GREEN INFRASTRUCTURE NETWORK (GIN) SOLUTIONS FOR A CONDUCIVE STREET NETWORK AT LOW-COST HOUSING AND THE NEIGHBOURHOOD OF UKAY PERDANA, ULU KLANG, SELANGOR

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ABSTRACT
Urban green infrastructure includes the street network a green amenity for people. It comprises transportation corridors, a linear pedestrian network, and linear green areas and reserves. The streets serve as a vital network connecting various facilities in a housing area. Applying a green infrastructure network (GIN) will contribute significantly to housing areas, particularly in low- and middle-income communities. It can facilitate people's access to various locations in and around the neighbourhood, thereby fostering a healthy society. The paper analyses the conditions of the green infrastructure network (GIN) in the form of the street network of Jalan Ukay Perdana at Sri Impian Flat and its neighbourhood of Ukay Perdana. The street network selected for the study is within 500 metres of the flat and the surrounding neighbourhood. In addition to a literature review, the study employed spatial mapping, analysis, and site observation. The methods were utilised to identify and assess the streets as pedestrian and transportation networks within the neighbourhood. The existing elements and potential GIN were examined to give recommendations for GIN solutions for street networks in the housing area. The proposal is suggested to promote the local community's well-being in low-cost housing areas.
Keywords: Green infrastructure, green network, street, pedestrian connectivity, affordable housing

1.0 INTRODUCTION
Good housing developments are planned to improve the well-being of residential communities and conserve the environment. To improve the aspects of the housing community, various facilities and amenities are proposed. These can be in terms of a conducive housing environment, public infrastructure, various public spaces, and recreational areas. Housing development policy aspires a green community living to be integrated with a proper layout planning of built spaces, open areas, and street networks (Harun et al., 2022). A conducive housing environment uses natural resources wisely and applies green practices, such as green technology and recycling. Also, sustainability and conservation of the environment emphasise creating a community area with beauty and comfort for the population rather than being a harmonious, prosperous, and healthy society (Mell & Whitten, 2021). As such, one of the efforts is highly accessible connected public transport, walking, and cycling routes and networks that offer a variety of facilities and services within a housing area. The design of the housing environment should include the elements of green infrastructure in its network of streetscape and public spaces (Harun et al., 2022). These include human-scale neighbourhood development, patches of green infrastructure in the form of various types of green space, and green networks. In addition, green technology, such as rainwater harvesting, rain gardens, stormwater streets, and cooling systems based on nature, can be incorporated into the development agenda. Those are examples of a comprehensive green infrastructure network (GIN) to achieve a conducive housing environment in promoting sustainable development goals for housing developments.

Green infrastructure (GI) is a term that is used in various contexts in the built environment and human ecology studies. Generally, it can refer to amenity areas with open spaces, trees, and greenery, which

provide ecological benefits to a geographical area (Pamukcu-Albers et al., 2021). The technical field of study relates to engineered structures designed to be environmentally friendly, such as stormwater management or water treatment facilities. Nonetheless, all green infrastructures are known to be essential indicators of environmental protection, particularly in places in urban areas (Pinho et al., 2016). In an urban setting, besides recreational parks and open spaces, a green infrastructure network (GIN) also comprises transport corridors, tree-lined streets, scenic roads, and pedestrian routes. It can also be linear open spaces for recreation, leisure, and social activities established in and around towns and neighbourhoods. Ideally, most of the GIN are green patches of space available in the urban housing areas and the neighbourhood, ready to be linked with a network of comfortable streets. In this research, the term green infrastructure network (GIN) comprises small community spaces and linear street networks that are well-linked.

