# The Library as an Architectural Typology and Social Infrastructure

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Abstract

Nowadays, political and socio-cultural transformations encourage public libraries to become platforms within communities by implementing new changes to their functions. Thus, future public libraries are anticipated to form social infrastructures maximizing their interventional impacts such as transport infrastructures, educational facilities, and public spaces. Accordingly, equal access to resources, socialization, and learning will be the priorities to distinguish the library as a probing place, interrelating with citizens and all surrounding sites.

Transforming typologies such as public libraries into adaptive social infrastructures requires that the concept of socialization be modified in both library's design approach and the library's location with regard to space syntax parameters in an urban context which is one of the objectives of this study in the urban context of Auckland. In the meantime, the Auckland public libraries have tried to develop services; however, the extensions are predictable with limited development. That is why still there is a gap in scholarly research about public libraries in Auckland. In fact, the concentration on libraries' services extension is not necessarily the way to construct/strengthen sociability, but a strategy addressing the public libraries to make connections directly from inside to outside and conversely be a reasonable way which is another key target of the aims of this research study. Hence, the new approach will be expected to boost the opportunity of forming a "public-interior" but in the form of an open space that is not under the same roof to give the term "public access" within the location to break the boundary between the library, location, and the surrounding urban context. With regards to the above, this study reviews a scenario analysis including a group of public libraries in a different country to achieve the experience that leads to a set of analyses on the formation of Auckland public libraries.

This research deploys a range of analytical ways for evaluating the space-society interrelation. As regards methodology, this analysis uses the qualitative method via applying mapping and space syntax methods.

From a practical viewpoint, the outcome of this study has the potential to lead to a model of approach to strengthening the sociability of the future libraries in urban context, specifically in the case of Auckland. Besides, it will also open a perspective, providing insights on possible additional contributions to the Auckland 2050 plan to better incorporate public libraries in each of the four nodes as a part of the social infrastructure.

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## Attestation of Authorship

I hereby declare that this research study submission is my own effort, which is the outcome of my knowledge and belief. There is not any former published writing by another researcher or expert except where clearly noted and explained both in the text and the references list. Besides, I have not used or applied artificial intelligence tools.

Ali Mohammad Khalili

February 2025

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Thank you to my family for supporting me throughout my research study. I am forevermore appreciative to my parents.

I highly appreciate my supervisors, Prof. Charles Walker and Prof. Ali GhaffarianHoseini. I was inspired to have your guidance and perspective throughout this research study, which was a great privilege for me.

# Chapter 1.

# Introduction

# Chapter 1

## 1.1. Research background and context

The public library is the public place that is not dictated by ruling and not restricted to transactions or any particular functional activity. The public library is an expression of investment for the common good. With that being said, public libraries are initiatives, among other things, that let us perceive the world and human nature. In fact, a public library causes the sense of collective resources as a physical platform for an entire community. To a degree, the role of the public library has been naturally a result of the intended function of making an opportunity to have access to a wide range of information in the physical space. In the meantime, the ongoing changes in human life have caused gradual updates, which have led the public library to come to the attention of the extent to which it can contribute to its function of providing a place for co-presence and encounters.

Nowadays, political and socio-cultural transformations encourage public libraries to become platforms within communities via implementing new changes to their functions. Thus, future public libraries are anticipated to form social infrastructures maximizing their interventional impacts such as transport infrastructures, educational facilities, and public spaces. According to (Klinenberg, 2018a, p. 4), public libraries as social infrastructure shape the way people interact. He, accordingly, added that the libraries are just as important as the highways. Having said that, public libraries are not singular platforms of resources in urban spaces, but they are members of an interconnected network of functions serving a community. Hence, they exist in an urban's larger network of social-cultural institutions. With regards to the above, I would like to clarify the meaning of ‘infrastructure’ and ‘public’. According to (Frischmann, 2012, pp. xiii-xvii), infrastructure is the underlying framework of a system. It could include traditional and non-traditional infrastructure such as transport systems and environmental infrastructures. According to Frischmann (2012, p. 91), all infrastructures have some common specifications: the governmental sector plays a key role in their preparation, they tend to be obviously accessible, and they produce important spillovers which lead to wide social gains. Accordingly, these specifications are related to the public library characteristics such as the tendency to be obviously accessible and its preparation by the council, and specifically, its nature which according to Frischmann (2012, p. 253) is the description of cultural-intellectual infrastructure that includes democratic participation, socialization, and many other social activities such as ideas, common-purpose researches, and cultural events. The public library as one node in a local community comes with the term "public". Calhoun describes that "public" likely refer to:

(a) the people, interests, or activities which are structured by or pertain to a state; (b) anything which is open or accessible; (c) that which is shared, especially that which must be shared; (d) all that is outside the household; and (e) knowledge or opinion that is formed or circulated in communicative exchange, especially through oratory, texts, or other impersonal media. (Calhoun, 2005, p.282)

With regards to the above, there are some points in relation to public libraries that are constructed by the government. Auckland public libraries are managed and ruled by Auckland councils. The flowing of ideas, learning, and science has a direct relation with the identity and purpose of public libraries. Finally, public libraries are accessible places to public spaces. According to Calhoun (2005, p.283), public libraries make the possibility of interaction lead to connecting strangers. Similarly, Iveson (2007, p.4) believes that public libraries are the specific places that should be open to community members in the city.

This research intends to study public libraries that are suburban branches. These libraries are located within the proposed multi-nodes that are undergone development according to the Auckland plan 2050. These places act as everyday public locations. According to Mattern (2014), public libraries are the specific places for collaborative spaces which let them become social and intellectual infrastructure.

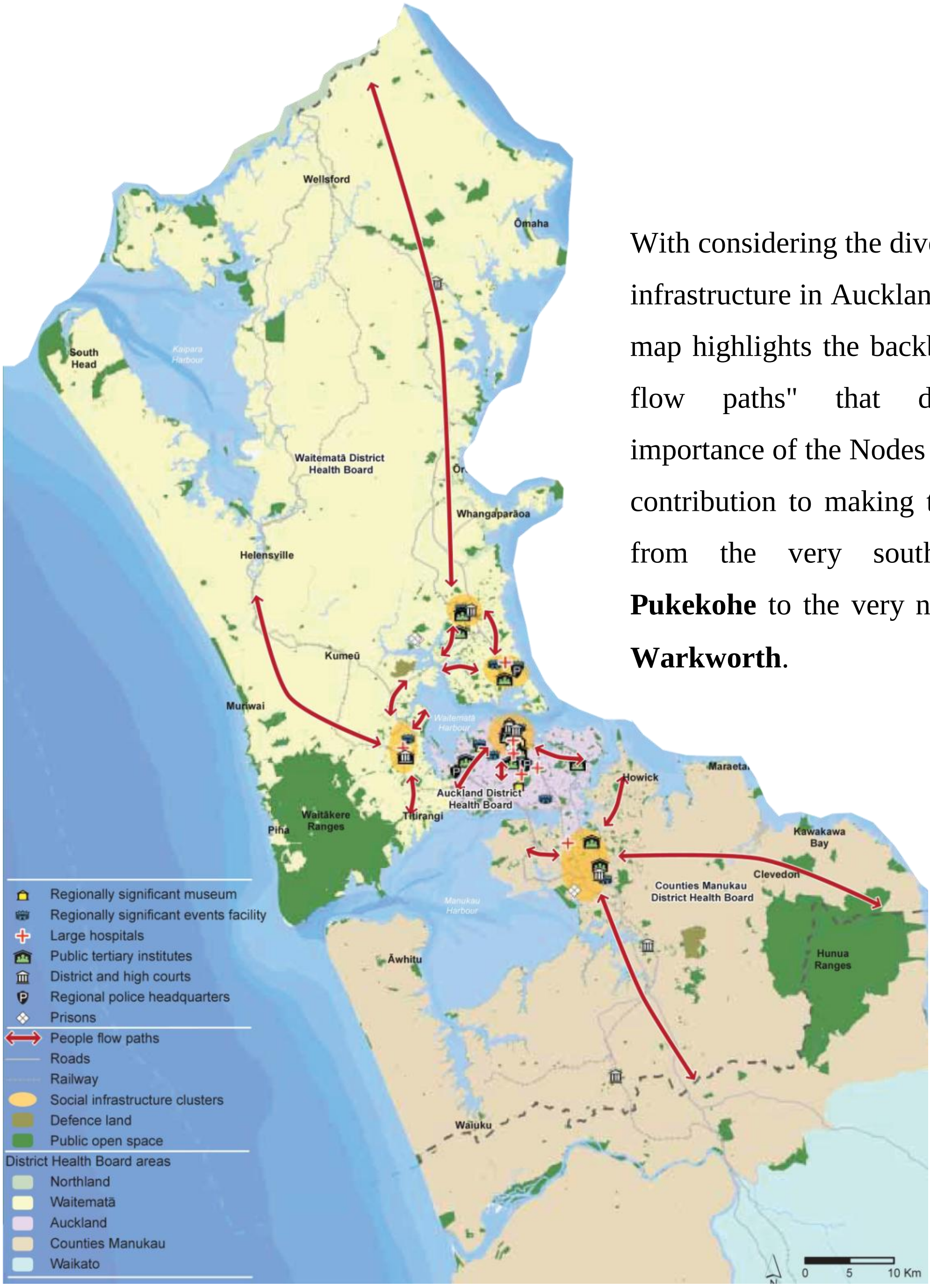
Accordingly, equal access to resources, socialization, and learning will be the priorities to distinguish the library as a probing place, interrelating with citizens and all surrounding sites. In fact, a large proportion of how the contribution of the public library works productively in a community is a result of its 'strategic' location in the local urban network space. Having said that, the public library produces the meaning of participation by distributing functions, encounters, and interactions both in community and in a physical space.

The intention is, within the set multi-nodes of Auckland, to take a broad approach to the subject - the connection between public libraries' locations and the urban spaces, and to develop a methodology for the analysis of it. Hence, a set of questions will be raised. Organizing the questions, the introduction of a set of discussions based on the literature review and analysis will generate knowledge and comprehend the public libraries as a social infrastructure within the urban spaces network.

- **Purposed context with regards to Auckland Plan 2050:**

According to the Auckland plan, from fast and efficient public transport services delivering the Auckland of the future, to fundamental water services delivering a basic human right; from public libraries providing local communities with access to knowledge, to ports and airports connecting Auckland to the world; infrastructure is the platform upon which Auckland is built. Accordingly, it influences where and when significant urban growth can occur, especially in future urban areas.

According to Chapter 12 of the Auckland plan, one of the priorities of Auckland plan 2050 to make Auckland liveable and resilient is to Protect, enable, align, integrate and provide social and community infrastructure for present and future generations. Hence, infrastructure refers to a broader range of services and includes investments in public spaces such as libraries in Auckland.




With considering the diversities of social infrastructure in Auckland, the Auckland map highlights the backbone of "people flow paths" that distinguish the importance of the Nodes because of their contribution to making the connectivity from the very southern node of **Pukekohe** to the very northern node of **Warkworth**.

Figure 1.1. Map 12.1 Social Infrastructure (Chapter 12 Auckland's Physical & Social Infrastructure)

Section 79 of the Local Government (Auckland Council) Act (2009) directs the Council in the Auckland Plan to identify the existing and future location and mix of critical infrastructure, services, and investment within Auckland". For the purposes of the Plan, critical infrastructure is defined as "Infrastructure assets, services, and systems which are fundamental to the long-term well-being of the community, and contribute to Auckland’s liveability, such as those components relating to cultural and social infrastructure (e.g. public open space and libraries)”.

With regards to the above, social Infrastructure is a subset of the infrastructure sector and typically includes assets that accommodate social services. Accordingly, public library is recognized as a social infrastructure.

With referring to the Chapter 12 of the Auckland plan;

1. Part of integrating social infrastructure planning into the compact city model is maximizing the benefits of clustering facilities within a hierarchy of centres. Effectively, it is expected of developing a network of community facilities designed to meet the full range of needs that public libraries are one of the facilities.

2. Community infrastructure promotes a range of different outcomes we value, such as community cohesion and positive social outcomes. Some facilities such as libraries could help Aucklanders learn more about themselves, their heritage, and their unique identity. The Council recognizes the role these services play in enhancing understanding of Auckland's different communities and bringing Aucklanders together.

## 1.2. Research Problem and Gap

With putting the aforementioned in perspective, the research problem of this study is considered aligned with the Auckland plan 2050 strategy for the selected Multi-Nodes.

As a public domain, a public library needs to be a civic network and a political emblem to combine knowledge and the importance it holds in society, which doesn’t automatically lead to an exchange of knowledge, ideas, and inspiration. To achieve that, the library needs to stimulate curiosity, reflection, and conversation.

In view of the above, the key issue with current public libraries in Auckland is the pinpointed features of public libraries that are yet to be reflected in the radius of the libraries’ surrounding via their architecture. Besides, the principal challenge facing the provision of social infrastructure under revised Auckland governance arrangements is to ensure fair access to services, as not all communities enjoy the same levels of service. An associated challenge is to establish new structures and arrangements which engage local communities, identify their needs and provide appropriate services. Accordingly, it is indispensable such social infrastructure be able to promote public participation.

### 1.3. Research objectives and contribution

With regards to the description noted through the research problem and gap, this study undergoing to explore a path toward addressing the outlined gap. On the one hand, there is a gap in promoting public participation, which causes neglect of the socio-cultural conditions of the community. Hence, such a stance causes disregard in order to the community members and recognition of their diversity of experiences with different backgrounds, which is more visible in calm and less populated suburbs such as **Warkworth** and **Pukekohe**. With that being said, if there is a quiet suburb with not many activities, then the potential of a public library could bring people together in the same place, which is dependent on the measure of sociability. On the other hand, sociability is not achievable only by libraries' services, but it also needs the breaking boundary between the public (street), the library, and its location, which leads to improving urban integration. To achieve this, utilizing the method of space syntax and realizing the theory of permeability are indispensable.

With regards to what discussed so far, the following main question and two objectives address the gaps;

- How can spatial modelling and design-led strategies reposition suburban libraries as socially integrated infrastructure within Auckland?
    - Evolve the concept of public library, within the context of Auckland, and promote public participation.
    - Break the boundary between the public (street) and internal location, including the public library and its site, to improve the urban integration of public libraries in Auckland.

The above questions are addressed by adopting the mapping approach and space syntax method. Hence, according to Cooper and Schindler (2014), mapping is the research method, which includes secondary data collected from online databases to help in conducting the study. Thus, this study is grounded in the use of relevant secondary sources in the field of urban planning and architectural designs of public libraries, which is including of comprehending the maps as the strategy for the visualization of data and ideas. These processes will be detailed in the further section. In the meantime, the methodological approaches will highlight the **contribution** of this study to the knowledge, which would be discussed in this section.

The major **contribution** of this study lies in the formation of collective values by public libraries as social infrastructure. Thus, the intention is not only to apply the theories from space syntax, but this method also lets this study analyse the urban space layouts and human activity patterns, whether by reaching the locations of public libraries or the surrounding urban areas of public libraries. In the meantime, linking space and community will be promoted by employing a set of theories of Space Syntax. In fact, the method lets us realise where people are, how they choose to move toward public libraries' locations, and how it is possible for libraries to be developed in the same place.

Hence, by employing the Space Syntax in this research, it is expected that the **contribution** of this study will provide representations of urban space at the location; the analysis of relationships between the public library's location and the urban context, which can be used in various measures such as **integration** (ease of access) and choice (passing flow); and also, the exploration of the relationships between public space such as public libraries and social patterns, which helps to understand how the public libraries are better to be formed and oriented as social infrastructure.

### 1.4. Theoretical Framework

With regard to the objectives of this research study, it is necessary for this study to consider the transformation of public libraries because it is fundamental to understand their formation as a typology that may disclose how they perform their social intentions through the organization of architectural space. As Bennett (1995, pp. 6, 71) argued, public libraries like museums and international exhibitions have an intention to educate society via "communicating a specific cultural meaning and value". By having this, 'Public access' is the key to the formation of public libraries that need a transformation from controlled places to informal social environments. Here, a public library would be a "public-interior" but in the form of an open space that is not under the same roof to give the term "public access," which could be a kind of meaning of social infrastructure in the context of the library. Here, the library is not just a generative field to form the structure of distribution of movement, co-presence, and interaction, but it also is a generative field to form connectivity with surrounding local urban spaces in the context of urban integration.

With regards to the above, how public libraries within the context of Auckland could combine open access and public participation? To replace the libraries as informal social environments instead of places of discipline and social control, the public libraries need fundamental shifts in how relations between society and libraries manifest. Accordingly, architecture has a pivotal role in these transformations. Hence, the first objective of this research study is to break the boundary between the public (street), the library, and its location to improve urban integration of public libraries in Auckland.

The undergoing transformation of public libraries is looking for a shift from a place where visitors were discouraged to interact with each other, to a place where people are interested to interact informally. With that being said, the transformation would propose a weakening of the boundary between public libraries and urban spaces. Hence, this part of the study addresses the ways in which new routes can boost the permeability through the site. This research study applies space syntax studies since they propose a methodological framework to analyse the relationship between location arrangement and templates of use. Accordingly, space syntax study displays the potential arrangements of new routes within locations that may limit or liberate forms of occupation and movement in combination with libraries' buildings.

According to Hillier et al. (1993b, p. 29), activities and interactions within buildings have a structure in how they should be implemented, while public urban spaces do not have such structure. Accordingly, this description not only exposes the potential of a building configuration in creating the opportunity for movement and occupancy, but it also performs the potential of how a location be connected with other urban spaces.

With regards to the above, we face the position that public libraries are arranged in outward-facing blocks like other buildings, so the building entrances continuously open to the space of public access (Hillier, 2007, p. 171). He argues that there is a direct link between the space of public access and the greater or lesser degree of linearization of space, and also, forming of the town. In the meantime, the linear structure lets the building entrances be linked to a pattern of the urban space which also links to the edges of the town. With regards to the above, the more regularized linear organization not just causes a better ‘axial map’ of the town, but also causes stronger integration driving the template of movement, distribution of land uses, public open spaces, landmarks, and building densities. **Secondly**, one part of a spatial complex such as a local area, town, or building is visible at a time by the movement which let to be comprehended as a whole. According to Hillier (2007, p. 185), progressively moving synchronizes the relations of spaces, and the effect of synchronizing could be stronger if there is a larger convex space or the longer axial space. **Thirdly**, the relation of building form and its location with urban space is to be considered. The building form is visible from some specified points in urban space whether partly or wholly. Hillier (2007, p. 187) mentioned that two different shapes will be concluded, which include ‘part-façade isovist’ and ‘full-façade isovist’. To understand the above, this study suggests an analysis approach, which needs to be drawn from the buildings' forms. In this way, the exterior form of each selected public library in Auckland should be drawn from each vertex of the buildings as far as possible from any part of the facade that can be seen. This method lets us have a comparative mapping of a combination of the shapes that emerged by the two vertices. This procedure explores the part-exterior building isovist of each public library and the intersection of the two shapes which is the full-exterior isovist.

With regards to the above, the space syntax method let us not only explore the relationship between built objects, but it provides a new window to realise the relationship between society and the public spaces such as public libraries, which also brings the opportunity for the method to facilitate the description of the spatial features of a sustainable city. Hillier (1996, pp. 53-54) argues that “How the urban system is put together spatially is the source of everything else”, which refers to his (2016, pp. 199-212) concentration on theories related to space-society relationships between buildings. This study exploiting Hillier's (1993a, pp. 8-27) distinguishment between extrinsic and intrinsic properties of space, applies the space syntax method as it works with extrinsic properties since it explores how space is related to other spaces within a spatial system. As the theoretical framework of this study takes into account the relations between public urban spaces and social patterns, space syntax is the way. With regards to this, considering extrinsic properties, convex space, isovist fields, and the axial line will be three spots that will be worked in this study via space syntax.

Accordingly, the developed theories of space syntax let us comprehend the productivity of the method for comparing before the condition of spatial changes and after the condition that will be offered via a proposal model. Hence, as this study will concentrate on public libraries' locations in terms of their relations with surrounding urban spaces, then it is crucial to realise how the urban spatial systems work with locations in retrospect and how it works in the future via the proposed model.

As part of the road frame, this study offers to bring the effects on building form isovists into attention, which will be from different types of axiality. As this point of view is very influential on the permeability of the selected locations of public libraries in Auckland, it is necessary to be analysed via this research study. Hence, it is crucial whether such public buildings are located in visible and larger-scale locations. Accordingly, it is questionable whether people can only see sideways the building forms, and whether they are visible in small or big-scale isovist, which will be studied through further sections. In the meantime, it will explore the degree to that views of public libraries in outward-facing blocks are axially synchronized and also explore the degree of convex the axial, which let the presence of public libraries become more pervasive and more invariant if there is the opportunity of having the more convex the axial.

### 1.5. Methodology and approach

Regarding methodology, this research study applies a qualitative research method to address the question of this study. In the meantime, a limited number of simple calculations will be applied to add accuracy and persuasive power to the qualitative description. This study followed a structured sequence from problem framing, and the main data-gathering technique is included spatial analyses applying the space syntax method via computer software to agent-based scenario analysis, which also needs to be applied to the computer software, and contextual SWOT analysis.

