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RESTORING RIVER ECOLOGICAL VALUE AT SUNGAI PUSU GOMBAK SELANGOR

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ABSTRACT

Rivers are among the most prevalent ecosystems that are either endangered, substantially degraded, in poor health, damaged, or heavily changed by human activity. Four main problems are occurring at the Pusu River: i) river pollution, ii) sedimentation, iii) flood risk, and iv) habitat loss. The study focuses on restoring river ecological value that was degraded due to human activities and development at the Pusu River in Gombak, Selangor. This study aims to develop a landscape masterplan for the Pusu River as a nature recreational activity park for the IIUM community while sustaining life on land, below water, well-being, and protecting life (al -'nafs). The objectives of this study are to restore the river ecosystem, create a nature preservation area, and provide a nature comprehensive design. This study used three methods to collect the data: i) document analysis, ii) site observation, and iii) survey questionnaire. These methods were chosen to analyse the site's current condition and propose design solutions to overcome the four main problems mentioned. The findings can be segmented into three main attributes: physical, natural, and social. The river hydrology observation indicates a very poor condition of the Pusu River, with sedimentation that causes the river to become shallow with murky water that reduces its aesthetic value. The output of the study encompasses the designing stage of proposing an eco-river park master plan and a detailed development plan that emphasises on restoring water quality, returning wildlife, and creating space for recreational activity.

Keywords: *restoring river, water quality, river, nature recreational activity, wildlife preservation*
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INTRODUCTION

A river is an important waterbody that requires great understanding and has been researched for various studies. A river can be defined as a "natural flow of water that continues in a long line across the land to the sea" or "a large amount of liquid flowing in a particular direction" (Oxford University Press, 2020). Limburg et al. (2013) describe rivers as the sinuous overland flow conduits that drain through the world's continents because they displace relatively little of the world's surface area and have a limited standing storage of water compared to other hydrologic reservoirs. A river is a basic right and a natural resource that serves as a flow path for floods, drainage channels, primary sources of water supply, rivers for communication and transit, food supplies, and other uses (Department of Irrigation and Drainage, 2022). Through on-site observation of the selected site at Pusu River, Gombak, the Pusu River experienced significant degradation due to sand mining activities. This anthropogenic activity led to sedimentation in river streams. Many Selangor streams, rivers, and floodplains have large amounts of sand and gravel that may be mined easily and affordably for several purposes (Ashraf et al., 2010). Then there is the sedimentation that made the Pusu River's river and water basin vulnerable to flooding. As a result of the deposition, rivers and streams could turn shallow, diminishing their capacity to store water and posing a flood danger that may result in the loss of public and private property (Zainudin et al., 2013). Next, the pollution of surrounding water courses, wetlands, and lakes is exacerbated by soil erosion, weathering, and sedimentation. Finally, human modification of the Pusu River hydrology has resulted in habitat loss and reduced the existing ecosystems that maintain the area's balance.

LITERATURE REVIEW

THE ANATOMY OF RIVER

A river is a natural flow of water that continues in a long line across the land to the sea or a large amount of liquid flowing in a particular direction (Oxford University Press, 2020). Limburg et al. (2013) describe rivers as the sinuous overland flow conduits that drain through the world's continents because they displace relatively little of the world's surface area and have a limited standing storage of water compared to other hydrologic reservoirs. Rivers worldwide have different identities, but each river has the same elements. Just like humans, rivers have an anatomy that has its function from the start to the end (Figure 1). River features begin at the source, or the headwaters, tributaries, or watershed, and end at the river mouth (Rutledge et al., 2022). Rivers are continually changing due to their speed, volume, and periods, ranging from instantaneous to millennial. Weathering is the process through which the flowing water of a river carves and shapes the terrain over time (Rutledge et al., 2022).

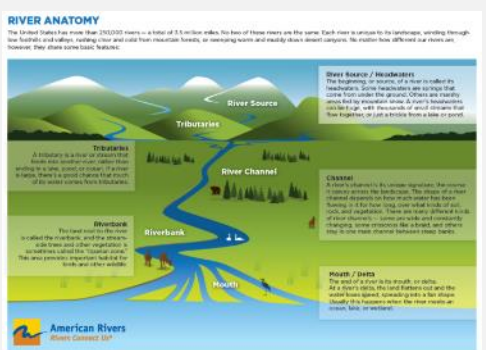

Figure 1: Anatomy of River (Source: What makes river? 2018)

RIVER ECOLOGICAL RESTORATION

River ecological restoration supports ecosystem recovery from degraded, damaged, or destroyed environments by correcting human-caused harm (Pan et al., 2016). River ecological restoration can be done with a natural restoration approach and an engineering approach. Through natural ecological restoration, land rehabilitation, phytoremediation and landscape resilience approach are introduced. Through the engineering ecological approach, the dredging method and bioengineering method are introduced. Rehabilitation of mine lands promotes biodiversity and ecosystem services (Gastauer, 2019). Phytoremediation uses plants and microbes to recover contaminated land, reducing environmental contaminants' concentrations and toxic effects. The ecological floating island method combines greening and floating techniques, using lightweight, durable foamed polystyrene for plant development (Figure 2). The engineering approach involves river dredging to deepen or remove contaminated sediment (Manap et al., 2019). Lastly, the Bioengineering method targets high erosion and flood risk areas using plant branches, pegs, sticks, and arbour-shrub-grass vegetation for secure biota habitats.