The community appreciates the availability of GIN in urban housing areas due to increased knowledge of the importance of quality of life, a liveable urban environment, and sustainability of urban areas. The GIN aspires to offer healthy, comfortable, and conducive outdoor places in the neighbourhood for people to live, work, and play. It can even entice purchasers to invest in a particular housing property (Nazir et al., 2014; Mohamad et al., 2015). The GIN becomes a local public amenity that serves the needs of all age groups within a community. Harun et al. (2022), National Housing Policy (2011), and National Housing Policy (2019) state that even a low-cost housing development should be conducive, which fulfils the local community's needs with a comfortable living environment. Thus, this paper aims to identify and assess the GIN in urban housing and its neighbourhood. The site selected is a low-cost housing environment in an urban setting in Selangor. Specifically, the study area is the street network near Sri Impian flat, within 500 metres to one kilometre of its surrounding neighbourhood area. The findings suggest recommendations for a conducive street network based on GIN solutions in a low-cost housing area. Firstly, the paper identifies the GI street elements in the housing area. Then, it analyses the existing characteristics and issues of the GIN that can assist or hinder the connectivity and mobility of residents within their neighbourhood. Based on the concept of a green infrastructure network, the GIN elements are vital in determining a community's comfort and overall well-being in their neighbourhood environment. Finally, green infrastructure network (GIN) solutions for the street network of Jalan Ukay Perdana are recommended. The street network aspires to connect the green infrastructure as a natural resource or ecosystem with the community through a conducive GIN system.

2.0 THEORETICAL REVIEW

The literature reviews consist of various reading materials from academic articles, books, and journal papers that identify the operational definitions of a green infrastructure network (GIN) and its related terms, the background of urban green infrastructure, green infrastructure elements, and GIN solutions for streets. The following sub-sections present the reviews.

2.1 Urban Green Infrastructure

Urban green infrastructure (GI) is a planning approach to create a network of multifunctional green spaces in urban environments (De Bellis et al., 2015). GI is increasingly recognised as a concept aiming for urban resilience. On a larger scale, it is an approach to deliver a comprehensive range set of ecosystem services in urban areas (Kilbane, 2019). It aims to deliver better urban land-use planning, nature-sensitive urban design, and a broad diversity of open spaces. The GI system ultimately helps to conserve the natural environment, air, water, and energy resources, and moderate

microclimate, thus enriching human quality of life. McPherson et al. (2015) and Meerow & Newell (2017) also propose that GI has several benefits through the specific delivery of ecosystem services. These benefits include recreational green spaces, stormwater management, good air quality, urban heat island amelioration, and landscape connectivity. These benefits are brought by diverse GI components such as green space, open space, public park, plazas, and streetscapes and their elements that weave through the urban fabric. The GI component used and ecosystem service provided and valued depends on how urban residents interact. Similarly, GI can help maintain and enhance the quality of life of urban residents through resource-efficient use and compact city living (Lafortezza, 2013; Banzhaf et al., 2018). Hence, multi-functionality, connectivity, multi-level, social inclusiveness, and adoption of a communicative approach have all been promoted as important principles in urban green infrastructure planning (Hansen & Pauleit, 2014; Mell & Clement, 2020).

2.2. Green Infrastructure Network

The use of the term green infrastructure network (GIN) began in the 1990s, and it is increasingly widely used today. The concept of GIN explains the importance of nature and the supporting function of its components in handling land use planning issues. The study of the green environment and its networking, as well as its relationship with the well-being of the population, has re-emerged today as an important topic due to increased interest in biodiversity conservation and concern over the degradation of the green environment, especially in the cities (Honeck et al., 2020). In natural resource conservation, as a concept, GIN connects the ecosystems and landscapes in a system of hubs, links, and sites (Benedict et al., 2012; Pozoukidou, 2020). In detail, hubs in the GIN system serve as anchor points with native plants and wildlife, acting as origins or destinations for both people and ecological processes. Meanwhile, links are the connections that join the system, playing a crucial role in maintaining environmental functions and wildlife biodiversity. In urban contexts, links refer to street networks for transportation and pedestrian mobility. Green infrastructure networks include sites smaller than hubs and may not be attached to the broader, interconnected community and regional conservation systems (Seiwert & Rößler, 2020). The idea of the GIN concept is shown in Figure 1, as visualized by (Benedict & McMahon, 2012; and Sant'Anna & Bezerra, 2019). Nevertheless, like other components of GIN, sites can also contribute important ecological and social values, such as protecting wildlife habitat and providing space for nature-based recreation and relaxation. In short, it serves multiple benefits for human and natural functions.

