront the design and intention. I think both sides have learned through this process, so if you ask me, I think it’s a good outcome”.<sup>257</sup>

### Outcomes from the EIA and Engagement Process with Nature Groups and the Public

The consultation efforts that were made over the years—from the initial engagements to help scope the EIA, to the publication of the EIA for public feedback, to the town hall-type meetings that evolved to smaller working groups—would not have been successful if the concerns raised by key stakeholders were not addressed.

For the Mandai Rejuvenation Project, MWG accepted the need to undertake serious and effective mitigation efforts to protect the surrounding nature areas, both in terms of the design and operations of the new nature-themed attractions, and during development work.

Land that may have otherwise been used for development was set aside as buffer areas, planned facilities were shifted to avoid sensitive nature areas, and the Mandai Wildlife Bridge was built to create a link for animals to move between parts of the CCNR that had long been separated by Mandai Lake Road, with the aim of reducing roadkill incidents.



53. An aerial view of the Mandai Wildlife Bridge, taken in 2025

## MONITORING ANIMAL USE OF THE MANDAI WILDLIFE BRIDGE

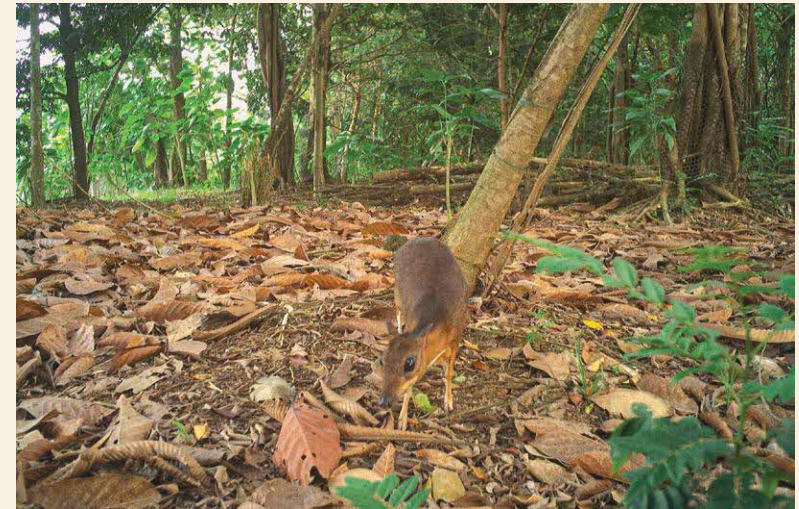
If the aim of the Mandai Wildlife Bridge was to renew an ecological link between the northern and southern stretches of the CCNR in Mandai, it fulfilled its mission. A week before its official opening in 2019, six cameras that had been set up along the bridge showed that long-tailed macaques were already using the bridge, and within the first week of its opening, larger mammals like wild pigs and sambar deer were spotted using the bridge.<sup>258</sup>



54. A male sambar deer on the Mandai Wildlife Bridge

By February 2022, more than 40 camera traps placed on the Mandai Wildlife Bridge and in the buffer zones had recorded nearly 70 vertebrate species using the bridge. This included not just long-tailed macaques, wild pigs and sambar deer, but species such as the large-tailed nightjar, lesser short-nosed fruit bat, common palm civet and Sunda scops owl.<sup>259</sup> Red junglefowl were seen taking advantage of upturned soil left by wild pigs digging for food.<sup>260</sup>

In 2022, Ms Chua Yen Kheng, MWG's Assistant Vice President for Sustainable Solutions, said that the bridge had created "vital habitat connectivity and a safe passage for wildlife", and that "when the vegetation is mature, we expect that elusive species like the lesser mousedeer and Sunda pangolin will use the bridge to move between forest patches".<sup>261</sup>



55. A lesser mousedeer on the Mandai Wildlife Bridge

To enrich the ground layer on the bridge, tree branches and leaf litter were collected from the wildlife parks and transported to the crossing. Log piles were added as stepping stones or refuge for small mammals, reptiles and amphibians.<sup>262</sup> By 2024, wildlife observed using the bridge directly or flying over it had risen to more than 80 vertebrate species.<sup>263</sup>



56. A wild pig with piglets crossing the Mandai Wildlife Bridge



57. The planting of a 3.5-m tall *Horsfieldia superba*, a critically endangered native tree species, on the Mandai Wildlife Bridge to mark its opening; participating in the planting were, from left to right, Er Lim Peng Hong, then member of Mandai's Environmental Advisory Panel; Mr Mike Barclay, then Group CEO of MWG; Mr S Dhanabalan, then Chairman of MWG; and Mr Desmond Lee, then Minister for Social and Family Development and Second Minister for National Development<sup>264</sup>

Mr Poh Chi Chuan, Executive Director, Experience Development Group, Exhibitions & Conferences at the STB, noted that the Mandai Wildlife Bridge could not be monetised since it was intended as a wild animal crossing.<sup>265</sup> Additionally, Mr Poh noted that despite its cost, the bridge was built as a mitigating measure because MWG and government stakeholders took seriously their responsibility to protect the environment as well as the concerns of the nature groups and the public.<sup>266</sup>

Mr Maniam further characterised the willingness to fund the construction of the Mandai Wildlife Bridge as being part of a responsibility to spend in response to market failure. He noted that the government recognised that there was a certain kind of core public good, like infrastructure, for which the private sector had no or little incentive to develop. Similar to spending on other infrastructure like roads and public amenities, building the Mandai Wildlife Bridge underscored the recognition of this infrastructure as a public good that served to protect the surrounding nature areas.<sup>267</sup>

Once the bridge had been built, efforts to engage the public about the ecological role of the Mandai Wildlife Bridge were redoubled, such as during the whole month of November 2019, when the bridge served as a venue for engaging and educating nearly 90 volunteers from local and international companies on the importance of ecological linkages between nature areas in Singapore.<sup>268</sup>

The tree planting was part of the process to create a multi-layered forest structure that would provide vegetation cover for shy, forest-dependent animals to move between the forest patches of the CCNR on either side of Mandai Lake Road; with the bridge, these were linked for the first time in more than 60 years.<sup>269</sup>



58. (Top) Belina Lee, then Chief Strategy and Innovation Officer of MWG, and a representative from Panasonic System Solutions Asia Pacific, planting a sapling on the Mandai Wildlife Bridge before it opened, and (bottom) representatives from Lam Soon Singapore doing their part for wildlife

The multi-year engagement between the various stakeholders comprising government agencies, MWG, nature groups and the general public was crucial to the realisation of the Mandai Rejuvenation Project. While there were understandably periods of tension due to deeply held concerns and considerations among all the stakeholders, the discussions and workshops enabled the formulation of a set of practical solutions to mitigate the impacts of the development on the surrounding ecologically sensitive nature areas. The final chapter reflects further on this theme and considers the road ahead for Mandai.

## CHAPTER 5

# REFLECTING ON MANDAI'S MILESTONES AND LOOKING TO THE FUTURE

“

I believe that along with climate change, nature and biodiversity loss are among the most pressing challenges for the planet. The Mandai Wildlife Group seeks to help find solutions to these problems.

”

**PIYUSH GUPTA**

Chairman, Mandai Wildlife Group<sup>270</sup>

From the outset, Mandai Wildlife Group (MWG), together with government agencies, engaged stakeholders to address concerns about the proximity of new developments to the Central Catchment Nature Reserve (CCNR). An important outcome of these engagements, and of the Environmental Impact Assessment (EIA) process, was the decision to set aside substantial areas of land as buffer zones. These areas, which might otherwise have been developed, were intentionally retained to separate man-made structures from existing forest habitats.

This early decision was made in direct response to nature groups calling for the need to have a separation between sites planned for future development and existing forest areas, in order to minimise impacts on the ecosystem.<sup>271</sup> As noted during public discourse on the Mandai redevelopment, buffer zones were seen as essential to reducing pressures on the surrounding ecosystem and safeguarding the integrity of the CCNR.

To protect the ecosystem, these buffers, along with setbacks and the retained forest areas, were declared out-of-bounds to visitors. Where feasible, dense vegetative barriers were used to discourage human incursions.<sup>272</sup> These areas were reserved primarily for ecological monitoring, research and restoration activities, and protected from further development.

The buffer areas also served as a refuge for wildlife displaced by the development and to protect the CCNR's forest from "edge effects" which are negative phenomena affecting the natural environment such as increased risks of parasitism, disease and predation that can occur when a habitat is exposed to a different habitat type or structure.<sup>273</sup>

This chapter builds on these foundational safeguards by examining how Mandai's restoration efforts, ecological monitoring, and nature-positive design strategies were implemented to support long-term habitat recovery and biodiversity conservation.

## Restoring Degraded Habitats and Monitoring Recovery

In parallel with setting aside the buffer areas, Mandai Wildlife Group committed to enhancing local habitat quality across the precinct through active ecological restoration, including the restoration of 0.027 km<sup>2</sup> of degraded areas in the buffer areas by 2030—over 0.008 km<sup>2</sup> of which had been restored by 2024.<sup>274</sup>

Some of these degraded areas were the legacy of past land use, storm damage, or competition from aggressive plants. To help these patches recover, Mandai adopted restoration approaches tailored to site conditions. In areas where natural regeneration was feasible, aggressive plants were removed to allow the forest to regenerate naturally. In more degraded areas, such as those with poor soil quality, a variety of native trees were planted to kick-start the development of the forest after removal of the aggressive plants.<sup>275</sup>

To ensure that the restored areas would thrive like the mature forest in the CCNR, MWG's staff monitored each plot every six months for at least two years. Monitoring was guided by the Ecological Restoration Recovery Wheel developed by the Society for Ecological Restoration, which assesses the health of reforested areas based on five attributes: species composition, community structure, ecosystem function, absence of threats and physical conditions.<sup>276</sup> This approach allowed restoration progress to be tracked systematically and supported adaptive management over time.

## Designing for Co-existence: Biodiversity-Sensitive Infrastructure

Beyond the documented key mitigation measures on construction activities as advised by the EIA report, mitigation measures to uphold biodiversity conservation were also embedded within the landscaping and infrastructural design of the parks themselves.

These included innovative design features which led the Bird Paradise to winning the prestigious Design of the Year Award in the President's Design Awards in 2025. At a time when nature-themed attractions like those in Mandai have sparked debate over whether these are merely for entertainment or serve a greater mission, the judges found that the Bird Paradise's integration of wildlife, landscaping and visitor engagement "present[ed] an innovative model for conservation, pointing towards the future of animal preservation in urban settings".<sup>277</sup>

## NETTING OVER BIRD PARADISE

In the early stages of designing the Bird Paradise, MWG engaged stakeholders, including agencies like the National Parks Board (NParks) and members of the nature community, to obtain their feedback on the park's design.

A major concern raised was the potential risk of birds escaping from the open-concept amphitheatre into the CCNR during bird shows.<sup>278,279</sup> Acknowledging this concern, the original design was refined to include netting over the entire amphitheatre.

Indeed, Mr Poh Chi Chuan from the Singapore Tourism Board (STB) explained that the netting and supporting pillars had to be light, as heavy structures would distract visitors away from the exhibits themselves. He recalled thinking that the "key exhibits are birds. And birds are best observed in flight. So, we wanted to create a big area with a lot of headroom so that birds can fly".<sup>280</sup>



59. The expansive overhead netting at the Bird Paradise

Apart from sourcing strong yet thin mesh to prevent escapees and yet retain the aesthetics of the landscape, the columns that supported the nets also had to be innovatively designed and constructed.

Home-grown structural and steel specialist, TTJ Design and Engineering built the columns that hold up the mesh for the Bird Paradise's aviaries. With no space for welding in the aviaries, they fabricated 78 columns—measuring up to 110 cm in diameter and 32 m in height—and their brackets off-site, which also gave the company better control over the manufacturing process and quality before assembling the columns on site.<sup>281</sup>

Given the site's undulating terrain and the aviaries' varying shapes, each column-and-bracket pair is unique. TTJ's Chief Executive Officer (CEO) Elavarasu Somasundaram said, "We used Building Information Modelling to design them, manufactured them from the drawings, and used 3D scanning to inspect them afterwards to ensure that they [were] correct".<sup>282</sup>

He added that the project was the "largest...of its kind that we've done" and noted that in the end, "none of the columns needed to be rectified. Everything, including the installation, went perfectly".<sup>283</sup>



60. A Balinese-inspired terraced rice field at the Kuok Group Wings of Asia

Mandai's exemplary landscapes were also highlighted in 2023 and 2024, when both the Bird Paradise and Mandai Wildlife West attained the highest level of certification under NParks' Landscape Excellence Assessment Framework (LEAF)—the Platinum award.<sup>284</sup> The two projects were commended by the LEAF assessors not just for their landscape designs and environmentally sustainable features but for their efforts to preserve and enhance biodiversity within the attractions themselves.

For example, at the Bird Paradise and Mandai Wildlife West, the landscape design prioritises the use of native plant species that are well-suited to the local climate and soil conditions.<sup>285</sup> This approach reduces the need for irrigation and intensive maintenance, while providing rich sources of food for birds and insects.<sup>286</sup>

### Big On Figs

- Figs are key species in rainforest ecosystems.
- They bear fruits year-round, providing a source of food for animals.
- Hardy and fast-growing, figs provide homes and shelter for many animals.



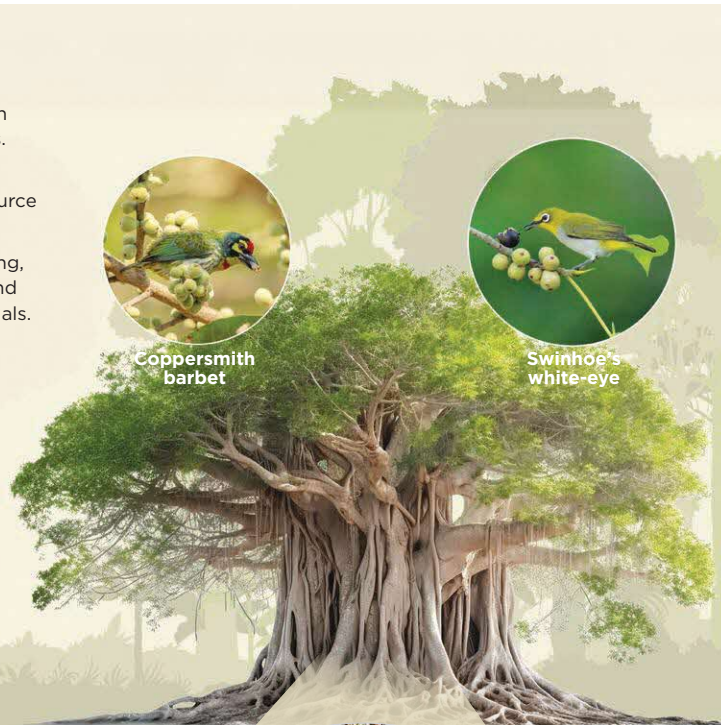
Coppersmith barbet



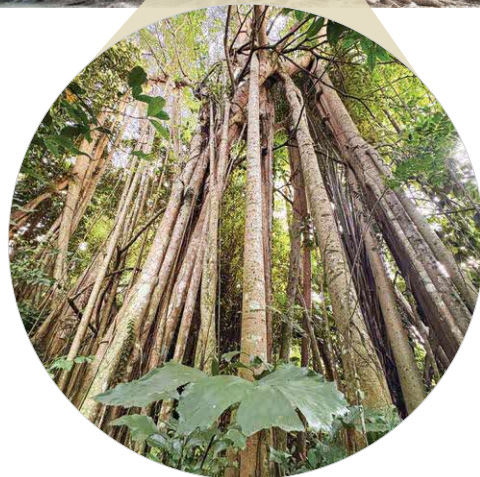
Swinhoe's white-eye



Red-stem fig



61. (Right) A mature native fig tree that was conserved and integrated along the hiking trail at the Rainforest Wild Adventure West, and (top) the interpretive sign that was placed at its base to educate visitors