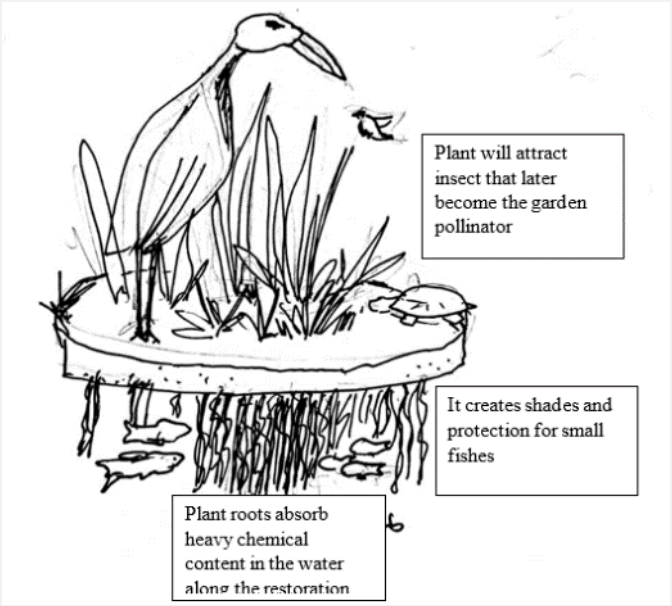

Figure 2: Ecological Floating Island Illustration

ECOLOGICAL RECREATIONAL ACTIVITY

Referring to Oxford University Press (2022), recreation is an activity for fun during leisure time. However, recreational activity could be described as Nature-based leisure or outdoor recreation (Monz et al., 2013). Nature-based tourism is becoming widely popular all over the globe. Since the 1960s, many environmentalists have studied nature-based tourist activities and their possible implications (Sumanapala et al., 2019). Recreational ecology encompasses various activities, including cycling, camping, skiing, and canoeing. These activities will give both benefits and impacts to society and the environment.

PROBLEM THAT COULD BE FOUND AT RIVER

The river ecosystem could be disturbed either by human forces or natural causes. For millennia, humans have relied on rivers for a variety of purposes. The evolved changes sometimes create a problem that can affect the habitat and the nearby ecosystem.

Some major problems that can be seen are river pollution, sedimentation, flood risk, and habitat loss. River pollution can be as a physical, chemical, or biological factor causing aesthetic or detrimental effects on aquatic life and on those who consume the water (Goel, 2006).
Furthermore, pollution may stem from either point sources or nonpoint sources. Sedimentation in riverbanks could be caused by several factors, which include human activities and natural disasters. River flood risk could happen either from human causes or natural phenomena. A flood plain is a flood-prone area adjacent to a river where the river dumps exceptionally fertile soil (Rutledge et al., 2022). Consequences of the problems that happen at the river will then lead to other problems, which is habitat loss.

SITE INTRODUCTION

The site is located at the International Islamic University Malaysia (IIUM), which includes three flowing river tributaries: the Pusu River, Batang Pusu River, and Anak Pusu River, as well as seven ponds along the river and its tributaries downstream, all of which are located within the IIUM campus area (Figure 3).

Figure 3: Location of Pusu River, Anak Pusu River and Batang Pusu River (Source: Google earth, 2023)

METHODOLOGY

This study involves qualitative and quantitative data to evaluate the existing condition of river quality, users, and biodiversity at Sungai Pusu. The qualitative data involves structured site observation, document analysis, and semi-structured interviews with IIUM agencies and the Selangor Landscape Department. A quantitative approach, like a survey questionnaire, was applied to identify awareness of the Pusu River condition and any opinion regarding the type of development they think is sustainable and suitable among the IIUM Gombak Campus community. Figure 4 shows the research stages carried out in the project.

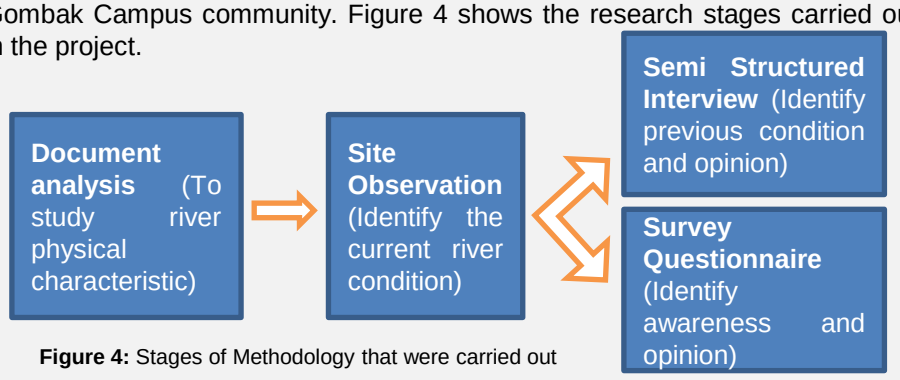

Figure 4: Stages of Methodology that were carried out

RESULT AND DISCUSSION

PHYSICAL ATTRIBUTE

Physical attributes include climatic factors such as temperature, rain distribution, precipitation, and wind direction. Based on document analysis, climate factors impact user experience, with clear weather from May to August providing the most opportunities for outdoor activities. However, frequent rainy days hinder users' enjoyment of nature. From site observation, the site's topography, surrounded by undulating hills, protects it from monsoon winds but increases water transmission during rainy days, reducing river capacity in erosion-prone areas (Figure 5). Rainy weather also creates soil conditions, causing silts to be transported and sedimented, leading to a shallow river. For the topography factor, the lowland area offers potential for light outdoor activities, while the hilly area preserves ecosystems and habitats suitable for nature-based activities like bird-watching. Lastly, from site observation, the soil type (Figure 6) has the potential for reforestation due to its rich nutrients and fertile soil. However, sedimentation hazards, such as high infiltration rates and slippery walkways, hinder the project's success.