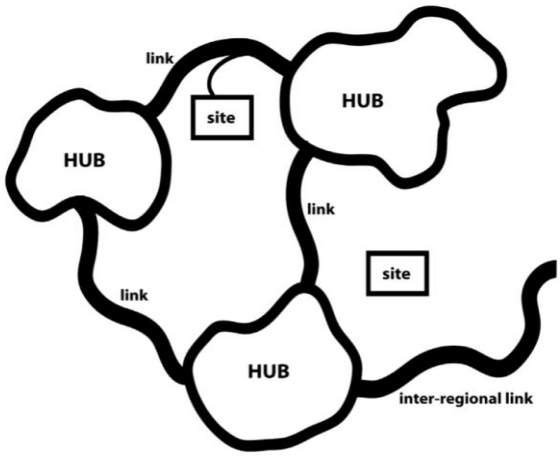

Fig. 1: A green infrastructure network (GIN) concept that connects ecosystems and landscapes in a system of hubs, links, and sites
Source: (Benedict & McMahon, 2006; Sant'Anna & Bezerra, 2019).

2.3 Street as Green Network in a Neighbourhood

In an urban neighbourhood setting, besides GI as hubs (as illustrated in Figure 1), the street network of GIN, which is the 'link' includes the transportation corridor such as scenic vehicular roads, tree-lined pedestrian streets, bicycle network, road median, back lane, side lane, river reserve, drainage reserve, utility reserve, and railway reserve in linear form. Yeo et al. (2023) referred to the link or network as a functional corridor. Various linear small green spaces can also exist along the street network as stop or node points (e.g., bus stops, incidental small spaces). As a functional space and network, the GIN can create greener and healthier neighbourhood areas whereby necessary activities such as walking to facilities, recreational areas, cultural spaces, and urban gardens can somehow be established along its network routes. This linear green facility includes streets and sidewalks to access vehicles, bike paths, and public walkways. This GIN is essential for residents to be connected to other built-up infrastructure around residential areas. Streets lined by greenery are networks shaded and planted with trees and other soft landscape elements. Green networks for cycling and public footpaths are comfortable and shaded by trees and other shading constructions. The public uses the GIN as a route to their destination. Residents must get into adjacent neighbourhoods and to the prominent neighbourhood recreational parks and open spaces. For example, the street network in a neighbourhood area is part of a more extensive GIN system that links one green space to another. However, it can also be used to enjoy the outdoor environment and recreational activities such as walking, cycling, and jogging. Streets and public routes close to homes are also helpful for youth and children, who can play and do various activities with friends, provided the networks are designed for safety. It will often be connected to other extensive recreational facilities, such as access to public parks and neighbourhood open spaces. In addition, many opportunities to engage with people happen in the streets compared to parks or other open spaces (Ujang et al., 2018). Therefore, it can be said that the street accurately represents public open space, which the whole population may be comfortable using (Thompson, 2002; Wen et al., 2020). Thus, it is vital to identify the existing conditions of GI in neighbourhood areas and explore the residents' responses through their experience and satisfaction with using the existing street network as a functional space for access and social opportunities.

2.4 Green Infrastructure Network (GIN) Solutions for Streets

GIN also includes systems that involve green technology. In most cities, streets make up a sizable portion of publicly owned land, creating an exceptional opportunity to manage environmental outcomes (Green Streets Handbook, 2021). Natural systems approach such as vegetation (perennials, shrubs, and trees), soil, and engineered systems (permeable pavements, bioretention, and swales) can improve community health and prosperity. Streets in residential areas and urban neighbourhoods offer the most significant opportunity to create GIN with green streets. Hence, green technology for street networks reduces stormwater runoff, improves water quality, reduces urban heating, reduces carbon footprints, increases pedestrian safety, and beautifies the neighbourhoods. The GIN solutions overview the many strategies used in local or residential neighbourhoods and the street system. For example, the permeability of the roadway can be increased by constructing the street's edges to allow runoff to flow into a landscape area or space within the paved area of the street can be converted to landscape, increasing permeability (Im, 2019). Additionally, water can be temporarily stored before infiltration using permeable paving that is strong, load-bearing, and constructed with an underlying reservoir (Ramkumar & Moorthy, 2019).