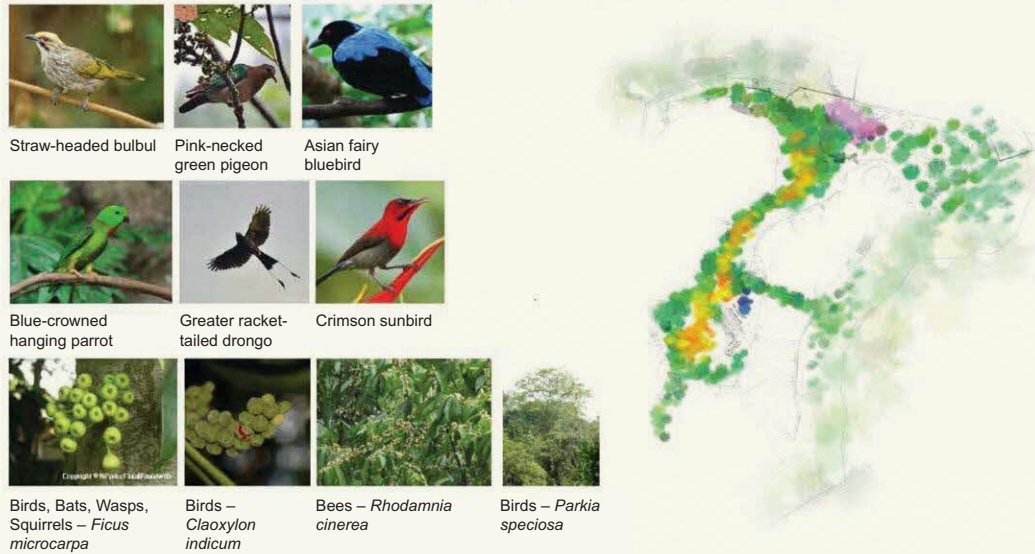


Environmentally friendly design was also applied to all of the constructed ponds and other water features at the Bird Paradise and Mandai Wildlife West.<sup>287</sup> These were designed to mimic natural wetlands, utilising a combination of physical and biological processes to effectively treat stormwater through the use of specific plants, soil types, and drainage systems to remove pollutants and other contaminants.<sup>288</sup>



62. A constructed pond that mimics the functioning of a natural wetland, with gravel and soil layers shown in the foreground

Landscape planting was carefully planned to create naturalistic settings within the aviaries, playgrounds and parks, with species selection informed by the EIA's Forest Restoration Plan. In Mandai Wildlife West, fruit trees were included to provide food resources for native birds, bats and pollinators within the developed area.<sup>289,290</sup>



63. Plans for creating habitats through the selection of plants, including trees that would provide food for identified fauna

Beyond the LEAF award, MWG also received the BCA Green Mark Platinum Award in 2022 for the Penguin Cove at the Bird Paradise and the East Arrival Node.<sup>291</sup> MWG's leadership in conservation and sustainability was also recognised by the STB by being conferred the Outstanding Achievement in Sustainability award in 2023 under the Enterprise Excellence award category.<sup>292</sup>

Internationally, MWG was awarded the World Association of Zoos and Aquariums (WAZA) 2024 Environmental Sustainability Award for having its net-zero science-based targets validated by the Science Based Targets Initiative (SBTi), and for showcasing best sustainable solutions to influence Singapore's general public.<sup>293</sup>



64. Then Group CEO of MWG, Mike Barclay, at the WAZA Environmental Sustainability Awards in 2025

## Redefining Purpose: Conservation at the Core

“Temasek’s role as a trusted steward and its commitment to advance communities remains steadfast amid these uncertain and volatile times. As climate change and the loss of biodiversity are pressing issues affecting all our lives, we think it is timely to establish Mandai Nature, in partnership with MPH (Mandai Park Holdings), to drive nature-based sustainability in Singapore and beyond. MPH is a natural partner, given its focus on biodiversity conservation, and together, we hope to deliver positive impact and catalyse changes to benefit our communities.”

—Mr Shaun Seow, Managing Director,  
Community Stewardship, Temasek<sup>294</sup>

According to Mr Aaron Maniam, aside from economic reasons, locating the Mandai Rejuvenation Project near the nature reserve presented a major strategic impetus for environmental conservation: a recognition by the government that people were interested in conservation tourism and wanted to see what that would look like in a tropical setting, to see how Singapore could be both a highly dense and liveable city, and also have deep conservation work happening all at the same time.<sup>295</sup>

A pillar of MWG’s commitment to environmental conservation was the creation in December 2020 of Mandai Nature, a non-profit organisation for wildlife conservation that aims to be a catalyst for action on climate change. MWG’s commitment to supporting Mandai Nature remains strong, building on contributions of more than S\$10 million over the past five years.<sup>296</sup>

Building on its predecessor, the Wildlife Reserves Singapore Conservation Fund, Mandai Nature now supports over 40 conservation projects across Singapore and Southeast Asia, creating positive impact for more than 30 conservation partners in the region. In collaboration with these partners, it champions the protection of threatened species and habitats—with work on the ground delivering tangible economic benefits to more than 71,000 people across the region. Its partnership with MWG means Mandai Nature can draw on the expertise of its veterinary and animal care teams, channelling that knowledge to partners in the field to train, build capacity and strengthen conservation practice where it is needed most.<sup>297</sup>

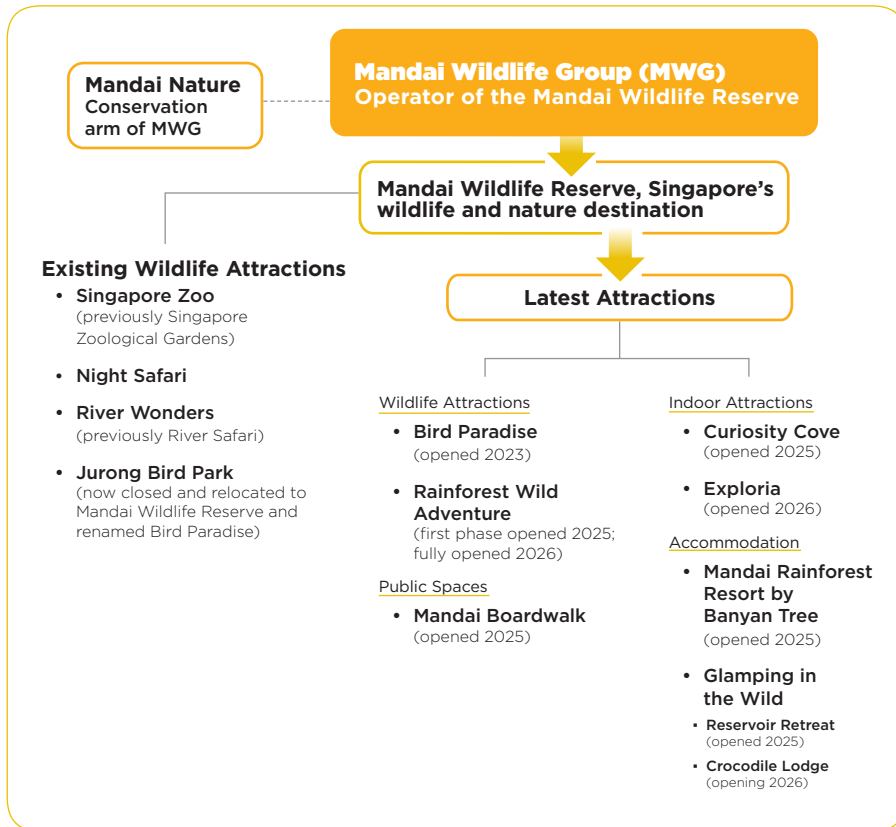
Today, Mandai Nature also works closely with Temasek and MWG to build partnerships with conservation experts and organisations, zoos and zoo associations, educational institutions, regulatory bodies, companies, local communities and philanthropists to continue to enhance Singapore’s efforts to support biodiversity conservation in Singapore and the region.<sup>298</sup>

These efforts were recognised when MWG won the President’s Award for the Environment 2025, where the Ministry of Sustainability and the Environment noted the funding and in-kind support of Mandai Nature, which supported over 40 projects across Southeast Asia.<sup>299</sup>

## Rebranding for the Future

The name Mandai Wildlife Reserve was introduced on 13 October 2021 to replace Wildlife Reserves Singapore and to serve as the official designation for the new wildlife and nature destination.<sup>300</sup>

Then Group CEO of MWG, Mike Barclay, underlined the Group’s commitment to “the vision of thriving wildlife and human communities living side-by-side, in well-functioning ecosystems”. He further stated that: “in working towards this vision, our focus therefore goes beyond protecting animals and habitats, to encompassing community support, championing sustainable living and promoting nature-based solutions to mitigate climate change. Our rebranding comes at a critical time when action is urgently needed to mitigate climate change and reverse the devastating decline in the earth’s biodiversity”.<sup>301</sup>



65. Organisational chart of MWG and its associated entities

In the process of consolidating Singapore’s wildlife parks under the new integrated destination of Mandai Wildlife Reserve, the visual identities of its parks were also revised to better reflect Singapore’s wildlife heritage.<sup>302</sup> For instance, the River Safari was renamed River Wonders to reframe the park as a place to appreciate the tranquillity and biodiversity of aquatic flora and fauna. The Jurong Bird Park was relocated to Mandai. It was renamed Bird Paradise to better emphasise the park’s dedication to bird conservation, particularly those endemic to the region.<sup>303</sup>

As a matter of corporate strategy, the rebranding signalled the MWG’s redoubling of its commitment to conservation and the reframing of its focus beyond the operations of its zoological institutions.

This cemented the trajectory that had been championed by the former managing director of sustainability at Temasek, Neo Gim Huay. In a 2024 article for Temasek’s 50 by Fifty series, A Sustainable Approach to Heritage and Conservation, Ms Neo emphasised the reorientation of approaching the Mandai project through an ecological lens.

She noted that it wasn’t a “typical urban development project”, and as such, it was important to understand and address the concerns of various stakeholders, while pioneering ideas and solutions in line with the project’s ambitions to build a “zoo of the future” that supported wildlife conservation beyond Singapore.<sup>304</sup>



66. Rebranding of the Mandai Wildlife Reserve and its attractions in 2021, from their former logos (left) to their new logos (right)

In May 2026, the opening of Rainforest Wild Adventure's second phase marked the completion of its long-anticipated rejuvenation project. Spanning two locations, the zones formerly known as Rainforest Wild Asia and Africa were rebranded as Rainforest Wild Adventure West and East respectively.

The renaming was accompanied by a refreshed logo for Rainforest Wild Adventure that underlined the innovative nature of "adventure" in the parks, where visitors could choose their own level and pace of exploration, with the chance of spontaneous wildlife encounters along the way.



67. The updated logo for Rainforest Wild Adventure

The new Rainforest Wild Adventure East, inspired by African and Madagascan environments, also saw the Southeast Asia debut of the okapi, an endangered species from Central Africa. The introduction of the okapis came through MWG's participation in the European Association of Zoos and Aquaria Ex Situ Programme (EAZA EEP), which coordinates the population management and breeding efforts of threatened species across member zoos worldwide.



68. An okapi; this endangered species, native to Central Africa, will make its Southeast Asia debut at the Rainforest Wild Adventure East

This allowed more opportunity to educate visitors on the importance of coordinated conservation initiatives to maintain healthy, genetically diverse populations of threatened species across accredited zoos worldwide.<sup>305</sup>

## The Nexus Between Education and Conservation

A recent effort that exemplifies Mandai's deeper focus on conservation education was unveiled on 16 May 2025 with the opening of Asia's first "ZooSchool" to nurture an appreciation for flora and fauna among children.<sup>306</sup> Designed for children aged 3 to 12, the ZooSchool's programmes are curated by experienced educators with expertise in wildlife conservation and early childhood education.<sup>307</sup> Along with Mandai's five wildlife parks, a 1,300-m<sup>2</sup> purpose-built facility—featuring indoor spaces modelled after natural ecosystems and a sensory-rich, multi-level playground—will serve as the children's classrooms.<sup>308</sup>



69. The Wild Rescue Rangers programme by ZooSchool

The ZooSchool's programmes provide an interactive, personalised learning experience that cultivates passion for wildlife conservation and blends the acquisition of theoretical and practical skills with character-building.<sup>309</sup> This includes understanding animal behaviour, how to protect wildlife, orienteering and knot-tying, which in turn support the development of resilience, empathy and curiosity.<sup>310</sup> Children get to learn first-hand from veterinarians, animal care experts and sustainability advocates.<sup>311</sup>

Recognising the urgency for climate action, one of the ZooSchool's intentions is to nurture more multidimensional notions of success around conservation and engender greater environmental responsibility. Ms Belina Lee, then Deputy Chief Executive Officer (Transformation and Growth) at MWG, stated at the launch of the ZooSchool that there is a need for “our next generation to grow up, not just thinking of the traditional sense of success, but that success also means being responsible to the environment”.

Going forward, MWG aims to adopt a strategic approach to ensure that conservation and environmental education is accessible to all segments of the population, especially those with special needs, and to strengthen youth engagement through the nurturing of future-forward skills and global citizenship to care about wildlife and the environment.<sup>312</sup> By 2030, MWG aims to engage with 50,000 children annually, outlining its commitment to education efforts.<sup>313</sup>

Following the opening of ZooSchool, Mandai Wildlife Reserve added to its educational attractions by opening Curiosity Cove in November 2025. The attraction encourages children to explore how animals live, adapt and thrive in the wild across four real-world ecosystems.<sup>314</sup>

Finally, the new Exploria indoor attraction that opened in March 2026 focuses on engaging and educating teenagers and young adults about how life survives and adapts across Earth's varied ecosystems by using real-life footage and science-led storytelling.<sup>315</sup>

## Conclusion

Looking back over the more-than-decade-long process of conceptualising, engaging and consulting, and finally executing Mandai's redevelopment as a wildlife and nature destination, it is worth revisiting then Prime Minister Lee Hsien Loong's outlining of the vision for Mandai during a 2014 televised interview. In the interview, he noted that the redevelopment was not an extension of the zoo, “but something bigger and better...something which is green, improves on what is there, and enhances the nature reserves, but does not infringe into [them]”.<sup>316</sup>

As a testament to the nature conservation efforts of Mandai's nature-themed attractions, nearly 1,000 birds and other animals from 143 species were born or hatched at the Bird Paradise, Night Safari, River Wonders and Singapore Zoo between 2024 and 2025. Thirty-four of these species are listed as threatened under the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species, including critically endangered ones like the woylie (a small Australian nocturnal kangaroo-like marsupial) and vulnerable species such as the giant anteater and West Indian manatee.<sup>317</sup>

These gratifying results were the result of a fragile and tenuous balance between the sustainable development of Mandai's attractions and efforts to conserve wildlife—an ongoing dialogue that has lasted decades. A portion of MWG's revenue continues to go to Mandai Nature, which contributed over S\$4.5 million to biodiversity conservation efforts in the financial year ending 31 March 2024.