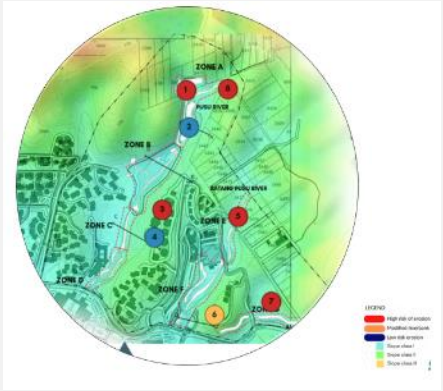

Figure 5: Topographic Map (Erosion prone area)

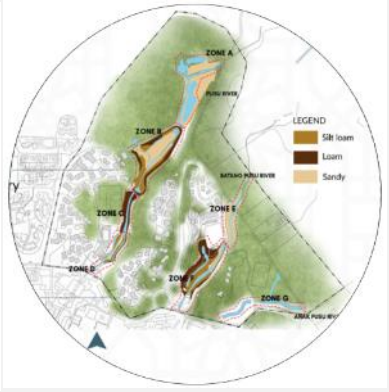

Figure 6: Soil type Map

NATURAL ATTRIBUTE

In natural attributes, the main attributes involved are hydrology, vegetation, and wildlife. For hydrology, the attributes were divided into four main elements: colour of water, voice of stream, smell and rubbish, and drainage point. The data was collected through site observation and survey questionnaires (Figures 7 and 8). River conditions impact habitat, ecosystem, and user experience. The river's strength allows small fish to shelter, while brown waste and algae bloom prevent habitat destruction. However, sewage and car park water damage the river's quality for animals. The river's sound offers potential therapy and stress relief, but mud and stagnant oil sheen cause discomfort and damage during rainy seasons.

Figure 7: Graph of Satisfaction with The IIUM River's Condition.

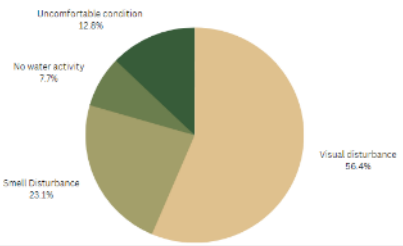

Figure 8: Percentage of IIUM River's Current Condition effects to User

Based on the observation and the interview, vegetation (Figure 9) affects river conditions by absorbing heavy metals, restoring contaminated water, and increasing aesthetic value. However, controlling invasive species like water hyacinths is crucial to prevent overtaking and protect existing species from suffocated roots. Vegetation affects wildlife, such as riverbank species like Colocasia, providing shelter for small fish and attracting pollinators, birds, bats, and butterflies. The investigation can analyse wildlife indicators, such as painted storks and kingfishers, indicating small fish habitats. However, constraints like sediment and shallow water limit fish populations. Additionally, user interactions with wildlife, such as bird-watching activities, may be affected by king cobras and monkeys in residential areas.

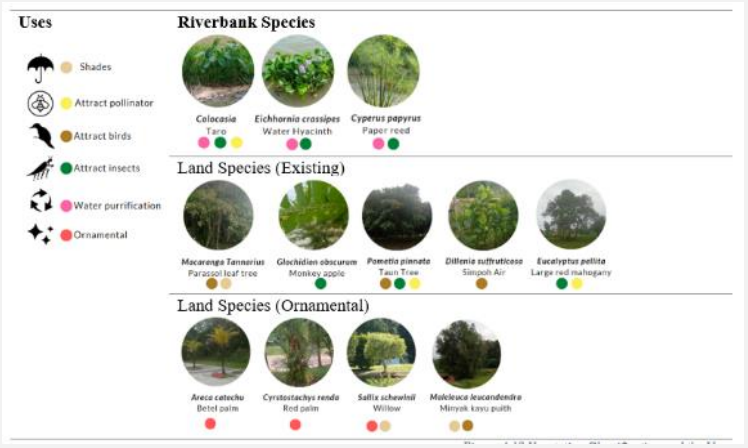

Figure 9: Vegetation classification and it's use

SOCIAL ATTRIBUTE

The elements included under social attributes are access and circulation, land use and activity, utilities, and facilities. Based on on-site observation, the site's circulation is analysed with poor walkways, slippery debris, and direct river access limiting user activity (Figure 10). A new hiking trail could increase nature-based activities. Based on the observation and survey, the site land use (Figure 11) has the potential for nature-based activities, with 50% green forest land use, but potential discomfort and pollution from direct forest access and parking. Lastly, for utilities and facilities, the data was collected through site observation, which included rusty outdoor gym equipment, unmaintained utilities, potential poisonous animals, and minimal amenities for user activity, affecting wildlife habitat.

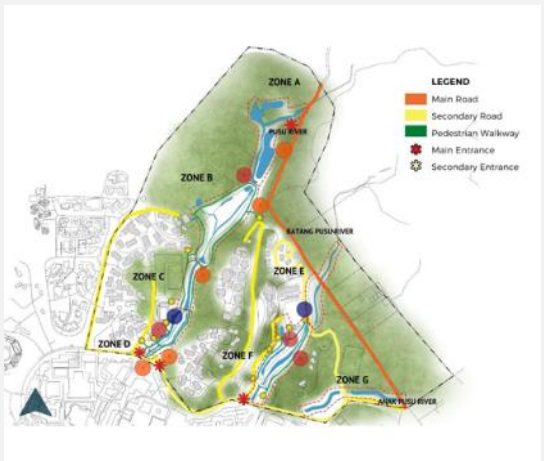

Figure 10: Accessibility and Circulation Map

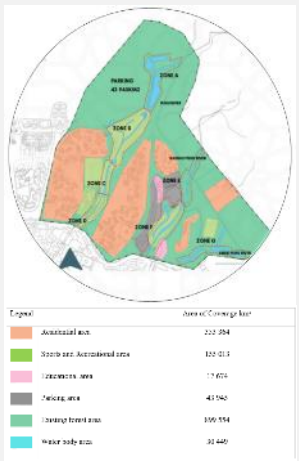

Figure 11: Land Use Map

RESEARCH FINDINGS

KEEPING CERTAIN AREA UNDISTURBED

Forestry areas are crucial for wildlife and vegetation, as they attract birds and help restore the animal ecosystem. To achieve this, design strategies include reducing light pollution, conserving existing forest areas, allowing low-impact development, and implementing measures to discourage destruction or degradation (Figure 12). Minimal design and low-impact development can create a sense of identity and protect the site from damage. Weir traps can be implemented to prevent sedimentation and pollution at lower stream catchments, providing a nursery area for small fish and riverbank species. Additionally, improving existing utilities for user safety and comfort can reduce high development and improve user experience.