In most urban areas, commercial streets must handle many users and uses, including pedestrians, vehicles, cyclists, transit users, on-street parking, outdoor seating, lighting, and trees. Several design

options can be considered when incorporating stormwater management into the streets. For example, some areas, such as street tree pits, can collect runoff or curb extensions at the corners that can turn into rain gardens. Rain gardens collect and retain water for some time and use it to nourish biomass (Sharma & Malaviya, 2021). Similarly, residential streets, stormwater curb extensions, or curb bulb-outs improve pedestrian safety and traffic calming. Rain gardens can manage runoff, often placed near corners for stormwater control and pedestrian crossings. Mid-block curb extensions can also create parking spots while still calming traffic. Furthermore, pavers and porous asphalt in parking lanes, and permeable paving let rainwater soak into the ground. The creative method manages stormwater well and visually narrows streets for better traffic calming. It is helpful for sidewalks and parking lanes in faster areas or spots needing parking, like loading zones and bus stops. On the other hand, vegetated swales serve as natural channels that facilitate the settling of sediments and pollutants from flowing water, achieved through their interaction with plants and soil, which slow down the water's movement. Lastly, stormwater planters, designed containers often linked to soil, store a lot of water in a small space. It holds plants and acts as water reservoirs and street trees that manage excess water by allowing it to overflow into a connected storm sewer system.

Vast stretches of pavement, limited vegetation, and inadequate attention to pedestrian requirements are the frequent characteristics of arterial or main streets in many neighbourhoods, towns, and cities (Im, 2019). Solutions such as grassy or groundcover medians can be modified to accommodate rainwater, significantly reducing runoff and helping maintain water quality. Road dieting can be used when there is no nearby landscape space. A road diet is a technique in transportation planning whereby the number of lanes and the width of the road are reduced. It entails figuring out how much paved area can be turned into green space and how much is required to manage travel safely (Nolan, 2021). Moreover, permeable paving can be integrated into long, linear stretches or uninterrupted spaces for pedestrians and cyclists. The solution can be implemented within sidewalks and parking lanes to provide effective permeability for stormwater management supported with the rain gardens, which the planted area covered with vegetated or landscaped depression. In addition to controlling runoff, GIN allows remodelling streets with sidewalks, on-street bike lanes, or landscape-separated cycling greenways to make them more people-friendly.

Besides, minor streets and alleys constitute many impermeable surfaces in many towns and cities that are prone to flooding and often not connected to the sewer system. Thus, permeable paving is a suitable choice, which is characterized by low traffic and low speeds, making them ideal locations for the implementation of environmentally friendly paving solutions. Stormwater management can also be enhanced by introducing vegetated swales and planters along the edges of streets and alleys, providing a green solution to handle runoff effectively. These are examples of green street systems that can successfully treat the runoff and lessen flooding.

3.0 METHODOLOGY

3.1 Study Site

The study of street networks as GIN in a neighbourhood setting is located at Ulu Klang, Selangor. The street network consists of Jalan Ukay Perdana with three hierarchies of the street: Primary, secondary, and minor streets of Ukay Perdana adjacent to the residential flats, including Sri Impian, Sri Wira, and Sri Melor flats in the Ukay Perdana residential area. The location of the case study is chosen to be within a radius of between five hundred metres and one kilometre from the Sri Impian flat in Ukay Perdana, Selangor (Figure 2). The site is an example of a neighbourhood environment in an urban fringe of Selangor. The site indicates a circulation network of a typical street hierarchy,

in which minor roads lead to the main highways. There are residential, business, and green amenity areas, in addition to transportation areas, that are located along the routes that run through the neighbourhood. The adjacent neighbourhood areas of Ukay Perdana are Kemensah and Zooview Park. The site is within the jurisdiction of Ampang Jaya Municipal Council (MPAJ) under Planning Block 5 (*Blok Pembangunan 5*/BP5). Ampang Jaya is municipal and consists of 9.1% of the total population in Selangor state, which is 612,126 people with an average household of 3.5 (Rancangan Tempatan Majlis Perbandaran Ampang Jaya, 2020).