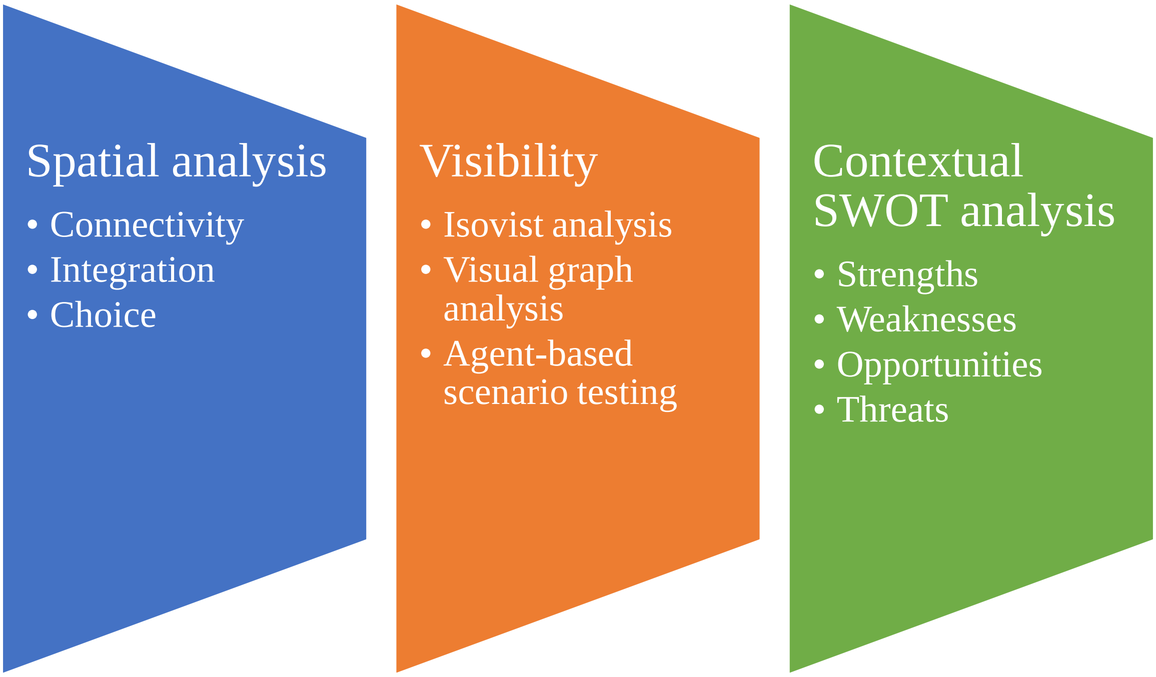



Chart 1.1: Proposed methods of the methodology (By author)

The spatial analyses of the selected libraries' locations apply mainly methodological techniques from space syntax research. In particular, this research performs 'connectivity analysis,' 'integration analysis,' 'choice analysis,' and the visibility analysis that leads to the agent-based model scenario analysis. Accordingly, I will explain in detail in Chapter 3, which supports this study, a clear understanding through the review of an international scenario analysis via space syntax tools. In the meantime, the outcomes from Chapter 3 enable this study to analyse the four selected libraries' locations in Auckland in Chapter 4 via space syntax parameters to agent-based model scenario analysis.

According to what was earlier noted, urban situational assessment of the four selected locations will be implemented via SWOT analysis as part of the methodology of this study in Chapter 5. Obviously, this analysis identifies four indicators of strengths, weaknesses, opportunities, and threats, which let this study explore an image of the selected locations' interaction with their surrounding environment.

With regard to the above description, the figure 1.2 presents the whole phases of this study that the proposed methodology is involved with.

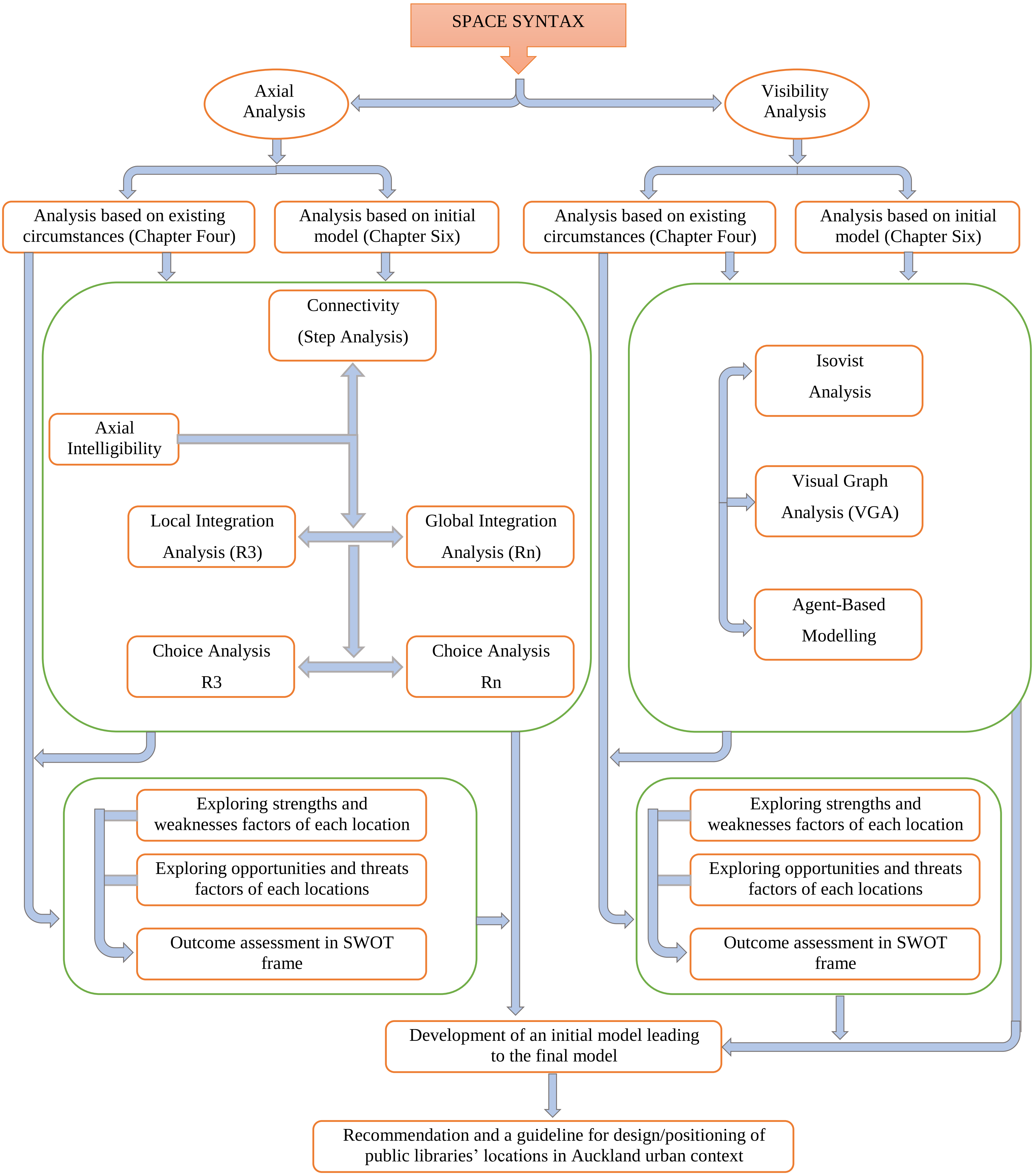


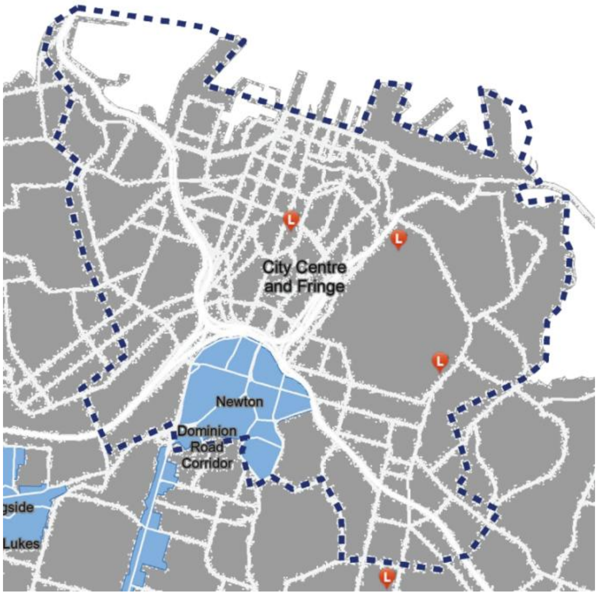
Figure 1.2: The diagram represents the research study approach via the proposed methodology (By author).

As it is shown in figure 1.2, the proposed analyses will be implemented into Chapter 4, which is based on existing circumstances, and Chapter 6, which is based on the proposed initial model. Respectively, exploring strengths and weaknesses factors of each location and exploring opportunities and threats factors of each location will be considered in Chapter 5, which will lead to the outcome assessment in the SWOT framework. In the meantime, in order to complete the analysis mentioned in chapter six, the development of an initial model leading to the final model will be implemented. Finally, the recommendation and a guideline for the design and/or positioning of public library locations in the Auckland urban context will be concluded.

The following steps present the applied approach of this study in brief:

1. Analysing placement/location of public libraries (in correspondence with the characteristics highlighted in the research problem section) based on the Auckland plan 2050.

    ➢ In this section, according to Auckland Plan 2050, this study analyses four public libraries' locations within the boundaries of the four selected nodes (Parnell, Albany, Pukekohe, and Warkworth).



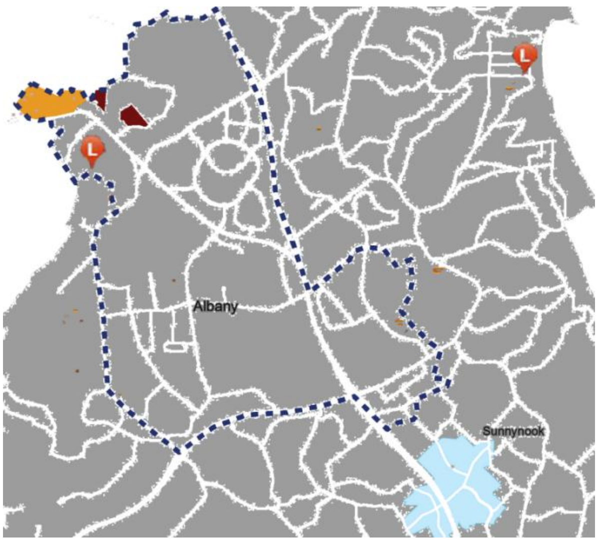
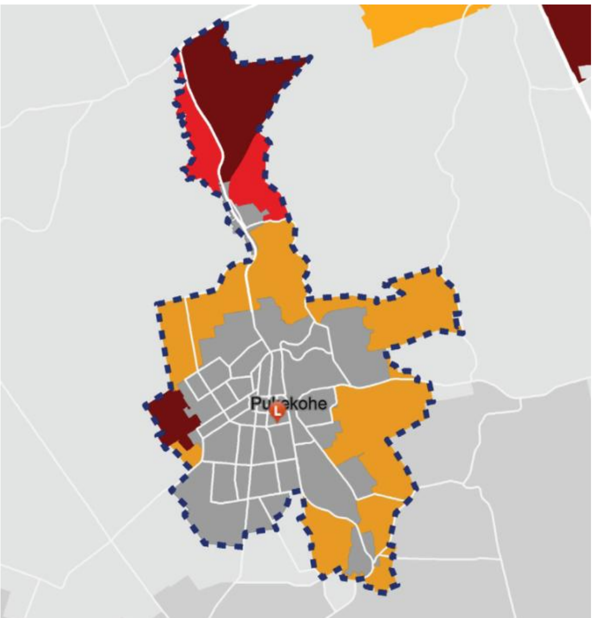




Figure 1.3. Multi-Nodes, city centre (Auckland Plan 2050, 2018)

Figure 1.4. Multi-Nodes, Albany (Auckland Plan 2050, 2018)



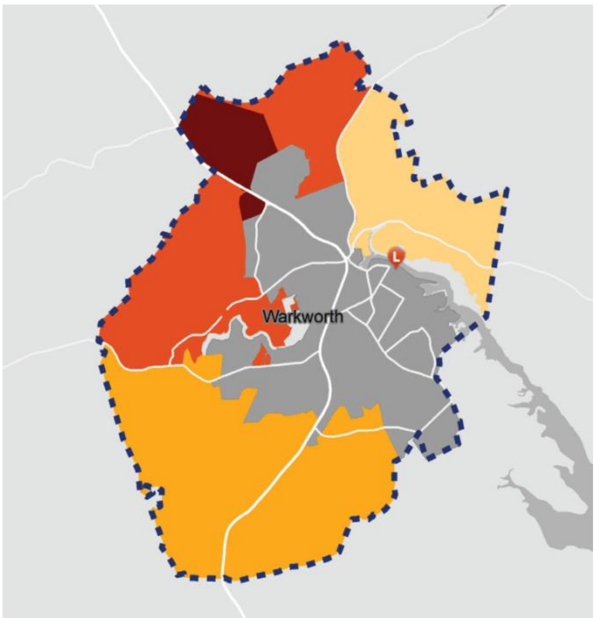




Figure 1.5. Multi-Nodes, Pukekohe (Auckland Plan 2050, 2018)

Figure 1.6. Multi-Nodes, Warkworth (Auckland Plan 2050, 2018)


Analysing locations of public libraries implements a table, which concentrates on six criteria with their subcategories.

The main criteria are;

- 1. Site properties and Geometry, 2. Infrastructure and Zoning, 3. Access, 4. Permeability, 5. Miscellaneous, 6. Population counts.

On the one hand, the aforementioned table presents a list of the libraries' locations, conditions, restrictions, and potential for future development. On the other hand, it makes an opportunity of comparing the locations to one another, which in turn distinguishes the locations with higher potential of being a social infrastructure via the criteria assessment.

- A set of experts' informal interviews of a maximum of 5 participants and their selection criteria will be applied.

2. Identifying the benefits, challenges, and potentials, classified by nodes, further categorized by established/planned (Pukekohe and Warkworth Vs the rest) from an urban integration perspective.

- This section follows two major strategies to meet the targets of this section:
  - Analyses the site locations in the urban context of each node in different radiuses to explore the highest and lowest levels of urban **integration**, **connectivity**, and **choices**. This analysis will be implemented via the **Depthmap X** platform.
  - The Second step includes **SWOT analysis**, which explores the **strengths**, **weaknesses**, **opportunities**, and **threats**. Accordingly, strengths and weaknesses as **internal factors** will focus on locations and the existing libraries' circumstances, and opportunities and threats as **external factors** will respectively reflect chances of exploitation from the urban context in each node and also undesirable impacts from the surrounding spaces against specified locations.

3. Providing suggestions for improvements

- By reaching a conclusion from the first two steps, this section will present a list of comments and suggestions, which help in shaping the sites in the local urban configuration to be aligned with the Auckland plan expectation for 2050.

4. Development of an initial model based on step 3

- In this section, this study will present a model according to the conclusion of step three. With that being said, the suggested model will indicate that the urban context of each node can reach an adaptable social infrastructure from the aspect of urban integration with a focus on public libraries.

5. Analysis of the model and provision of the fine-tuned final model

- This step will analyse the suggested model to explore the benefits, restrictions, and challenges of the implementing the model. For instance:
  On the one hand;
  - This model can direct the design approach to strengthen the sense of protection of cultural heritage in the urban context.
  - The design approach by implementing the suggested model can reach the space to help local visitors to escape the pressures and socialize and/or meet new people.

  On the other hand;
  - **Insufficient** urban integration, connectivity, and permeability could be considerable challenges against the model implementing.

### 1.6. Outline of chapters

With the outline of the theoretical frame and methodological approaches of this research thesis, this study is going to outline its structure to explore the stream of the argument and present the substantial findings of the qualitative and analytical sections of this research study.

- **Chapter 2. A qualitative review: Public library in the context of social infrastructure**

Chapter 2 opens the theoretical discourse regarding public libraries as an architectural typology. This section reviews and discusses the literature on the relationship between public libraries and their social functions. The discussion will be started by clarifying the characteristic of social infrastructure. In the following, the characteristic of public libraries as an architectural typology will be reviewed. Accordingly, it is considered to be discussed how public libraries could play their role as a public platform. It also addresses the undergoing changes of public libraries, which discuss how they could become organizations of knowledge and education in communities.

By step in the further section of this chapter, the discussion move to explore the Interrelation between the public library location and society in the urban context. The first subdivision looks at how the relationship between power and public libraries has been changing over time. In fact, it is expected for public libraries to become multifunctional locations for providing opportunities for informal encounters instead of former conventional places for the regulation of behaviours of their visitors. The increasing tendency of giving value to socialization is the key reason for the transformation. Apart from the large extent of reasonable literature regarding changes in the services and management of public libraries, this study is intended to explore the absence of reasonable and systematic analysis of urban space and architectural aspects of the transformations.

With regards to the above, this section steps on the formation of conventional public libraries as an architectural building type. The target is to explore what were the conventional social purposes of public libraries and why they appeared, and how they manifested into public libraries' forms and functions. Apart from what was mentioned, it is noteworthy that former conventional public libraries were formed in resembling forms of other buildings such as museums or governmental buildings. Arguably, the difference between the public libraries and other pinpointed building types was the combination of educational purposes with public access. Hence, they were looking for educating the community to regulate the behaviour of people and also represent the libraries' resources like how art objects are exhibited in museums or official documents on shelves are accessible to staff or permitted people in governmental buildings. Thus, public libraries are identified as institutions where they use their power by providing access to knowledge. This section explores how giving the value to socialization transfer the public libraries from an institution of knowledge to a spot of social relations in urban spaces, which will be applied as a reference for the purpose of this study in the context of Auckland.

The further subdivision of this chapter as the complement to the previous one addresses how the relationship between the public library as the "Third place" and social activities would be realised. Accordingly, this part deals with aim of this section by considering the literature revised in the previous subdivision. On the one hand, the public library's function in the form of a "third place" could be a maker public space, which includes spaces such as "virtual net space", "workshop space", and "adult and children reading spaces". On the other hand, the public library as a "third place" could promote public participation through the functional mix and street life vitality. In the meantime, the significance of the distribution of openings on the same floor as the street is located will be discussed with regard to their position and form.

- **Chapter 3. Review the method of Space syntax and scenario analysis of selective public libraries' locations via applying the parameters of space syntax**

This chapter first addresses the theoretical and methodological framework of space syntax. To reach an approach to exploring how to break the boundary between local public spaces and public library locations, it is necessary to explore the relationship between built environments and social forces, which is achievable through space syntax. Arguably, this approach let us comprehend the relationship between the sociality and spatiality of the city. Accordingly, as was previously mentioned, space syntax lets this study analyse relationships between the public library's location and the urban context, which can be used by various measures such as connectivity, integration (ease of access), choice (passing flow), and isovist analysis.

In addition, this chapter reviews a scenario analysis of selective public libraries' locations in Medellin by applying the parameters of space syntax. This review describes each library as a particular spatial culture in an urban context. Hence, an opportunity comes in not only to review the methods and theories of space syntax but also to divulge the context that lets the current research study exploit such experience.

- **Chapter 4. Analysis of four space syntax parameters via "DepthmapX" platform for selected public libraries' locations within the proposed multi-nodes in Auckland**

This chapter is divided into two sections for each selected region in Auckland.

Auckland Plan 2050 addresses the concentration on creating more opportunities for environmental enhancement, which demands a large extent of infrastructure upgrades. In the meantime, greater social and cultural vitality is a highlighted priority of the plan, which brings attention to a wide range of activities in urban centres and neighbourhoods to meet the full range of people's needs. Hence, the priorities of the plan in turn boost interaction and social cohesion in the community of Auckland. With this image in mind, as public libraries could act as proactive infrastructure in the multi-nodes, there is considerable reason to concentrate on the multi-nodes in detail. With that being said, this chapter looks at four nodes in order to address the geographical scope of this research study. According to the Auckland Plan, the purpose of the node is to take the opportunity to shape a regional, inter-regional, and sub-regional core that causes the surrounding residential and industrial activities to be rallied around. With regards to the above, public libraries with the potential to be social infrastructure could be a node with the attribute of boosting socialization inside each of the aforementioned nodes.

As the Auckland Plan's multi-nodal model is expected to service the nodes' surrounding communities and to be connected to urban sectors via highways or rail, the locations of public libraries as socio-cultural nodes within the multi-nodal model have the potential to draw community members to the same physical locations, which are also expected to boost socialization.

An analysis of the site locations in the urban context of each node is considered in different radii to explore the highest and lowest levels of urban integration, connectivity, and choices. This analysis will be implemented via the Depthmap X platform.

This chapter opens a set of analyses on public libraries' locations in the urban context of multi-nodes, which include different radiuses with the centrality of each public library's location. Accordingly, this analysis lets us explore the highest and lowest levels of urban integration, connectivity, and choices.

By following the approach analysis, this chapter addresses a set of comparative analyses of parameters including integration, connectivity, choices, and isovist analysis, followed by visibility graph analysis (VGA), and Agent-Based modelling, which are the key discussion subjects in this chapter. The separate analyses of each parameter will be gathered for each node prior to the comparative analyses of each parameter for four nodes with the centrality of public libraries' locations. In addition, this chapter looks at permeability, which in turn brings the opportunity to explore urban spatial cognition through wayfinding within the considered radius with the centrality of public libraries' locations in each node. Accordingly, it is intended that permeability increase the chance of exploring the number of various routes from any point within the considered radius inside each node to the selected public library's location at the same node. In the meantime, this chapter intends to address the physical permeability between public space and the entrance to the library's location. It is important to consider how the level of social activity around the location's edges can be increased in order to enrich the public space.

- **Chapter 5. Urban Situational assessment of the libraries' locations**

This chapter opens into two stages, each of which, in turn, includes two divisions. Hence, the four subjects of strengths, weaknesses, opportunities, and threats are the key discourses in this section through locations within four nodes. With that being said, the external and internal factors such as locations' circumstances, traffic, access network, congestion, any possibility of public transport disturbance, the potential of future development or improvement, legibility, visibility, and any nearby reserve/stream will be gathered. Accordingly, all factors relating to any of the four aforementioned categories will be evaluated in a comparative assessment. Finally, the outcome of the above analysis will be presented in the SWOT frame.

- **Chapter 6. Development of an initial model leading to the final model**

This chapter addresses the outcomes of chapters 4 & 5. Accordingly, this chapter with a look at four locations that were previously analysed addresses the questions of this research. Arguably, the initial model responds to gaps in promoting public participation and Breaking the boundary between libraries' locations and public spaces in the four pinpointed nodes.

In the meantime, this section looks at the data collected prior to the analysis of each of the four public libraries' locations. In nutshell, this chapter shapes from the last two previous chapters, addressing how the space syntax parameters analysis displays the effect of the existing conditions on the socialization at the locations on the one hand. On the other hand, it presents an explicit potential letting us reach the views that lead to the initial model, which boosts informal encounters.

In the further discussion of this chapter, the initial model will be analysed to work out the gaps. Hence, with the tracking of the improvement via exploiting of space syntax approach, it is also attended to raise socialization upon the desire to enable informal encounters. Accordingly, the above procedures let us achieve the fine-tuned final model. The final model delivers suggestions over alternation of the libraries' orientations, possible new ways within the locations in the favour of breaking boundaries between location and public spaces, any flexible improvement of public network access to the libraries from any point within nodes, and obvious legibility along locations' boundaries.

- **Chapter 7. Discussions and Conclusions**

This chapter discusses the outcomes of the analyses utilized in chapters 5, 6, and 7. With that being said, this chapter addresses how this study carried out the aforementioned methods to figure out gaps in the knowledge about the social aspect of public libraries' buildings and their locations in Auckland.

According to Chapter 12 of the Auckland plan (Auckland plan), public libraries are counted as critical infrastructure as they are fundamental to the long-term well-being of the community and contribute to Auckland's liveability (Auckland plan). Hence, this chapter responds to the questions of this research which are aligned with the concerns of Auckland plan 2050.

With regards to the above, this section describes the adoption of the final model in order to break the boundaries between the selected public libraries' locations and public spaces, and also, in order to promote public participation. Accordingly, the role of public libraries in building and communicating social values and socialization in the community is the key discourse. Finally, this chapter presents the limitations of this research and possible questions that may open to future research.