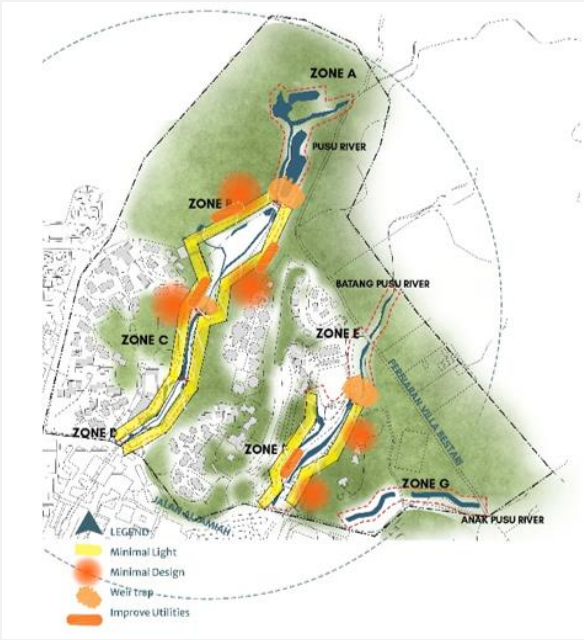

Figure 12: Keeping Certain Area Undisturbed map

APPLYING SUSTAINABLE AND INNOVATIVE LANDSCAPE DESIGN

A sustainable environment requires designers to consider several elements to create a pleasant atmosphere that is part of a solution rather than a problem. The measures taken could be divided into two design principles: ecological approaches and engineering approaches. This action is important to enhance the site condition with the existing issue and avoid it from degrading. An ecological approach can address water quality issues in land and river areas. This approach aims to create a resilient landscape to help recover areas and preserve the site's natural identity. Strategies include rehabilitating exposed land with reforestation, using existing species for vegetation design, and enhancing river conditions with phytoremediation. Phytoremediation absorbs heavy metal particles in water, brightening the site's visuals. In the case of engineering, addressing sedimentation is crucial. Design strategies include establishing accessibility for river maintenance, using bio-engineering methods like nature gabion walls, deepening riverbanks, and reusing sand as fertilisers for vegetation. These methods help prevent flood risk, restore habitat, and reduce contaminated water. Figure 13 displays the suggested strategies on the site.

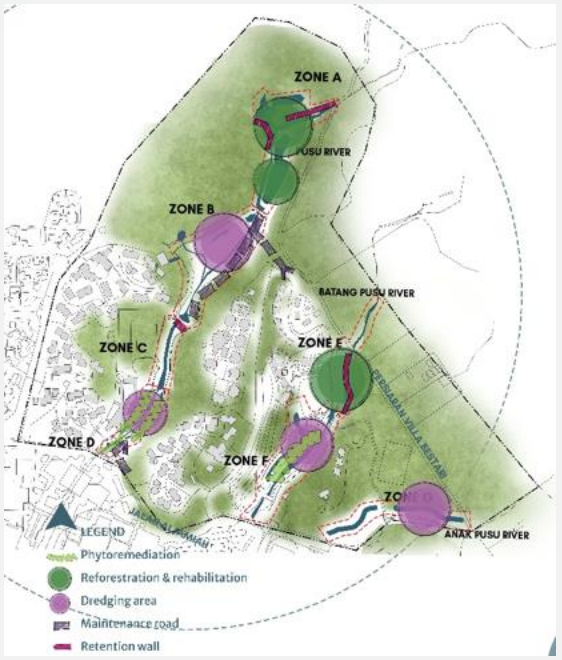

Figure 13: Applying sustainable and innovative landscape design

CREATE AWARENESS ON SUSTAINABLE ENVIRONMENTAL CONSERVATION

Sustainable conservation awareness can be spread through nature-based recreational activities and spaces. The principles include integrating activities with existing nature, creating new spaces for public enjoyment without harming nature, and enhancing leisure spaces with information exposure. Minimal design and low-impact development are essential, with activities like camping, hiking, and bird-watching being suggested to avoid deforestation and promote a connection to nature. The next principle involves enhancing leisure spaces with new information exposure. Design strategies include cycling activities, interactive information areas, and introducing wildlife species.

Additionally, creating new spaces for users to enjoy without damaging nature, such as outdoor learning and hangout spaces, is essential for students' relaxation and IIUM Community classes. These spaces can also be used for nature-related programs. Figure 14 displays the suggested strategies on the site.

Figure 14: Create Awareness on Sustainable Environmental Conservation Map

MASTER PLAN

AIM

To develop a landscape masterplan of Pusu River for a nature recreational activity park for the IIUM community while sustaining life on land, bellow water, well-being and protecting life (al -'nafs).

OBJECTIVE AND DESIGN STRATERGIES

1. To restore the river ecosystem by implementing green landscape solutions:
    a) Implement regular river maintenance by adding a river dredging point.
    b) Installing bio-engineering retention wall to avoid erosion.
    c) Reforestation of exposed land.
2. To create a nature preservation area by applying sustainable landscape design:
    a) Use minimal design with minimal lighting to reduce environmental destruction.
    b) Phytoremediation to restore the water quality and bring back water habitat.
    c) Usage of weir trap to slow down river channel as fish sanctuary.
3. To provide nature design that boosts ecological recreational area:
    a) Creating land recreational activity
    b) Proposing water recreational activity.
    c) Proposing leisure and relaxing space.
    d) Creating river awareness educational area.

DESIGN CONCEPT

The design concept for this project is "The life Tempua: Into the biophilic realm“. The Tempua bird is one of the unique bird species at the site. The unique characteristic of the nest and the way the birds built their home by hanging on the branches above the water was a way to protect their hatchlings. Biophilia means the love of nature that integrates human activity with nature. The design concept derived from the Tempua bird's character that focused on protecting nature while creating a natural sanctuary that connects to nature and promotes well-being. The design processes started with Figure 15, followed by Figure 19 to 21.