This was accompanied by successes like having 23 Rote Island snake-necked turtles being brought to Singapore in 2016 to form an “assurance colony” or back-up population. In 2021, the zoo-bred turtles were transferred to a conservation breeding facility on Indonesia's Rote Island through a joint effort between MWG, Mandai Nature, the Indonesian government and the Wildlife Conservation Society Indonesia Programme (WCS Indonesia). By 2023, they were nesting.<sup>318</sup>

Ecologist Dr Shawn Lum, former President of the NSS, and senior lecturer at Nanyang Technological University's Asian School of the Environment, noted, "From the point of forest conservation, the Mandai [wildlife] parks have come at an ecological cost of cleared habitats... However, through [their] research efforts, public outreach, and in management of the considerable green spaces within the parks, the Mandai Wildlife Reserve individually and collectively do a good deal for local conservation."<sup>319</sup>

With the completion of the Bird Paradise and Rainforest Wild Adventure, the Mandai Wildlife Reserve has become part of the broader land use plans for Singapore's North Region, and an example of Singapore's wider vision of how green spaces are being conserved.

This is exemplified in the publicity materials for the Urban Redevelopment Authority (URA)'s Draft Master Plan 2025, where the Mandai attractions, including the publicly accessible Mandai Boardwalk which was built around the perimeter of the Upper Seletar Reservoir as part of the Mandai Rejuvenation Project, have been integrated into the larger green and blue network in the region. This network is being linked to create more recreational opportunities along waterways like the Central Catchment reservoirs, the Mandai Mangrove and Mudflat, Sungei Seletar, and Nee Soon Nature Park.<sup>320</sup>

Beyond recreational opportunities outside of Mandai, there are also plans to introduce a new family-friendly attraction at the site of the former Singapore Racecourse that will complement MWG's offerings. Future residents at Kranji and the North Region will also have increased accessibility to recreational options anchored by the Mandai Wildlife Reserve with the Mandai attractions being adjacent to and contiguous with the wider CCNR, which is part of the Kranji Nature Corridor that connects the CCNR with the Mandai Mangrove and Mudflat Nature Park.<sup>321</sup>



70. The Mandai Wildlife Reserve as part of the URA Draft Master Plan 2025's Leisure and Wellness Plan for the north of Singapore<sup>322</sup>

The process of developing Mandai's new attractions underlined the importance of balancing the interests of multiple stakeholders, and the need for in-good-faith discussions and compromise. Despite initial tensions between the Mandai Rejuvenation Project's backers, nature groups and interested members of the public, suspicions were in part overcome by making public the EIA, which offered stakeholders an evidence-based framework around which mitigation strategies could be agreed upon to reduce disruptions during and after development works.

Thoughtful engagements with stakeholders also gave rise to new ideas to better protect wildlife, such as colugo poles, wildlife rope bridges, and the Mandai Wildlife Bridge which reconnected previously separated parts of the CCNR.

By the end of 2025, the opening of the Bird Paradise and Rainforest Wild Adventure attractions and the new Mandai Boardwalk had created new avenues for both residents and tourists to approach nature and wildlife, and opened more people's minds to the importance of co-existing with the natural world.

Crucially, the existence of all of the Mandai Wildlife Reserve attractions enabled more resources to be put into Singapore's nature protection and conservation efforts, in terms of public education and research in Singapore, as well as overseas.

Some of these achievements were quantified in Mandai Nature's *Mandai Nature Impact Report 2024/2025*, including the 1,146 rescued birds and other animals that were admitted into MWG's Wildlife Healthcare and Research Centre over the fiscal year to receive vital care and support for their recovery.<sup>323</sup>

In addition, Mandai Nature "biobanked"<sup>324</sup> more than 80 wildlife species, and recorded over 119 species during surveys in the Mandai Wildlife Reserve. These efforts expanded understanding of the area's biodiversity and helped advance long-term conservation and research efforts.

Mandai Nature also reported funding and otherwise supporting more than 40 projects in Singapore and elsewhere in Southeast Asia, which had targeted conservation actions for over 50 threatened Southeast Asian species, and created positive impact for more than 30 conservation partners and 71,000 individuals in Southeast Asia.



71. Dr Charlene Yang, Senior Manager for Wildlife Health, Mandai Nature, and a colleague, tend to a rescued Sunda Colugo at the Wildlife Healthcare and Research Centre

In his concluding reflections on the development of Mandai's new wildlife-themed attractions as a learning opportunity, Mr Maniam observed that:

"In many ways, Mandai is a textbook example of what it means to do any economic development in Singapore. Because of our land scarcity, there are always going to be trade-offs and difficulties and tensions to manage. The most important questions then become: How do we manage the tensions? How do we deal with the polarities and the trade-offs? How do we give ourselves time, build up relationships, be creative, break binary thinking and consider new ways of framing the project so that it does not force us into opposition with one another?"<sup>325</sup>

By taking step-by-step efforts at building a collaborative ecosystem and through a dogged pursuit of solutions, rather than by holding on to intractable initial positions, planning in nature areas in Singapore enabled the learning and management of better ways of development and construction, while also contributing to Singapore's nature conservation and sustainability efforts.

## TIMELINE

### MID-1800s

Whampoa zoo opened by Hoo Ah Kay

### 1875

First public zoo opened at Singapore Botanic Gardens

### 1928

Punggol Zoo opened by William Lawrence Soma Basapa

### 1954

Tampines zoo opened by L.F. de Jong

### 1957

Singapore Miniature Zoo opened at Pasir Panjang by Tong Seng Mun

### 1963

Punggol zoo opened by the Chan Brothers

### 1969

Construction of Jurong Bird Park began

### 1971

JAN: Jurong Bird Park opened by then Minister for Defence Dr Goh Keng Swee

Construction of Singapore Zoo began

### 1973

JUN: Singapore Zoo opened by then Deputy Prime Minister Dr Goh Keng Swee

### 1991

Construction of Night Safari began

### 1994

MAY: Night Safari opened by then Prime Minister Goh Chok Tong

### 2000

AUG: Formation of Wildlife Reserves Singapore

### 2006

MAR: Wildlife Healthcare and Research Centre at Singapore Zoo opened

JUL: Jurong Bird Park unveiled Asia-Pacific's first avian hospital

### 2009

JUL: Wildlife Reserves Singapore Conservation Fund launched

### 2010

Construction of River Safari began

### 2014

FEB: River Safari opened by then Prime Minister Lee Hsien Loong

SEP: Prime Minister Lee announced relocation of Jurong Bird Park

### 2016

JUL: Environmental Impact Assessment commissioned by Mandai Park Holdings was released for public consultation

### 2017

JUN: Construction of Mandai Wildlife Bridge began

### 2018

JUL: World's first colugo poles installed along Mandai Lake Road

### 2019

DEC: Mandai Wildlife Bridge became operational

### 2020

DEC: Mandai Nature established

### 2021

OCT: Rebranding of Wildlife Reserves Singapore into Mandai Wildlife Group and River Safari into River Wonders

### 2023

JAN: Jurong Bird Park closed on its 52nd birthday

NOV: Bird Paradise opened by then Deputy Prime Minister Lawrence Wong

### 2025

JAN: Mandai Boardwalk opened

MAR: Rainforest Wild Asia opened by Minister for Sustainability and the Environment Grace Fu

APR: Mandai Rainforest Resort by Banyan Tree opened

JUN: ZooSchool opened

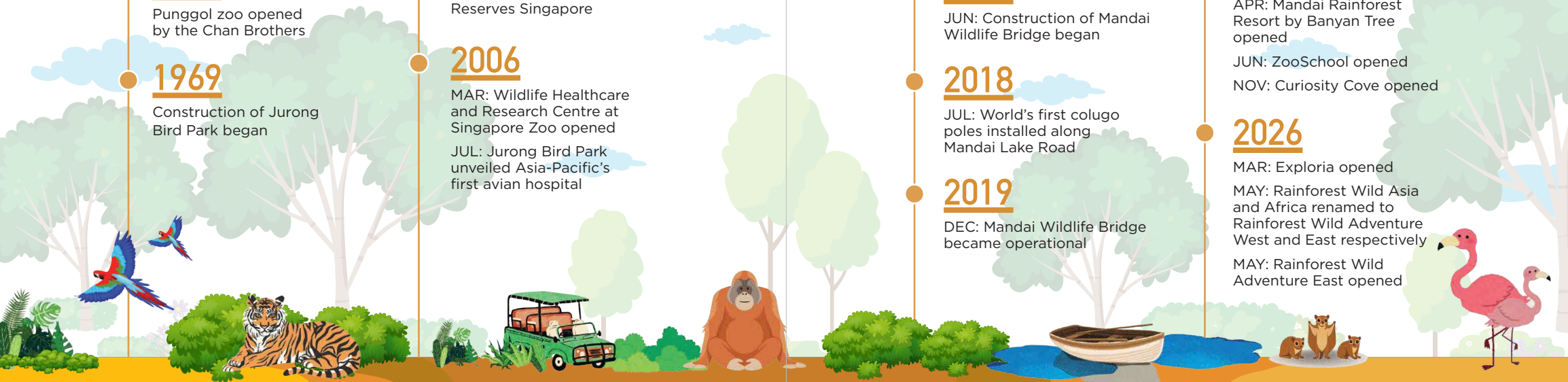
NOV: Curiosity Cove opened

### 2026

MAR: Exploria opened

MAY: Rainforest Wild Asia and Africa renamed to Rainforest Wild Adventure West and East respectively

MAY: Rainforest Wild Adventure East opened



## ENDNOTES

- <sup>1</sup> "Speech by (then) Deputy Prime Minister and Minister for Finance Lawrence Wong at the grand opening of Bird Paradise", *Prime Minister's Office Newsroom*, 15 November 2023, <https://www.pmo.gov.sg/newsroom/dpm-lawrence-wong-at-the-grand-opening-of-bird-paradise/>.
- <sup>2</sup> Centre for Liveable Cities, *Building Liveable & Sustainable Cities: A Framework for the Future* (Singapore: Centre for Liveable Cities, 2025).
- <sup>3</sup> Mandai Wildlife Group, "Mandai Wildlife Group announces leadership transition with appointment of new Group CEO as Mike Barclay retires", 21 July 2025, <https://www.mandai.com/en/about-mandai/media-centre/Mandai-Wildlife-Group-announces-leadership-transition-with-appointment-of-new-Group-CEO-as-Mike-Barclay-retires.html>.
- <sup>4</sup> Stacey Leasca, "20 of the Best Zoos in the World", *Travel + Leisure*, 26 November 2022, <https://www.travelandleisure.com/best-zoos-in-the-world-6826018>.
- <sup>5</sup> Clara Chong, "Singapore's zoo ranked No. 4 in the world, best in Asia on TripAdvisor", *The Straits Times*, 31 August 2017, <https://www.straitstimes.com/singapore/singapores-zoo-ranked-no-4-in-the-world-best-in-asia-on-tripadvisor>.
- <sup>6</sup> "The world's best zoos", *Condé Nast Traveller*, 10 March 2011, <https://www.cntraveller.in/story/world-s-best-zoos/>.
- <sup>7</sup> Timothy P. Barnard, *Nature's Colony: Empire, Nation and Environment in the Singapore Botanic Gardens*, (Singapore: NUS Press, 2016).
- <sup>8</sup> Choo Ruizhi, "Animals, Anxieties and Aspirations: The Earlier Years of the Singapore Zoo", *Biblioasia*, 1 October 2024, <https://biblioasia.nlb.gov.sg/vol-20/issue-3/oct-dec-2024/singapore-zoo-animals/>.
- <sup>9</sup> "The decline and fall of Singapore's zoo", *The Singapore Free Press*, 23 July 1958, <https://eresources.nlb.gov.sg/newspapers/digitised/article/freepress19580723-1.2.421>.
- <sup>10</sup> Choo, "Animals, Anxieties and Aspirations".
- <sup>11</sup> "The decline and fall of Singapore's zoo".
- <sup>12</sup> Choo, "Animals, Anxieties and Aspirations".
- <sup>13</sup> Ibid.
- <sup>14</sup> Ibid.
- <sup>15</sup> Sharon Teng, "Punggol Zoo", *Singapore Infopedia*, National Library Board, <https://www.nlb.gov.sg/main/article-detail?cmsuuid=1473095b-ceb1-460e-9f12-d4b8357743be>.
- <sup>16</sup> Lim Tin Seng, "All Creatures Great and Small: Singapore's First Zoos", *Biblioasia*, 7 July 2015, <https://biblioasia.nlb.gov.sg/vol-11/issue-2/jul-sep-2015/sg-first-zoo/>.
- <sup>17</sup> Ibid.
- <sup>18</sup> Ibid.
- <sup>19</sup> R. Chandran, "A haven for animal lovers of S'pore", *The Straits Times*, 28 June 1973, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19730628-1.2.80>.
- <sup>20</sup> Tan Wang Joo, "Planning for Leisure of Four Million", *The Straits Times*, 27 April 1971, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19710427-1.2.94>.
- <sup>21</sup> Ibid.
- <sup>22</sup> "The men behind the project", *The Straits Times*, 29 January 1973, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19730129-1.2.60>.
- <sup>23</sup> Ilsa Sharp, *The First 21 Years: The Singapore Zoological Gardens Story* (Singapore: Singapore Zoological Gardens, 1994).
- <sup>24</sup> Chandran, "A haven for animal lovers of S'pore".
- <sup>25</sup> "Govt's \$5 mil firm to set up a zoo", *The Straits Times*, 24 April 1971, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19710424-1.2.68>.
- <sup>26</sup> Chandran, "A haven for animal lovers of S'pore".
- <sup>27</sup> "Zoo will get its millionth visitor in October", *New Nation*, 28 June 1974, <https://eresources.nlb.gov.sg/newspapers/digitised/article/newnation19740628-1.2.19.4>.
- <sup>28</sup> Ibid.
- <sup>29</sup> "SM: Zoo pollution was main worry", *The Straits Times*, 20 June 1993, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19930620-1.2.6.8>.
- <sup>30</sup> "Keeping the water clean for \$1.7m", *The Straits Times*, 29 January 1973, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19730129-1.2.62>.
- <sup>31</sup> Mandai Wildlife Group, "Energy and Water Conservation", last updated 2026, <https://www.mandai.com/en/care-for-planet/environmental-sustainability/energy-and-water-conservation.html>.
- <sup>32</sup> "Designing spaces for people and animals: How she partners eco experts and builders to create Bird Paradise", *The Straits Times*, 16 July 2024, <https://www.straitstimes.com/singapore/design-wildlife-park-sustainability-built-environment-mandai-bird-paradise-building-and-construction-authority>.
- <sup>33</sup> Chandran, "A haven for animal lovers of S'pore".
- <sup>34</sup> P.M. Raman, "S'pore zoological gardens to be opened in mid-June", *The Straits Times*, 30 April 1973, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19730430-1.2.94>.
- <sup>35</sup> Ang Seow Leng, "Nature Conservation in Singapore", *Biblioasia*, 4 April 2021, <https://biblioasia.nlb.gov.sg/vol-17/issue-1/apr-jun-2021/nature/>.
- <sup>36</sup> Ibid.
- <sup>37</sup> Ibid.
- <sup>38</sup> Sharp, *The First 21 Years*.
- <sup>39</sup> Mandai Nature is the conservation arm of Mandai Wildlife Group (MWG) and was established in December 2020 by Temasek and MWG. Based in Singapore, Mandai Nature receives funding and in-kind support from MWG.
- <sup>40</sup> Judith Tan, "National action plan to keep endangered straw-headed bulbuls singing in the wild", *The Straits Times*, 18 December 2023, <https://www.straitstimes.com/singapore/national-action-plan-to-keep-endangered-straw-headed-bulbuls-singing-in-the-wild>.
- <sup>41</sup> Ibid.
- <sup>42</sup> Mandai Wildlife Group, "Straw-Headed bulbul", last updated 2026, <https://www.mandai.com/en/bird-paradise/animals-and-zones/songs-of-the-forest/straw-headed-bulbul.html>.
- <sup>43</sup> Sharp, *The First 21 Years*.
- <sup>44</sup> Ibid.
- <sup>45</sup> "The men behind the project".
- <sup>46</sup> Sharp, *The First 21 Years*.
- <sup>47</sup> Phillip J. Greenwell et al, "The Societal Value of the Modern Zoo: A Commentary on How Zoos Can Positively Impact on Human Populations Locally and Globally", *Journal of Zoological and Botanical Gardens* 4.1 (2023): 53-69, <https://doi.org/10.3390/jzbg4010006>.
- <sup>48</sup> Kaley Overstreet, "From Aristocratic Displays to Eco-parks: The Current Questions and Future Design of Zoos", *ArchDaily*, 3 January 2022, <https://www.archdaily.com/974439/rethinking-zoo-design-in-our-future-cities>.
- <sup>49</sup> Leslie Fong, "Into a World of Sights and Sounds", *The Straits Times*, 3 January 1971, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19710103-1.2.55.1>.
- <sup>50</sup> Zoe Yeo, "How Jurong Bird Park was Hatched", *Biblioasia*, 7 July 2021, <https://biblioasia.nlb.gov.sg/all-sections/vol-20-issue-3-oct-dec-2024-singapore-zoo-animals/>.
- <sup>51</sup> Tan Siok Sun, *Goh Keng Swee: A portrait* (Singapore: Editions Didier Millet, 2007), 175.
- <sup>52</sup> Lee Kuan Yew, *From Third World to First: The Singapore Story, 1965-2000* (Singapore: Times Media and the Straits Times Press, 2000), 208.