# Chapter 2.

## A qualitative review: Public library in the context of social infrastructure

# Chapter 2

## 2.1. Introduction

In designing public infrastructure, it is noteworthy to perpend the changing social and demographic trends within the community. In the meantime, it is important to consider how these cases may affect the role of public infrastructure such as libraries in the community. With that being said, the social function of public libraries is in the attention in this circumstance. Hence, this chapter discusses and argues the place of public libraries as social infrastructure, and also reviews the literature on the relationship between public libraries and their social functions.

Since the library is counted as social capital, it could be one of the building blocks of a strong community that is related to public infrastructure characteristics. The key reason is the value of such public infrastructure to cause of building bridges of support between vulnerable groups such as older people, people with a disability, new residents with different cultural backgrounds, and other members of the community. Accordingly, this is a flick to persuade councils and communities to concentrate on the regeneration of public libraries.

With regards to the first section (2.1) description, the second section (2.2) intends to provide a general introduction to social infrastructure in order to realise the place of public libraries in the form of social infrastructure characteristics. The third section (2.3) addresses the architectural position of the public library as a typology. By following this discussion, this section extends into two parts to argue the public library as a public platform in an urban context, and in the further part, the public library will be addressed as an organization of knowledge and education. Since the public libraries' function has the responsibility to collect, organize and provide access to all existing knowledge as Markus (1993, p.172) says, an opportunity has been brought to public libraries to provide public access to the knowledge. This opportunity in turn gives a chance to the libraries to promote socialization as a form of learning. With that being said, the public library as an organization of knowledge plays its role as a social infrastructure to promote social relations as well. In the meantime, this section brings to attention how the public library as social infrastructure is a "**cultural focal point**". The fourth section of this chapter (2.4) reviews literature about the interrelation between public libraries' locations and their communities in the urban context. This section extends to two subjects. Firstly, it reviews the interface between power and public libraries. This subject comes to attention when we recognize that "knowledge is power" as Markus pinpoints (1993, p.169) which accompanies political and civic significance, and it maps the origins of many functional types such as libraries, schools, and museums. Secondly, it looks at how public libraries are locations of open access to knowledge and how they have a role in social control. Accordingly, the social aspect of public spaces such as public libraries is the most key feature of the public spaces that not only attends to people's activities and optimal management of the spaces but also causes an encouraging sense to them to educate and learn. The fifth section (2.5) reviews the literature on the term "Third Place" and its access to a community. This discussion will be extended in the form of public libraries which let us explore it as a platform for social connexions. Accordingly, this review brings the interrelation between public libraries and social activities into attention to give the chance of arguing the considerable potential of public libraries in order to promote various social participation.

### 2.2. Exploring Social Infrastructure as a Type of Infrastructure

The concept of social infrastructure comes from the meaning of "public space", and therefore, it can be considered within the scope of infrastructure types. According to Begum, Hossain, and Stevens (2021, p. 143), since "public space" preferably provides an interactive platform for people from social and cultural backgrounds and styles of common life they value, public space is a necessary social infrastructure for the ongoing negotiation of urban life. With that being said, considering public libraries as social infrastructure because they arguably are public spaces, it is controversial how much they have been successful in appearing as an interactive platform that can promote public participation and sociability, which are also key discussions in this study.

Over the last two decades, the design and implementation of public libraries have been greatly affected by the strategy of a hybrid approach from partially digitalizing them to complete digitalization. However, current libraries as we know them won't satisfy the role of an urban social infrastructure. By having this into account, it is expected an urban social infrastructure enables contacts and collaborations between people, ideas, and connecting places (Merkel, 2015, p. 121). In fact, the expected approach should be considered an initial model to simulate and forecast how the concept of the library will be evolved in an urban context. Hence, the development of this approach predominantly depends upon a cultural shift rather than a technological development. To reach this out, it is needed to explore how architecture can plan an approach leading the library as a public domain that represents a social platform (a place that fits in with the surrounding community where different groups have social interaction).

With keeping attention to Auckland Plan 2050, there is a reasonable expectation that what makes an urban node an adaptable environment in order to meet a community's demands? Certainly, challenging architecture, and also, places with the potential to promote connections with other people. It is common that cities are included many social networks which interconnect people together. Hence, collective public attendance is a key aspect of an ideal city. Eric Klinenberg (2018, pp.1-19) argues that a wide range of physical and institutional infrastructures are essential for the development and retention of social connections. This argument is a concept for social infrastructure. Arguably, this argument is eligible for places such as public libraries to share their significant contribution to making an ideal city, which is crucial to recognize their role in promoting social life in communities. The importance of these places comes to attention where strangers can meet others. Hence, such places are not just an instrumental need, but also they are locations where an urban node and cities can be experienced as welcoming. With regards to Klinenberg's (2018, p. 27) argument, social infrastructures are not just needed for bringing up public life but also for addressing and preventing some of the most urgent issues of contemporary urban life, such as overcoming social isolation and establishing places for everyone regardless of background, sexual orientation, or socioeconomic status.

By keeping the above arguments into account, infrastructures are an inseparable part of the urban foundation. Arguably, they are infrastructures with technologies that support urban life. Infrastructures are an important part of how communities function as socio-technological institutions; however, they are often overlooked. In the meantime, they are involved with how socio-economic inequalities are retained and continued. The reason for the use of infrastructure is laid on structures and arrangements that allow urban life to happen from various aspects such as social, economic, cultural, and political views. Accordingly, Gandy (2005, p. 38; 2014, p. 11) argues that infrastructure is physical morphological existence, but it is also entwisted with political and cultural natures. In this way, the facilitation of urban activities is the main reason for infrastructure existence. This reason can be extended to more than what infrastructures deliver services such as water distribution, sanitation, electrical power, or communication technologies. With regard to this, social infrastructure is part of the extension of the aforementioned reason for infrastructure existence. With that being said, Klinenberg (2018a, p.13) describes social infrastructure comprehensively:

> Public institutions, such as **libraries**, schools, playgrounds, parks, athletic fields, and swimming pools, are vital parts of the **social infrastructure**. So too are sidewalks, courtyards, community gardens, and other green spaces that invite people into the public realm. Community organizations, including churches and civic associations, act as social infrastructures when they have an established physical space where people can assemble, as do regularly scheduled markets for food, furniture, clothing, art, and other consumer goods. Commercial establishments can also be important parts of the social infrastructure.

Facilitating sociality is a substantial part of how social infrastructures manage to present their main functions whether the main functions of some of them are proposed to promote sociality or not. According to (Blommaert, 2014), as social infrastructures are able to augment connections within groups, they are also able to orientate people towards interaction among differences. There are some explicit connections between Klinenberg's argument and the arguments of some earlier writers such as Putnam and Oldenberg. Putnam (2000, p. 288) argued that informal social networks foster a society's “civic infrastructure”, Oldenberg (1989, cited in Ringas & Christopoulou, 2015, p. 179) discusses “inclusively sociable” places such as restaurants, cafes, and stores for creating trust and community. With that being said, networks of spaces, facilities, institutions, and groups form the social infrastructure as they can construct feasibility for social relationships.

So far comprehension of the above discussion clears that infrastructure is formed within networks and relationships. Accordingly, Mattern (2014, 2015) argues that a public library as a social infrastructure is organized within networks of book distribution and relations of lending and borrowing. Hence, such relationships make an opportunity for no renegotiation regarding the procedures of the loan after each time we borrow a book. Arguably, we can use it repeatedly. Therefore, lending books is the conventional characteristic of public libraries; however, lending books is not the meaning of all functions that libraries are expected to do in the contemporary world.

### 2.2.1. An Infrastructural Approach To Community Life

Social infrastructure includes various necessary facilities for communities to function as social spaces. Hence, these facilities present separate functions. For instance, libraries lend books, leisure spots bring the opportunity of having exercise, malls provide places to sell and buy various products, and schools provide spaces for educating children. Such functions play an important role in community members' lives. In addition, these are places where people socialize with others and encounter strangers. Arguably, they are public places in various ways as they are accessible to the public. Having said that, Professor Michael Kenny, the director of the Bennett Institute for Public Policy, and Tom Kelsey (2021, p. 11) propose that social infrastructure be viewed by policymakers as those physical areas that facilitate regular interactions between and among the various segments of a community, where meaningful connections, fresh levels of trust, and a sense of reciprocity are fostered among locals.

With regard to the above, a type of citizen participation is observed through everyday practices and daily activities in the public sphere (Bherer, Dufour, and Montambeault, 2023, p. 1), which notes "public" as a term that addresses collective life and its quality and therefore illustrates the concept of being out among the citizenry at the very first step. This is significant because it relates to the opportunities and capabilities for certain people from various social backgrounds to go about their daily activities freely and without interference. According to Bherer, Dufour, and Montambeault (2023, p. 9), by passively resisting together in the public space, people can learn from one another and acquire self-assurance by seeing other people behave similarly. They also add that "do-it-yourself" (DIY) would be exposed to the concept of appropriating public space in urbanism. Accordingly, the public sphere becomes the location of non-coordinated acts, enabling the testing of novel planning techniques. Secondly, the phrase can be used to describe speaking in front of an audience and taking part in discussions about issues that affect a community in a more outwardly focused kind of publicness. Participating in the public realm, whether in person or through the use of communications technologies, is what the public is all about. With that being said, these first two aspects of publicness may entail the means of making claims, but they may also involve how people reach agreements with one another, according to the argument of Koch and Latham (2013, pp. 6-21). Thirdly, and connected to the previous point, "matters of concern" are what Marres (2012, cited in Knox, 2015, pp. 947-949) refers to as "things that affect a community or society." Last but not least, publicness refers to the concept of collectively providing facilities for either public or private usage. All of this is done to acknowledge the multifaceted nature of the idea of the public and publicness. It's not only the reverse of private, either. When we refer to social infrastructure as public space, we are referring to a wide variety of locations that many of them are not often thought of as public spaces, where these many notions of publicness can be located and put into effect.

The idea of social infrastructure directs our attention to how the sociality that is intertwined with publicness occurs in specific locations and facilities, which is one way it aids in our thinking about the public aspects of urban life. This publicness is not just encompassed encounter-related concepts, but it's also about how communities are formed, trust is forged, cooperation is accomplished, and friendships are formed. According to Amin (2002, p. 12; 2008, p. 8), various types of urban sociality are dependent on and intertwined with the creation and availability of material aspects. Amin's (2006, p. 1021; 2013, pp. 3-7) thought is valuable because it emphasizes how the creation and maintenance of a sense of trust are necessary for the operation of public and social spaces. When considering infrastructure, it is crucial to think about the types and quality of facilities that support social life, the types of sociality that are obtained by infrastructure, and how this might be recognized as a kind of public life. In the meantime, what makes Amin's discourse compelling is that the virtues that can result from this material support have a quality of "surplus"; via the shared use of social infrastructure, it is feasible to recognize characteristics of civic culture, tolerance, and communal life. An understanding of the world's multiplicity that extends beyond the simple confines of any one encounter between individuals can arise from pragmatic, practical, and social interactions in shared space, and the concept of social surplus helps to communicate this idea, as Amin (2013, p. 7) argued. With regard to the above, through utilizing social infrastructure, according to Sennett (2017, cited in Yarker, 2021, p. 266), it is possible to discover the social ethics of togetherness via interactions as incidental encounters.

The advantages that various locations or facilities provide for habitation and social interaction are highlighted while focusing on social infrastructure. It entails examining the networks and communities of affiliation formed through such locations. Bratt (2020, p. 474) describes Talen's argument that how connection be made between a neighbourhood and many service-related activities. In the meantime, Talen (2017, p. 363) points out that design specifications such as size, layout, street connectivity, and location of facilities are avoided to a large degree. For instance, the connection between neighbourhoods and public library locations is the focus of this study. Accordingly, attention to the design and provision of specific facilities and how their material characteristics impact the activity that takes place within and around them in an urban context is substantial. However, there are always a variety of entry barriers that can cause contemporary urban spaces to become strongly unequal according to Madden's (2010, pp. 190-191) argument. But advancing the idea of social infrastructure calls attention to a wide range of frequently ignored and undervalued urban spaces as well as many ignored and underappreciated activities. In this way, the above argument can be reflected in promoting public participation by public libraries in an urban context, which is a key objective of this study.

### 2.2.2. Social Infrastructure Location and Socialities

Unsurprisingly, a lot of research has been done on public institutions, which are publicly offered and created as public spaces. They are a crucial part of a city's social infrastructure. The areas that are most plainly involved are those that are specifically intended and created for the public to gather. Street benches, for example, can serve as places for social interaction and self-care, as researched by Rishbeth and Rogaly (2017, pp. 284-298). Kenny and Kelsey (2021, p. 29) argue that one of the distinguishing characteristics of social infrastructure is that it offers chances for community members to interact with one another repeatedly that they might not otherwise have. It has the ability to foster greater levels of mutual understanding and trust amongst various segments of the larger community, which can have a significant impact on the nature and quality of social connections in a given area. In this regard, a central aspect of how a social infrastructure works is the role of people, which is obvious in public libraries as an appropriate example. Wilson (2013, p. 627) discovered that playgrounds can be sites where parents interact and socialize in ways that they might not do so in other social situations when he spotted an urban multicultural primary school as a case research study. From tiny micro libraries to large libraries that might lend items other than books, Mattern (2007, pp. 277-302; 2012; 2014) has explored the various shapes and notions of what a library can be. Mickiewicz (2016, pp. 237–250) argues that the significance of a library as a public resource prompts inquiries about who should be involved in the design process, how public a library actually is, and how libraries are valued and evaluated by those who fund them, and more. The ability of libraries' social spaces to be dynamic is striking. That is why from a social infrastructure point of view, libraries are highly inventive.

Mattern (2018) argues that the special functionality of hardware stores can form a place to deliver "competence, intention, utility, care, repair, and maintenance." She added that such places are constitutive components of a vibrant and thriving high street. According to research by Massey (1994, cited in Hall, 2012, pp. 98-100), a prosperous high street can serve a crucial role as a foothold for immigrant groups in cities like London. With regards to the above examples, social infrastructures with a variety of functions, such as public libraries, can be valuable resources in the aforementioned cases for those who are economically or socially marginalized. According to Hubbard and Lyon (2018, pp. 940-942), this relates to the kinds of work and activities that acknowledge the connections between specific streets and sidewalks vibrancy and businesses and other comparable socio-economic activities. Interestingly, the Association of Public Library Managers of New Zealand (The National Strategic Framework of Public Libraries New Zealand, 2020, p. 16) traces libraries as an inseparable section of social infrastructure. Accordingly, they argue that libraries are frequently applied as a strategy for urban redevelopment and draw large crowds of people. In the meantime, they argue that libraries are "anchor" buildings that drag foot traffic to a neighbourhood and, when combined with other social, cultural, educational, and recreational events, can develop into thriving community centres. In the meantime, some retail or entertainment near libraries might increase the appeal of "destination" visits without taking away from the library experience. With regard to the above argument, libraries have a significant role in developing sociability in a region, which is related to this study's objectives.

Different communities, social networks, and experiences might be identified depending on the social infrastructures being researched. The conclusion is that thinking about social infrastructure broadens and deepens understandings of the types and dimensions of social life that occur in cities. Social infrastructure can therefore also serve as a pathway to civic participation. In the meantime, the location of the social infrastructure and the scale and functionality of community and cultural facilities are directly related to the size of the region and the characteristics of the local people they serve. In this regard, according to the report "Places for the Future: Social Infrastructure Future Directions Plan 2022-2036" considered by the Wollongong City Council (2022, p. 21), social infrastructure is categorized through the hierarchy into one the following facility types:

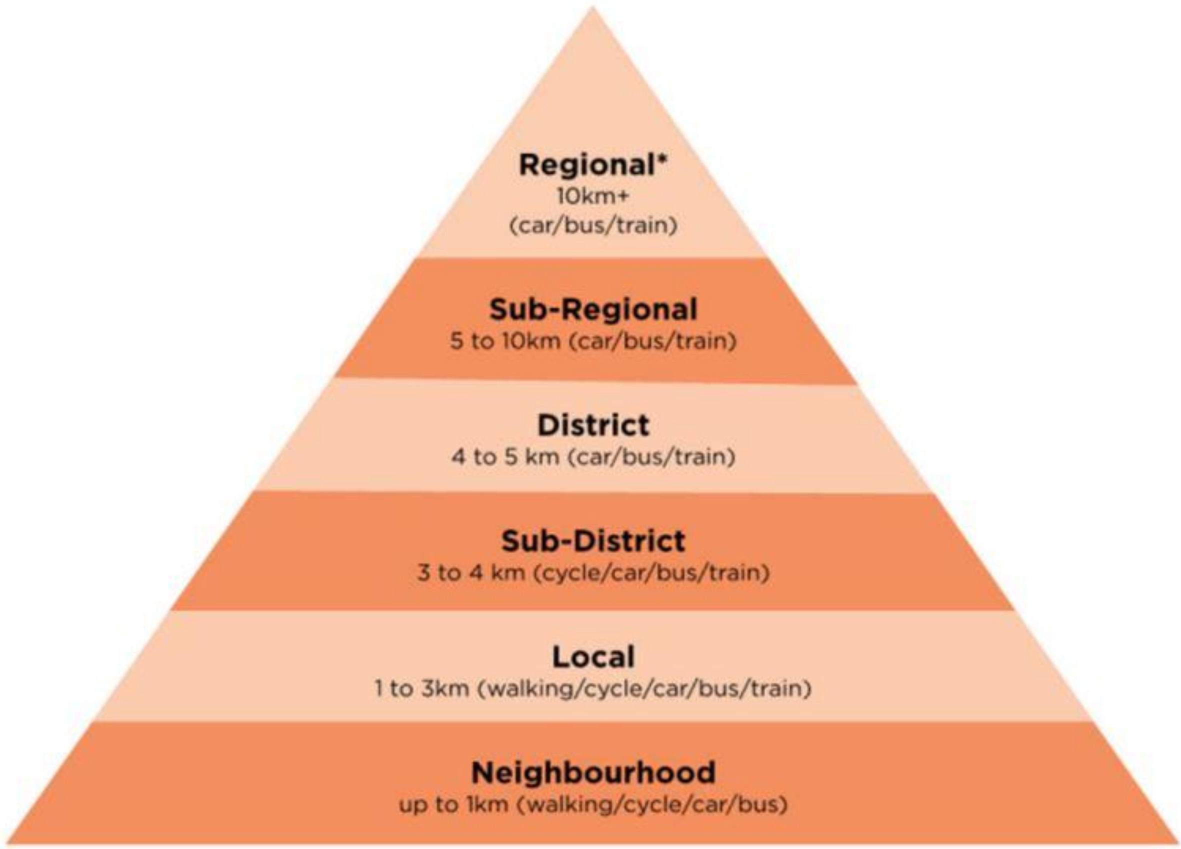



Figure 2.1: Social Infrastructure Location Hierarchies (Wollongong City Council, 2022, p. 21)

### 2.2.3. The Policy of Social Infrastructure Provision

The claim made in this section is that social infrastructure has a significant role in how people interact with one another and engage in public life in cities. Aspects of communal urban life that are neglected or devalued can be brought to light by paying attention to the various places, amenities, and organizations that foster opportunities for social engagement. An infrastructural perspective is crucial to this; it is an approach that is sensitive to how places and amenities are constructed and planned, considering their interrelations with the urban context as well as how spaces are used. The social relationships and socialities that are created and maintained by utilizing social infrastructure have tangible material advantages and effects; Amin (2008, pp. 8-10) argues that social infrastructure produces a "social surplus" by fostering cooperation, civility, encounters, and shared goals. In this regard, "social infrastructure can help build the social capital and fabric of a community by enabling active living, learning opportunities, social interactions, and supporting programs that help people innovate, express themselves, and adapt to major life events. It is social capital that makes a community liveable, inclusive, competitive, and diverse' (The Western Australian Government's State Planning Strategy 2050, 2021, cited in City of Subiaco Council, 2021, p. 3). Hence, the importance of social infrastructure is to enable liveable, inclusive, and diverse communities (Figure 2.2).


Figure 2.2: The importance of social infrastructure (City of Subiaco Council, 2021, p. 11)

The creation of social infrastructure has a variety of components that might increase or decrease its effectiveness.

> **One**, it's crucial that there are a lot of provisions. Social infrastructures do not express a social surplus when they are hard to find or just transmit a sense of usefulness. **Second**, it's important to have a diverse social infrastructure. People seek out a variety of activities and communities, necessitating a variety of places and facilities. **Third**, the upkeep of social infrastructures influences how trust is built and how providing is perceived. Although this is about upkeeping of the surfaces and materials, it also has a social component; places and amenities need to feel maintained and secure. **Four**, in order for social infrastructure to be really public, it must be accessible to all members of society, regardless of their age, ethnicity, class, sexual orientation, or gender. **Five**, the service should be receptive to the demands and wants of the populace. The idea that a facility's use and purpose may change and vary over time is illustrated by tracing how infrastructure is used in daily life. Consider the ways in which numerous museums and art galleries now offer kid-friendly

programming. **Sixth**, the establishment of social infrastructure can encapsulate a democratic lifestyle. The ideal social infrastructure has a shared space attitude that values all residents as equals.

If social infrastructure is a crucial component of every successful city, then it becomes a matter of social justice when it is concentrated in different nodes of urban areas. Accordingly, it would be important to examine the success of social infrastructure if access to it is overly constrained. In the meantime, an infrastructure's ability to serve as a social infrastructure may be compromised if it is created, maintained, and operated with only a specific population in mind. According to (Anguelovski, Irazábal-Zurita, and Connolly 2018, pp. 133–156; Simone, 2006), the many forms of sociality that social infrastructures around the world support should also be taken into account. According to (Damyanovic, Reinwald, and Weikmann, 2013), it's crucial to recognize the function of design in the creation and provision of social infrastructure. It is important to realise illustrative examples of communities that have received underserved and underutilized infrastructure.

Studying social infrastructure; however, also entails looking at how it is applied in an urban context. On the one hand, identifying and comprehending the locations and amenities that promote social interaction. On the other hand, making sense of how social infrastructure is successful in encouraging community members to come in through and socialize with each other. Accordingly, as Klinenberg (2018, pp. 104-109) argues, the importance of encounters can be seen in social infrastructure, but it is also frequently about being able to go out, use facilities as a free citizen, and move on.

### 2.3. Public library as a typology of architecture

First of all, this section asks: how did public libraries appear as a typology of architecture? To respond to this question, this section reviews the history of the formation of the library from the ancient era to the current time. Accordingly, it explores how public libraries' social aspects have affected the formation of the library's building and function.