SPACE PROGRAMMING

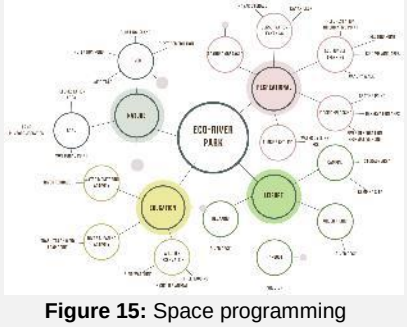

Figure 15: Space programming

FUNCTIONAL DIAGRAM AND CONCEPTUAL PLAN

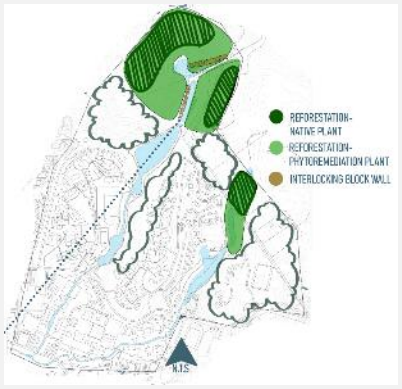

Figure 16: Green infrastructure

Figure 17: Blue infrastructure

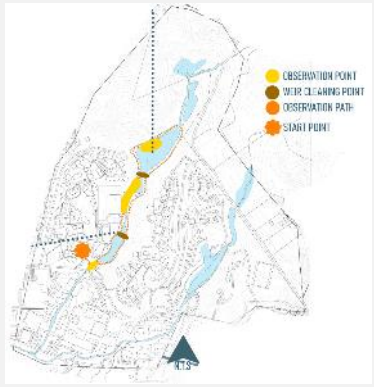

Figure 18: Red infrastructure (Educational)

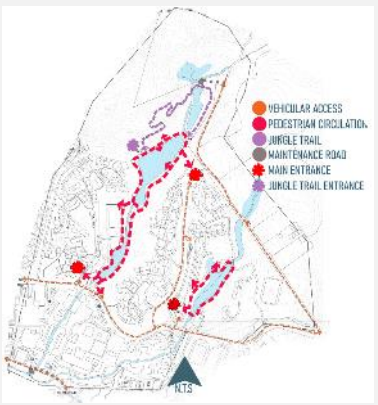

Figure 20: Circulation

Figure 21: Conceptual Plan

Figure 19: Red infrastructure (Recreational)

PLANTING CONCEPT AND PLAN

The planting concept is Nature Rhythm (Figure 22) which creates a therapeutic ambience for users by hearing the sounds of birds and insects. This immersive experience allows individuals to reconnect with nature and find solace in the harmonious symphony of the natural world. Nature sounds provide respite, connection, mindfulness, and harmony, promoting mindfulness and harmony.

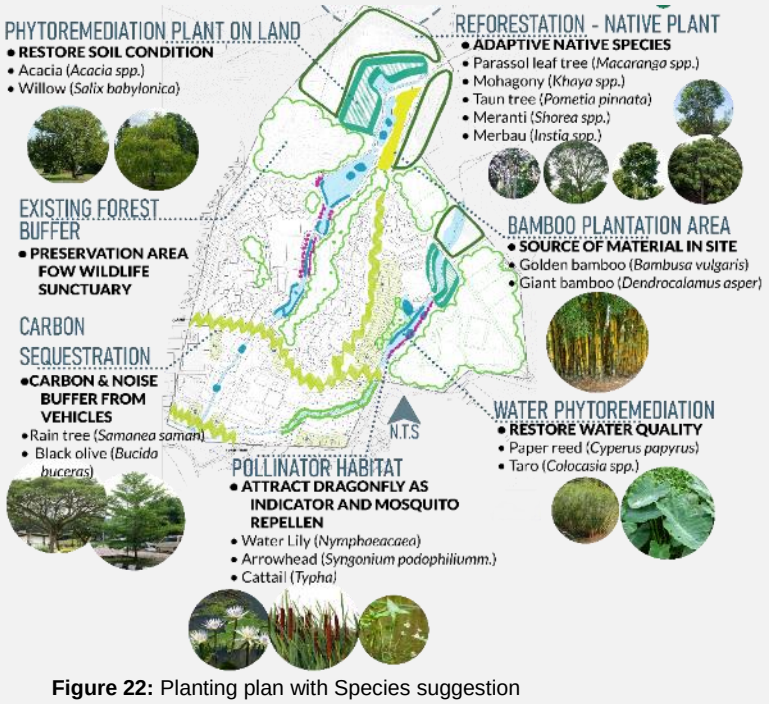

Figure 22: Planting plan with Species suggestion

DESIGN PROCESS

SCHEMATIC, PRELIMINARY AND MASTER PLAN

Figure 23: Schematic plan

Figure 24: Preliminary Masterplan

Figure 25: Masterplan

In reference to Figure 23 to 28, the features of the design are as follow:

1. PUSU ACCESS POINT
   The starting point for river observation activity.
2. JOGGING TRAIL
   Open boardwalk path connects to weir point cleaning area, educating users on the river ecosystem.
3. SPORT ARENA
   Courts with vibrant surfaces for fun, exciting competition.
4. SUNSET VISTA DECK
   Second observation deck offers panoramic Bukit Tabur views and sunset views.
5. RIVERSIDE OBSERVATORY
   River terrace enhances ecosystem monitoring, allowing users to access it in both dry and wet seasons.
6. MARYAM ECO-KAYAK
   A conservative kayak area promotes sustainable practices, responsible recreation, and wildlife encounters in new waterways.
7. FOREST EDGE RETREAT CAMP
   The camping site offers a peaceful, secluded forest retreat, surrounded by soothing lake sounds.
8. FOREST SANCTUARY
   Reborn forest enhances the ecosystem, and buffers rainwater runoff.
9. CANOPY WALK
   Elevated walk through the forest, bird-watching area, resting point.
10. BAMBOO GROOVE
    Path transitions from canopy walk to relaxing bamboo walk, utilizing site materials.
11. CHALLENGE COURS
    Active spaces with various obstacles for skill-level enjoyment.
12. WATER WALK
    Deck path for exploring wetland species and dragonflies.
13. AQUACYCLE
    Experience unique outdoor gym cycling with water turbine generating energy.
14. TEMPUA SANCTUARY RETREAT
    Relaxing hangout space for Tempua bird observation.
15. RESILIENT RESERVE
    Dry pond with bio-engineered grass terrace for rainy season storage.