Fig. 2: The study area
(Source: Adapted from Google map)

Fig. 3: Drone image of Jalan Ukay Perdana

3.2 Data Collection and Analysis

The primary method of data collection is qualitative. The spatial mapping and analysis used drone images to get detailed information in the determined radius of the site. The data is supplemented with site observation of the Jalan Ukay Perdana street network. In addition, literature reviews on definitions, concepts, and solutions for streets using GIN support the primary data collection. The spatial mapping and site observation were conducted to explore GIN elements in the housing area's street network. Three hierarchies of Ukay Perdana streets were identified: the main, secondary, and minor roads of Jalan Ukay Perdana. These identify the availability of transport corridors, tree-lined streets, pedestrian networks, and linear open spaces. Areal view taken from images using drone survey were used to obtain real-time images of the study site. Once acquired, the images were transferred to AutoCAD maps to see the details of the spaces and street network in the form of built and natural elements. The site observation was then carried out based on the data produced by the AutoCAD map. This is to verify the spatial analysis maps and to get detailed images of the streets. Hence, the images of the street network and its conditions were recorded and analyzed using photographs. The methods are the main data collection of the research aimed at analyzing the existing condition of the study area before proposing GIN solutions for the street network.

4.0 RESULTS AND DISCUSSION

Figure 3 displays the representation of Jalan Ukay Perdana streets utilising an aerial view image captured by a drone. The varying hues of lines depict the three distinct levels of street hierarchy. Utilising this image, the final AutoCAD map of the location was generated, as depicted in Figure 4. This map effectively portrays the surroundings and terrain within a 500-metre perimetre around the Sri Impian flat, extending to the neighbouring vicinity.

Fig. 4: AutoCAD map showing the road systems, housings and greenery of Jalan Ukay Perdana within a 500-metre radius of Sri Impian Flat

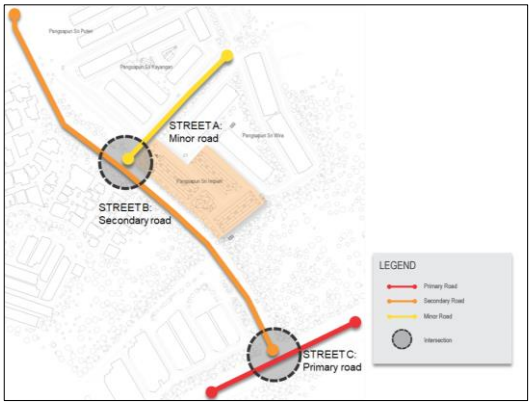

Fig. 5: AutoCAD map showing Jalan Ukay Perdana consisting of primary, secondary, and minor roads and the compound of Sri Impian flat

Utilising photographic images from on-site observation data, the street network of Jalan Ukay Perdana was documented and analysed through the final AutoCAD map. The spatial mapping process was augmented with photographs that captured and assessed the linear spaces, green network features (such as connectivity, walkability, trees, and greenery), and built facilities within the street network. This data forms the foundation for identifying issues, potentials, and prospective solutions related to the street network. The extraction of the street network, a pivotal aspect of this research, is depicted in Figure 5. This encompasses (a) Street A - the minor road of Ukay Perdana in front of Sri Impian flat, (b) Street B - the secondary road together with its intersection, and (c) Street C - the primary road of Jalan Ukay Perdana, in conjunction with its intersection leading to the Middle Ring Road 2 (MRR2).

4.1 Street A: Minor Road of Jalan Ukay Perdana in front of Sri Impian Flat

The street is positioned in front of the entrance to the Sri Impian flat, spanning an approximate length of 440 metres from the intersection to the Tanah Perkuburan Islam Ukay Perdana. Spatial analysis indicates that the street predominantly comprises parking spaces for the residential flats of Sri Kayangan, Sri Impian, and Sri Wira, situated on both sides of the street. Notably, the green elements, mainly composed of *Peltophorum pterocarpum* (Angsana) trees, are primarily arranged in sequences along the roadside facing the Sri Impian flat. Clusters of trees are evident at the junction of Street A and Street B, and similar clusters of vegetation are observable close to the cemetery area. Concerning connectivity and walkability, observations reveal the absence of designated sidewalks with appropriate hard surfaces on both sides of the road.

The lack of appropriate sidewalks forces pedestrians to utilise the existing spaces as incidental sidewalks, which are devoid of trees. This situation is also used by residents and guests as parking spots. This state was also visible in images taken during site observation as shown in Figure 6, where most of the street networks were devoid of human activity for most of the day. Adjacent to the entrance of the Sri Impian flat, a spacious area is earmarked for a children's playground and community space. Consequently, efforts are required to establish connections between these spaces, the flat's compound, and the minor street of Jalan Ukay Perdana. Additional photographic analyses of the minor street are presented in Figure 6. Based on observations, the area exhibits potential for

developing a green network, featuring well-designed sidewalks and shaded planting along the roadside, in alignment with the Green Infrastructure Network (GIN) solutions proposed in the literature review.