- <sup>53</sup> "New attractions almost every year to whip up visitor interest", *The Straits Times*, 24 February 1995, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19950224-1.2.68.3.1>.
- <sup>54</sup> "One cassowary for sale, cheap - until yesterday", *The Straits Times*, 14 September 1969, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19690914-1.2.57>.
- <sup>55</sup> Leslie Fong, "Rainbow on the falls on a sunny afternoon", *The Straits Times*, 3 January 1971, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19710103-1.2.55.4>.
- <sup>56</sup> "What a lark! This bird park which has almost everything...", *Singapore Herald*, 17 December 1970.
- <sup>57</sup> "New attractions almost every year to whip up visitor interest".
- <sup>58</sup> Yeo, "How Jurong Bird Park was Hatched", *Biblioasia*, 7 July 2021, <https://biblioasia.nlb.gov.sg/vol-17/issue-2/jul-sep-2021/jurong-bird-park/>.
- <sup>59</sup> Jamie Ee and Stacey Chia, "Wildlife Reserves' corporate wild ride", *The Straits Times*, 25 September 2011, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes20110925-1.2.4.5.1>.
- <sup>60</sup> Joy Fang, "Mandai Area Set for Major Redevelopment", *Today*, 5 September 2014, <https://eresources.nlb.gov.sg/newspapers/digitised/article/today20140905-1.2.3>.
- <sup>61</sup> Mandai Wildlife Reserve, "Visitors bid farewell to Jurong Bird Park", 3 January 2023, <https://www.mandai.com/en/about-mandai/media-centre/visitors-bid-farewell-to-Jurong-Bird-Park.html>.
- <sup>62</sup> "Govt 'committed' to promoting leisure industry", *The Straits Times*, 31 October 1991, page 35.
- <sup>63</sup> Michael Koh, Executive Fellow of Centre for Liveable Cities, verbal consultation, 23 April 2026.
- <sup>64</sup> Charissa Yong, "Dr Kwa, the healthcare pioneer and nature lover", *The Straits Times*, 1 November 2016, <https://www.straitstimes.com/singapore/dr-kwa-the-healthcare-pioneer-and-nature-lover>.
- <sup>65</sup> Ginnie Teo, "Safari stops sale of advance tickets", *The Straits Times*, 22 June 1994, <https://eresources.nlb.gov.sg/newspapers/digitised/page/straitstimes19940622-1.1.22>.
- <sup>66</sup> Zoe Yeo Lock Yan and Fiona Lim, "River Safari", *Singapore Infopedia*, National Library Board, 25 June 2015, <https://www.nlb.gov.sg/main/article-detail?cmsuud=b0f23259-35ce-4dcf-9631-3b93643cd9ac>.
- <sup>67</sup> Lucas Romero, "Number of Visitors to the River Wonders in Singapore from 2014 to 2022", Statista, 2 April 2024, <https://www.statista.com/statistics/1025414/singapore-river-safari-visitor-numbers/>.
- <sup>68</sup> "\$60m night zoo opens", *The Straits Times*, 29 April 1994, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19940429-1.2.78.2.1>.
- <sup>69</sup> SG101, "Singapore Night Safari", *Connexionsg*, 28 May 2023, <https://www.sg101.gov.sg/resources/archives/til-singapore-night-safari/>.
- <sup>70</sup> "\$60m night zoo opens".
- <sup>71</sup> Teo, "Safari stops sale of advance tickets".
- <sup>72</sup> "\$60m night zoo opens".
- <sup>73</sup> Kirpal Singh, *Naked Ape. Naked Boss: Bernard Harrison, The Man Behind the Singapore Zoo & the World's First Night Safari* (Singapore: Marshall Cavendish Editions, 2014), 107.
- <sup>74</sup> Ibid.
- <sup>75</sup> Ibid.
- <sup>76</sup> Ibid.
- <sup>77</sup> "5 More Trams for Night Safari", *The Straits Times*, 8 December 1994, <http://eresources.nlb.gov.sg/newspapers/Digitised/Article/straitstimes19941208-1.2.34.21.aspx>.
- <sup>78</sup> Ho Aloysius, "Night Safari", *Singapore Infopedia*, National Library Board, 24 June 2014, <https://www.nlb.gov.sg/main/article-detail?cmsuud=70eb2bc3-d19e-4d2d-844e-d948b9b8710b>.
- <sup>79</sup> Lee U-Wen, "Continual effort needed to keep Spore's tourism edge: PM Lee", *The Business Times*, 1 March 2014, <https://eresources.nlb.gov.sg/newspapers/digitised/article/biztimes20140301-1.2.9.8>.
- <sup>80</sup> Chew Hui Min, "River Safari renamed, new bird park named Bird Paradise in Mandai Wildlife Group rebranding", *Channel News Asia*, 13 October 2021, <https://www.channelnewsasia.com/singapore/river-safari-renamed-jurong-bird-park-paradise-mandai-wildlife-2240906>.
- <sup>81</sup> Ng Kai Ling, "The seed that grew into a wildlife park", *The Straits Times*, 3 February 2013, <https://eresources.nlb.gov.sg/newspapers/Digitised/Article/straitstimes20130203-1.2.16.3>.
- <sup>82</sup> Tessa Wong and Lim Wei Chean, "New Wildlife Draw: River Safari Ready in 2011", *The Straits Times*, 11 February 2009, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes20090212-1.2.3>.
- <sup>83</sup> Wildlife Reserves Singapore, *Year Book 2009/2010* (Singapore: Wildlife Reserves Singapore, 2010), 17.
- <sup>84</sup> Temasek, "Temasek partners Singapore Government to rejuvenate Mandai wildlife and nature heritage", Press Release, 14 January 2015, <https://www.temasek.com.sg/en/news-and-resources/news-room/news/2015/temasek-partners-singapore-government-to-rejuvenate-mandai-wildl>.
- <sup>85</sup> Yashita Vashishth, "Meet and Greet Unique Wildlife At These Popular Zoos In Singapore", *Travel + Leisure (Southeast Asia, Hong Kong and Macau)*, 21 December 2024, <https://www.travelandleisureasia.com/hk/destinations/southeast-asia/zoos-in-singapore-night-safari-park-bird-paradise-river-wonders/>.
- <sup>86</sup> Interview with Khoo Teng Chye, 13 October 2025, by Bert Wee via email, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- <sup>87</sup> Ibid.
- <sup>88</sup> Mok Fei Fei, "Major makeover of Mandai zoo precinct to be led by Temasek Holdings and STB", *The Straits Times*, 14 January 2015, <https://www.straitstimes.com/singapore/environment/major-makeover-of-mandai-zoo-precinct-to-be-led-by-temasek-holdings-and-stb>.
- <sup>89</sup> Ministry of Trade and Industry, "STB-Temasek Partnership to Enhance Mandai as Iconic Singapore Nature Attraction", 14 January 2015, <https://www.mti.gov.sg/newsroom/stb-temasek-partnership-to-enhance-mandai-as-iconic-singapore-nature-attraction/>.
- <sup>90</sup> Mandai Wildlife Reserve, "Singapore's Rainforest Wild Asia to welcome the public from 12 March 2025", 12 February 2025, <https://www.mandai.com/en/about-mandai/media-centre/temasek-partners-singapore-government-to-rejuvenate-mandai-wildl.html>.
- <sup>91</sup> Tang Yi Ching, "Mandai Rainforest Resort to open in April 2025", *The Straits Times*, 19 December 2024, <https://www.straitstimes.com/singapore/mandai-rainforest-resort-to-open-in-april-2025>.
- <sup>92</sup> "3 attractions team up to draw visitors", *The Straits Times*, 1 September 2000, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes20000901-1.2.5.6>.
- <sup>93</sup> Choo, "Animals, Anxieties and Aspirations".
- <sup>94</sup> Interview with Poh Chi Chuan, 14 August 2024, by Bert Wee and Harini Racvichandran at the Singapore Tourism Board's headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- <sup>95</sup> Wildlife Reserves Singapore, *Yearbook 2005/2006* (Singapore: Wildlife Reserves Singapore, 2006), 12.
- <sup>96</sup> Ibid.
- <sup>97</sup> Choo, "Animals, Anxieties and Aspirations".
- <sup>98</sup> Mak Mun Sun, "Woo... The Zoo Is Cool," *The Straits Times*, 20 May 2006, <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes20060520-1.2.234.5>.
- <sup>99</sup> Raman, "Spore zoological gardens to be opened in mid-June".
- <sup>100</sup> Wildlife Reserves Singapore, *Yearbook 2006/2007* (Singapore: Wildlife Reserves Singapore, 2007), 10.
- <sup>101</sup> Ibid.
- <sup>102</sup> Wildlife Reserves Singapore, *Yearbook 2007/2008* (Singapore: Wildlife Reserves Singapore, 2008), 32.
- <sup>103</sup> Neo Xiaobin and Kevin Lim, "The doc is in - for avian patients big and small at Jurong Bird Park", *The Straits Times*, 28 June 2021, <https://www.straitstimes.com/singapore/the-doc-is-in-for-avian-patients-big-and-small>.

- <sup>104</sup> Lin Yanqin, "Mating in Mandai", *Today Online*, 25 January 2007, <https://eresources.nlb.gov.sg/newspapers/digitised/page/today20070125-2.1.8>.
- <sup>105</sup> Mandai Wildlife Reserve, "Wildlife Reserves Singapore Conservation Fund celebrates 10 years of protecting native wildlife", 23 August 2019, <https://www.mandai.com/en/about-mandai/media-centre/wildlife-reserves-singapore-conservation-fund-celebrates-10-years-of-protecting-native-wildlife>.
- <sup>106</sup> Established in 1895, the Wildlife Conservation Society has built a strong global conservation network with the aim of conserving wild places in 14 priority regions worldwide, including archipelagic Southeast Asia.
- <sup>107</sup> Wildlife Conservation Society, "Wildlife Reserves Singapore Signs MOU with WCS", 29 January 2010, <https://programs.wcs.org/newsroom/News-Releases/articleType/ArticleView/articleId/6392/Wildlife-Reserves-Singapore-Signs-MOU-with-WCS.aspx>.
- <sup>108</sup> Cheng Wen-Haur, "A multi-pronged, collaborative approach to wildlife conservation", *Today Online*, 23 February 2015, <https://eresources.nlb.gov.sg/newspapers/digitised/article/today20150223-1.2.20.1>.
- <sup>109</sup> Ng Huiwen, "Jurong Bird Park is first wildlife park to successfully breed endangered Solomon Islands bird", *The Straits Times*, 28 January 2019, <https://www.straitstimes.com/singapore/jurong-bird-park-is-first-wildlife-park-to-successfully-breed-endangered-solomon-islands>.
- <sup>110</sup> Toh Ting Wei, "Cheep thrills: Over 700 animals born at Wildlife Reserves Singapore parks last year", *The Straits Times*, 26 February 2019, <https://www.straitstimes.com/singapore/environment/cheep-thrills-over-700-animals-born-at-wildlife-reserves-singapore-parks-last>.
- <sup>111</sup> Mandai Wildlife Reserve, "Wildlife Reserves Singapore Conservation Fund celebrates 10 years of protecting native wildlife".
- <sup>112</sup> Ministry of Trade and Industry, "Speech by Mr S Iswaran, Minister of State for Trade and Industry, at the Official Opening of the African Cheetah Enclosure", 20 November 2007, transcript, <https://www.mti.gov.sg/Newsroom/Speeches/2007/11/Mr-S-Iswaran-at-the-Official-Opening-of-the-African-Cheetah-Enclosure>.
- <sup>113</sup> Ibid.
- <sup>114</sup> Prime Minister's Office, "Transcript of speech by Prime Minister Lee Hsien Loong at the River Safari grand opening", 28 February 2014, <https://www.pmo.gov.sg/Newsroom/transcript-speech-prime-minister-lee-hsien-loong-river-safari-grand-opening-28-feb-2014>.
- <sup>115</sup> Mandai Wildlife Reserve, "New Corporate Identity, New Names for Singapore's Wildlife Parks and a Renewed Commitment to Conservation and a Sustainable Future", 13 October 2021, <https://www.mandai.com/en/about-mandai/media-centre/new-corporate-identity-new-names-for-singapores-wildlife-parks-and-a-renewed-commitment-to-conservation-and-a-sustainable-future.html>.
- <sup>116</sup> Poh, CLC Interview.
- <sup>117</sup> Ministry of Trade and Industry, "Speech by Mr S Iswaran, Minister of State for Trade and Industry, at the Official Opening of the African Cheetah Enclosure".
- <sup>118</sup> Mandai Wildlife Reserve, "New corporate Identity".
- <sup>119</sup> Ong Soh Chin and Goh Yee Huay, *By Generations, For Generations: Fifty Years of Temasek as Told by the People Who Shaped It* (Singapore: Temasek Holdings (Private) Limited, 2024), 164.
- <sup>120</sup> Mandai Wildlife Reserve, "Temasek partners Singapore Government to rejuvenate Mandai wildlife and nature heritage".
- <sup>121</sup> Ong and Goh, *By Generations, For Generations*, 164.
- <sup>122</sup> Ibid., 165.
- <sup>123</sup> Ibid.
- <sup>124</sup> Temasek, "A Sustainable Approach to Heritage and Conservation", 20 November 2024, <https://www.temasek.com.sg/en/news-and-resources/stories/t50/50-by-fifty/a-sustainable-approach-to-heritage-and-conservation>
- <sup>125</sup> Ong and Goh, *By Generations, For Generations*, 166.
- <sup>126</sup> Temasek, "A Sustainable Approach to Heritage and Conservation".
- <sup>127</sup> Ibid.
- <sup>128</sup> Ibid.
- <sup>129</sup> Ibid.
- <sup>130</sup> Ibid.
- <sup>131</sup> Interview with Neo Gim Huay, 20 May 2024, by Bert Wee and Ong Wei Bin at the Fullerton Hotel Lounge, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- <sup>132</sup> Temasek, "A Sustainable Approach to Heritage and Conservation".
- <sup>133</sup> Neo, CLC Interview.
- <sup>134</sup> Temasek, "A Sustainable Approach to Heritage and Conservation".
- <sup>135</sup> Ibid.
- <sup>136</sup> Ibid.
- <sup>137</sup> Mandai Wildlife Reserve, "Temasek partners Singapore Government to rejuvenate Mandai wildlife and nature heritage".
- <sup>138</sup> Fang, "Mandai Area Set for Major Redevelopment".
- <sup>139</sup> Ibid.
- <sup>140</sup> Mandai Wildlife Group, "Mandai to become integrated nature and wildlife destination for Singaporeans", 6 January 2016, <https://www.mandai.com/en/about-mandai/media-centre/mandai-to-become-integrated-nature-and-wildlife-destination-for-.html>.
- <sup>141</sup> Environmental Resources Management, *Environmental Impact Assessment for Mandai Development, Final Scoping Report* (Singapore: Environmental Resources Management, February 2015), 12.
- <sup>142</sup> Lim Wei Chean, "Nature Society expresses concerns about plans for Mandai", *The Straits Times*, 21 November 2007.
- <sup>143</sup> Marianne Maes, "If not properly done, plans to turn Mandai into nature retreat could backfire – Beware the wildlife tradeoff", originally published in *Today Online*, 22 November 2007, available at <https://wildsingaporenews.blogspot.com/2007/11/if-not-properly-done-plans-to-turn.html>.
- <sup>144</sup> Ibid.
- <sup>145</sup> Muhamad Rostam Umar, Singapore Tourism Board, "Sensitive approach to Mandai revamp", originally published in *Today Online*, 5 December 2007, available at <https://wildsingaporenews.blogspot.com/2007/12/stb-reply-sensitive-approach-to-mandai.html>.
- <sup>146</sup> Singapore does not have specific EIA legislation, but there is an EIA framework that was formalised in 2008.
- <sup>147</sup> Audrey Tan, "A better way to assess harm to the environment", *The Straits Times*, 3 November 2016, <https://www.straitstimes.com/singapore/environment/a-better-way-to-assess-harm-to-environment>.
- <sup>148</sup> Environmental Resources Management, *Mandai Park Holdings Environmental Impact Assessment Report* (Singapore: Environmental Resources Management, 26 September 2016).
- <sup>149</sup> Ibid.
- <sup>150</sup> Urban Redevelopment Authority, "Environmental Impact Assessment (EIA)", last updated 24 April 2026, <https://www.ura.gov.sg/Corporate/Planning/Our-Planning-Process/Bringing-plans-to-Reality/Environmental-Impact-Assessment>.
- <sup>151</sup> Ibid.
- <sup>152</sup> National Parks Board, *Biodiversity Impact Assessment (BIA) Guidelines* (Singapore: National Biodiversity Centre, National Parks Board, 2024).
- <sup>153</sup> Centre for Liveable Cities and National Parks Board, *Biodiversity: Nature Conservation in the Greening of Singapore, Singapore Urban Systems Studies Booklet Series* (Singapore: Centre for Liveable Cities and National Parks Board, 2015), 9, 14.
- <sup>154</sup> Cai Weiqian, "Understanding the Law: Environmental Impact Assessments Must Not Be a Mere Formality – Confidentiality Should Not Come at the Expense of Public Participation", originally published in *Lianhe Zaobao*, 13 July 2025, available at <https://law.nus.edu.sg/apcel/media/understanding-the-law-environmental-impact-assessments-must-not-be-a-mere-formality-confidentiality-should-not-come-at-the-expense-of-public-participation/>.