SECTION

Figure 26: Section from Parking Area to Jogging Trail at Anak Pusu River

Figure 27: Section from Forest Sanctuary to Riverside Observatory at Pusu River

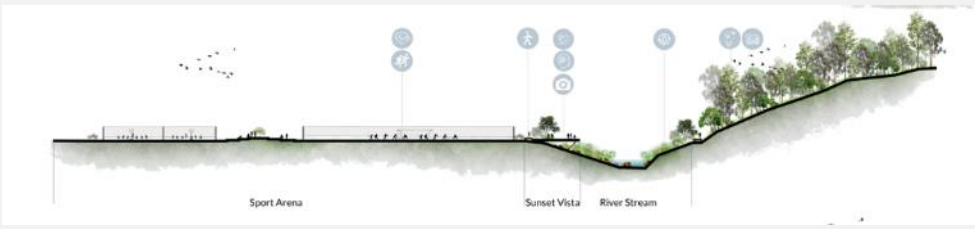

Figure 28: Section from Sport Arena to Jogging Trail at Pusu River

DETAIL DEVELOPMENT PLAN

AIM

To develop a detailed development plan for the river rehabilitation and nature areas for social and well-being.

DESIGN OBJECTIVES AND STRATERGIES

1. To restore the river ecosystem by implementing a green landscape solution
   - Implement regular river maintenance by adding a river dredging point
   - Bio-engineering retention wall to avoid erosion
   - Reforestation of exposed land

2. To create a nature preservation area by applying sustainable landscape design
   - Minimal design with minimal lighting to reduce environmental destruction
   - Phytoremediation to restore the water quality and bring back water habitat
   - Usage of weir trap to slow down river channel as fish sanctuary

3. To provide nature design that boosts ecological recreational area
   - Land recreational activity
   - Water recreational activity
   - Leisure and relaxing space
   - River awareness educational area.

SPACE PROGRAMMING

The Nest is divided into four design elements: Pusu Plaza, Tempua Retreat, Tempua Thrill and Tempua Plaza. Each element caters to water and land activity. Figure 29 displays the activity and space programming according to the elements.

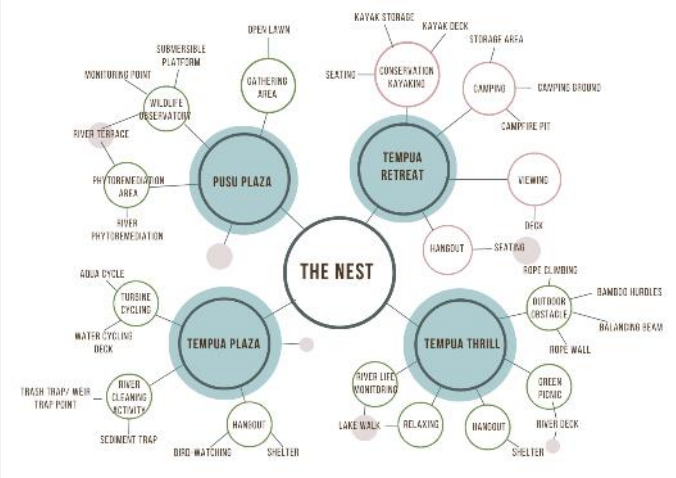

Figure 29: Space programming

FUNCTIONAL DIAGRAM

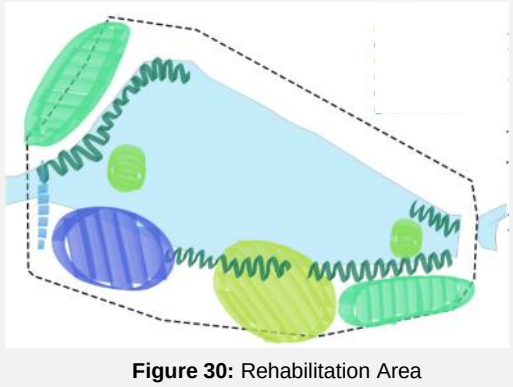

Figure 30: Rehabilitation Area

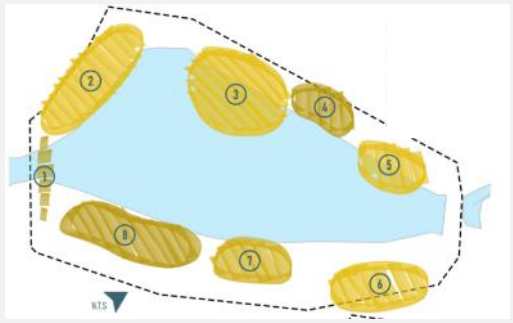

Figure 31: Educational Area

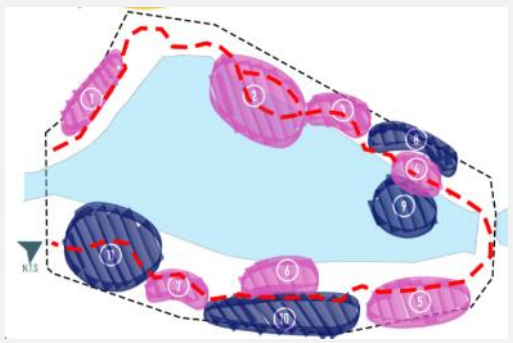

Figure 32: Recreational Area

Figures 30 to 33 show the areas of the design, circulation, and planting plan.