(a) Random parking spots at the intersection of minor and secondary roads due to lack of proper sidewalk

(b) View towards the minor road from the intersection showing asymmetrical tree planting on the sidewalks.

(c) The main entrance of Sri Impian flat is also crowded with vehicles, blocking the entrance's view

Fig. 6: Analyses of photograph images of the minor street of Ukay Perdana

4.2 Street B: Secondary Road of Jalan Ukay Perdana including the intersection.

Figure 7 illustrates the attributes of Street B extracted from a drone's image, while Figure 8 depicts the photographic analyses gathered from on-site observations. The distance from the intersection to Sri Impian flat, extending towards the primary road of Jalan Ukay Perdana (Street C), is roughly equivalent to that of Street A.

Fig. 7: Drone image of Street B: Secondary Road of Jalan Ukay Perdana

Observations on-site (Figure 8) indicate an absence of appropriate pedestrian infrastructure within the transit system and the neighbourhood area. Adequate sidewalks are not provided to enable pedestrians to journey comfortably and safely to their intended destinations or bus stops. Furthermore, the presence of proper walkways connecting different locations is notably absent.

(a) Front view of the bus stop across the main street

b) No proper sidewalk along the street

(c) Undesignated parking space near the bus stop

Fig. 8: The flat close to the transit system but without a properly connected pedestrian walkway.

Most trees predominantly consist of *Peltophorum pterocarpum* trees, strategically planted along the secondary street. These trees serve as canopy and shade providers, intermittently covering the sidewalk of Street B. Nevertheless, despite the public bus stop being conveniently situated within a one-minute walk from the flat, the absence of a designated sidewalk and a suitable crossroad poses challenges in connecting residents to the transportation facilities and the neighbouring residential complexes.

(a) Street intersection between minor and secondary road shows possibilities of sidewalk with good surface and pedestrian crossing

b) The secondary road leading towards he primary road of Ukay Perdana is inked with trees and provides shade nd scenic views

(c) The bus stop is very near to Sri Impian flat but with no proper pedestrian sidewalk.

Fig. 9: Analyses of photograph images of the secondary road of Ukay Perdana

On the other hand, the pedestrian environment along the secondary street of Jalan Ukay Perdana is expected to offer comfort and perhaps even enjoyment. This can be attributed to the tranquil surroundings, picturesque views, and relatively low traffic flow. Plus, the presence of trees enhances the visual quality of the landscape and offers shading benefits along the street network when strategically planted. Figure 10 portrays the trees and greenery that constitute the Green Infrastructure Network (GIN) of the neighbourhood. However, within the premises of the Sri Impian flat, most of the greenery is accommodated in pots and planter boxes due to spatial constraints. Consequently, the housing blocks would benefit from increased green areas, such as community gardens, kitchen herb gardens, and even vertical gardens, to enhance the overall greenery within the compound.

(a) Shaded trees along the street

(b) Shade area becomes undesignated parking space

Fig. 10: Shaded trees planted along the street provide comfort and safety for walking and activities.

Furthermore, the trees contribute to a sense of security, as they create incidental spaces along the streets that can be utilised for outdoor and community activities. Substantial, shade-providing trees will create incidental spaces, encompassing sidewalks, open areas, and parking zones. These spaces address the absence of designated pedestrian walkways connecting different spaces or buildings, provide open areas for outdoor activities, and offer supplementary parking capacity when the existing area is utilised for community events or celebrations. Therefore, the pedestrian-friendliness of the street is contingent upon the presence of a proper and designated sidewalk, allowing residents to navigate the area on foot or by bicycle while ensuring comfort and safety.

4.3 Street C: Primary Road of Ukay Perdana leading to the Middle Ring Road 2 (MRR2)

The central thoroughfare is Jalan Ukay Perdana, serving as the primary street hierarchy that interconnects various residential edifices within the Ukay Perdana residential neighbourhood. It establishes links between all the nearby residential enclaves to the vital thoroughfare, the Middle Ring Road 2 (MRR2). Along the roadside, a profusion of shaded trees has been thoughtfully planted.