- <sup>155</sup> Patrick A. Hesp, "The Environmental Impact Assessment process in Singapore with particular respect to coastal environments and the role of NGOs", *Journal of Coastal Conservation* 1 (1995): 135-144, <https://doi.org/10.1007/BF02905122>.
- <sup>156</sup> CLC and NParks, *Biodiversity*, 6.
- <sup>157</sup> *Ibid.*, 7.
- <sup>158</sup> Audrey Tan, "Development works in Singapore to be more sensitive to wildlife under changes to EIA framework", *The Straits Times*, 25 October 2025, <https://www.straitstimes.com/singapore/environment/development-works-in-singapore-to-be-more-sensitive-to-wildlife-under-changes>.
- <sup>159</sup> Natasha Ganesan, "NParks to manage consultants for environmental impact assessments of nature-sensitive projects", *Channel News Asia*, 27 August 2022, <https://www.channelnewsasia.com/singapore/nparks-environmental-impact-assessment-consultancy-biodiversity-nature-clementi-forest-2903851>.
- <sup>160</sup> Interview with Peter Ng, 22 November 2023, by Shawn Tan and Bert Wee at the Lee Kong Chian Natural History Museum, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- <sup>161</sup> *Ibid.*
- <sup>162</sup> Interview with Leong Yue Kheong, 18 October 2023, by Shawn Tan and Bert Wee at Mandai Wildlife Group's headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- <sup>163</sup> Carrie Kwik, Singapore Tourism Board, "STB statement on the Mandai Environmental Impact Assessment Report Gazette", National Archives of Singapore, 26 July 2016, <https://www.nas.gov.sg/archivesonline/speeches/record-details/c19ceba0-07e4-11e7-afb1-0050568939ad>.
- <sup>164</sup> Mandai Wildlife Group, "Environmental Impact Assessment guides sustainable development at Mandai", 26 July 2016, <https://www.mandai.com/en/about-mandai/media-centre/environmental-impact-assessment-guides-sustainable-development-a.html>.
- <sup>165</sup> Siau Ming En, "Mandai plans altered to limit environmental impact", *Channel News Asia*, 26 July 2016, <https://www.channelnewsasia.com/singapore/nature-groups-propose-changes-alleviate-environmental-impact-in-mandai-5785471>.
- <sup>166</sup> Mandai Wildlife Group, "Environmental Impact Assessment guides sustainable development at Mandai".
- <sup>167</sup> Lin Yangchen, "Plans for Mandai eco-tourism hub tweaked to reduce environmental impact; locations for Bird Park and Rainforest Park swapped", *The Straits Times*, 26 July 2016, <https://www.straitstimes.com/singapore/environment/plans-for-mandai-development-tweaked-to-reduce-environmental-impact>.
- <sup>168</sup> Mandai Wildlife Group, "Native Biodiversity Protection", n.d., <https://www.mandai.com/en/care-for-planet/environmental-sustainability/native-biodiversity-protection.html>
- <sup>169</sup> Toh Ee Ming, "Nature groups propose changes to alleviate environmental impact in Mandai", *Channel News Asia*, 28 July 2016, <https://www.channelnewsasia.com/singapore/nature-groups-propose-changes-alleviate-environmental-impact-in-mandai-5785471>.
- <sup>170</sup> *Ibid.*
- <sup>171</sup> Navene Elangovan, "The Big Read: Saving Singapore's endangered species, one 'animal bridge' at a time", *Channel News Asia*, 14 February 2022, <https://www.channelnewsasia.com/today/big-read/saving-singapores-endangered-species-animal-bridge-2494596>.
- <sup>172</sup> Audrey Tan, "Mandai Eco-Link: All you need to know about the wildlife bridge", *The Straits Times*, 27 July 2017, <https://www.straitstimes.com/singapore/environment/mandai-eco-link-how-wildlife-crossing-works>.
- <sup>173</sup> Elangovan, "The Big Read".
- <sup>174</sup> Mandai Wildlife Group, "Environmental Impact Assessment guides sustainable development at Mandai".
- <sup>175</sup> ERM, *Mandai Park Holdings EIA Report*, 2-4.
- <sup>176</sup> *Ibid.*, 2-6.
- <sup>177</sup> *Ibid.*, 2-22.
- <sup>178</sup> Siau, "Mandai plans altered to limit environmental impact".
- <sup>179</sup> ERM, *Mandai Park Holdings EIA Report*, 2-22.
- <sup>180</sup> *Ibid.*, 2-11.
- <sup>181</sup> Mandai Wildlife Group, "Environmental Impact Assessment guides sustainable development at Mandai".
- <sup>182</sup> ERM, *Mandai Park Holdings EIA Report*, 2-26.
- <sup>183</sup> Mandai Wildlife Group, "Environmental Impact Assessment guides sustainable development at Mandai".
- <sup>184</sup> ERM, *Mandai Park Holdings EIA Report*, 2-23.
- <sup>185</sup> Mandai Wildlife Group, "Environmental Impact Assessment guides sustainable development at Mandai".
- <sup>186</sup> *Ibid.*
- <sup>187</sup> *Ibid.*
- <sup>188</sup> Mandai Wildlife Group, "Mandai Park Holdings Enhances Mitigation Measures for Mandai Rejuvenation Project", 10 October 2016, <https://www.mandai.com/en/about-mandai/media-centre/mandai-park-holdings-enhances-mitigation-measures-for-mandai-rej.html>.
- <sup>189</sup> Mandai Wildlife Group, "Mandai Park Holdings Announces Environmental Advisory Panel Members", 1 November 2016, <https://www.mandai.com/en/about-mandai/media-centre/mandai-park-holdings-announces-environmental-advisory-panel-memb.html>.
- <sup>190</sup> Mandai Wildlife Group, "Mandai Park Holdings Enhances Mitigation Measures for Mandai Rejuvenation Project".
- <sup>191</sup> Mandai Wildlife Group, "Mandai Park Holdings Announces Environmental Advisory Panel Members".
- <sup>192</sup> *Ibid.*
- <sup>193</sup> Ng, CLC Interview.
- <sup>194</sup> *Ibid.*
- <sup>195</sup> Leong, CLC Interview.
- <sup>196</sup> Panel members reviewing environmental measures for Mandai nature hub named", *The Straits Times*, 1 November 2016, <https://www.straitstimes.com/singapore/panel-members-reviewing-environmental-measures-for-mandai-nature-hub-named>.
- <sup>197</sup> Mandai Wildlife Group, "Mandai Park Holdings Appoints Banyan Tree as Operator of Eco-Friendly Resort in Mandai", 11 October 2017, <https://www.mandai.com/en/about-mandai/media-centre/mandai-park-holdings-appoints-banyan-tree-as-operator-of-eco-fri.html>.
- <sup>198</sup> Mandai Wildlife Group, "Over Half a Million Dollars in Research Grants Awarded by Mandai Park Development for Environmental-Related Studies", 29 July 2019, [https://www.mandai.com/en/about-mandai/media-centre/over-half-a-million-dollars-in-research-grants-awarded-by-mandai.html#\\_ftn1](https://www.mandai.com/en/about-mandai/media-centre/over-half-a-million-dollars-in-research-grants-awarded-by-mandai.html#_ftn1).
- <sup>199</sup> Mandai Wildlife Group, "Mandai Park Holdings Enhances Mitigation Measures for Mandai Rejuvenation Project".
- <sup>200</sup> "No 'observable increase' in roadkill since Mandai development works began, says developer", originally published in *Channel News Asia*, 29 March 2018, available at <https://wildsingaporenews.blogspot.com/2018/03/no-observable-increase-in-roadkill.html>.
- <sup>201</sup> Ng Huiwen, "Sambar deer dies after being hit by vehicle in Mandai Road", *The Straits Times*, 5 February 2018, <https://www.straitstimes.com/singapore/sambar-deer-dies-after-being-hit-by-vehicle-in-mandai-road>.
- <sup>202</sup> "Deer dies, motorcyclist injured in Mandai road accident", *Channel News Asia*, 19 December 2018, <https://www.channelnewsasia.com/singapore/deer-dies-motorcyclist-injured-in-mandai-road-accident-5717421>.
- <sup>203</sup> Roadkill incidents in Mandai", Infographic, *The Straits Times*, 24 March 2018, [https://static1.straitstimes.com.sg/s3fs-public/attachments/2018/03/24/st\\_20180324\\_aumandai24a\\_3859726.pdf](https://static1.straitstimes.com.sg/s3fs-public/attachments/2018/03/24/st_20180324_aumandai24a_3859726.pdf).
- <sup>204</sup> Audrey Tan, "Animals affected by Mandai park works: Wildlife groups", *The Straits Times*, 24 March 2018, <https://www.straitstimes.com/singapore/environment/animals-affected-by-mandai-park-works-wildlife-groups>.

- 205 "Facilitating wildlife connectivity", Infographic, *The Straits Times*, 9 January 2019, [https://static1.straitstimes.com.sg/s3fs-public/attachments/2018/12/22/st\\_20181222\\_ctmandai22a\\_4502374.pdf](https://static1.straitstimes.com.sg/s3fs-public/attachments/2018/12/22/st_20181222_ctmandai22a_4502374.pdf).
- 206 Written inputs and information received from Mandai Wildlife Group, 23 March 2026.
- 207 Interview with Tony O'Dempsey, 18 December 2023, by Bert Wee at the Centre for Liveable Cities' headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- 208 "Facilitating wildlife connectivity".
- 209 Leong, CLC Interview.
- 210 Rachel S.K. Lee et al., "Bridging the gap: Optimising connectivity solutions for an arboreal gliding mammal", *Journal of Applied Ecology*, 60.5 (2023): 778-789, <https://doi.org/10.1111/1365-2664.14372>.
- 211 Chery Teh, "Efforts to make it safer for animals in Mandai area", *The Straits Times*, 22 December 2018, <https://www.straitstimes.com/singapore/environment/efforts-to-make-it-safer-for-animals-in-mandai-area>.
- 212 Ibid.
- 213 "Facilitating wildlife connectivity".
- 214 Written inputs and information received from Mandai Wildlife Group, 23 March 2026.
- 215 Ibid.
- 216 Leong, CLC Interview.
- 217 Teh, "Efforts to make it safer for animals in Mandai area".
- 218 Ibid.
- 219 Audrey Tan, "Mandai Lake Road bridge used by wildlife; seven roadkill incidents reported", *The Straits Times*, 3 February 2022, <https://www.straitstimes.com/singapore/environment/mandai-lake-road-bridge-used-by-wildlife-but-does-not-eliminate-roadkill-incidents>.
- 220 Mandai Wildlife Group, "Mandai Park Holdings Enhances Mitigation Measures for Mandai Rejuvenation Project".
- 221 Siau, "Mandai plans altered to limit environmental impact".
- 222 Toh, "Nature groups propose changes to alleviate environmental impact in Mandai".
- 223 Ibid.
- 224 Interview with Aaron Maniam, 23 January 2026, by Bert Wee online, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- 225 Dr Ho Hua Chew, "Nature Society Singapore's post", Nature Society Singapore Facebook, 11 October 2016, <https://www.facebook.com/naturesocietysingapore/posts/dr-ho-hua-chew-vice-chairperson-of-the-conservation-committee-from-nature-societ/10154450285929404/>.
- 226 Laura Elizabeth Philomin, "Impact on existing wildlife, plants among concerns over Mandai project", *Channel News Asia*, 2 June 2016, <https://www.channelnewsasia.com/singapore/impact-existing-wildlife-plants-among-concerns-over-mandai-project-5792066>.
- 227 Ibid.
- 228 Siau, "EIA report details impact of Mandai park construction on animals and their habitats".
- 229 Nature Society (Singapore) Conservation Committee, "Nature Society's Position Paper on the Mandai Safari Park Holdings (MSPH)'s Mandai Development Plan", 2 September 2016.
- 230 Siau, "EIA report details impact of Mandai park construction on animals and their habitats".
- 231 Maniam, CLC Interview.
- 232 Ibid.
- 233 Ibid.
- 234 Ibid.
- 235 O'Dempsey, CLC Interview.
- 236 Ng, CLC Interview.
- 237 Maniam, CLC Interview.
- 238 Ibid.