- Semi Green Area
- Phytoremediation Area
- Preserved Tree Area
- Floating Island
- Weir Trap Area
- Waterbike Area

1. River Cleaning Area
2. Tree Observation Area
3. Water Monitoring Area
4. Bird Watching Area
5. Viewing Area
6. Tree Observation Area
7. Aquatic Life Monitoring
8. Viewing Area

LEISURE ACTIVITY

1. Forest Seating Area
2. Relaxing Terrace
3. Hangout Area
4. Viewing Deck
5. Forest Seating Area
6. Water Walk
7. Viewing Deck

RECREATIONAL ACTIVITY

8. Camping Area
9. Eco Kayaking
10. Obstacles Course
11. Waterbiking

JOGGING ROUTE

- Pedestrian Walkway
- Bicycle Lane
- Kayak Route
- Main Entrance
- Entrance to Canopy walk
- Water flow

Figure 33: Circulation

PLANTING PLAN

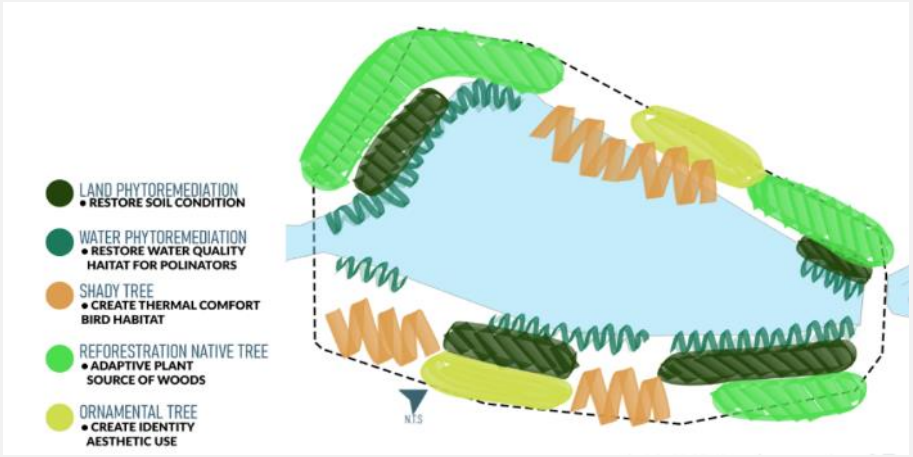

Figure 34: Planting Plan

DESIGN PROCESS

CONCEPTUAL PLAN

The conceptual zones of the design are shown in Figure 35 below.

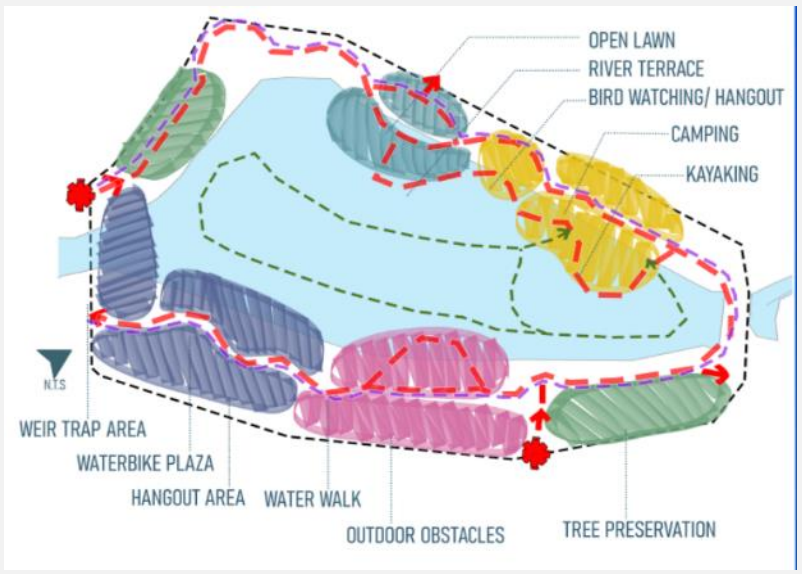

Figure 35: Conceptual Plan

SCHEMATIC PLAN

1. THE SUNCTUARY
2. MEMORIA LAWN
3. RIVER TERRACE
4. NEST N REST
5. THE EDGE CAMP
6. MARYAM ECO-KAYAK
7. THE SUNCTUARY
8. CHALLENGE COURSE
9. WATER WALK
10. NEST N REST
11. AQUACYCLE
12. THE WEIR

Figure 36: Schematic Plan

PRELIMINARY AND MASTER PLAN

Figure 37: Preliminary plan

Figure 38: Detail Development Master Plan

The area chosen for the detailed development plan is an existing retention pond that has not been utilised well due to the sedimentation problem. The site's strategic location, between a female residential area connected to water bodies and a green forest area, is very suitable for nature recreational space. It could also be considered the heart of the river area as it incorporates river and forest ecosystems.

SUPPORTING DRAWING

Figure 39: View of River Terrace

The River Terrace at Pusu Plaza. A therapeutic series of sitting that would bring the users closer to nature. The educational water monitoring provides the opportunity for users to learn about river flora and fauna, emphasising river restoration (Figures 39 & 42)

Figure 40: View of Eco Kayak

The Eco Kayak at Tempua Retreat. A relaxing space for emphasising water recreation activity. Provided storage and a shaded sitting area underneath the viewing deck (Figures 40 & 41).