(a) Lack of sidewalk even though the trees and greenery provide enough shade along the street

(b) Other secondary streets of Jalan Ukay Perdana leading the primary street to various residential buildings

Fig. 11: Analysis of the photograph images of the main street of Ukay Perdana and the intersection

The community amenities, including shops, a playfield, and a mosque, lie within a radius of 500 metres, approximately equating to a 10 to 15-minute stroll from the Sri Impian flat. However, once again, there is an absence of pedestrian walkways facilitating access to these amenities along the street or across to the opposite side of the road, such as the route to the mosque. The Ukay Perdana mosque, situated close to the junction of Street B, remains reachable only by vehicles. The findings from observations indicate the lack of suitable pedestrian walkways and designated crossings for residents to reach various facilities, including bus stops along the street, convenience stores, and mosques, either on foot or by bicycle. Moreover, pedestrians encounter hindrances in traversing the expansive road to access facilities on the opposite side of the street. Additional analyses delving into the conditions and attributes of the main thoroughfare are portrayed through photographic images in Figure 11. However, the primary road must be undergoing alterations due to its incorporation into the evolving road network within the Gombak district.

5.0 CONCLUSION AND RECOMMENDATIONS

This research emphasises the importance of recognising the Green Infrastructure Network (GIN) within urban low-cost housing to meet the needs and well-being of the local community. Consequently, people's contentment with the neighbourhood environment should be considered across a spectrum of income groups, ensuring their comfort and quality of life, particularly amidst the rapid development of urban areas. The residential neighbourhood of Ukay Perdana, characterized by its numerous low-cost flats, is strategically situated in a comfortable locale. The data has

demonstrated that the street networks possess spaciousness and are amenable to enhancement through GIN solutions. Spatial analysis and site observations have highlighted several challenges regarding connectivity and walkability, affecting the accessibility to various locations within the neighbourhood. This encompasses the necessity for appropriately designed sidewalks, pedestrian walkways, public rights of way, or even potential linear spaces along the three streets of Ukay Perdana. However, these challenges have the potential to be ameliorated owing to the positive attributes inherent in the street network. Moreover, introducing a green network comprising planting strips, planter beds, vegetated bioswales, rain gardens, and permeable pavements will champion the natural ecosystem and foster biodiversity conservation within the 'green street'.

This concept has been previously discussed in the literature review section. Given the extensive potential for enhancing the street network within the neighbourhood, this section puts forth essential solutions for improved planning of neighbourhood street design in a low-cost housing area. The Green Infrastructure Network (GIN) street solutions presented here are intended to facilitate more effective future neighbourhood planning, aiming to achieve sustainable living and well-being for the local community, particularly the low-income demographic.

Figure 12 illustrates and visualises the recommendations for the intersection between the minor and secondary streets of Ukay Perdana. Such solutions can also be adapted for the arterial or main street of Jalan Ukay Perdana.

Based on the specific recommendations for the streets studied, the following recommendations highlight feasible solutions within the context of urban neighbourhoods, focusing on aspects of access, connectivity, walkability, and public transit improvements:

1. Establish transportation transits and nodes within walking distance from the flats, integrating a transit system with pedestrian pathways to ensure eco-friendly mobility. Then, implement lay-bys for transport transits and nodes to mitigate traffic disruptions.
2. Develop integrated pathways to regulate vehicle speeds. Comfort and secure pedestrian and cycling paths can be established by prioritizing bicycle and motorcycle lanes and incorporating road design elements that encourage lower speeds.
3. Apply universal and barrier-free designs to interconnected pathways to foster a walkable community, connecting community centers, commercial districts, and public spaces.
4. Utilise natural boundaries (trees, shrubs, and ground cover) to mitigate noise and enhance biodiversity. Street planting forming a natural boundary can buffer against street pollution, reduce surface water runoff, mitigate the urban heat island effect, and contribute to biodiversity conservation.
5. Maximise urban tree canopy to provide optimal shading for the street network.
6. Implement streetscape design and planting strips for pedestrians to enhance the aesthetic quality of tree-lined streets. A green network integrated along pedestrian walkways, streets, and parking areas offers shaded landscapes but also aids in stormwater runoff infiltration and enhances the visual appeal.
7. Design incidental spaces within small and linear areas along the streets.
8. Utilise low-emission materials and permeable paving in streetscape elements to aid stormwater runoff infiltration.
9. Deploy catch-basins like swales for managing water run-off.