### 2.3.1. The shaping of the library over time

### The Ancient and Medieval Era

According to MacLeod (2000, p.19), with the discovery of the earliest known writing system and the first known location of written material storage more than 5500 years ago, the ancient period experienced the establishment of the library as an institution. According to Campbell (2013, pp. 37-79), the library of the ancient era may have been quite modest in terms of its outward appearance, but it pioneered the idea of knowledge preservation and extracted old knowledge from narratives to produce preservable artifacts. However, access to this old knowledge was limited to members of the ruling class and was considered a tremendous privilege. The concept of the library evolved over the centuries, demanding a physical presence in urban centres and being portrayed architecturally as a symbol of authority. The ancient library laid the groundwork for many ideas that have persisted throughout the history of the library, although being very different from the libraries of today.

The demise of the Roman Empire also signalled the end of the library's ancient era and the beginning of the characteristics that would define the medieval era. Religious organizations and the monasteries that they were linked with helped to retain a great deal of the knowledge of the ancient world during this time. Hermits who had escaped from populous places to meditate and study ancient and sacred literature were frequently the founders of monasteries. The old preservation culture was perpetuated in these monasteries through everyday rituals like reading and copying from texts. The monastery of the medieval era also established the connection between knowledge and a location and continued to improve access to knowledge procedures. Numerous monasteries were situated in rural locations, a great distance from urban centres, which added a major journey to the processes of acquiring information. This division bolstered the idea that information belonged in a unique setting, virtually a secret universe. By relocating from metropolitan areas, monasteries and the collections they housed became a destination for pilgrims, establishing the idea of regulated access to knowledge. According to (Nicholson & Petrović, 2018, pp. 390-391), the idea of visiting a library was first popularized during the medieval era, when procedures for knowledge sharing and information preservation were also evolving.

### Presence of libraries within early universities

The university was a new development in the role of the library and the transmission of knowledge at the end of the Middle Ages. Several monastic schools rose to prominence in the late 11th and early 12th centuries. Cordasco (1976, p.32) notes that early universities were the first to include any form of **democratic organization into knowledge processes** and had a considerable impact on both the educational and political environments.

### Renaissance Era

The Renaissance and the Protestant Reformation in Europe had considerable influence on library development, which caused the library to undergo its next big set of changes. As Nicholson and Petrović (2018, pp. 391-393) argue, each of these periods had unique characteristics that contributed to the growth of the library, and also, taken together, they show a clear progression centred on related key processes: as literacy increased, a larger reading audience resulted; as bookcentres proliferated; as knowledge came to be an increasingly valued commodity. Burke (1982, pp. 163-165) notes that this process persisted throughout the 16th century, and the library started to transition from monasteries and private places into a more open structure. Libraries throughout this time evolved architecturally to once again reflect a symbol of power and presence in an urban context. The social role of the library with regard to public access was developed by these libraries during the Renaissance. They reinstated "public" access to information, albeit at the time the term "public" still only applied to the literate, who were mainly from the upper classes. Accordingly, Campbell (2013, p.105) says that this was a wider and more inclusive approach than what had previously been seen.

### Public library at 18th and 19th centuries

The 18th and 19th centuries saw the next substantial expansion of the library's social role as it grew more inclusive and truly public, supporting and reflecting a time of larger social change. The emergence of democracy was this transition. Specifically, referring to the expanded accessibility of public services to all that took place during this time throughout Europe. As a result, the concept of knowledge and the library underwent some basic alterations. The Boston Public Library is one structure that exemplifies this Western shift toward a more democratic and open library. With regards to Palfrey (2015, p. 10), this library reflects the democratic growth of the libraries that took place during this time period, as do the principles upon which it was constructed and open access to information.

**Public library at 20th century**

The 20th century was the library's final crucial period of development. In order to strengthen its social role and public importance in democratic processes and urban life, the contemporary library is pushing toward adopting a bigger urban presence. Buildings like the Seattle Public Library in the US show an effort to engage with the urban environment and take part in daily urban life. Connections to outdoor public spaces, a thoroughfare, and a visual connection with the streetscape all convey the goal of having a more welcoming presence in the urban context. These buildings begin to merge analogue7 and digital resources, as do many other modern libraries. The usefulness of venues for social interaction and information sharing in the present, which neither technology nor the internet can provide, is also recognized by this awareness of digital media. Nicholson & Petrovi (2018, pp. 394-396) argue that these buildings show how the role of the modern library has changed from being purely about information access to one that emphasizes social interaction and urban connectivity.

With regards to the above review of the library's shaping as an architectural typology over time, it illustrates the steady shift from a nearly sole concentration on knowledge preservation to an institution with a crucial social and urban role. This gets to the point where the library's social, civic, and urban role is essentially its main purpose, which also highlights the characteristics of the public library as an architectural typology. Along with the patterns of other public institutions, the library's history demonstrates an expanding responsibility for the community. Throughout history, churches, community halls, and other institutions have served as places for the general public to congregate. Religion has been internalized, and as a result, the church is no longer the place where people used to gather. The public library reacted to this situation by expanding its social and civic responsibilities. It is especially important for the library's present and future that it participates in recent history as a public venue.

### 2.3.2. Public library as a public platform

According to Harris (1999, p.149), a "public library" is not only owned by the public and tax-supported, but it is also space that provides access to any person who wishes to use it, which is the modern definition of "public library." Accordingly, Dewe (2016, cited in Askarizad & Safari, 2020, p. 253) pointed out that libraries are one aspect of public space, and so this space should be a platform for visitors to use and communicate to make the spaces more social. Harris (1999, p.3) argues that public libraries appeared in the form of communication from the very beginning of writing, which clarifies that their purpose is directly linked to the interest in preserving ideas and knowledge and thus extends beyond the span of the spoken language. In addition, he considers that public libraries are constructed via the convergence of a number of conditions, such as social, political, and economic. Arguably, the form and function of libraries at each stage have been affected by changes in spatial, political, economic, and cultural matters such as the publishing industry after Gutenberg and the emergence of information technology, as two outstanding changes among many cases. Arguably, libraries have been the host of ever-changing impressive approaches and functions that would be expected to be aligned with social demands. However, libraries have been endangered because of the diminishing value of their role in the views of today's society, and architectural approaches haven't had a clear horizon to strengthen the future coexistence between public libraries and communities. It is possible that we find current libraries to be social centres and landmarks, but how could they play a key role as "pioneer think rooms" to integrate "Knowledge" and "Creativity," as we saw with the integration of "Knowledge" and "Power" that the ancient Library of Alexandria held the eminent position in for such innovation at the time? As it is mentioned by Arizona State University (2013), the Alexandria Library was not just about books; in essence, it was society's first collaborative co-working space and knowledge hub. People would gather in the library to discuss, debate, and tackle issues such as astronomy, mathematics, philosophy, and anatomy. Arguably, Alexandria Public Library could be a prototype concept of a combination of entrepreneurship programs in the library as a known public space and innovative ideas.

It is true that the building of public libraries as an architectural typology is old-fashioned in terms of a place for presenting books, but it is still contemporary in terms of reviving the public, which highlights the importance of how public libraries in the 21st century can be social platforms. With that being said, it is appropriate to refer to Peter Gisolfi's advice:

> "Whether you build a new library or transform an existing one, do not build the best library of the previous century. Create an environment that facilitates new patterns of interacting, learning, and accessing information and is sufficiently flexible to accommodate changes that inevitably will come" (Gisolfi, 2014).

Griffis (2010, p.185) says that a public library is a lively and adaptable area inside a community. He argues that the concept of a library as a "place" has developed, which also creates a connection between the library's physical manifestation and its visitors, and how the latter can affect the building's evolution over time. On the other hand, if the public library is important to the community, then how can this be reflected via the library's building? Hence, it is important to realise how significant the architectural aspect of a public library is if we accept the significance of the library as a public location in an urban context. To realise this importance, it is necessary to keep in mind that the public library remains a destination for many visitors for a wide range of activities such as reading, research, public events, and meetings. Having said that, the public library as a social platform should be considered a quite independent but well-integrated experience. That is, in addition to their operational and functional benefits, the intended platform should promote civic development and address the emotional and highly social benefits of libraries. It is noteworthy that the public domain has become more polarizing in recent years, and social, economic, and political divisions within society have widened. As a method of therapy, the public library as a platform via its civic role can facilitate the exchange and sharing of a diversity of ideas. Why? According to Kranich (2012, p.75), libraries not only make information freely available to everyone but also promote the growth of a civil society since they defend and strengthen some of the most essential democratic ideals of our society. Additionally, they offer comfortable, welcoming, neutral, safe public venues that support democratic conversation and allow for collaborative problem-solving among community members.

Weinberger's argument could be a reference for both the digital and physical characteristics of public libraries in the 21st century. As this study concentrates on the architectural aspects of public libraries in an urban context, it exploits his argument in favour of this research. David Weinberger (2012, Library Journal) argues that the public library as a platform could be considered "as an infrastructure that is as ubiquitous and persistent as the streets and sidewalks of a town, or the classrooms and yards of a university. Think of the library as coextensive with the geographic area that it serves, like a canopy." Thus, such a platform creates community dialogue and lets visitors contribute their knowledge and experiences to this place, which makes way for new expertise and creates social knowledge. Accordingly, such a platform is also an opportunity to help communities solve local problems. In the meantime, with regards to Weinberger's argument, it would be deduced that public libraries could serve as today's "town square," which could offer freely accessible public space for community events. Hence, they can play a variety of roles in civic engagement, whether it is through initiatives that address difficult social issues or motivate young people to get involved in their communities, which can lead to improving the quality of life in their communities.

### 2.3.3. Public library as an organization of knowledge and education

Public access to items such as books shows that public libraries have become a predefined conceptual infrastructure of information. Markus (1993, p.172) says that public libraries' function has the responsibility to collect, organize, and provide access to all existing knowledge, which is the prototype of typologies such as museums. According to Harris (1999, p.148), public libraries served for educational and governmental purposes to reproduce the organization of knowledge set by the state, in addition to their role in sharing equitable access to information to improve the habits of the lower and middle classes. However, during the 16th and 17th centuries (Markus 1993, p.172), only people who used private colleges and monastic libraries were allowed to access knowledge, and so it illustrates that there were a few influential people who had come to understand the expansive role that libraries play in communities, as it is also quoted by Klinenberg (2018b) regarding the current era. After a while, public libraries appeared at the moment that the number of visitors was rapidly growing due to improvements in the printing and distribution of books. At this moment, national libraries and "community" libraries emerge almost at the same time, and they have a similar intention regarding access to knowledge via books, but they have a different purpose, size, and resources. According to Harris (1999, p.116), national libraries preserve the cultural heritage of a nation, and they have a key role in keeping archives, while ‘community’ libraries don't intend to keep archives and they are almost publicly accessible. However, it is possible that "community" libraries keep some important archives that are not meant as national libraries. Markus (1993, p.183) points out that "community" libraries emerged against the **control of reading**, despite the opposite parties' opposition to free access to knowledge. He stated that this appearance made public libraries not only the most accessible places for reading, but also places for leisure, stating that "**stepping from the street to the reading room would feel like stepping into the pub**" (Markus 1993, p.183). Arguably, we can conclude that such libraries bring value, which is much more than books and resources, and they have a key role in building community and promoting local culture, as Twomey (2017) quoted. As a result, as Forgan (2005, pp. 572-585) mentioned, public libraries become the manifestation of an epistemology of science and ideology of social behaviour, and libraries are also an example of what Klinenberg (2018a, p.4) refers to as "social infrastructure," which are the physical spaces and organizations that shape how people interact.

Forgan (1986, pp. 91–92) connects the evolution of knowledge to how buildings looked in the 18th century. **Buildings can be seen of as statements** that, through their typologies and architectural styles, reflect a discourse and culture, according to Forgan (1986, pp. 91–92). According to her (1986, p.100), architectural components like shape and facade convey messages about stability and respectability while also making references to earlier periods. Additionally, those who are expected to use the structures express their meaning through their positions and functions (Forgan 1986, pp.90–91). As a result, she (1986, p. 113) draws the conclusion that structures embody the ideology of science and its circumstances of existence and that they symbolize the evolution of a particular kind.

Similar to Forgan, Markus is concerned with how **social concepts are translated into physical forms**. Forgan also claims that "buildings were, and still are, reflective of ideologies encoded in their construction" (Forgan 2005, p.583). In actuality, this is the crucial point at which **scientific concepts take on corporeal forms**. According to Koch's (2004, p. 29) quotation, this makes public libraries seem like places that place an emphasis on social meaning. Public libraries are considered when **producing knowledge through contact and repeating the concept of knowledge**. It may also be noted how knowledge and social relations are organized through form, space, and social function. Keeping the aforementioned points in mind, it is envisaged that public libraries will persuade people to aim higher than the bottom line as they represent a vibrant democratic culture. Manguel (2006, pp. 23-24) is interested in the idea of public libraries because they bring harmony and order to a chaotic environment, in contrast to Markus, Forgan, and Koch's ideas about **public libraries as physical forms**. According to Manguel (2006, p. 41), private libraries showcase individualism, whereas public libraries must provide collectivity that may be experienced by every visitor.

According to Mattern (2012), the concept of creating a physical structure where people may gather and access media that teaches, challenges, and codifies their values has been a major topic in the history of libraries and is articulated in public sphere theories. Meanwhile, Mattern (2019) argues that even as we celebrate the library as a public common, we should acknowledge that not everyone uses it, or uses it differently, even though it was assumed that public libraries would guarantee equal access for all as a place for the homeless to find shelter and protection from oppression.

According to Harris (1999, p. 152), a different kind of library existed in communities at the same time as public libraries. It was referred to as a "**commercial circulating library**," and it served a similar purpose as public libraries in that it not only provided free access to reading resources but also offered guidance on what to read. However, Harris (1999, p. 152) notes that while conservative groups in the neighbourhood saw these libraries as threats to the community, they were known for their romance books, which were popular with the middleclass. For this reason, public libraries were given the responsibility of teaching the middle and lower classes how to read better. The view that "literacy is both a tool for the extension of knowledge and for control" expressed by Markus (1993, p. 172) was closely related to this choice. As a result, these viewpoints served as the initial impetus for the development of public libraries' **social infrastructure**. Markus suggested that since **literacy** is one of the duties of public libraries, it may be used as a tool for political dominance. In light of the aforementioned, Bennett (1995, p. 2) believes that public libraries serve the common objective of creating order out of chaos. A democratic society, which is often founded on equality and allows for everyone to have equal access to resources, would be tied to this reality in the interim. Therefore, an educational goal for social transformation could combine the aforementioned social philosophies.

With regards to the above, the expected public libraries as social infrastructure transcend being a destination—a term that denotes an end or arrival point—by becoming a place of learning and meeting. Arguably, the library as a social platform becomes a stopover along the path of learning, a site to be traversed en-route to another location. With that being said, such a platform allows itself to be a pivotal spot in the community where visitors are encouraged to contribute to sociability and be merged with technology and learning.

### 2.4. The Interrelation between Public library and society in local urban context

According to Markus (1993, p. xix), buildings are fundamentally social objects rather than artistic, technical, or investment objects. In his book "Buildings and Power," Markus introduces the topic of the relationship between form and function and how this relationship explains the meanings of power. Markus (1993, pp. 27–28) asserted that, while architecture appears to have a functional program at its core, there is no direct causal link between form and function. Because of this, many distinct functions appear to be assigned to similar forms, and vice versa, numerous forms appear to be proposed for various functions, making the study of architectural typology, as Markus noted, a challenging endeavour (1993, p.38). In light of the discussion above, it is important to consider the connection between built environments such as public libraries and social dynamics, which will be presented in the following sections from two points of view.

#### 2.4.1. Power and public library

According to Markus (1993, p. 169), "**knowledge is power**," which is associated with political and civic significance and charts the roots of several functional kinds, including libraries, schools, and museums. With that being said, it is noteworthy to realise what makes a valid transmission of knowledge and also what makes a valid perception of knowledge. Explicitly, pedagogy and evaluation are two keys in response to the above, which will be implemented in the context of social discipline. Accordingly, public libraries have shown their potential and stability to boost social discipline in communities. According to Bernstein (2003, p.98), when rigid classification and framing produce social interactions based on compliance, **explicit social discipline** would result. However, Bernstein (2003, pp. 107–109) pointed out that poor categorization and framing create social discipline by implying that people must clearly engage in social activities, which implies a more intense and likely more powerful kind of social rule projection. Meanwhile, his argument highlights the pedagogical ethos of public libraries by emphasizing the term "do your own thing," which could make it easier to monitor visitors. Bennett (1992, pp. 395-408) argues whether democratic or non-democratic governments use culture to maintain their position of power, while Golten (2019, p. 3) says that public libraries should be a place for everyone, regardless of their political opinions, religious affiliations, or socioeconomic standing. The independence of public libraries arguably plays a big role in their serving as democratic spaces.

With regard to the above argument, two views would be experienced. On the one hand, public libraries want to make a political argument for free and open access to information a reality. On the other hand, they have functional and epistemological requirements that may limit or condition how and where books, tools, and people are distributed and accessed. In the meantime, we encounter the interrelationships between factors of space, program, and use that prompted the appearance of public libraries as a building typology, with a focus on how they convey a desired public message and achieve particular social and cultural impacts. Accordingly, a public library's location in an urban context, in addition to the three factors mentioned above, supports the power of the public library. Space also embeds social and cultural hierarchies by enshrining a scientific epistemology, and location, as a supplement to space, presents the public library as a social platform among other building types in the same urban context. The initiative supports the notion that education and literacy are necessary for citizenship, thus endorsing technocracy by setting an educational agenda for public libraries. Finally, the use materializes the concept of a "self-governed society," which embeds a dual process: being controlled by all others and engaging in a process of participatory action and regulation. This is accomplished by being collective within the frameworks of location, space, and program.

### 2.4.2. Public libraries as the spot of open access and social control

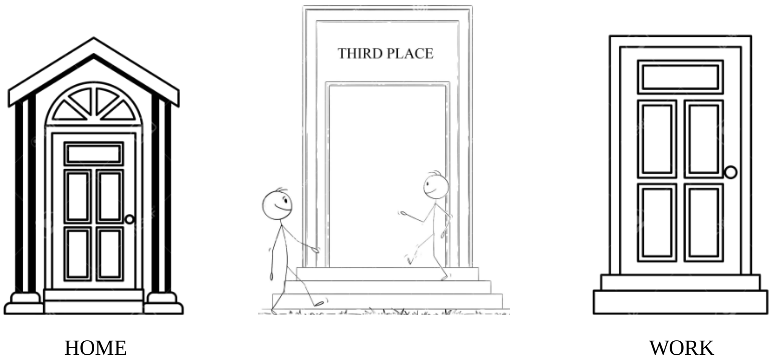
The importance of **how public libraries balance open access and social control** will be reviewed in this section. According to Harris (1999, p. 112-113), libraries were included in religious and administrative buildings up until the early sixteenth century, and libraries are constructed as distinct structures nowadays. As noted by Harris (1999, p. 157), librarians had the power to forbid reading by some specific visitors, and Koch (2004, p. 131-132) observes that libraries still had to deal with complex relationships between freedom, service, openness, and control. It is important to consider Bennett's (1995, pp. 90-91) claims regarding the "political rationality" of the museum in light of the aforementioned. He noted that while museums place visitor distinctions in relation to culture and instruct public behaviour, they also demonstrate access and equality for the community to know itself. They probably wanted to avoid creating a community of people, as Bennet (1995, p. 55) notes. As indicated by Bennet's argument, power and control are two important variables in this context. According to Stavrides (2016, p. 22), **disciplinary power** uses space to identify, define, and shape those subjects not only as subjects of law but as members of a specific social articulation, and it also regenerates itself in public spaces like public libraries through everyday life activities. He argues that **Sovereign power**, on the other hand, uses space to control those people whom power defines as subjects of a set of rules. Arguably, the aforementioned argument pinpoints that space can restrict liberty and that **political action, social connections, and spatial distribution must all come together in order for freedom to exist**. The above argument necessitates an investigation of the power relations between space, function, and usage. Accordingly, the social aspect of public spaces, like public libraries, is the most important feature of the spaces since it not only attends to people's activities and promotes effective space management, but it also gives them a sense of encouragement to educate and learn. According to Forgan's (1986, pp. 108-112) argument, public libraries' spaces give social hierarchies a physical form so they can shape their potential functions in accordance with organized systems. This is done through the use of architectural forms that communicate symbolic signals of hierarchy. Regarding the aforesaid, public libraries' spaces encompass power relations that they transmit from visitors in order to encourage people to learn. Markus (1993, p. 25) asserted that as buildings produce two distinct kinds of power and connection relationships, they also foster relationships through the creation of control interfaces between people and objects as well as between people and spaces. In the interim, he believes that the relationship between links and places is not simple.

Visitors most often expect that public libraries' core values liberate them from power relations and limitations. It is important to highlight that Tschumi (1996, pp. 122-127) argues in favour of architecture in order to liberate visitors from the control of rituals and limitations. According to him (Tschumi 1996, p.127), the **built environment can either act in support of or opposition to function**. In the paragraphs that follow, he argues that while space and function are distinct from one another, they can still have a close relationship. According to Tschumi (1996, p. 159), **"indifference," "reciprocity," and "conflict"** can influence how function and space interact. In this sense, "indifference" also refers to the fact that a sequence of events and spaces are unrelated to one another. Ye (2018, p. 147) asserts that when a venue can accommodate a variety of different activities, events and spaces can sometimes be uninterested in one another. Instead of generating a clear list of practical fixed uses, he claimed that architects should also suggest planned spaces with unpredictable programs. "Reciprocity" refers to the relationship in which a sequence of occasions and locations influence one another's ability to exist. Conflict refers to a situation where a chain of events or spaces deviates from one party's internal logic. Tschumi (1996, pp. 159–160) thinks that **protecting architecture from conflict leads to free visitors from power relations for this reason**. Additionally, his concept still requires a way to control spatial social interactions. According to Bennett (1995, p. 48), **public libraries have gradually lowered their control on procedures to encourage free mobility and engagement in the area**, which is one of their primary goals. On the other hand, Tschumi's claim that function is essential for control initially appears to be in opposition, as it was thought free movement in space can be raised when control is reduced step by step. If this is the case, why did they first control something before reducing their power over it? They may have gradually come to understand that a ritual of function can be spelled out explicitly. Regarding this, it is important to remember Bennett's (1995, p. 55) opinion that without humans, **structures like cathedrals** would not be able to serve their purpose. Accordingly, public libraries also would be seen as a social infrastructure because the community's members are the reason for outstanding role of social contribution. The library is one of the most important types of social infrastructure that we have, according to Klinenberg, because it offers the setting and context for social involvement (Klinenberg 2018a, p.33). Bennett, meanwhile, emphasizes the value of space through the presence of a community. With regard to Lefebvre's (1991, p. 11) ideas, it could be led up to that public libraries are a chance to comprehend the political creation of space, and it is clear that the people in the community are almost seeking them as **a place serving liberation and revolutionary power**. Accordingly, "spatial practice" is required for the public library as a typology to generate social formation that results from group performance. Therefore, Lefebvre's theory does not govern how people use public libraries; rather, it focuses on how people utilize them collectively for political activity and social engagement. The theoretical discussion concerning the space, society, and correlation of public libraries is the focus in light of the aforementioned. By using the presence of visitors in public libraries as evidence of their primary role in fostering socialization in architectural space, Lefebvre clearly considers the spatial practice to be a guideline for the justification of social practices for contemporary discourse, which can also be developed to the periphery of the space's location in an urban context, which is a key discussion to this research study's objectives.