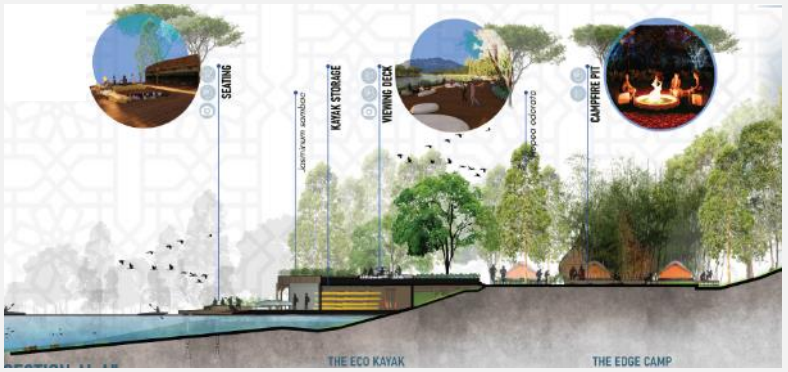

Figure 41: Section Cut at Tempua Retreat

Figure 42: Section Cut at Pusu Plaza

INNOVATIVE DESIGN ELEMENTS

THE AQUACYCLE

Pedalling bicycles can be a remarkable way to generate electrical energy while prioritising the users' and the environment's well-being. By harnessing the mechanical energy produced while pedalling, this energy can be efficiently transformed into electrical energy and stored in a battery. The stored energy can be utilised for various purposes, such as lighting and phone charging. Just 30 minutes of pedalling can produce enough electricity to power seven light bulbs for up to 12 hours. Additionally, this energy can be used to turn on a fan and charge a phone simultaneously, providing comfort and convenience. This ingenious method combines physical activity with sustainable energy generation, promoting a healthier lifestyle while contributing to a greener future (Figures 43 & 44).

Figure 43: The Aquacycle equipment

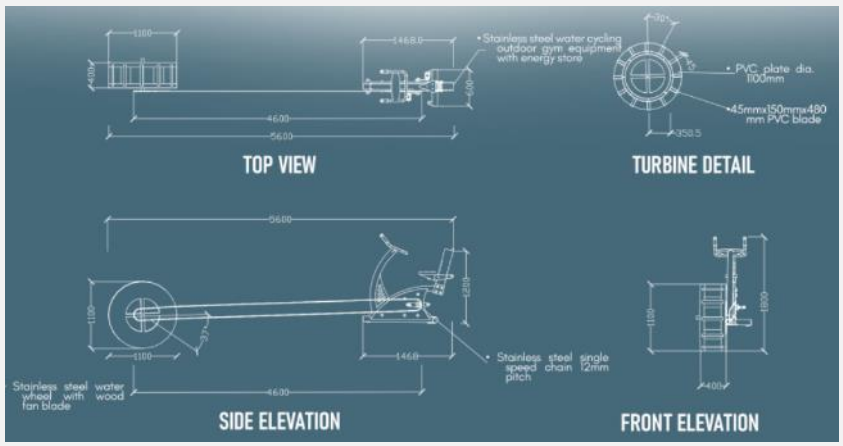

Figure 44: Construction Drawing of The Aquacycle

SOFTSCAPE PLAN

Figure 45 shows the proposed plan for the softscape with the detail labeled in Table 1. The plan is proposed according to the planting concept that fits the site context, climatic factor, and habitat. Figure 46 shows the softscape pallette that supports the design concept.

Figure 45: Softscape plan

Table 1: Softscape Schedule

NO	SYM	SCIENTIFIC NAME	COMMON NAME	NOS
1		*Hopea odorata*	Merawan Siput Jantan	87
2		*Acacia magnium*	Black Wattle	61
3		*Salix babylonica*	Weeping Wilow	41
4		*Saraca thaipingensis*	Gapis	15
5		*Eucalyptus pelita*	Large-Fruited Red Mahogany	71
6		*Melaleuca leucadendra*	Tea Tree	44
7		*Bambusa Vulgaris*	Common Bamboo	43
8		*Cocos nucifera*	Coconut palm	10
9		*Jasminum samboc*	Arabian jasmine	41
10		*Calathea lutea*	Cigar Plant	140
11		*Colocasia heterochroma*	Elephent Ear	140
12		*Colocasia esculenta*	Taro Plant	120
13		*Syngonium podophyllum*	Arrowhead Plant	210
14		*Cyperus papyrus*	Paper Reed	330
15		*Nelumbo Nucifera*	Sacred Lotus	40
16		*Sphagneticola trilobata*	Singapore Daisy	-
		Axonopus compressus	Cowgrass	-

Figure 46: Softscape Palette

HARDSCAPE PLAN

Figure 46 shows the hardscape proposed at the site. The hardscape proposed considers the microclimatic, durability, and maintenance factors. Table 2 lists the hardscape's details.

Figure 46: Hardscape Plan

Table 2: Hardscape Schedule

NO	SYMBOL	HARDSCAPE NAME	MATERIAL	NOS
1		Entrance signage	Bamboo, stainless steel and concrete base	1
2		Bird nest shelter	Bamboo thatch, concrete base	9
3		Camping ground	Synthetic wood	11
4		Campfire pit	Cut stone and stainless steel	4
5		Stone shape seating	Cast stone	13
6		Terrace Seating	Cast stone	40
7		Long curvy bench	Composite timber	4
8		Obstacles course	Bamboo and hardwood	9
9		Waterbike	Stainless steel and synthetic wood	18
10		Weir trap	Cut stone	48
11		Signage	Aluminum alloy	14
12		Curb lamp	Aluminum alloy and LED	231
13		Pedestrian walkway	Concrete paver	-
14		Decking	Synthetic wood	-
15		River terrace	Gabion stone and stainless steel	
16		Camping Area	Gold washed gravel stone	
17		Nest N Rest Area	White Gravel Stone	
18		Outdoor obstacles area	Sand	

CONCLUSION

In conclusion, the ecological restoration project at the Pusu River in Gombak is extremely important for the local environment, community, and overall ecology. This project has effectively revitalised the deteriorated river environment via meticulous design, implementation, and teamwork, resulting in multiple ecological and social advantages. The restoration efforts have resulted in the restoration of biodiversity within the river ecosystem, attracting a diverse range of plant and animal species. The restored river now serves as an important habitat for various forest organisms, helping preserve vulnerable ecosystems and promote a healthier, more balanced environment.

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