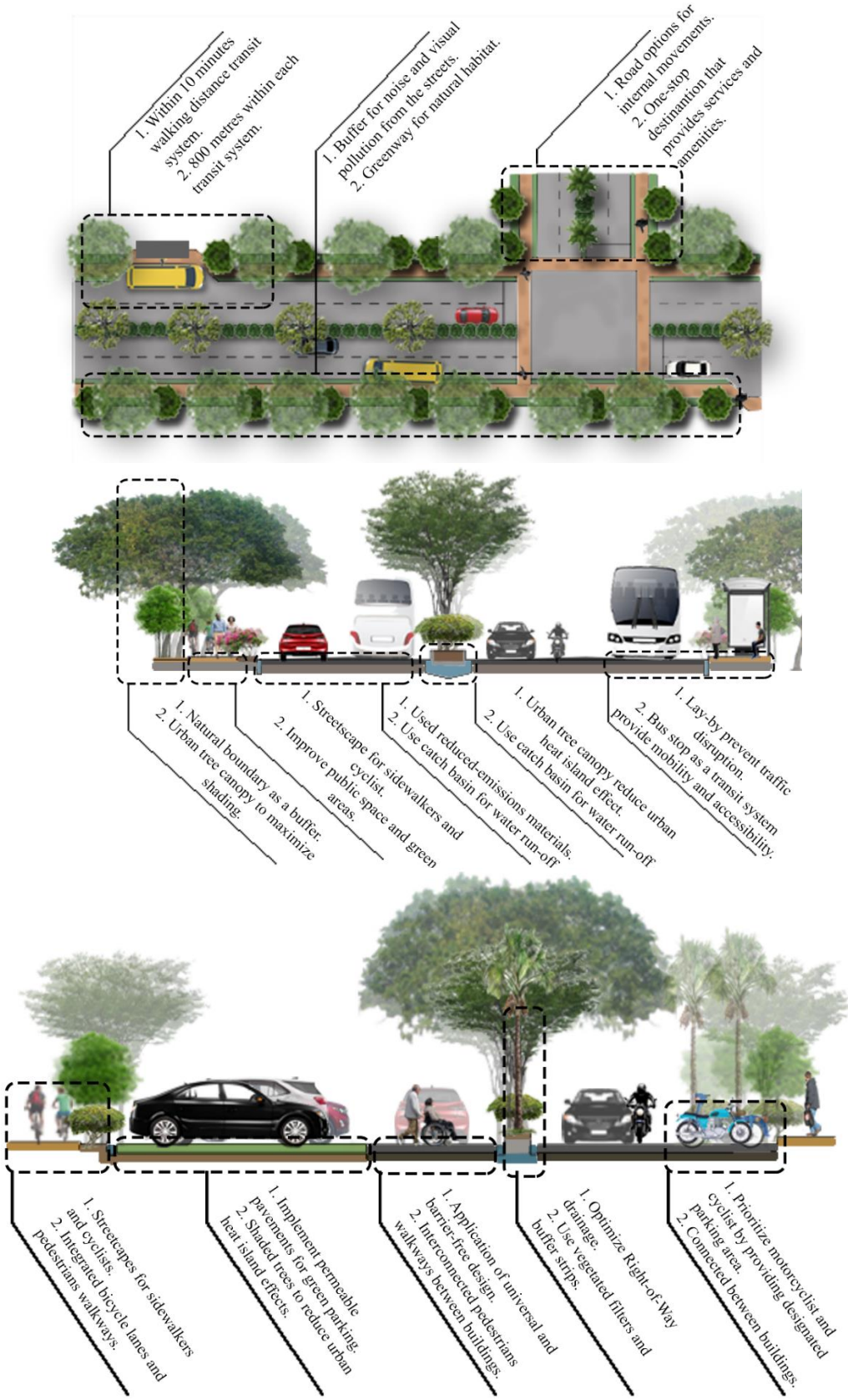

Fig. 12: Plan and section views of the street design layout at the intersection of minor and secondary streets of Ukay Perdana showing recommendations for the streets

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