The social function of public libraries exemplifies how space facilitates access to knowledge, function highlights the educational potential of libraries, and usage entails the viability of these crucial components in the context of social behaviour. Additionally, **power relations make it clear that public libraries' spaces integrate social and cultural elements, and their functions provide educational potential, proving that reading and education are necessary for citizenship**. Usage thus makes it apparent that individuals control their communities and that this control entails group and participation actions.

### 2.5. From "Third place" to accessing community

Dalmer et al. (2020, p. 29) argue that there are clear subscription points between the library as a third place and the library as a social infrastructure in that both are according to eight characteristics coined by Oldenburg (1999, p. 42), which means that the library creates local face-to-face encounters and abets the creation of bonds.




Social Places: Interactions, connections, Networks

| | | |
|---|---|---|
| Educational | Educational<br>Entertainment<br>Social interactions | Entertainment<br>Social interactions |
| Childcare<br>PreSchool<br>Primary<br>Intermediate<br>High school<br>University | Community Centre<br>Public Library | Church<br>Gym<br>Casino<br>Pub<br>Cafe<br>Restaurant |

Figure 2.3: General concept of Third place (by author)

The third place is a generic designation for a great variety of public spaces that host the regular, voluntary, informal, and happily anticipated gatherings of individuals beyond the realms of home and work (Oldenburg, 1999, cited in Evansville Vanderburgh Public Library: Facilities Master Plan, 2022, p. 20) (figure 2.3). Accordingly, particular focus is placed on how the library functions as a public meeting place in an urban context and how the library' building affects the well-being of the community, which can provide an opportunity for realization in this study to explore the role of the library's location on sociability in an urban context.

The developed goals of the buildings of the new public libraries are the message to communities rather than their function. Thus, despite having access to digitally accessible information, communities are still interested in getting physical attendance in libraries, which is proof of the social importance of public libraries. For a variety of reasons, public libraries act as a "third place." According to Garmer (2014, cited in Evansville Vanderburgh Public Library: Facilities Master Plan, 2022, p. 19), the public library as a public platform makes it possible to curate and distribute the creativity and knowledge of the local community on the one hand. On the other hand, such a platform is a "third place", which is an interactive space that can accommodate many individuals working both individually and in groups, and it also meets the community's educational and civic requirements. In addition, public libraries as venues for social connections are the "third place" that is different from what people experience as their first place in houses or second place in workplaces (figure 2.4). With regard to the above, it is noteworthy to know that a public library's location and the configuration of its architectural building type play a key factor in the creation of social ties in such public spaces. Informal social ties are, according to Scott (2011, pp. 206-207), the meaning that separates "third place" from other places, as it induces the collectivity of a social community.

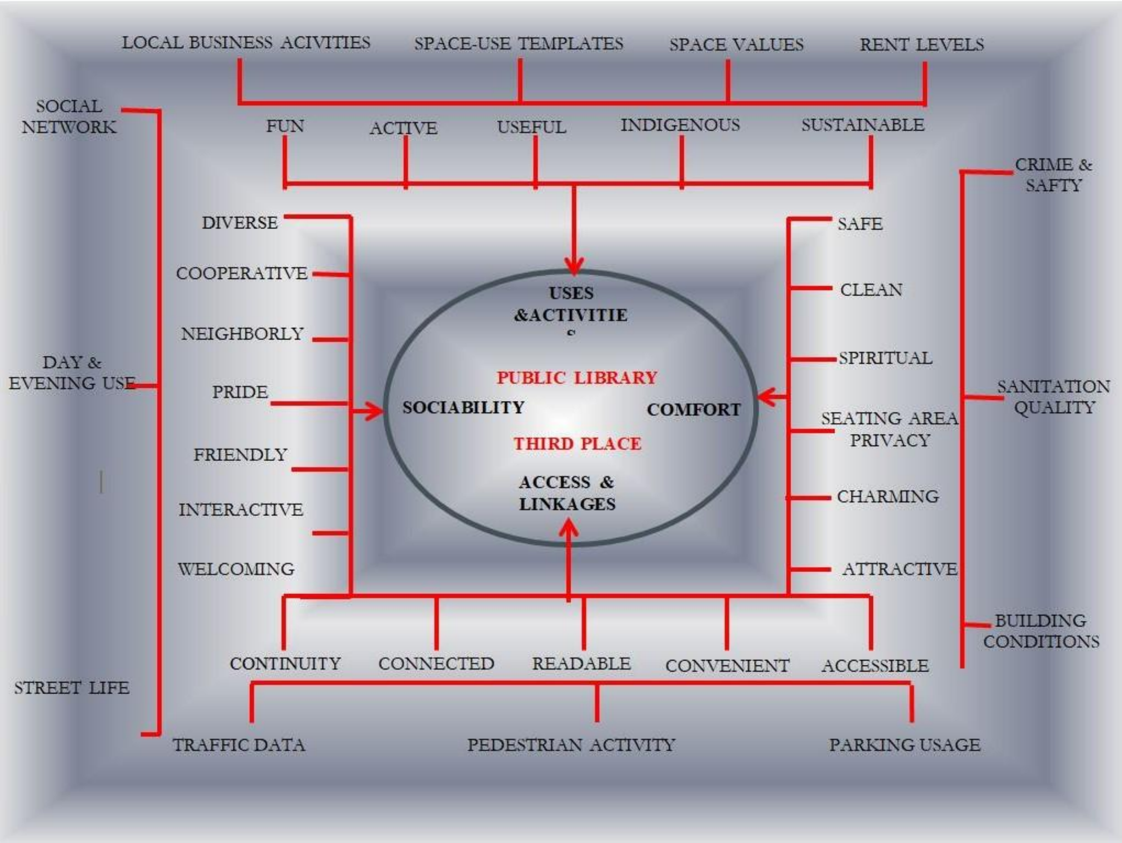



Figure 2.4: The Public library Diagram representing the Third place (by author)

Bogue and Ouillon (2023, p. 12) argue that third places have an impact on our daily lives and have an impact on the places we can travel to, the people we can interact with in person, and the knowledge and information we can use. Accordingly, Koch (2004, p. 76) believes "communication, exchange, and knowledge as produced through human interaction" are the three purposes that public libraries work for. With regard to both arguments, we learn how "public library" can represent the third place's characteristics. Thus, the two key strategies are access to the library's materials and the building itself as a typology. Likewise, social values are a significant segment of spatial and social relations in public library buildings. Therefore, developing a public library as a third location entails realizing its social potential and fostering participation opportunities as well as increasing awareness of space and its various dimensions. In this discourse, socializing is the crucial concept that necessitates drawing others in and encouraging social connections. Accordingly, the blending of multiple spaces at the same location leads to a hybrid concept to encourage people to use the space constantly. As mentioned by Zerouati (2020, p. 36), this idea might arguably function in the form of transitional places to provide possibilities for people to socialize on their own. By the aforesaid, transitional places could unveil the invitation to the public by blending multiple spaces from the site location's edges to any eligible building spaces to be connected. Such status results in a behavioural setting that promotes third-place socialization by causing spatial variation and integrity. Gaiman (2013) asserts that because public libraries are well known as **unbroken centres for research** and as gathering **spaces for social interaction and culture**, they play a crucial part in **fostering democratic communication** in local communities. Buschman (2005, pp.1-12), however, offers a different viewpoint, contending that economics permeates virtually all public institutions and areas, turning social discourse into a consumerist one. Buschman's concept is a new public philosophy that focuses on resource networking rather than research. His argument demonstrates how, in the interim, the new public attitude makes the phrase "keeping libraries alive" the justification for libraries' modifications, which entails having well-liked collections like coffee shops and electronic resources. According to Buschman (2005, p. 10), the way that public libraries are changing today is causing the democratic public dialogue that they are supposed to represent to be destroyed. Buschman's viewpoints obviously conflict with those mentioned by Scott (2011, pp. 223-224) about the promotion of community values through public libraries. Two concerns with contemporary public libraries are planned in relation to the aforementioned concepts: "**how much they are public**" and "**how much they are libraries.**" A good illustration of the aforementioned concepts is the public library in New York City, which was designed by Foster and Partners. There were two opposing factions. According to Steinhauer (2014), one group accepted that the revised plan would make the library more accessible to the public and make it more public. The opposing faction, on the other hand, according to Teeman (2012), viewed the new design as a visitor attraction with a cafe, or, according to

Rosenfield (2013), it was perceived as a suburban mall that overlooked the primary purpose of a true library.

### 2.5.1. The relationship between public library and social activities

What has been experienced so far is that, rather than talking about different visitor types and how users' activities are carried out at the location of public libraries, the social function and purpose of public libraries are frequently expressed through language. With that being said, three accesses—physical access to resources, digital access to resources, and public access to common areas—are evident in today's public libraries (Figure 2.5).

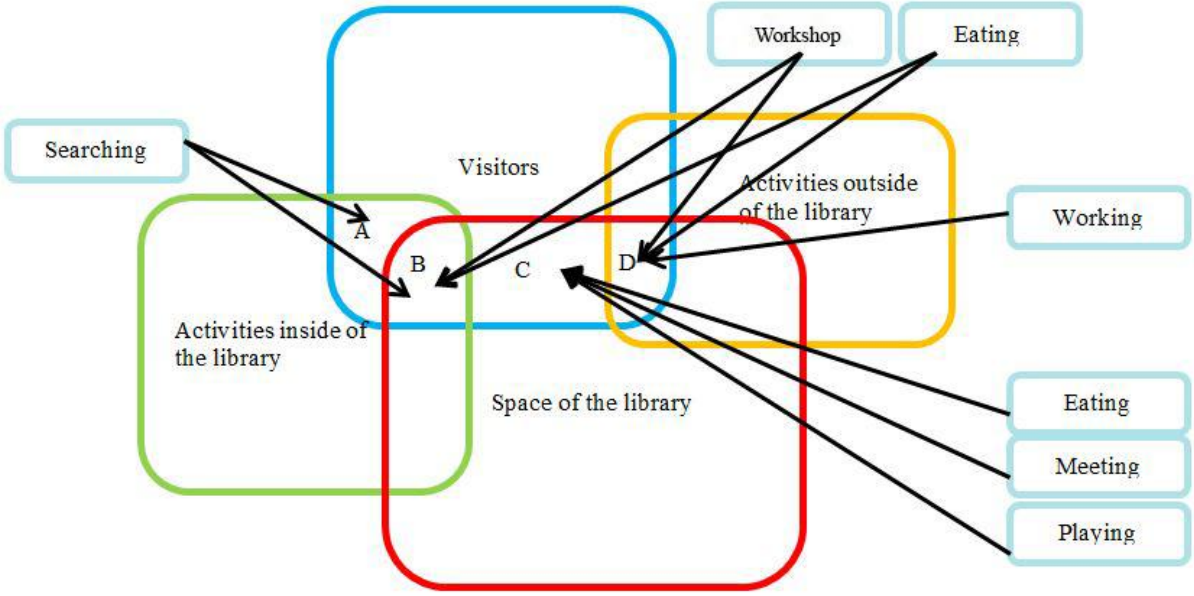



Figure 2.5: Diagram representing the association of the types of activities observed in the library and the different purposes of the library (by author).

With regards to the above, while it is important to realise how visitors use the library, it is also important to consider how community members have **physical access to the library's location** on an urban scale, which is the focus of this study. However, this study takes the opportunity to keep the experience of Zook and Bafna (2012) into consideration of how the functional adjustments have affected how the public uses the Seattle Public Library. They discovered how to track the visitors' footprints, which allowed them to map their group's routines in space. Recognizing similar activities and differences in their footprints inside the library would involve some sort of mapping procedure. They said that the Seattle public library serves as a "stage" to entice people to investigate the structure, drawing on Goffman's (1959) explanation of the dramaturgical perspective in social life.

With regards to the so far reviewed, the influence of public libraries' changes on their value to society and social function is substantial. According to Forgan (1986, pp.108-112) and Markus (1993, pp. 172-183), the purpose of public libraries is to educate society and enable the enmeshing of power relations. According to socialization and easily accessible digital resources, public libraries are shifting from places for knowledge to places for social interactions. In other words, power relations have changed in public library spaces, notwithstanding the functional modifications. That is why the possibility of a gradual increase in informal social activities would appear in public libraries.

It is noteworthy to keep the concept in mind that, according to Daneshpour and Charkhchyan (2007, cited in Golshan, Motalebi and Behzadfar, 2021, p. 5), social contact is the relationship between two or more people that could cause them to react. Social contact can also include physical contact, an exchange of glances, a chat, and a connection. The amount of social engagement that is desirable varies across cultures and between individuals. People's comments and typical views about having a nice social life, congestion and density, social norms and relationships, beliefs and ethics, social classification, seclusion, and physical placement all fall within this acceptable level. Hillier (1999b, pp. 344-349) argues that the amount of social engagement that is desirable varies across cultures and between individuals. People's comments and typical views about having a nice social life, congestion and density, social norms and relationships, beliefs and ethics, social classification, seclusion, and physical placement all fall within this favourable level. With that being said, the role of the public library as a public location in relation to a region and its local street network is the key discussion of this research, which can illustrate how such a public spot can be a **social infrastructure** that can provide the opportunity to increase informal social activities gradually.

The public library as a social infrastructure becomes distinguished when it brings attention to and accents the shifting and transforming social dynamics, contexts, and perceptions of the population and the societies that the public libraries are located within. This is what makes defining the library as a social infrastructure so attractive, and significantly it reminds us that the public library is not static as Mattern (2014, cited in Dalmer et al., 2020, p. 29) stated, and accordingly the public library is "network of integrated, mutually reinforcing, evolving infrastructures" (Mattern, 2014), which is thoroughly and intimately involved in fostering a community that is infused with cultural, political, and economic ideals as well as the advancement of knowledge. With that being said, the public library as a social infrastructure in an urban context brings attention to a variety of interconnected individuals, organizations, and components that are included in creating an inclusive community space on the one hand. On the other hand, the library promotes the opportunity to develop social interaction and civic involvement, which makes the library distinguished as a social infrastructure.

According to Buschman (2005, p.10), informal social activities bring people together and help create communities where there would otherwise be racial and economic segregation. Accordingly, she meant that the public library changes do not just encourage visitors to be more activated but also cause "strengthening communities." Having said that, visitors will also seek to contribute to the strengthening of their communities through the opportunities provided by their local libraries. Malyarov (2023) refers to Klinenberg's opinion that people tend to think they can solve a serious social problem when faced with it. He also added that even when the wheel already works flawlessly, they still try to reinvent it, which brings the opportunity to make a **novelty**. With regards to the above and with regard to Hillier and Hanson (1984, pp. 223-224), public libraries as a social infrastructure need a program that has a pre-established structure for how interactions and activities are to be carried out before the actual act of inhabitation. From such a point of view, a program can be thought of as a "social script" that, like in a play, establishes roles for various social groups and their behaviour in public spaces such as public libraries. Hence, community members realise what types of social activities could occur on such a social platform. In the meantime, to boost social activities, it is important to realise how public libraries as a social infrastructure could be adaptable in an urban context. On the one hand, it is crucial to how much the location is **central** in the local area, how much the location is **pivotal** in the area, how much the location is **permeable** in the area, and how it is accessible. On the other hand, three public functions of the public library are important to boost the activities, which are, according to Hillier (1996, p.258), how buildings are **intelligible**, how visitors can occupy the spaces, and how they are able to move about between spaces.

## 2.6. Conclusion

Urban areas require social infrastructure. Public libraries are essential in cities because of their practical value as well as the fact that they provide areas for interaction and socialization. In this way, public libraries as a social platform are significant. They matter because they are public spots within an urban context in many aspects. They are areas that provide opportunities for people to interact with others. The public library as a "third place" is central to social matters that people become concerned about within urban environments. Concentrating on public libraries as social infrastructure brings to light a variety of frequently underutilized opportunities, such as the integration of architectural and urban aspects that can form the library as an adaptable social platform in an urban context. Accordingly, it could lead to exposing the distinct features of the public library, specifically socialization. Exploring public libraries as social infrastructure, as places that promote social connection, directs attention to the breadth, depth, and texture of social activities that can be promoted in the urban environment. According to Klinenberg (2018, cited in Smith, 2019, 242), libraries are among the most critical forms of social infrastructure that we have. That is why that public libraries are important because of the effects they have on society, politics, health, and general well-being.

Thinking from an infrastructure perspective draws attention to the ways public libraries are designed and shaped. Infrastructure is about the facilitation of activity. Hence, apart from maintenance and distribution, the design and the quality of the location in an urban context and public access affect how social infrastructures such as public libraries function. Generally, social infrastructure's usefulness is not immediately apparent. Often, only when something goes wrong or has been taken away does its absence become apparent. However, because they are open to the public every day, public libraries serve as social infrastructure, reminding us of their values.

This chapter reviewed the theoretical discourse to open a window leading to a comprehension of social infrastructure, the importance of the infrastructure's location, and exploring the public library as social infrastructure. With that being said, it is realised that the library as a social platform has the potential to be a generative field that creates connectivity with the surrounding area as well as the distribution of movement, co-presence, and interaction. It is noteworthy that public libraries frequently serve as catalysts for the revival of society and the economy. They offer tools for lifelong learning, literacy and digital literacy, skill development, and training. The public library building is frequently the sole civic structure in many areas that is open to the general public. In addition, it also addressed how public libraries' changes appeared over time and how giving value to socialization transferred the public libraries from an institution of knowledge to a spot of social relations in urban spaces, which will be applied as a reference for the purpose of this study in the context of Auckland.

With regard to what has been argued in this chapter and the aim of this research study, it is necessary to bring the importance that what strategy would be into attention in further sections. According to Melik and Merry (2021, p. 763), conceptualizing the public library as a social infrastructure necessitates not just analysing it as a meeting place but also looking into the infrastructure-building practices to revive the library as a social infrastructure. Taking what they argued into account, practices of infrastructure building are not limited to services or recreation of new building structures; they can also be concentrated on the urban connectivity and accessibility of the library's location within the local urban context, which can accordingly boost the library's sociability in the region. To support the above argument, it is noteworthy to note that street networks have commonly been treated as sets of more or less homogeneous linear elements, connecting locations and intersecting at junctions (Marshall et al., 2018, p. 735). They accordingly add that street networks serve as the basis for network research and facilitate a variety of urban processes. Hence, it is possible that street networks could play a key role as part of the practices of infrastructuring in a region. Having said that, in the next chapter, we concentrate on the space syntax method to describe how the expected analysis will assist this research approach.

# Chapter 3.

# Review the method of Space syntax and scenario analysis of selective public libraries' locations via applying the parameters of space syntax

# Chapter3

## 3.1. Introduction

Social infrastructure as an urban public space plays a significant role in the building of the city and also the architectural and urbanistic approach. However, different attitudes lead to various design approaches. Social infrastructure could be a way to harmonize the heterogeneous spaces of the urban fabric as much as possible by boosting its sociability potential. The public library as a social infrastructure is the place where visitors have both margins of freedom and generally accepted kinds of control in this set of social interactions. This is the common place where the community members are able to share and live together. Accordingly, this place needs to have distinguished qualities such as permeability in the local urban context.

This study's analysis model is considered to aim at analysing the selected public libraries' places as urban public spaces in Auckland in terms of their integration into the local urban network and their quality measures (permeability) among public spaces surrounding them. Accordingly, a framework of the factors affecting sociability is considered, and these factors will be analysed via the space syntax method. On the one hand, connectivity, integration, and choice will be analysed in the urban network. On the other hand, accessibility via Isovist analysis will be analysed, which help to explore the measure of permeability toward the public libraries' locations.

In addition, this chapter reviews a scenario analysis of selective public libraries' locations in Medellin via applying the parameters of space syntax. This review describes each library as a particular spatial culture in an urban context. Hence, an opportunity comes in not only to review the methods and theories of space syntax but also to divulge the context that lets the current research study exploit such experience.

### 3.2. Space syntax

Space syntax includes theories and techniques to concentrate on street structures or spatial configurations. Space syntax can calculate the relationships between spaces, whether within buildings or between urban spaces. In the meantime, according to **Yamu, Van Nes, and Garau (2021, p. 1)**, space syntax's role in our understanding of the built environment provided a new, more nuanced understanding of the relationship between space and society by providing an operational approach to studying spatial relationships between built buildings and/or objects, **which can assist this study in evolving the relationship between the concept of the public library as a public building within the urban context of Auckland and sociability and promoting public participation**. Yamu, Van Nes, and Garau (2021, p. 1) argue that space syntax blends tangible aspects (movement and land use) with intangible aspects (cognition and behaviour), unlike other methods for the analysis of space. This method was introduced by Bill Hillier and his colleagues at University College London in the 1970s. Arguably, space syntax includes a set of techniques for analysing urban networks that are formed by the locating, grouping, and orienting of buildings. In addition, these techniques let us explore how an intended street relates to other streets within the same built environment, spatially. In fact, space syntax helps with the conception of how urban space, in turn, causes socio-economic activities. With that being said, according to Yamu, Van Nes, and Garau (2021, p. 2), the above importance relies on how buildings are arranged and how the street network is organized, which influence social interactions and people's socioeconomic activities. They also mention that the term "space" appears in the space syntax technique as an active matrix of settlement processes in which the physical organization of the city is strongly linked to its social and cultural interactions. With regard to above, we learn that space syntax is a collection of theories about the connections between space, spatial relationships, and society. Hence, space syntax gives the opportunity to learn how its potential can be applied to boost **sociability** in an urban context between the street network and public spaces such as public libraries.

Space syntax measures the relationship of each public space or street segment to all other public spaces in a built environment. On the one hand, space syntax quantifies the proximity, or potential for movement, of each street segment to every other. The through-movement potential of each street segment in relation to all others is measured by space syntax, on the other hand. Different accessibility possibilities are represented by the through- and to-movement potentials of the street network. According to Hillier and Iida (2005, pp. 477–478), by defining the radius in terms of the shortest length, the fewest turns, or the least number of angle changes, each type of relation can be determined at various radii from each street segment.