- 239 Ibid.
- 240 Ibid.
- 241 Ibid.
- 242 Leong, CLC Interview.
- 243 O'Dempsey, CLC Interview.
- 244 Maniam, CLC Interview.
- 245 Ng, CLC Interview.
- 246 Ibid.
- 247 Interview with Adrian Loo, 19 December 2023, by Bert Wee at the Centre for Liveable Cities' headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- 248 Audrey Tan, "Mandai makeover: Eco-bridge, biodiversity classes for contractors among measures to protect wildlife in area", *The Straits Times*, 26 July 2017, <https://www.straitstimes.com/singapore/environment/mandai-makeover-eco-bridge-biodiversity-classes-for-contractors-among-measures>.
- 249 Ibid.
- 250 Mandai Wildlife Group, "Dedicated Bridge for Wildlife Crossings at Mandai", 26 July 2017, <https://www.mandai.com/en/about-mandai/media-centre/dedicated-bridge-for-wildlife-crossings-at-mandai.html>.
- 251 Mandai Park Holdings, *Second Addendum to Environmental Impact Assessment Report* (Singapore: Mandai Park Holdings, updated 18 February 2022).
- 252 Leong, CLC Interview.
- 253 Ibid.
- 254 Ibid.
- 255 Ibid.
- 256 Ibid.
- 257 Ibid.
- 258 Elangovan, "How wildlife bridges help save Singapore's endangered animals".
- 259 Ibid.
- 260 Davina Tham, "Animal crossing: Sambar deer, wild pigs among dozens of species seen using Mandai Wildlife Bridge", *Channel News Asia*, 3 February 2022, <https://www.channelnewsasia.com/singapore/animals-mandai-wildlife-bridge-sambar-deer-2476291>.
- 261 Daryl Choo, "Mandai wildlife bridge: Rare sambar deer among nearly 70 species spotted using crossing", *Channel News Asia*, 3 February 2022, <https://www.channelnewsasia.com/singapore/mandai-wildlife-bridge-rare-sambar-deer-among-nearly-70-species-spotted-using-crossing-5625501>.
- 262 Ibid.
- 263 Mandai Wildlife Group, "Native Biodiversity Protection".
- 264 Mandai Wildlife Group, "Mandai Wildlife Bridge Officially Launched for Wildlife Crossings", 6 December 2019, <https://www.mandai.com/en/about-mandai/media-centre/mandai-wildlife-bridge-officially-launched-for-wildlife-crossing.html>.
- 265 Poh, CLC Interview.
- 266 Ibid.
- 267 Maniam, CLC Interview.
- 268 Mandai Wildlife Group, "Community Groups Add Finishing Touches to The Mandai Wildlife Bridge", 23 December 2019, <https://www.mandai.com/en/about-mandai/media-centre/community-groups-add-finishing-touches-to-the-mandai-wildlife-br.html>.
- 269 Ibid.
- 270 Mandai Wildlife Group, "New chairman and directors appointed to the Mandai Park Holdings board", 31 May 2024, <https://www.mandai.com/en/about-mandai/media-centre/New-chairman-and-directors-appointed-to-the-Mandai-Park-Holdings-board.html>.

- 271 Xue Jianyue, "Buffer zones should be part of Mandai redevelopment, say green groups", originally published in *Today Online*, September 6, 2014, available at <https://wildsingaporenews.blogspot.com/2014/09/buffer-zones-should-be-part-of-mandai.html>.
- 272 Mandai Park Holdings, *Second Addendum to Environmental Impact Report*, 16.
- 273 ERM, *Mandai Park Holdings EIA Report*, September 2016, 8–62.
- 274 Mandai Wildlife Group, "Native Biodiversity Protection".
- 275 Interview with Wilfred Yu, 9 October 2025, by Bert Wee via email, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- 276 Ibid.
- 277 Chantal Sajan, "President's Design Award: Sensitive and thoughtful designs win prestigious prize", *The Straits Times*, 8 August 2025. <https://www.straitstimes.com/life/presidents-design-award-sensitive-and-thoughtful-designs-win-prestigious-prize>
- 278 Poh, CLC Interview.
- 279 Interview with Sharon Chan, 19 December 2023, by Bert Wee at the Centre for Liveable Cities' headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- 280 Poh, CLC Interview.
- 281 "Designing spaces for people and animals".
- 282 Ibid.
- 283 Ibid.
- 284 Introduced in 2013, LEAF is Singapore's first and only certification scheme dedicated to recognising excellence in the provision and management of greenery within developments. It celebrates outstanding landscape design, construction and maintenance, which brings greenery closer to communities.
- 285 Mandai Wildlife Group, *Mandai Wildlife West and Bird Paradise LEAF Assessment* (Singapore: Mandai Wildlife Group, February 2023), Part 1–2, 16.
- 286 Ibid., Part 1–2, 15.
- 287 Ibid., Bonus Part, 10.
- 288 Ibid.
- 289 Mandai Wildlife Group, *Mandai Wildlife West and Bird Paradise LEAF Assessment*, Part 5, 29.
- 290 Ibid., Part 5, 30.
- 291 The BCA Green Mark Award recognises buildings with sustainable designs and best practices that enable an efficient use of energy, water and material resources.
- 292 Mandai Wildlife Group, "Awards And Accolades", n.d., <https://www.mandai.com/en/care-for-planet/environmental-sustainability/awards-and-accolades.html>.
- 293 World Association of Zoos and Aquariums (WAZA), "Recap of the 79th WAZA Annual Conference", 3–7 November 2024, <https://www.waza.org/events/recap-of-the-79th-waza-annual-conference/>.
- 294 Mandai Nature, "Temasek and Mandai Park Holdings establish Mandai Nature to help wildlife, nature and communities thrive in Singapore and Asia", 9 December 2020, [https://www.mandainature.org/en/home/news-and-update/temasek\\_and\\_mandai\\_park\\_holdings\\_establish\\_mandai\\_nature\\_to\\_help\\_wildlife\\_nature\\_and\\_communities\\_thrive\\_in\\_singapore\\_and\\_asia.html](https://www.mandainature.org/en/home/news-and-update/temasek_and_mandai_park_holdings_establish_mandai_nature_to_help_wildlife_nature_and_communities_thrive_in_singapore_and_asia.html).
- 295 Maniam, CLC Interview.
- 296 Mandai Nature, "Temasek and Mandai Park Holdings establish Mandai Nature".
- 297 Ibid.
- 298 Mandai Nature, "Temasek and Mandai Park Holdings establish Mandai Nature".
- 299 Ministry of Sustainability and the Environment, "President's Award for the Environment 2025", Press Release, 2 October 2025, <https://www.mse.gov.sg/latest-news/president-s-award-for-the-environment-2025/>.
- 300 Mandai Wildlife Group, "New Corporate Identity, New Names for Singapore's Wildlife Parks and a Renewed Commitment to Conservation and a Sustainable Future".
- 301 Ibid.
- 302 Jessica Goodfellow, "The making of Mandai Wildlife Group, a four-year branding project", *Campaign Asia*, 15 October 2021, <https://www.campaignasia.com/article/the-making-of-mandai-wildlife-group-a-four-year-branding-project/473286>.
- 303 Mandai Wildlife Group, "New Corporate Identity, New Names for Singapore's Wildlife Parks and a Renewed Commitment to Conservation and a Sustainable Future".
- 304 Nafeesa Saini, "Where the wild things are: how Mandai is redefining wildlife tourism for Singapore and beyond", *Tatler Asia*, 6 August 2025, <https://www.tatlerasia.com/power-purpose/impact/how-mandai-singapore-living-blueprint-for-co-existence>.
- 305 Mandai Wildlife Reserve, "Rainforest Wild Adventure opens second phase this May", 6 May 2026, <https://www.mandai.com/en/about-mandai/media-centre/Rainforest-Wild-Adventure-opens-second-phase-this-May.html>.
- 306 NTUC First Campus, "Mandai Wildlife Group and NTUC First Campus Launch Asia's First ZooSchool: A Nature-Inspired Learning Experience for Children", 16 May 2025, <https://www.ntucfirstcampus.com/news/mandai-wildlife-group-and-ntuc-first-campus-launch-asias-first-zooschool-a-nature-inspired-learning-experience-for-children/>.
- 307 Ibid.
- 308 Ibid.
- 309 Ibid.
- 310 Ibid.
- 311 Ibid.
- 312 Yu, CLC Interview.
- 313 Emerald Lo, "Animal interactions and outdoor adventure camps: New ZooSchool for children opens in June", *The Straits Times*, 16 May 2025, <https://www.straitstimes.com/singapore/animal-interactions-and-outdoor-adventure-camps-new-zooschool-for-children-opens-in-june-2025>.
- 314 Hazeeq Sukri, "The new Curiosity Cove at Mandai Wildlife Reserve lets children climb an orangutan tree-bed, explore a maze tunnel", *Channel News Asia*, 5 November 2025, <https://cnalifestyle.channelnewsasia.com/singapore/curiosity-cove-mandai-wildlife-reserve-473491>.
- 315 Mandai Wildlife Reserve, "New indoor multimedia attraction, Exploria, to open at the Mandai Wildlife Reserve in March 2026", 23 February 2026, <https://www.mandai.com/en/about-mandai/media-centre/New-Indoor-Multimedia-Attraction-Exploria-To-Open-At-The-Mandai-Wildlife-Reserve-In-March-2026.html>.
- 316 Saini, "Where the wild things are".
- 317 Darcel Al Anthony, "Baby boom at Singapore's wildlife parks includes first penguin chicks, endangered species", *Channel News Asia*, 27 March 2025, <https://www.channelnewsasia.com/singapore/mandai-baby-boom-bird-paradise-penguins-river-wonders-night-safari-5027096>.
- 318 Temasek, "Letting animals be animals: An elephant and the evolving role of zoos", 9 September 2025, <https://www.temasek.com.sg/en/news-and-resources/stories/future/our-singapore-dna/letting-animals-be-animals>.
- 319 Saini, "Where the wild things are".
- 320 Ibid.
- 321 Ibid.
- 322 Urban Redevelopment Authority, "Delightful Spaces for Leisure and Wellness", last updated 29 July 2025, <https://www.uradraftmasterplan.gov.sg/regional-plans/north/delightful-spaces-for-leisure-and-wellness/>.
- 323 Mandai Nature, *Protecting Nature, Empowering Action: Building a Healthier Planet for Every Generation, Mandai Nature Impact Report 2024/2025* (Singapore: Mandai Nature, 2024).
- 324 "Biobanking" involves the collection, storage and management of biological samples from animals, and is a crucial tool for advancing science and conserving threatened species. As part of a joint effort with Mandai Wildlife Group, Mandai Nature maintains a repository of biological samples such as DNA, tissues, somatic cells, stem cells and gametes (sperm and egg cells). This biobank serves as a safety net for endangered species like the Sunda pangolin, contributing to global efforts in wildlife biobanking.
- 325 Maniam, CLC Interview.

# BIBLIOGRAPHY

## Books, Journals, Conference Proceedings

- Barnard, Timothy P. *Nature's Colony: Empire, Nation and Environment in the Singapore Botanic Gardens*. Singapore: NUS Press, 2016.
- Environmental Resources Management. *Environmental Impact Assessment for Mandai Development, Final Scoping Report*. Singapore: Environmental Resources Management, February 2015.
- \_\_\_\_\_. *Mandai Park Holdings Environmental Impact Assessment Report*. Singapore: Environmental Resources Management, 26 September 2016.
- Gann, George D., et al. "International principles and standards for the practice of ecological restoration. Second edition." *Restoration Ecology* 27 (2019): S1-S46. <https://doi.org/10.1111/rec.13035>.
- Greenwell, Phillip J., et al. "The Societal Value of the Modern Zoo: A Commentary on How Zoos Can Positively Impact on Human Populations Locally and Globally." *Journal of Zoological and Botanical Gardens* 4.1 (2023): 53-69. <https://doi.org/10.3390/jzbg4010006>.
- Hesp, Patrick A. "The Environmental Impact Assessment process in Singapore with particular respect to coastal environments and the role of NGOs". *Journal of Coastal Conservation* 1 (1995): 135-144. <https://doi.org/10.1007/BF02905122>.
- Lee, Kuan Yew. *From Third World to First: The Singapore Story, 1965-2000*. Singapore: Times Media and the Straits Times Press, 2000.
- Lee, Rachel S.K., et al. "Bridging the gap: Optimising connectivity solutions for an arboreal gliding mammal". *Journal of Applied Ecology* 60.5 (2023): 778-789. <https://doi.org/10.1111/1365-2664.14372>.
- Mandai Nature. *Protecting Nature, Empowering Action: Building a Healthier Planet for Every Generation, Mandai Nature Impact Report 2024/2025*. Singapore: Mandai Nature, 2024. <https://www.mandainature.org/en/home/publications.html>.
- Mandai Park Holdings. *Second Addendum to Environmental Impact Assessment Report*. Singapore: Mandai Park Holdings, 26 September 2016. Updated 18 February 2022.
- Mandai Wildlife Group. *Mandai Wildlife West and Bird Paradise LEAF Assessment*. Singapore: Mandai Wildlife Group, February 2023. Part 1-2.
- \_\_\_\_\_. *Mandai Wildlife West and Bird Paradise LEAF Assessment*. Singapore: Mandai Wildlife Group, February 2023. Bonus Part.
- Nature Society (Singapore) Conservation Committee. *Nature Society's Position Paper on the Mandai Safari Park Holdings (MSPH)'s Mandai Development Plan*. 2 September 2016.
- Ong, Soh Chin and Goh Yee Huay. *By Generations, For Generations: Fifty Years of Temasek as Told by the People Who Shaped It*. Singapore: Temasek Holdings (Private) Limited, 2024.
- Sharp, Ilsa. *The First 21 Years: The Singapore Zoological Gardens Story*. Singapore: Singapore Zoological Gardens, 1994.
- Singh, Kirpal. *Ape. Naked Boss: Bernard Harrison, the Man Behind the Singapore Zoo and the World's First Night Safari*. Singapore: Marshall Cavendish Editions, 2014.
- Tan, Siok Sun. *Goh Keng Swee: A portrait*. Singapore: Editions Didier Millet, 2007.
- Wildlife Reserves Singapore. *Year Book 2009/2010*. Singapore: Wildlife Reserves Singapore, 2010.
- \_\_\_\_\_. *Yearbook 2005/2006*. Singapore: Wildlife Reserves Singapore, 2006.
- \_\_\_\_\_. *Yearbook 2006/2007*. Singapore: Wildlife Reserves Singapore, 2007.
- \_\_\_\_\_. *Yearbook 2007/2008*. Singapore: Wildlife Reserves Singapore, 2008.

## Government Publications, Singapore Parliamentary Reports

- Centre for Liveable Cities. *Building Liveable & Sustainable Cities: A Framework for the Future*. Singapore: Centre for Liveable Cities, 2025.
- Centre for Liveable Cities and National Parks Board. *Biodiversity: Nature Conservation in the Greening of Singapore, Singapore Urban Systems Studies Booklet Series*. Singapore: Centre for Liveable Cities and National Parks Board, 2015.
- National Parks Board. *Biodiversity Impact Assessment (BIA) Guidelines*. Singapore: National Biodiversity Centre, National Parks Board, 2024.

## Interviews, Speeches, Lectures, Oral Histories, Press Releases

- Interview with Aaron Maniam. 23 January 2026, by Bert Wee online, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Interview with Adrian Loo. 19 December 2023, by Bert Wee at the Centre for Liveable Cities' headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Interview with Khoo Teng Chye. 13 October 2025, by Bert Wee via email, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Interview with Leong Yue Kheong. 18 October 2023, by Shawn Tan and Bert Wee at Mandai Wildlife Group's headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Interview with Neo Gim Huay. 20 May 2024, by Bert Wee at the Fullerton Hotel Lounge, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Interview with Peter Ng. 22 November 2023, by Shawn Tan and Bert Wee at the Lee Kong Chian Natural History Museum, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Interview with Poh Chi Chuan. 14 August 2024, by Bert Wee and Harini Ravichandran at the Singapore Tourism Board's headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Interview with Sharon Chan. 19 December 2023, by Bert Wee at the Centre for Liveable Cities' headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Interview with Tony O'Dempsey. 18 December 2023, by Bert Wee at the Centre for Liveable Cities' headquarters, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Interview with Wilfred Yu. 9 October 2025, by Bert Wee via email, for the Centre for Liveable Cities' Urban System Studies publication, *Mandai: Balancing Development and Nature*.
- Mandai Nature. "Temasek and Mandai Park Holdings establish Mandai Nature to help wildlife, nature and communities thrive in Singapore and Asia". Press Release, 9 December 2020. [https://www.mandainature.org/en/home/news-and-update/temasek\\_and\\_mandai\\_park\\_holdings\\_establish\\_mandai\\_nature\\_to\\_help\\_wildlife\\_nature\\_and\\_communities\\_thrive\\_in\\_singapore\\_and\\_asia.html](https://www.mandainature.org/en/home/news-and-update/temasek_and_mandai_park_holdings_establish_mandai_nature_to_help_wildlife_nature_and_communities_thrive_in_singapore_and_asia.html).
- Mandai Wildlife Group. "Community Groups Add Finishing Touches to The Mandai Wildlife Bridge". Press Release, 23 December 2019. <https://www.mandai.com/en/about-mandai/media-centre/community-groups-add-finishing-touches-to-the-mandai-wildlife-br.html>.
- \_\_\_\_\_. "Dedicated Bridge for Wildlife Crossings at Mandai". Press Release, 26 July 2017. <https://www.mandai.com/en/about-mandai/media-centre/dedicated-bridge-for-wildlife-crossings-at-mandai.html>.
- \_\_\_\_\_. "Environmental Impact Assessment guides sustainable development at Mandai". Press Release, 26 July 2016. <https://www.mandai.com/en/about-mandai/media-centre/environmental-impact-assessment-guides-sustainable-development-a.html>.
- \_\_\_\_\_. "Mandai Park Holdings Announces Environmental Advisory Panel Members". Press Release, 1 November 2016. <https://www.mandai.com/en/about-mandai/media-centre/mandai-park-holdings-announces-environmental-advisory-panel-memb.html>.

- \_\_\_\_\_. "Mandai Park Holdings Appoints Banyan Tree as Operator of Eco-Friendly Resort in Mandai". Press Release, 11 October 2017. <https://www.mandai.com/en/about-mandai/media-centre/mandai-park-holdings-appoints-banyan-tree-as-operator-of-eco-fri.html>.
- \_\_\_\_\_. "Mandai Park Holdings Enhances Mitigation Measures for Mandai Rejuvenation Project". Press Release, 10 October 2016. <https://www.mandai.com/en/about-mandai/media-centre/mandai-park-holdings-enhances-mitigation-measures-for-mandai-rej.html>.
- \_\_\_\_\_. "Mandai to become integrated nature and wildlife destination for Singaporeans". Press Release, 6 January 2016. <https://www.mandai.com/en/about-mandai/media-centre/mandai-to-become-integrated-nature-and-wildlife-destination-for-.html>.
- \_\_\_\_\_. "Mandai Wildlife Bridge Officially Launched for Wildlife Crossings". Press Release, 6 December 2019. <https://www.mandai.com/en/about-mandai/media-centre/mandai-wildlife-bridge-officially-launched-for-wildlife-crossing.html>.
- \_\_\_\_\_. "Mandai Wildlife Group announces leadership transition with appointment of new Group CEO as Mike Barclay retires". Press Release, 21 July 2025. <https://www.mandai.com/en/about-mandai/media-centre/Mandai-Wildlife-Group-announces-leadership-transition-with-appointment-of-new-Group-CEO-as-Mike-Barclay-retires.html>.
- \_\_\_\_\_. "New chairman and directors appointed to the Mandai Park Holdings board". Press Release, 31 May 2024. <https://www.mandai.com/en/about-mandai/media-centre/mandai-to-become-integrated-nature-and-wildlife-destination-for-.html>.
- \_\_\_\_\_. "Over Half a Million Dollars in Research Grants Awarded by Mandai Park Development for Environmental-Related Studies". Press Release, 29 July 2019. [https://www.mandai.com/en/about-mandai/media-centre/over-half-a-million-dollars-in-research-grants-awarded-by-mandai.html#\\_ftn1](https://www.mandai.com/en/about-mandai/media-centre/over-half-a-million-dollars-in-research-grants-awarded-by-mandai.html#_ftn1).
- Mandai Wildlife Reserve. "New Corporate Identity, New Names for Singapore's Wildlife Parks and a Renewed Commitment to Conservation and a Sustainable Future". Press Release, 13 October 2021. <https://www.mandai.com/en/about-mandai/media-centre/new-corporate-identity-new-names-for-singapores-wildlife-parks-and-a-renewed-commitment-to-conservation-and-a-sustainable-future.html>.
- \_\_\_\_\_. "New indoor multimedia attraction, Exploria, to open at the Mandai Wildlife Reserve in March 2026". Press Release, 23 February 2026. <https://www.mandai.com/en/about-mandai/media-centre/New-Indoor-Multimedia-Attraction-Exploria-To-Open-At-The-Mandai-Wildlife-Reserve-In-March-2026.html>.
- \_\_\_\_\_. "Rainforest Wild Adventure opens second phase this May". Press Release, 6 May 2026. <https://www.mandai.com/en/about-mandai/media-centre/Rainforest-Wild-Adventure-opens-second-phase-this-May.html>.
- \_\_\_\_\_. "Singapore's Rainforest Wild Asia to welcome the public from 12 March 2025". Press Release, 12 February 2025. <https://www.mandai.com/en/about-mandai/media-centre/temasek-partners-singapore-government-to-rejuvenate-mandai-wildl.html>.
- \_\_\_\_\_. "Temasek partners Singapore Government to rejuvenate Mandai wildlife and nature heritage". Press Release, 14 January 2015. <https://www.mandai.com/en/about-mandai/media-centre/temasek-partners-singapore-government-to-rejuvenate-mandai-wildl.html>.
- \_\_\_\_\_. "Visitors bid farewell to Jurong Bird Park". Press Release, 3 January 2023. <https://www.mandai.com/en/about-mandai/media-centre/Visitors-bid-farewell-to-Jurong-Bird-Park.html>.
- \_\_\_\_\_. "Wildlife Reserves Singapore Conservation Fund celebrates 10 years of protecting native wildlife". Press Release, 23 August 2019. <https://www.mandai.com/en/about-mandai/media-centre/wildlife-reserves-singapore-conservation-fund-celebrates-10-years-of-protecting-native-wildlife>.
- Ministry of Sustainability and the Environment. "President's Award for the Environment 2025". Press Release, 2 October 2025. <https://www.mse.gov.sg/latest-news/president-s-award-for-the-environment-2025/>.
- Ministry of Trade and Industry. "Speech by Mr S Iswaran, Minister of State for Trade and Industry, at the Official Opening of the African Cheetah Enclosure". 20 November 2007. Transcript. <https://www.mti.gov.sg/Newsroom/Speeches/2007/11/Mr-S-Iswaran-at-the-Official-Opening-of-the-African-Cheetah-Enclosure>.
- \_\_\_\_\_. "STB-Temasek Partnership to Enhance Mandai as Iconic Singapore Nature Attraction". Press Release, 14 January 2015. <https://www.mti.gov.sg/newsroom/stb-temasek-partnership-to-enhance-mandai-as-iconic-singapore-nature-attraction/>.
- NTUC First Campus. "Mandai Wildlife Group and NTUC First Campus Launch Asia's First ZooSchool: A Nature-Inspired Learning Experience for Children". Press Release, 16 May 2025. <https://www.ntucfirstcampus.com/news/mandai-wildlife-group-and-ntuc-first-campus-launch-asias-first-zooschoola-nature-inspired-learning-experience-for-children/>.
- Prime Minister's Office. "Transcript of speech by Prime Minister Lee Hsien Loong at the River Safari grand opening", 28 February 2014. Transcript. <https://www.pmo.gov.sg/Newsroom/transcript-speech-prime-minister-lee-hsien-loong-river-safari-grand-opening-28-feb-2014>.
- Temasek. "A Sustainable Approach to Heritage and Conservation". Media Release, 20 November 2024. <https://www.temasek.com.sg/en/news-and-resources/stories/t50/50-by-fifty/a-sustainable-approach-to-heritage-and-conservation>.
- \_\_\_\_\_. "Letting animals be animals: An elephant and the evolving role of zoos". Media Release, 9 September 2025. <https://www.temasek.com.sg/en/news-and-resources/stories/future/our-singapore-dna/letting-animals-be-animals>.
- \_\_\_\_\_. "Temasek partners Singapore Government to rejuvenate Mandai wildlife and nature heritage". Press Release, 14 January 2015. <https://www.temasek.com.sg/en/news-and-resources/news-room/news/2015/temasek-partners-singapore-government-to-rejuvenate-mandai-wildl>.
- Wildlife Conservation Society. "Wildlife Reserves Singapore Signs MOU with WCS". Press Release, 29 January 2010. <https://programs.wcs.org/newsroom/News-Releases/articleType/ArticleView/articleId/6392/Wildlife-Reserves-Singapore-Signs-MOU-with-WCS.aspx>.

### Newspapers, Magazines

- Ang, Seow Leng. "Nature Conservation in Singapore". *Biblioasia*, 4 April 2021. <https://biblioasia.nlb.gov.sg/vol-17/issue-1/apr-jun-2021/nature/>.
- Anthony, Darcel Al. "Baby boom at Singapore's wildlife parks includes first penguin chicks, endangered species". *Channel News Asia*, 27 March 2025. <https://www.channelnewsasia.com/singapore/mandai-baby-boom-bird-paradise-penguins-river-wonders-night-safari-5027096>.
- Cai, Weiqian. "Understanding the Law: Environmental Impact Assessments Must Not Be a Mere Formality – Confidentiality Should Not Come at the Expense of Public Participation". Originally published in *Lianhe Zaobao*, 13 July 2025. Available at <https://law.nus.edu.sg/apcel/media/understanding-the-law-environmental-impact-assessments-must-not-be-a-mere-formality-confidentiality-should-not-come-at-the-expense-of-public-participation/>.
- Chandran, R. "A haven for animal lovers of S'pore". *The Straits Times*, 28 June 1973. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19730628-1.2.80>.
- Channel News Asia. "Deer dies, motorcyclist injured in Mandai road accident". *Channel News Asia*, 19 December 2018. <https://www.channelnewsasia.com/singapore/deer-dies-motorcyclist-injured-in-mandai-road-accident-5717421>.
- \_\_\_\_\_. "No 'observable increase' in roadkill since Mandai development works began, says developer". Originally published in *Channel News Asia*, 29 March 2018. Available at <https://wildsingaporenews.blogspot.com/2018/03/no-observable-increase-in-roadkill.html>.
- Cheng, Wen-Haur. "A multi-pronged, collaborative approach to wildlife conservation". *Today Online*, 23 February 2015. <https://eresources.nlb.gov.sg/newspapers/digitised/article/today20150223-1.2.201>.
- Chew, Hui Min. "River Safari renamed, new bird park named Bird Paradise in Mandai Wildlife Group rebranding". *Channel News Asia*, 13 October 2021. <https://www.channelnewsasia.com/singapore/river-safari-renamed-jurong-bird-park-paradise-mandai-wildlife-2240906>.
- Chong, Clara. "Singapore's zoo ranked No. 4 in the world, best in Asia on TripAdvisor". *The Straits Times*, 31 August 2017. <https://www.straitstimes.com/singapore/singapores-zoo-ranked-no-4-in-the-world-best-in-asia-on-tripadvisor>.
- Choo, Daryl. "Mandai wildlife bridge: Rare sambar deer among nearly 70 species spotted using crossing". *Channel News Asia*, 3 February 2022. <https://www.channelnewsasia.com/singapore/mandai-wildlife-bridge-rare-sambar-deer-among-nearly-70-species-spotted-using-crossing-5625501>.
- Choo, Ruizhi. "Animals, Anxieties and Aspirations: The Earlier Years of the Singapore Zoo". *Biblioasia*, 1 October 2024. <https://biblioasia.nlb.gov.sg/all-sections/vol-20-issue-3-oct-dec-2024-singapore-zoo-animals/>.