According to Hillier et al. (1993b, pp. 31-33, 1998, p. 60-61), there is a cohesion between the movement in the street and the spatial configuration of the street network. In the meantime, space syntax gives us the opportunity to recognize regeneration opportunities, and accordingly, it ensures that new ideas are able to meet the spatial potentials of existing urban areas.  Accordingly, space syntax focuses on how buildings and other urban spaces influence spaces to shape their spatial configuration instead of analysing building forms. Space syntax is able to calculate the relationships between the spaces via graph theory. Hence, the focus of space syntax is not on the physical object's shape, but rather on the spaces that exist between them and also how they are connected to all other spaces within the same built environment. With regard to the role of space syntax, it is necessary to consider that connection between urban spaces helps us understand how the physical aspects of the built environment and urban social life interact. Through such consideration, locations, spaces, boundaries, and qualities can be described. As a result of the connection between urban spaces, the types of activities mentioned by Jan Gehl (2011) in his book (Life Between Buildings) occur. He argues that "what is important is not whether factories, residences, service functions, and so on are placed close together on the architects’ drawings, but whether the people who work and live in the different buildings use the same public spaces and meet in connection with daily activities" (Gehl, 2011, p. 101). Accordingly, these activities depend on the physical qualities of the built environment, which could lead to sociability and urban vitality. With that being said, the objectives of this study can exploit his argument in terms of how the connectivity and relationship of public libraries' locations with their local urban context lead to sociability.

As Hillier (1993a, pp. 8-27) mentioned, there are differences between extrinsic and intrinsic attributes of space. In an urban region, these extrinsic attributes specify how urban spaces relate to each other. In the meantime, their relationships are invisible while their intrinsic attributes are visible, which can be seen via physical form, dimensions, plan, and texture. Therefore, while we face a set of observable characteristics of a built environment that instantly appear to us, there is hidden structure in the form of the same physical object.

### 3.2.1. Extrinsic attributes

As the space syntax method examines the topological spatial relationships of buildings and mostly uses extrinsic attributes, this study focuses on the same attributes as well.

Unlike intrinsic attributes, extrinsic attributes are difficult to put into words. That is why considering an urban scale that includes spaces is necessary. With regard to Hillier's argument, extrinsic properties of space "cannot be seen all at once, but must be pieced together through movement, inference, recollection and so on". Accordingly, it can also be inferred that people travel or live in a way that shows their activities take place in a variety of areas in addition to one. (Hillier, 1999, cited in Bereczki, 2022, p.6). Accordingly, it can also be inferred that people travel or live in a way that shows their activities take place in a variety of areas in addition to one. The types of human activities that occur are influenced by how these locations are interrelated to one another. Obviously, these locations, such as buildings, squares, parks, and playgrounds, are connected to each other by urban spaces such as streets, roads, boulevards, highways, etc. All these urban spaces create a network that could serve as a potential pathway for people to travel from one place to another. Accordingly, as this network is a linear network, people's movement depends on these linear grids. Arguably, the roads and streets are the armatures of the network. In the meantime, space syntax is based on two crucial statements: space does not play a background role in people's activities, but it is central to them, and areas such as a room, street, or public space are influenced by the connections between that place and the arrangement of places to which it is connected.

Space syntax with research on urban transformations and working with the concepts of ‘isovist field’, ‘convex space’, and ‘axial line’ with the capacity to measure objectively the physical characteristics of cities, including those of urban spaces concerning various patterns of human activity, citing connectivity, choice, and global and local integration as significant and essential spatial measures.

An isovist scope is about perceiving of changing visual fields. Arguably, according to Bendikt (1979), everything that can be observed directly from a specific place in space is represented by an isovist. The isovist changes as we walk through the intricate patterns of space in built environments, and the collection of these isovists creates a lasting image of the pattern of space as a whole. A visual record of what may be seen in a 360-degree view from a specific place is what an isovist is, to put it simply. The idea of an isovist is directly tied to the concepts of visual perception and spatial description. The visual recording is made at average eye level. A field of vision from which several geometrical qualities, such as area and perimeter, may be determined is what Batty describes as an isovist. According to Batty (2001, p. 123), for each point that makes up an environment, isovists can be specified, and an isovist field is defined by the spatial union of any given geometrical characteristic.

Place-bound functions and human behaviours like standing and sitting predominately occupy convex space. Convex maps are used for spatial analysis to examine the internal spaces of buildings and common areas between clusters of buildings in a neighbourhood or small region. According to Hillier (1988, p.68), interaction in a convex space is for everybody, where everyone can see everyone else on any spot inside the same space because they don't need to pass any boundary in the space. As this study focuses on the integration of the Auckland selected libraries' locations into the local urban network and their permeability among the public spaces surrounding them, therefore, axial maps and axial sightlines are more appropriate to be addressed.

According to Hillier and Hanson (1984, p. 94), an axial line indicates the longest sightline distance for movement within a collection of convex spaces, and an axial map is the smallest set of axial lines. Also, the axial line depicts how people travel linearly through the network of metropolitan streets and roads. A series of convex regions that can be seen and travelled through one after the other are connected by an axial line. In the meantime, an axial map is the minimal set of axial lines such that the set taken together fully surveils the system, and that every axial line that may connect two otherwise-unconnected lines is included (Turner, Penn, and Hillier, 2005a, p. 428). The axial line serves in numerous ways as both the movement line and the optical sightline. As Hillier and Hanson (1984, p. 91) found in their research on urban public space, an urban network can be represented by a series of axial lines that connect convex regions like "beads on a string." Arguably, it means that one-dimensional space reflecting the movement through built environments is represented by the axial lines, while two-dimensional spaces are convex spaces that are connected by one-dimensional space.

For analysing the street and road network in the multi-nodes of Auckland by considering a specified radius with the centrality of selected public libraries, the network of streets and roads will be shown on the axial map with the movement paths with the longest and fewest sightlines that can display movement paths and present direction shifts in terms of visibility. In this way, the link between urban convex spaces is topologically represented by the axial map, which is a representation of extrinsic characteristics.

### 3.2.2. Summary

In a nutshell, the extrinsic attributes of space are all about spatial interactions and how they influence where different urban functions are located and how people move through space. Hence, consideration is given to the invisible spaces that are shaped by walls and objects as well as how they relate to one another instead of considering the meaning of spaces in the analysis and description of the built environment in such context. With that being said, the relationship between the selected public libraries in Auckland and their surrounding urban spaces and the movement of people represents the secret DNA of the built environment, which explores the genotype of the environment.

The space syntax lets this study explore the relationships of the selected public libraries' locations to other public spaces via analysis of the local street network within a specified radius. In this way, as an example of integration analysis shown in Figure 3.1, streets with fewer direction changes than the rest (indicated in red) have strong spatial integration. These streets frequently host active shopping districts and have high pedestrian traffic rates. On the other hand, streets with limited spatial integration and a large proportion of direction changes compared to all others are highlighted in blue. Accordingly, pedestrian traffic rates wouldn't be high on these streets. This is an illustration of the analysis of the extrinsic characteristics of space. The 'hidden' spatial structure of the built environment is represented by space syntax analysis, which gathers different levels of street life, urban vibrancy, and the locations of active land use. As a result, this study can take advantage of the potential of these indicators to explore opportunities to improve the sociability of the selected public library locations.

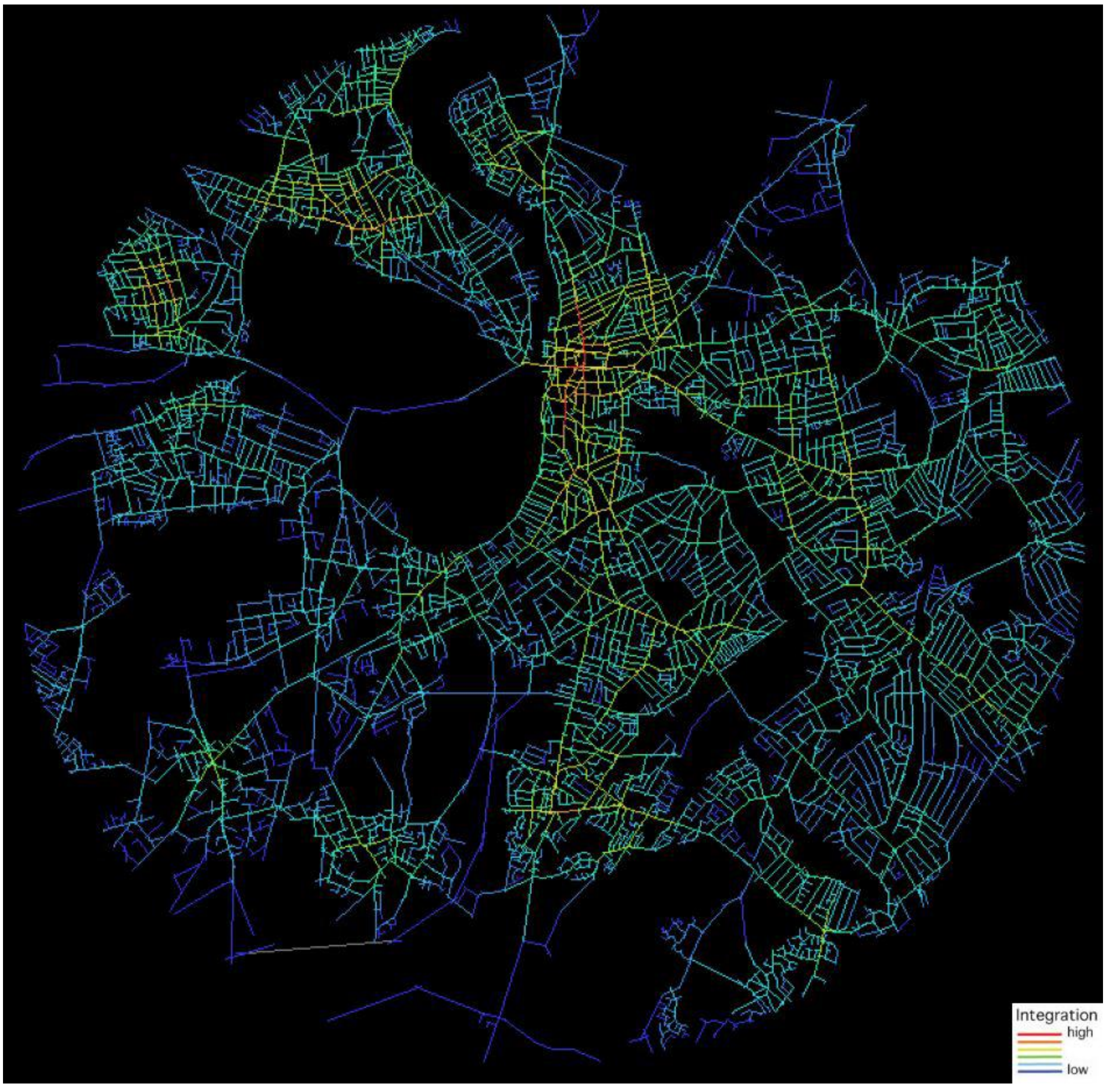



Figure 3.1: Surbiton integration analysis radius 800m (Dhanani et al., 2012, p. 8211.19)

The spatial configurative relation of the publicly accessible places that are represented by streets and squares, determines how architectural forms and functions are associated. In the meantime, some streets are spatially more integrated than others, making them appear to be more "central." On the other hand, there are some other streets that are more spatially segregated. Besides, while homes are located on spatially more segregated side streets, active land uses such as stores are found on spatially integrated major streets. As a result, an urban region's genotype is explained by the extrinsic characteristics of space; its "secret" spatial structure is defined by buildings, land use demarcations, walls, and fences. The framework for what we can view, what we can access, and how we can move through and between all the physical barriers placed in space is established by these concealed spatial structures.

With regards to the four nodes in Auckland, in order to address the geographical scope of this research study, a framework of the factors that affect sociability is considered and needs to be analysed. Van Nes & Yamu (2017, p. 10) mention that the accessibility and wayfinding of any area can be analysed and quantified by using space syntax, which makes use of graph theory, this study would take the initiative to utilize space syntax. As previously mentioned, axial connectivity and axial integration need to be analysed, as according to Hillier et al. (1987, pp. 233-250), the correlation between these two leads to axial intelligibility, which represents the number of immediate connections on a route. In the following, the choice analysis will be considered in the urban network by radii 3 and n. On the other hand, visibility analysis is considered by isovist analysis, visual graph analysis (VGA), and agent-based modelling, which leads to the degree of accessibility and accordingly the degree of permeability toward the public libraries' locations.

## 3.3. Connectivity

Connectivity as a static local assessment expresses the number of streets immediately connecting a street of origin. Besides, Ozbek et al. (2022, p. 50) argue that the role of street connectivity is a key factor in causing pedestrian accessibility to destinations, which has consistently been connected to walking. Accordingly, connectivity has an impact on transport and activities. According to Neckel, A. et al. (2020, p. 612), the quantity of integrated lines or segments is correlated with connectivity. They argue that the degree of direct visible connection between each axial line and the number of near neighbours that intersect it determines connectivity, which is a local spatial feature. In the meantime, this measurement counts all of the direct links between any two streets in a given area. Hence, streets with many connections have a high connectivity rating, whereas those with few connections have a low connectivity value. These values can be depicted using a colour scheme.

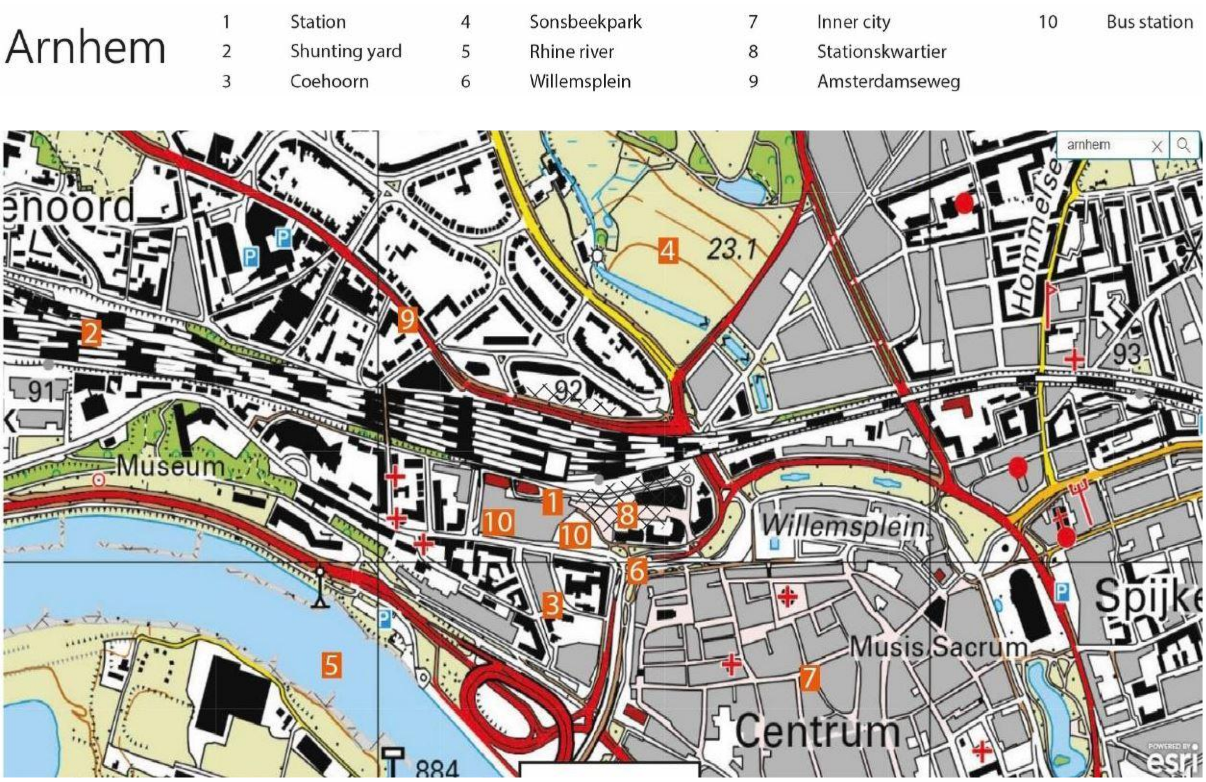



Figure 3.2: Arnhem station year 2020 (Petit, 2021, p.28)

Arnhem station is a clear example to illustrate the above (Figure 3.2). According to Petit (2021, p. 66), Arnhem station does not have a walking pass-through. Additionally, there are several highways in the Arnhem region that do not have pedestrian roads because it is difficult to cross them or there are no sidewalks next to them. Less infrastructure change has occurred in Arnhem over the past two decades. The tunnel under Willemsplein, which will lessen the barrier effect between the station area and the inner city, and the minor road changes along the north and south sides of the station are the two that are most significant. In the meantime, the roads near the station's entrances have slightly higher connectivity values, as shown in Figure 3.3.

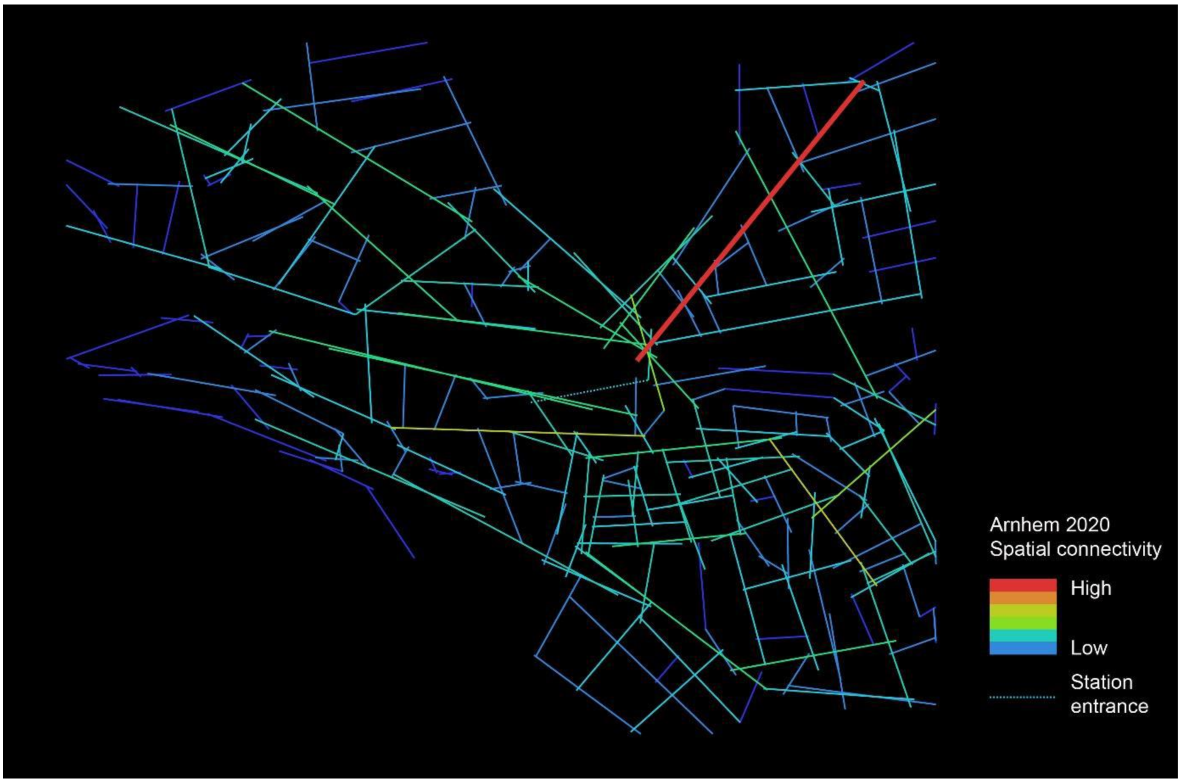



Figure 3.3: Arnhem station spatial connectivity year 2020 (Petit, 2021, p. 67)

Within a specified radius, the degree of connectivity for each street in the region surrounding the Arnhem station is visualized in Figure 3.4. The streets with the most links to neighbouring streets are shown in the analysis as axial lines marked in red and yellow. The Cronjéstraat street at the north-east of the station is the most highlighted. All of the dark blue streets have just one or two connections nearby. In the meantime, except for Cronjéstraat Street, the majority of higher values for connectivity can be found on southerly and south-easterly adjacent streets to the station.

In a nutshell, the number of other lines that an axial line (origin) intersects inside a network is referred to as its "axial connectivity." If this parameter has a high value, the analysed line may be characterized by access movements to (or from) many other network lines. Two essential physical characteristics that can positively influence pedestrian mobility and encourage more frequent walking trips are the connectivity of the streets and the closeness of the destinations. Connectivity is determined by the grid designs of linked streets in particular. In the following, some more advanced connectivity analysis techniques will be described that could help the axial connectivity analysis in this study.

### 3.3.1. One-Step analysis

According to Van Nes and Yamu (2021, p. 39), there are four types of connectivity analysis, including one-step, two-step, three-step, and N-step. The **one-step analysis** explores how immediately a street is connected to its adjacency. Figure 4 represents a one-step analysis in examples A and B. The main streets are shown in red. The street (red) in Figure 3.4 (A) has two direct connections, while the street (red) in Figure 3.5 (B) has 19 direct connections to the green-coloured streets (Figure 3.4).

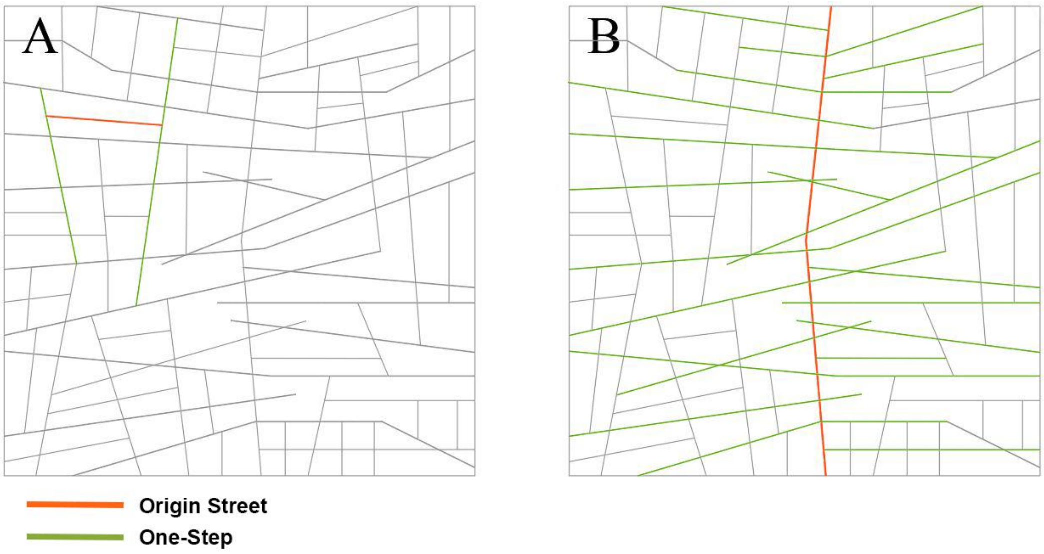



Figure 3.4: One-Step connectivity analysis (by author)

The degree to which a street is connected to its surroundings is depended on the number of axial lines directly related to that street. The one-step analysis is important for determining how connected the selected streets are to their surroundings, which shows the degree of connectivity in the specified area. According to Van Nes (2009, pp. 121.10-121.11), the main routes are those that people prefer to travel on to and from urban centres. With regard to Van

Nes and Yamu's (2021, p. 40) citation of the thought of Klaus Humpert, pedestrians follow an "ideal movement line" to get to their destination. In addition, according to Humpert (2007, cited in Van Nes and Yamu, 2021, p. 40), the pedestrian changes his or her path if the optimal moving line diverges from the endpoint by more than 20°–30°. Accordingly, the path is being branched. Older boulevards, major thoroughfares, and major distributors typically feature extensive visual sightlines that indicate movement routes.