- Ee, Jamie and Stacey Chia. "Wildlife Reserves' corporate wild ride". *The Straits Times*, 25 September 2011. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes20110925-1.2.4.5.1>.
- Elangovan, Navene. "The Big Read: Saving Singapore's endangered species, one 'animal bridge' at a time". *Channel News Asia*, 14 February 2022. <https://www.channelnewsasia.com/today/big-read/saving-singapores-endangered-species-animal-bridge-2494596>.
- Fang, Joy. "Mandai Area Set for Major Redevelopment". *Today*, 5 September 2014. <https://eresources.nlb.gov.sg/newspapers/digitised/article/today20140905-1.2.3>.
- Fong, Leslie. "Into a World of Sights and Sounds". *The Straits Times*, 3 January 1971. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19710103-1.2.55.1>.
- \_\_\_\_\_. "Rainbow on the falls on a sunny afternoon". *The Straits Times*, 3 January 1971. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19710103-1.2.55.4>.
- Ganesan, Natasha. "NParks to manage consultants for environmental impact assessments of nature-sensitive projects". *Channel News Asia*, 27 August 2022. <https://www.channelnewsasia.com/singapore/nparks-environmental-impact-assessment-consultancy-biodiversity-nature-clementi-forest-2903851>.
- Goodfellow, Jessica. "The making of Mandai Wildlife Group, a four-year branding project". *Campaign Asia*, 15 October 2021. <https://www.campaignasia.com/article/the-making-of-mandai-wildlife-group-a-four-year-branding-project/473286>.
- Lee, U-Wen. "Continual effort needed to keep S'pore's tourism edge: PM Lee". *The Business Times*, 1 March 2014. <https://eresources.nlb.gov.sg/newspapers/digitised/article/biztimes20140301-1.2.9.8>.
- Lim, Tin Seng. "All Creatures Great and Small: Singapore's First Zoos". *Biblioasia*, 7 July 2015. <https://biblioasia.nlb.gov.sg/vol-11/issue-2/jul-sep-2015/sg-first-zoo/>.
- Lim, Wei Chean. "Nature Society expresses concerns about plans for Mandai". *The Straits Times*, 21 November 2007.
- Lin, Yangchen. "Plans for Mandai eco-tourism hub tweaked to reduce environmental impact; locations for Bird Park and Rainforest Park swapped". *The Straits Times*, 26 July 2016. <https://www.straitstimes.com/singapore/environment/plans-for-mandai-development-tweaked-to-reduce-environmental-impact>.
- Lin, Yanqin. "Mating in Mandai". *Today Online*, 25 January 2007. <https://eresources.nlb.gov.sg/newspapers/digitised/page/today20070125-2.1.8>.
- Lo, Emerald. "Animal interactions and outdoor adventure camps: New ZooSchool for children opens in June". *The Straits Times*, 16 May 2025. <https://www.straitstimes.com/singapore/animal-interactions-and-outdoor-adventure-camps-new-zooschool-for-children-opens-in-june-2025>.
- Maes, Marianne. "If not properly done, plans to turn Mandai into nature retreat could backfire - Beware the wildlife tradeoff". Originally published in *Today Online*, 22 November 2007. Available at <https://wildsingaporenews.blogspot.com/2007/11/if-not-properly-done-plans-to-turn.html>.
- Mak, Mun Sun. "Woo... The Zoo Is Cool". *The Straits Times*, 20 May 2006. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes20060520-1.2.234.5>.
- Mok, Fei Fei. "Major makeover of Mandai zoo precinct to be led by Temasek Holdings and STB". *The Straits Times*, 14 January 2015. <https://www.straitstimes.com/singapore/environment/major-makeover-of-mandai-zoo-precinct-to-be-led-by-temasek-holdings-and-stb>.
- Muhamad Rostam Umar, Singapore Tourism Board. "Sensitive approach to Mandai revamp". Originally published in *Today Online*, 5 December 2007. Available at <https://wildsingaporenews.blogspot.com/2007/12/stb-reply-sensitive-approach-to-mandai.html>.
- Neo, Xiaobin and Kevin Lim. "The doc is in - for avian patients big and small at Jurong Bird Park". *The Straits Times*, 28 June 2021. <https://www.straitstimes.com/singapore/the-doc-is-in-for-avian-patients-big-and-small>.
- New Nation. "Zoo will get its millionth visitor in October". *New Nation*, 28 June 1974. <https://eresources.nlb.gov.sg/newspapers/digitised/article/newnation19740628-1.2.19.4>.
- Ng, Huiwen. "Jurong Bird Park is first wildlife park to successfully breed endangered Solomon Islands bird". *The Straits Times*, 28 January 2019. <https://www.straitstimes.com/singapore/jurong-bird-park-is-first-wildlife-park-to-successfully-breed-endangered-solomon-islands>.
- \_\_\_\_\_. "Sambar deer dies after being hit by vehicle in Mandai Road". *The Straits Times*, 5 February 2018. <https://www.straitstimes.com/singapore/sambar-deer-dies-after-being-hit-by-vehicle-in-mandai-road>.
- Ng, Kai Ling. "The seed that grew into a wildlife park". *The Straits Times*, 3 February 2013. <https://eresources.nlb.gov.sg/newspapers/Digitised/Article/straitstimes20130203-1.2.16.3>.
- P.M. Raman. "S'pore zoological gardens to be opened in mid-June". *The Straits Times*, 30 April 1973. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19730430-1.2.94>.
- Philomin, Laura Elizabeth. "Impact on existing wildlife, plants among concerns over Mandai project". *Channel News Asia*, 2 June 2016. <https://www.channelnewsasia.com/singapore/impact-existing-wildlife-plants-among-concerns-over-mandai-project-5792066>.
- Saini, Nafeesa. "Where the wild things are: how Mandai is redefining wildlife tourism for Singapore and beyond". *Tatler Asia*, 6 August 2025. <https://www.tatlerasia.com/power-purpose/impact/how-mandai-singapore-living-blueprint-for-co-existence>.
- Sajan, Chantal. "President's Design Award: Sensitive and thoughtful designs win prestigious prize". *The Straits Times*, 8 August 2025. <https://www.straitstimes.com/life/presidents-design-award-sensitive-and-thoughtful-designs-win-prestigious-prize>.
- Siau, Ming En. "EIA report details impact of Mandai park construction on animals and their habitats". *Channel News Asia*, 26 July 2016. <https://www.channelnewsasia.com/singapore/eia-report-details-impact-mandai-park-construction-animals-and-their-habitats-5785506>.
- \_\_\_\_\_. "Mandai plans altered to limit environmental impact". *Channel News Asia*, 26 July 2016. <https://www.channelnewsasia.com/singapore/nature-groups-propose-changes-alleviate-environmental-impact-in-mandai-5785471>.
- Singapore Herald. "What a lark! This bird park which has almost everything...". *Singapore Herald*, 17 December 1970.
- Sukri, Hazeq. "The new Curiosity Cove at Mandai Wildlife Reserve lets children climb an orangutan tree-bed, explore a maze tunnel". *Channel News Asia*, 5 November 2025. <https://cnaifestyle.channelnewsasia.com/singapore/curiosity-cove-mandai-wildlife-reserve-473491>.
- Tan, Audrey. "A better way to assess harm to the environment". *The Straits Times*, 3 November 2016. <https://www.straitstimes.com/singapore/environment/a-better-way-to-assess-harm-to-environment>.
- \_\_\_\_\_. "Animals affected by Mandai park works: Wildlife groups". *The Straits Times*, 24 March 2018. <https://www.straitstimes.com/singapore/environment/animals-affected-by-mandai-park-works-wildlife-groups>.
- \_\_\_\_\_. "Development works in Singapore to be more sensitive to wildlife under changes to EIA framework". *The Straits Times*, 25 October 2025. <https://www.straitstimes.com/singapore/environment/development-works-in-singapore-to-be-more-sensitive-to-wildlife-under-changes>.
- \_\_\_\_\_. "Mandai Eco-Link: All you need to know about the wildlife bridge". *The Straits Times*, 27 July 2017. <https://www.straitstimes.com/singapore/environment/mandai-eco-link-how-wildlife-crossing-works>.
- \_\_\_\_\_. "Mandai Lake Road bridge used by wildlife; seven roadkill incidents reported". *The Straits Times*, 3 February 2022. <https://www.straitstimes.com/singapore/environment/mandai-lake-road-bridge-used-by-wildlife-but-does-not-eliminate-roadkill-incident>.
- \_\_\_\_\_. "Mandai makeover: Eco-bridge, biodiversity classes for contractors among measures to protect wildlife in area". *The Straits Times*, 26 July 2017. <https://www.straitstimes.com/singapore/environment/mandai-makeover-eco-bridge-biodiversity-classes-for-contractors-among-measures>.
- Tan, Judith. "National action plan to keep endangered straw-headed bulbuls singing in the wild". *The Straits Times*, 18 December 2023. <https://www.straitstimes.com/singapore/national-action-plan-to-keep-endangered-straw-headed-bulbuls-singing-in-the-wild>.
- Tan, Wang Joo. "Planning for Leisure of Four Million". *The Straits Times*, 27 April 1971. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19710427-1.2.94>.
- Tang, Yi Ching. "Mandai Rainforest Resort to open in April 2025". *The Straits Times*, 19 December 2024. <https://www.straitstimes.com/singapore/mandai-rainforest-resort-to-open-in-april-2025>.
- Teh, Cheryl. "Efforts to make it safer for animals in Mandai area". *The Straits Times*, 22 December 2018. <https://www.straitstimes.com/singapore/environment/efforts-to-make-it-safer-for-animals-in-mandai-area>.
- Teo, Ginnie. "Safari stops sale of advance tickets". *The Straits Times*, 22 June 1994. <https://eresources.nlb.gov.sg/newspapers/digitised/page/straitstimes19940622-1.1.22>.

- Tham, Davina. "Animal crossing: Sambar deer, wild pigs among dozens of species seen using Mandai Wildlife Bridge". *Channel News Asia*, 3 February 2022. <https://www.channelnewsasia.com/singapore/animals-mandai-wildlife-bridge-sambar-deer-2476291>.
- The Singapore Free Press. "The decline and fall of Singapore's zoo". *The Singapore Free Press*, 23 July 1958. <https://eresources.nlb.gov.sg/newspapers/digitised/article/freepress19580723-1.2.42.1>.
- The Straits Times. "\$60m night zoo opens". *The Straits Times*, 29 April 1994. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19940429-1.2.78.2.1>.
- \_\_\_\_\_. "3 attractions team up to draw visitors". *The Straits Times*, 1 September 2000. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes20000901-1.2.5.6>.
- \_\_\_\_\_. "5 More Trams for Night Safari". *The Straits Times*, 8 December 1994. <http://eresources.nlb.gov.sg/newspapers/Digitised/Article/straitstimes19941208-1.2.34.21.aspx>.
- \_\_\_\_\_. "Designing spaces for people and animals: How she partners eco experts and builders to create Bird Paradise". *The Straits Times*, 16 July 2024. <https://www.straitstimes.com/singapore/design-wildlife-park-sustainability-built-environment-mandai-bird-paradise-building-and-construction-authority>.
- \_\_\_\_\_. "Facilitating wildlife connectivity". Infographic, *The Straits Times*, 9 January 2019. [https://static1.straitstimes.com.sg/s3fs-public/attachments/2018/12/22/st\\_20181222\\_ctmandai22a\\_4502374.pdf](https://static1.straitstimes.com.sg/s3fs-public/attachments/2018/12/22/st_20181222_ctmandai22a_4502374.pdf). <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19710424-1.2.68>.
- \_\_\_\_\_. "Govt 'committed' to promoting leisure industry". *The Straits Times*, 31 October 1991. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19911031-1.2.51.13>.
- \_\_\_\_\_. "Keeping the water clean for \$1.7m". *The Straits Times*, 29 January 1973. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19730129-1.2.62>.
- \_\_\_\_\_. "New attractions almost every year to whip up visitor interest". *The Straits Times*, 24 February 1995. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19950224-1.2.68.3.1>.
- \_\_\_\_\_. "One cassowary for sale, cheap - until yesterday". *The Straits Times*, 14 September 1969. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19690914-1.2.57>.
- \_\_\_\_\_. "Panel members reviewing environmental measures for Mandai nature hub named". *The Straits Times*, 1 November 2016. <https://www.straitstimes.com/singapore/panel-members-reviewing-environmental-measures-for-mandai-nature-hub-named>.
- \_\_\_\_\_. "Roadkill incidents in Mandai". Infographic, *The Straits Times*, 24 March 2018. [https://static1.straitstimes.com.sg/s3fs-public/attachments/2018/03/24/st\\_20180324\\_aumandai24a\\_3859726.pdf](https://static1.straitstimes.com.sg/s3fs-public/attachments/2018/03/24/st_20180324_aumandai24a_3859726.pdf).
- \_\_\_\_\_. "SM: Zoo pollution was main worry". *The Straits Times*, 20 June 1993. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19930620-1.2.6.8>.
- \_\_\_\_\_. "The men behind the project". *The Straits Times*, 29 January 1973. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes19730129-1.2.60>.
- Toh, Ee Ming. "Nature groups propose changes to alleviate environmental impact in Mandai". *Channel News Asia*, 28 July 2016. <https://www.channelnewsasia.com/singapore/nature-groups-propose-changes-alleviate-environmental-impact-in-mandai-5785471>.
- Toh, Ting Wei. "Cheep thrills: Over 700 animals born at Wildlife Reserves Singapore parks last year". *The Straits Times*, 26 February 2019. <https://www.straitstimes.com/singapore/environment/cheep-thrills-over-700-animals-born-at-wildlife-reserves-singapore-parks-last>.
- Wong, Tessa and Lim Wei Chean. "New Wildlife Draw: River Safari Ready in 2011". *The Straits Times*, 11 February 2009. <https://eresources.nlb.gov.sg/newspapers/digitised/article/straitstimes20090212-1.2.3>.
- Xue, Jianyue. "Buffer zones should be part of Mandai redevelopment, say green groups". Originally published in *Today Online*, September 6, 2014. Available at <https://wildsingaporenews.blogspot.com/2014/09/buffer-zones-should-be-part-of-mandai.html>.
- Yeo, Zoe. "How Jurong Bird Park was Hatched". *Biblioasia*, 2 July 2021. <https://biblioasia.nlb.gov.sg/vol-17/issue-2/jul-sep-2021/jurong-bird-park/>.
- Yong, Charissa. "Dr Kwa, the healthcare pioneer and nature lover". *The Straits Times*, 1 November 2016. <https://www.straitstimes.com/singapore/dr-kwa-the-healthcare-pioneer-and-nature-lover>.

## Websites

- Condé Nast Traveller. "The world's best zoos". *Condé Nast Traveller*, 10 March 2011. <https://www.cntraveller.in/story/world-s-best-zoos/>.
- Ho, Aloysius. "Night Safari". *Singapore Infopedia*, National Library Board, 24 June 2014. <https://www.nlb.gov.sg/main/article-detail?cmsuuiid=70eb2bc3-d19e-4d2d-844e-d948b9b8710b>.
- Ho, Hua Chew. "Nature Society Singapore's post". *Nature Society Singapore Facebook*, 11 October 2016. <https://www.facebook.com/naturesocietysingapore/posts/dr-ho-hua-chew-vice-chairperson-of-the-conservation-committee-from-nature-society/10154450285929404>.
- Leasca, Stacey. "20 of the Best Zoos in the World". *Travel + Leisure*, 26 November 2022. <https://www.travelandleisure.com/best-zoos-in-the-world-6826018>.
- Mandai Wildlife Group. "Energy and Water Conservation". Last updated 2026. <https://www.mandai.com/en/care-for-planet/environmental-sustainability/energy-and-water-conservation.html>.
- \_\_\_\_\_. "Native Biodiversity Protection". n.d., <https://www.mandai.com/en/care-for-planet/environmental-sustainability/native-biodiversity-protection.html>.
- \_\_\_\_\_. "Straw-Headed bulbul". Last updated 2026. <https://www.mandai.com/en/bird-paradise/animals-and-zones/songs-of-the-forest/straw-headed-bulbul.html>.
- Overstreet, Kaley. "From Aristocratic Displays to Eco-parks: The Current Questions and Future Design of Zoos". *ArchDaily*, 3 January 2022. <https://www.archdaily.com/974439/rethinking-zoo-design-in-our-future-cities>.
- Romero, Lucas. "Number of Visitors to the River Wonders in Singapore from 2014 to 2022". *Statista*, 2 April 2024. <https://www.statista.com/statistics/1025414/singapore-river-safari-visitor-numbers/>.
- SG101. "Singapore Night Safari". *Connexionsg*, 28 May 2023. <https://www.sg101.gov.sg/resources/archives/til-singapore-night-safari/>.
- Teng, Sharon. "Punggol Zoo". *Singapore Infopedia*, National Library Board. <https://www.nlb.gov.sg/main/article-detail?cmsuuiid=1473095b-ceb1-460e-9f12-d4b8357743be>.
- Urban Redevelopment Authority. "Delightful Spaces for Leisure and Wellness". Last updated 29 July 2025. <https://www.uradraftmasterplan.gov.sg/regional-plans/north/delightful-spaces-for-leisure-and-wellness/>.
- \_\_\_\_\_. "Environmental Impact Assessment (EIA)". Last updated 24 April 2026. <https://www.ura.gov.sg/Corporate/Planning/Our-Planning-Process/Bringing-plans-to-Reality/Environmental-Impact-Assessment>.
- Vashishth, Yashita. "Meet and Greet Unique Wildlife At These Popular Zoos In Singapore". *Travel + Leisure* (Southeast Asia, Hong Kong and Macau), 21 December 2024. <https://www.travelandleisureasia.com/hk/destinations/southeast-asia/zoos-in-singapore-night-safari-park-bird-paradise-river-wonders/>.
- World Association of Zoos and Aquariums (WAZA). "Recap of the 79th WAZA Annual Conference". 3-7 November 2024. <https://www.waza.org/events/recap-of-the-79th-waza-annual-conference/>.
- Yeo, Zoe and Fiona Lim. "River Safari". *Singapore Infopedia*, National Library Board, 25 June 2015. <https://www.nlb.gov.sg/main/article-detail?cmsuuiid=b0f23259-35ce-4dcf-9631-3b93643cd9ac>.

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