With regard to this type of connectivity analysis, the paths with the longest sightlines are marked in a specified colour, such as red, and following this step, all streets that connect to the red-indicated streets are identified in green. These serve as the major route network's one-step analysis. Grey represents all remaining streets. This analysis allows this study to investigate the number of green axial lines connected to the main route network within a specified radius of selected Auckland public library locations. If we have a high density in an area, we can conclude that this neighbourhood is a topologically "shallow" system due to its high degree of connectivity. It is simple to go to all destinations from all starting points. The grey-coloured streets are the remaining streets. A major path can be accessed within such a region by merely turning around once or twice. On the other hand, if we have a lower density in an area, we can conclude that this neighbourhood is a topologically "deep" system due to its low degree of connectivity. In this way, the main path network within the specified area is more fragmented, and accordingly, to access the major route network, a lot of direction changes are necessary. In the meantime, the number of remaining axial lines in a topologically "deep" system is higher than in a topologically "shallow" system.

### 3.3.2. Two-Step analysis

With the help of a selected set of axial lines in a **two-step analysis**, it is possible to visualize the local catchment area for two direction modifications in the network. Arguably, the level of accessibility to the surrounding neighbourhood is depicted by the "two-step grid." This analysis includes step zero, step one, and step two. Step zero of this analysis can be completed manually by colouring the selected streets that will be examined. Applying the one-step analysis logic, the first step marks each connected street with a different colour, in this case, green. By step two, once again starting from these streets, all linked streets are now designated in a different colour (Figure 3.5). The streets in two topological steps or two direction changes from the origin streets are marked in blue in Figure 3.5, examples A and B. The catchment area for the selected streets shown in red is made up of the total of all axial lines from steps one and two. Comparatively to the one-step analysis, the local catchment area of the two-step analysis for example (B) of Figure 3.5 encompasses the majority of the street net in example (B) of Figure 3.4.

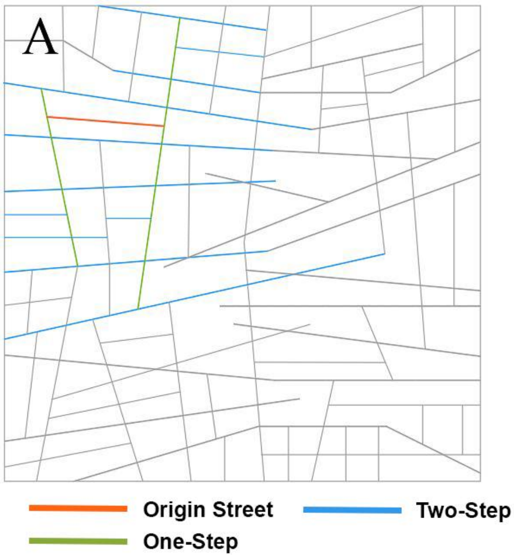



Figure 3.5: Two-Step connectivity analysis (by author)

With regards to Hillier's (1999a, p. 119) argument that the most important local shopping routes are frequently those that span the majority of a neighbourhood’s street network and have a topological "two-step grid" within close metric distances, this study would take inspiration from the argument to analyse the streets that include the selected public libraries in Auckland, as most commercial buildings, governmental buildings, and shopping stores are located close to the selected locations. Hence, we have this opportunity to determine the degree of connectivity and, accordingly, examine how the selected streets have accessibility in their neighbourhoods. In the meantime, this analysis lets us explore whether the selected route is a crucial component of a pedestrian zone that lets the path become a simply accessible zone that is effective by foot, bicycle, or public transportation.

The quantity and diversity of public buildings and stores increase with the street network density for a **two-step** grid on a shopping street. In this way, it is a general rule that diverse active land uses develop along streets with lots of links to the area. In this way, such streets are central to the urban system, which causes more sociability and vitality, and accordingly, they are an opportunity for public sectors such as public libraries.

### 3.3.3. Three-Step analysis

In a nutshell, the **one-step** and **two-step** studies show how a specific street or route is connected to other paths in its immediate neighbourhood. It is possible to increase the number of syntactic steps by using a specific axial line or route segment for the analysis. The **three-step** analysis would be explained by applying the previous instances of streets A and B. In contrast to the **three-step** analysis for the (A) street, where the (B) street is the third syntactical step, the **three-step** analysis for the (B) street reveals that the "three-step grid" encompasses nearly every street in the zone (Figure 3.6).

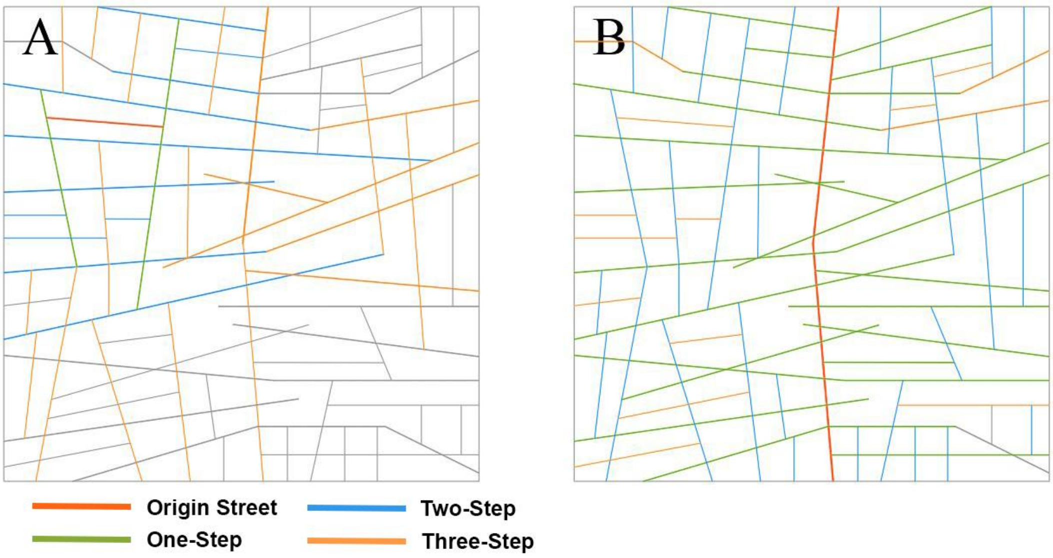



Figure 3.6: Three-Step connectivity analysis (by author)

### 3.3.4. N-Step analysis

**N-step** analysis or point-depth analysis represents the scheme of how topological depth is calculated from one specific street to all routes in relation to the same street. In this way, six syntactic steps make up the **n-step** analysis shown via the scheme in Figure 3.7. The syntactic step value from step (0) to step (n) rises with each change in the street via the analysis of every single direction. The depth value is affected by the length of the axial line or sightline, and every axial line has a unique value. A single street, a group of streets, or the entire main route network can all be subjected to the n-step analysis at once. The **N-step** analysis is not just used to examine the accessibility of shopping areas, railroad stations, and public transportation stops from various points in the city, but it can also be applied to evaluate how accessible public spaces such as schools, community centres, public libraries, etc.

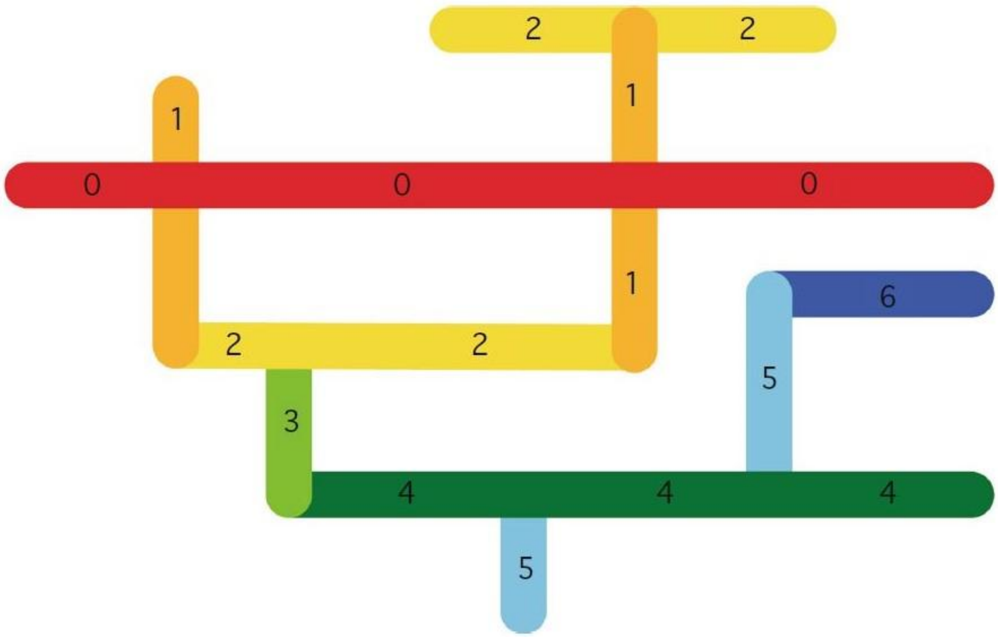



Figure 3.7: N-Step/ point-depth connectivity analysis (Van Nes & Yamu, 2021, p.45)

As a result, this study takes advantage of this opportunity to conduct a topological depth assessment from the locations of the selected public libraries to all routes in relation to the street where they are located. Accordingly, the expected assessment will be applied within a specified radius by the **n-step** analysis.

### 3.4. Integration

There is a need for measures to be applied to study the relationships of all lines to all others, according to Matejcek and Pribyl (2020). Measurement of the movements in the urban system with the least and most potential leads to integration. According to Yamu, Van Nes, and Garau (2021, p. 46), the higher integration of a street and, thus, its inter-accessibility, would be achieved when there were fewer direction changes from a particular street to every other street in the system. In a nutshell, stronger connectivity of an axial line to other lines would be achieved when there is a longer axial line in an urban area that also leads to its higher integration value, and vice versa. Hence, according to Hillier, B. et al. (1987, pp. 233-250), integration analysis as a key measure can illustrate how a street segment is spatially integrated or segregated in relation to all others. He, therefore, points out that this measure represents a space's potential for 'to-movement'. Hillier (1996, pp. 46-47) argues that the 'depth' of one line from another, or the number of intermediate lines required, determines how well integrated the two lines are. Specifically, the total quantity of directional changes. Matejcek and Pribyl (2020) point out that this form of study of a selected area often highlights the centres of studied areas because those are the parts that are easiest to be accessed from every corner of the area.

There are two types of integration analysis: global axial integration analysis and local integration analysis. This study applies global integration analysis on the one hand. On the other hand, it will apply local integration analysis in a specified circumstance that will be explained in further steps. According to Ozbek et al. (2022, p. 51), after calculating the local and global integration in each appropriate system, it is possible to analyse the city grid system, anticipate mobility, and provide data to explain the mobility. Accordingly, this section illustrates the differences between these two types of integration analysis.

#### 3.4.1. Global integration analysis

A street's relationship to every other street in a predetermined spatial system is referred to as its global integration analysis, which includes syntactic steps. This type of integration can be in a city, a rural area, a region, or a neighbourhood. According to Lee, Yoo, and Seo (2020, p. 3), global integration denotes the degree of accessibility between each axial line and other axial lines that allow large-scale movement, while local integration denotes the degree of localized accessibility that an axial line has with its adjacent axial lines, as well as the space syntax control value. According to Hillier (1996, p. 47), global integration analysis calculates the level of accessibility that a street has to all other streets within the selected urban area, which, accordingly, considers the total number of direction changes made by the urban context. Integration of a street axis, or axial line, spatially in relation to every other street in the system is determined by a global integration study. There is greater value in global integration for a street when fewer changes of direction, or syntactic steps, are required to get to all spots in the system from a street. Roads that require multiple direction changes to reach all other parts of the urban system, on the other hand, have low levels of global integration. Hence, they are separated spatially. Arguably, as long as the more lengthy axial line has higher and stronger connectivity to other axial lines, then it meets the greater value of global integration, and conversely. In general, according to Ozbek et al. (2022, p. 52), global integration analysis provides the opportunity to recognize the strong axes in the entire system. In addition to indicating various land uses and significant connections to other regions, the roadways created by these axes present hints that the movement may have been dense at certain locations.

In the following, referring to an example by Van Nes and Yamu (2021, pp. 46-47), the procedure of global integration analysis is going to be illustrated. Figure 3.08 depicts town X in three maps: the town's morphological footprint (a), an axial map (b), and an axial integration analysis (c) (Figure 3.8).

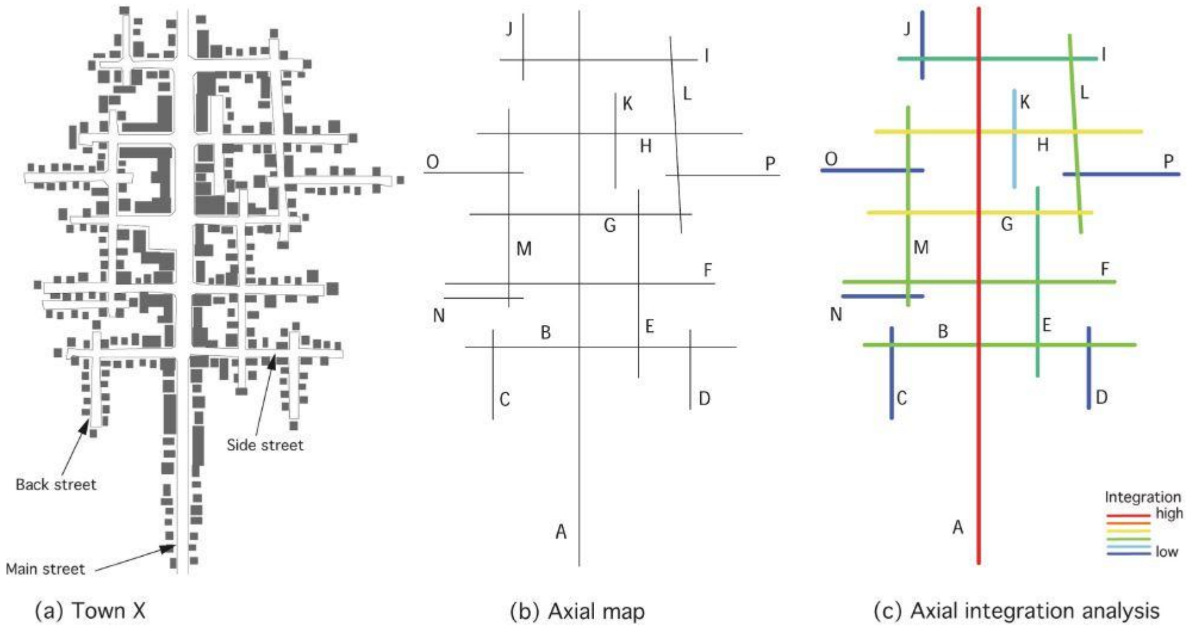



Figure 3.8: Town X (Van Nes & Yamu, 2021, p.46)

In the following, referring to an example by Van Nes and Yamu (2021, p. 46), the procedure of global integration analysis is going to be illustrated. Figure 3.9 depicts town X on three maps: the town's morphological footprint (a), an axial map (b), and an axial integration analysis (c). With regard to this, it is noteworthy that the axial map is composed of the fewest sightlines that show movement routes. In this scenario, a public urban space would be displayed as an axial line that connects to other axial lines or other public urban spaces. Accordingly, an opportunity comes through that lets us determine how each axial line or public urban space in the provided system relates to every other axial line. In this way, a calculation is made to determine the topological depth of every single axial line relative to all other axial lines. In other words, a calculation is made to determine the topological depth of each public urban space in the form of an axial line relative to all other axial lines. In the meantime, each change in direction is marked by a syntactic movement. As it shows in Figure 8, the axes with the highest levels of integration and segregation are represented by the red axial lines and the dark blue axial lines, respectively.

With regards to the above example, street (C) as a sample is considered to be the beginning point. The TD, or total depth, would be calculated from the point to all other streets. In this way, the number of spaces that must be traversed through the beginning point of a system defines the total depth. The sum of all applied steps from the beginning point is used to determine total depth. Accordingly, the number of spaces should be multiplied by the number of corresponding topological depths to determine the TD, which is then determined by adding the values for each topological depth (Figure 3.9).

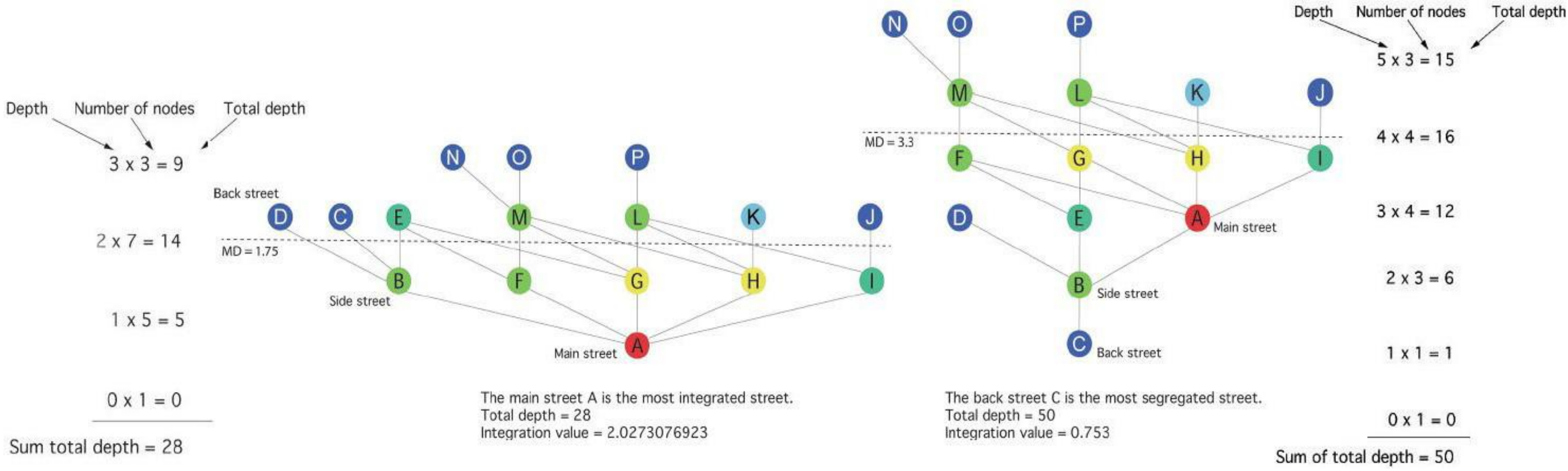



Figure 3.9: Comparison of two J-graphs and Global Integration calculation (Van Nes & Yamu, 2021, pp.47-51)

Global integration analysis, according to Kruger (1989, pp. 1-34; 2012, pp. 194-203); Teklenburg et al. (1993, pp. 349-355); and Hillier & Hanson (1984, pp. 108-113), requires the consideration of multiple mathematical equations. These equations determine mean depth (MD), real asymmetry (RA), real relative asymmetry (RRA), and integration value (INT). However, because it is impossible to calculate the above equations manually for the large scale of suburbs in this study, this study makes use of the space syntax computer application Depthmap, but the equations are illustrated here (Figure 3.10):

Mean Depth (MD) = total depth (TD) / k-1

Real Asymmetry (RA) = 2(MD-1) / k-2

Real Relative Asymmetry (RRA) = RA / $D_k$

Integration Value (INT) = 1 / RRA

k = number of axes/nodes in the system

$D_k$ = D-value

$D_k = 2 \{k [\log_2 (k+2/3) -1] + 1\} / (k-1) (k-2)$

Figure 3.10: The mathematical calculation for global integration analysis (Kruger, 1989, pp. 1-34; 2012, pp. 194-203; Teklenburg et al. 1993, pp. 349-355; Hillier & Hanson,1984, pp. 108-113)

A street's topological distance from every other street in the urban system is inversely proportional to how integrated that street is. Conversely, the topological distance between a street and every other street in the urban system increases with a street's level of segregation. As it was shown in Figure 3.10, the two streets, the main street and the dead-end street, have some considerable differences. Topologically speaking, the graph that concentrates on street A, which looks like a bush shape, is shallower than the graph that focuses on street C, which looks like a tree shape. According to Van Nes and Yamu (2021, p. 50), it is more likely that the space under consideration will have a low integration value if the majority of the spaces are spread out over a large number of syntactic steps. It is a segregated space in this instance, and the justified tree-shaped graph is topologically deep.

In terms of the previously discussed global integration analysis, this study uses it to investigate how the streets where selected public libraries in Auckland are located are spatially integrated in relation to every other street in the specified region, on the one hand. On the other hand, this analysis assists this research to find out whether each selected street as a public space in the specified regions is a car-based public space or a pedestrian-friendly public space with adjacent streets.

### 3.4.2. Local integration analysis

The streets where selected public libraries in Auckland are located probably have low global integration, but they likely have high local integration, which is necessary to be analysed as it is possible for some of them to have high global and local integration at the same time or conversely.

Calculating the average mean depth value of all streets in a given syntactic radius, such as a radius of three, is commonly the key to evaluating local integration. Since the topological radius indicates the number of syntactic steps, integer numbers must be chosen, and therefore, non-integer numbers like 3.5 are not acceptable. For instance, for a radius of two, two syntactic steps contain one direction change and the starting point or root node. Three syntactic steps are two changes in direction, including the origin for a three-step radius. For a radius of four, all streets that are more than three topological steps away from the street indicate that the root node must be removed.

Referring to the example of Figure 3.09, two streets (A) and (C) are compared by local integration analysis in Figure 3.11. In this scenario, the determined radius is three. Hence, some axial lines such as N, O, and P are not part of the analysis where street (A) is the main street, and also, the considered axial lines are restricted to five axes where street (C) is the main street. With that being said, local integration analysis doesn't consider any of the urban spaces beyond the second syntactic step from the street that the analysis is determined for (Figure 3.11). In this way, the total depth sum value and the D-value are the key differences between global and local integration investigations when determining the true relative asymmetry.

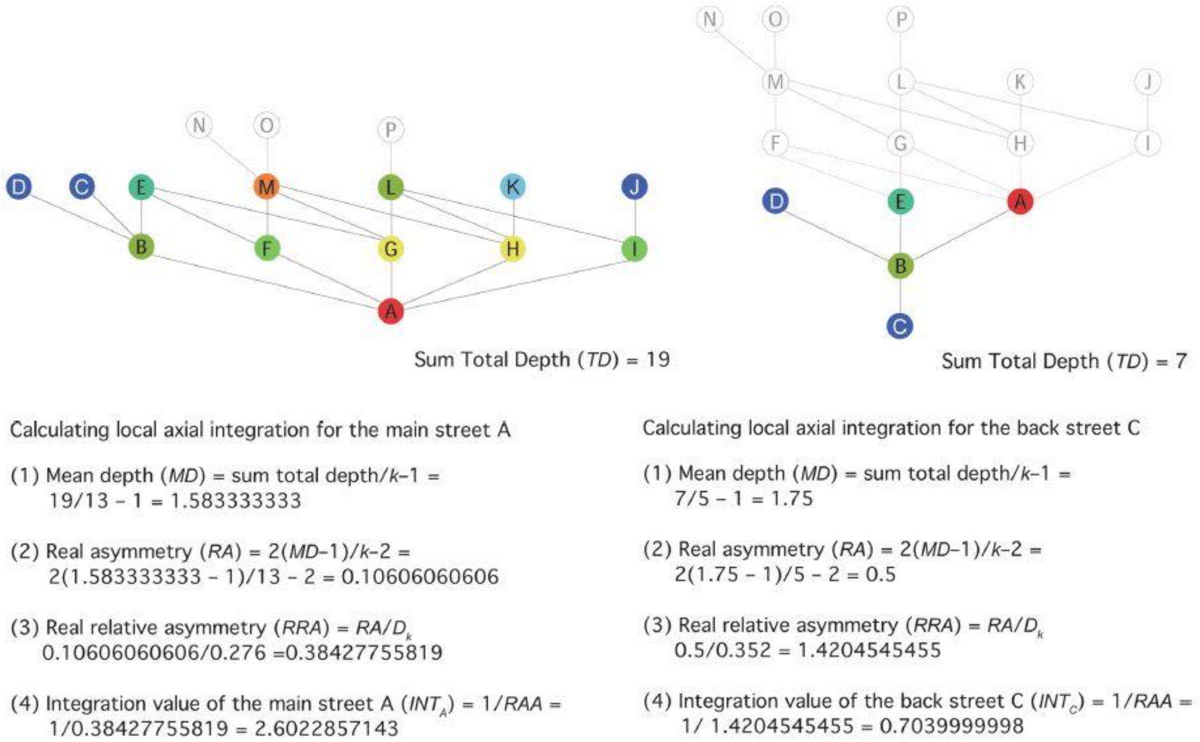



Figure 3.11: Comparison of two J-graphs for Local Integration calculation (Van Nes & Yamu, 2021, p. 55)

With regard to the above, according to Hillier et al. (1998, pp. 59-84), the flow measures of public transportation and other vehicles correspond to global integration values, while the flow measures of pedestrians correlate to local integration values. In the meantime, a local integration analysis gives the opportunity to identify the neighbourhood’s busy centre, which includes public spaces such as shopping areas, social-cultural spaces, etc.

### 3.5. Choice Analysis

According to Matejcek and Pribyl (2020), the measure of "choice," which is frequently referred to as "betweenness," reveals how likely it is for someone to travel through a segment on journeys between all conjunctions of lines in the system. According to Hillier, B. et al. (1987, pp. 233-250), choice, as opposed to the integration measure, which indicates "to-movement," is a measure of the possibility of a space for "through-movement". Matejcek and Pribyl (2020) add that the segments that will probably be chosen for travel within a given radius are highlighted by the choice analysis of a particular location.

According to Ruth Conroy Dalton (2003, p. 108), people often follow pathways that are linear with minimum angle deflection. Arguably, she indicated how angles affect individuals' choices regarding the simplest path between their starting point and destination. Accordingly, Dalton adds that people typically choose an angle near 90 degrees or 180 degrees when shifting directions. Urban blocks with uncommon angles, such as 30 or 60 degrees, can cause individuals to become disoriented. She also found that people typically chose the street that has the least angle to the direction they are aiming. In other words, when navigating metropolitan street grids, individuals take the straightest route feasible to reduce complications.

Metric distance assesses how metrically integrated a street or route is in respect to all others, whereas angular choice measurements demonstrate how integrated a street is in terms of the angular degrees required to switch from one street to all others in a system. According to Hillier (2005, pp. 96–102), choice, as opposed to integration, indicates to what degree a line sits on the shortest paths from one line to another. **Integration** quantifies the ease with which one line can be connected to all other lines in a spatial system, demonstrating a line's potential for **to-movement**. **Choice**, on the other hand, indicates a line's potential for **through-movement** by determining how frequently it is picked up on paths connecting one line to another in a spatial system.

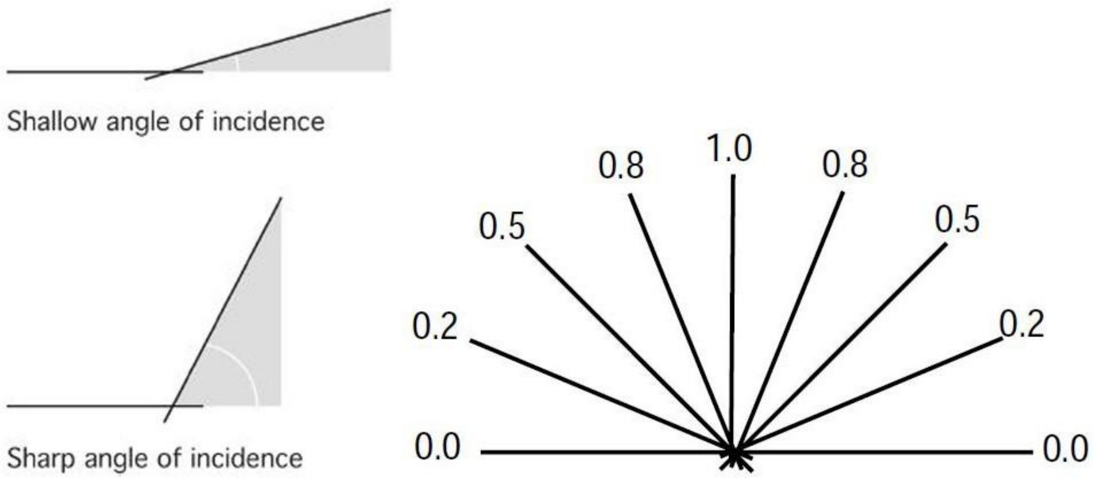



Figure 3.12: Angular weighting used in the computer application Depthmap (Dalton, 2001, p. 26.8)

It is noteworthy to note that an axial line splits into many street segments when we have a curved street. In this way, a junction is where two or more axial lines come together. Every time there is a direction shift in the axial line depiction of a curving street, there is a "junction." The angle at which one street section connects to adjacent streets determines its weight. Based on the notion that angles affect people's choice of routing, this asserts that angular interactions between streets are crucial for when people are conducting themselves through the streets and routes. When a segment's angular turn is sharper, the step is weighted higher. Sharp angles close to 90° are weighted with a numerical value of one, whereas shallow angles of incidence of almost 180° are weighted with a numerical value of zero (Figure 3.12).

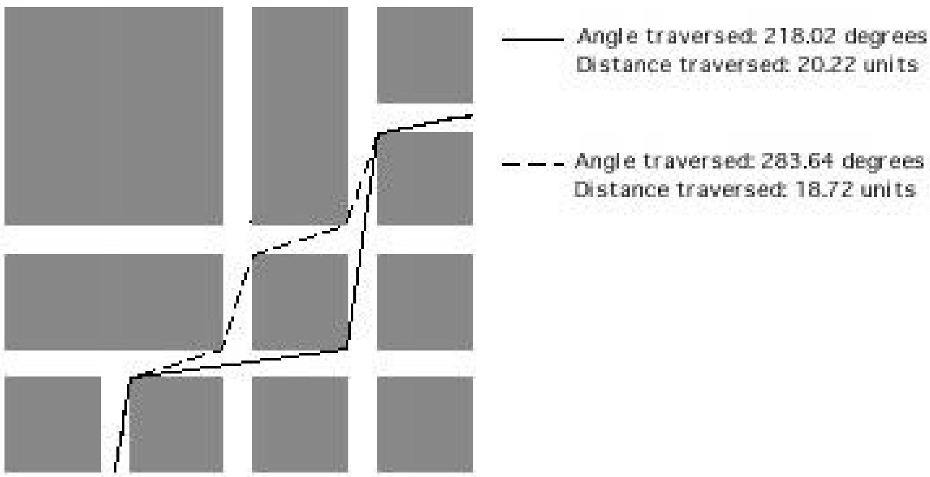
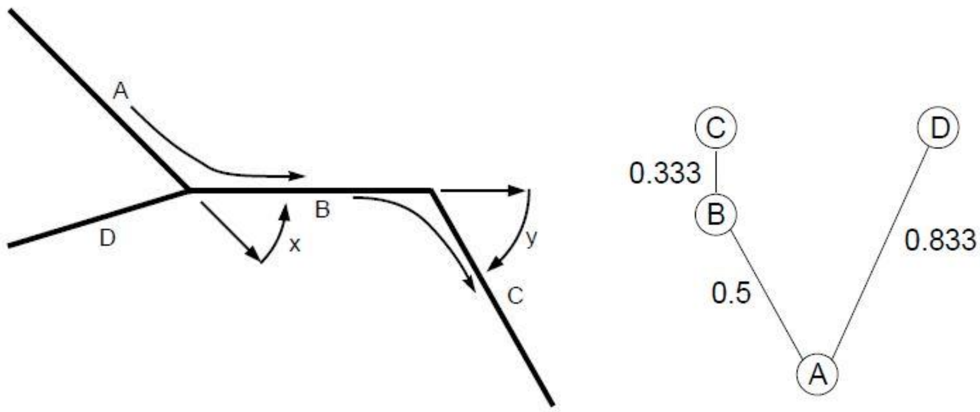



Figure 3.13: The minimum Euclidean path and the minimum angular path between two locations (Turner, 2000, p. 4)

By following the above description, people can find orientation easier when the roadway network is not dominated by unusual angles. In the meantime, people tend to choose linear routes when they face shallower turns in the direction of their objectives. According to Turner (2000, p. 3), the difference between the minimum angular path (MAP) and the minimum distance path (MDP) between two locations in the urban system is a Euclidean measure. A local community member will typically go the shortest Euclidean distance, while a tourist will typically travel the least angular path. Referring to the example in Figure 3.13 by Turner (2000, p. 4), which shows two different paths between two locations in the same urban system, we learn that the path represented by the dotted line has the fewest Euclidean distances between the two places while having the most angular deviations. However, the solid line, despite having a longer Euclidean distance between the two places, has the fewest angular deviations.




$$C_A = \frac{\text{Sum of the angular weigths from segment (A) to (B),(C) and (D)}}{\text{total number of segments - 1}}$$

$$= \frac{\text{(B) } 0.5 + \text{(C) } 0.833 + \text{(D) } 0.833}{3} = 0.722$$

Figure 3.14: Four Paths through a network, the justified j-graph, and Choice calculation (Turner, 2005b, p. 148)

The mean angular depth between each segment and every other segment is calculated as the first step in determining angular choice. In this way, it is illustrated how to calculate angular mean depth or choice by referring to an example in Figure 3.14. In this example, four street segments are joined to one another at various angles. Since the angle of incidence between A and B is 45°, the angular segment depth value from street segment A to B is 0.5. The aggregate of the depths of the segments A to B with an angle of 45° and B to C with a total angle of 30° (75° minus 45°) yields a value of 0.833 for the angular segment depth from A to

C. Because of the 75° angle incidence of A to D, the angular segment depth from A to D is also 0.833. In the meantime, the computations of the angular mean depth or choice for path (A) are displayed with the numeric depth values in the justified graph in Figure 3.14.

Because the primary routes of the network of cities have the fewest total numbers of angular deflections in relation to all other routes in the system, the angular mean depth and the angular choice analysis help identify the main route network of cities, suburbs, and regions. Because these routes connect people's orientation and navigational strategies via the urban system, angular choice analysis emphasizes a street hierarchy and street choice. In addition, according to Van Nes & Yamu (2021, p. 62), because the metric radius has been applied mostly in the different angular choice analyses since 2012, this study follows the same radius measurement, which has been emphasized by Joutsiniemi (2005, cited in Van Nes & Yamu, 2021, p. 63) because of its importance, especially on a local scale that is important to this study for the selected locations in Auckland. In this way, this research concentrates on radii of "800 or 1200 m" that assist us in highlighting various local regions in Auckland with the centrality of the selected public libraries' locations. In the meantime, 800 m refers to a 10-minute walk, and such a metric distance highlights the local main routes in the selected region.

In a nutshell, the discussion of various space syntax analyses that has been noted up to this point lets this study explore: (1) how the street network within the selected region is well-integrated from a local to a global scale; (2) how main routes in a global radius within the selected region have high accessibility values for angular choice analyses; (3) how main routes are crossing through the selected regions instead of traversing around them; (4) how main routes within the selected areas are straightly connected to the local residential routes; and (5) how the main routes have well connectivity to the locally integrated centre of the selected region.

### 3.6. Isovist Analysis

In space syntax, the isovist tool is based on the set of all points observable from a specific vantage point in space and with regard to an environment. In a nutshell, an isovist is a visual record of what can be seen at average eye level from a specific position in all directions. According to Turner et al. (2001, p. 103), isovists define the physical space from the perspective of people as they experience, engage with, and traverse through it.

The isovist's area is characterized by individuals, buildings, objects, trees, and plants in the open region under observation. The size and shape of the isovist field change as one moves through urban areas. Thus, it is feasible to see certain movement paths through urban regions as visual field sequences. As an individual (yellow circle) with 180° isovist is displayed in figure 3.15, the isovist field is impacted because the nearby trees, buildings, and objects affect the person's visual field. The same holds true for everyone else standing near trees, buildings, and objects. Accordingly, numerous barriers, including trees, structures, and street lights, might partially block the view and so diminish the isovist field.

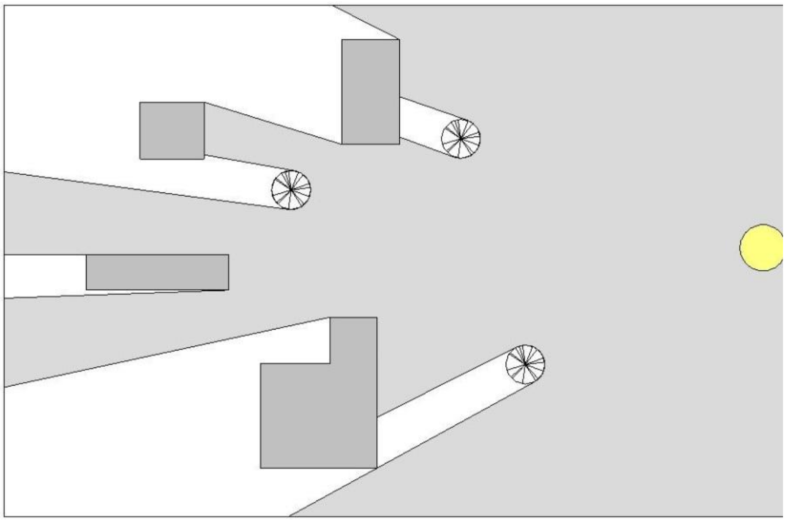


Figure 3.15: A 180° isovist from an individual's (yellow circle) location (by author)

We meet sequences of 180° isovists as constant visual information about an urban space is revealed when people travel through it. Figure 3.16 illustrates how the impressions of the facades of buildings and public areas can vary from spot to spot. Particularly in public urban areas like the main square, the vision field might drastically alter after only a few meters. As a result, one-point and serial vision path isovists can help us investigate the permeability of a specific location in a region and improve local region planning.

By isovist analysis, the type of overview of a person of a space could be studied where the root of the visual field is located. In the meantime, the root of the isovist can also be located at locations with lower use to find their spatial characteristics. According to Trova et al. (1999, pp. 53.8-53.9), there is a correlation between the isovist field and static social interaction in public spaces, such as where individuals stand and sit. In this way, the total isovist field as a whole and the overlap of each person's individual isovist fields increase with the population density in a given region. Accordingly, it is very likely that the distribution of individuals within the visual field is not uniform. Instead, Trova et al. (1999, p. 53.9) add that they move closer to places where there is a better chance of becoming aware of the moving visual field. The orientation toward the most integrated lines is complemented by the orientation towards the places that offer a higher awareness of co-presence. Furthermore, the impacts of the visual field's structure are equally obvious when there are still stationary people as when there are moving people about.

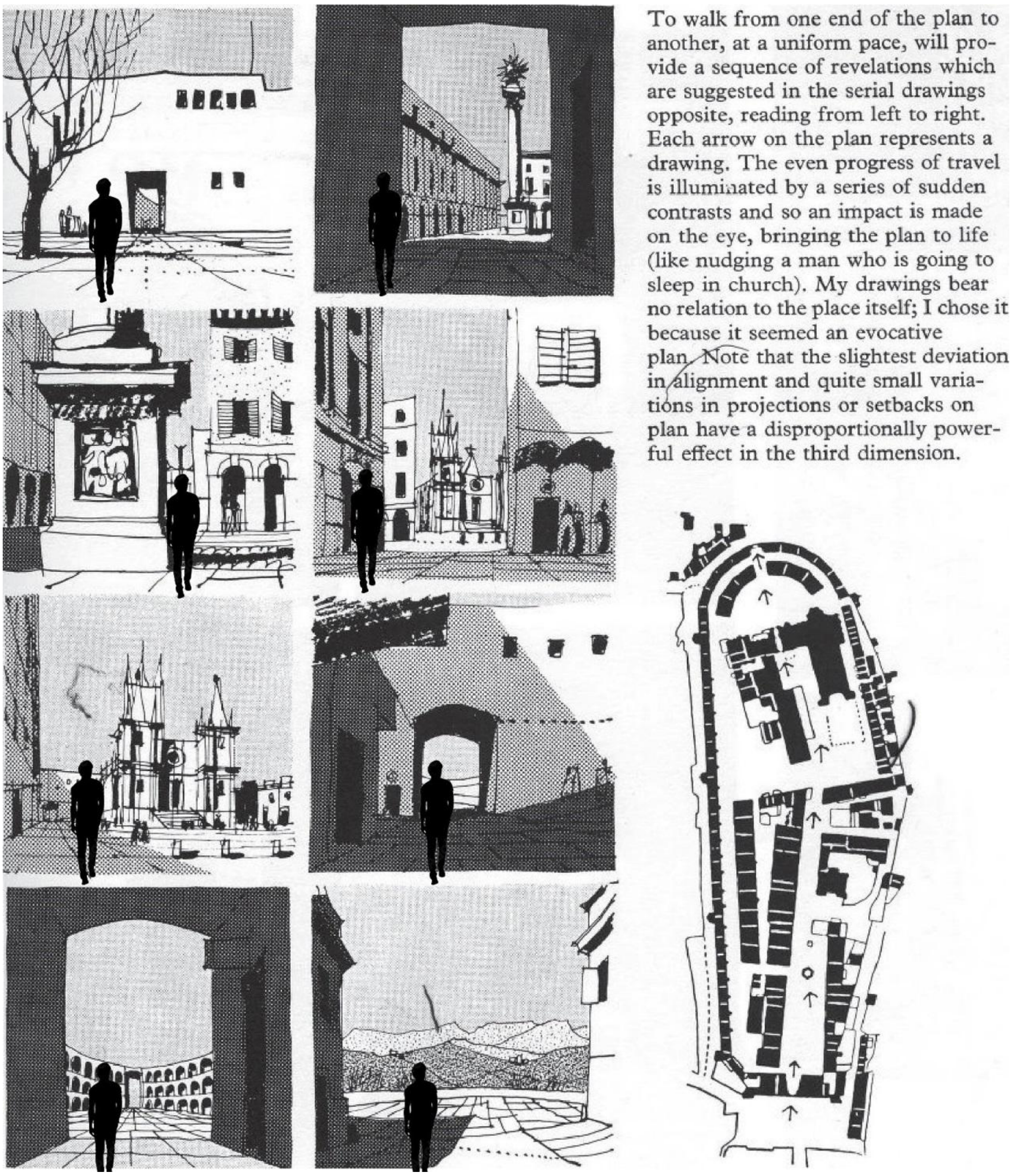



Figure 3.16: Serial Vision as presented in Cullen's book "The Concise Townscape" (Cullen, 1971, p. 17)

### 3.6.1. Visibility graph analysis

According to Turner et al. (2001, p. 104), using isovists, we can generate a visibility graph of mutually visible locations in the built environment. In addition, Turner et al. (2001, p. 108) argue that taking an isovist at any height above the floor creates the opportunity to form the visibility graph. **Visibility graph analysis (VGA)** investigates the characteristics of a visibility graph produced in a spatial environment. In the meantime, VGA assists this study by showing how people's perceptions change visually. Arguably, the isovist is the fundamental building element of a visibility graph.

In this way, as previously mentioned, individuals determine their orientation based on what they can see and where they can walk. Additionally, we should not be limited by the practicalities of regular space utilization and movement while examining the quality of the built environment that we can see. In fact, we shouldn't worry because architectural speculation nearly always involves the interaction between visibility (what can be seen) and permeability (where you can go). Therefore, it becomes sensible to reach the point that there is a mutual relationship between them, and with that being said, a visibility graph can be a reflection of the permeability quality. Overall, VGA shows how simple or challenging it is to orient and move through neighbourhoods. Additionally, VGA identifies possible locations for social contact in streets and public spaces, among other stationary activities. Arguably, this analysis is a static local measure.

VGA follows the same calculation approach that is also applied to the axial map in integration analysis. Accordingly, the mean depth (MD) is calculated using the following formula:

| |
|---|
| MD = TD / K - 1 |
| MD = mean depth |
| TD = total depth |
| K = number of spaces in a system |

With regard to the above, the point-depth analysis and "through vision" analysis would be calculated similarly for the grid, root cells, and barriers for calculating the mean depth. Figure 3.17 illustrates a "through vision" analysis via four different positions of the given root cell.

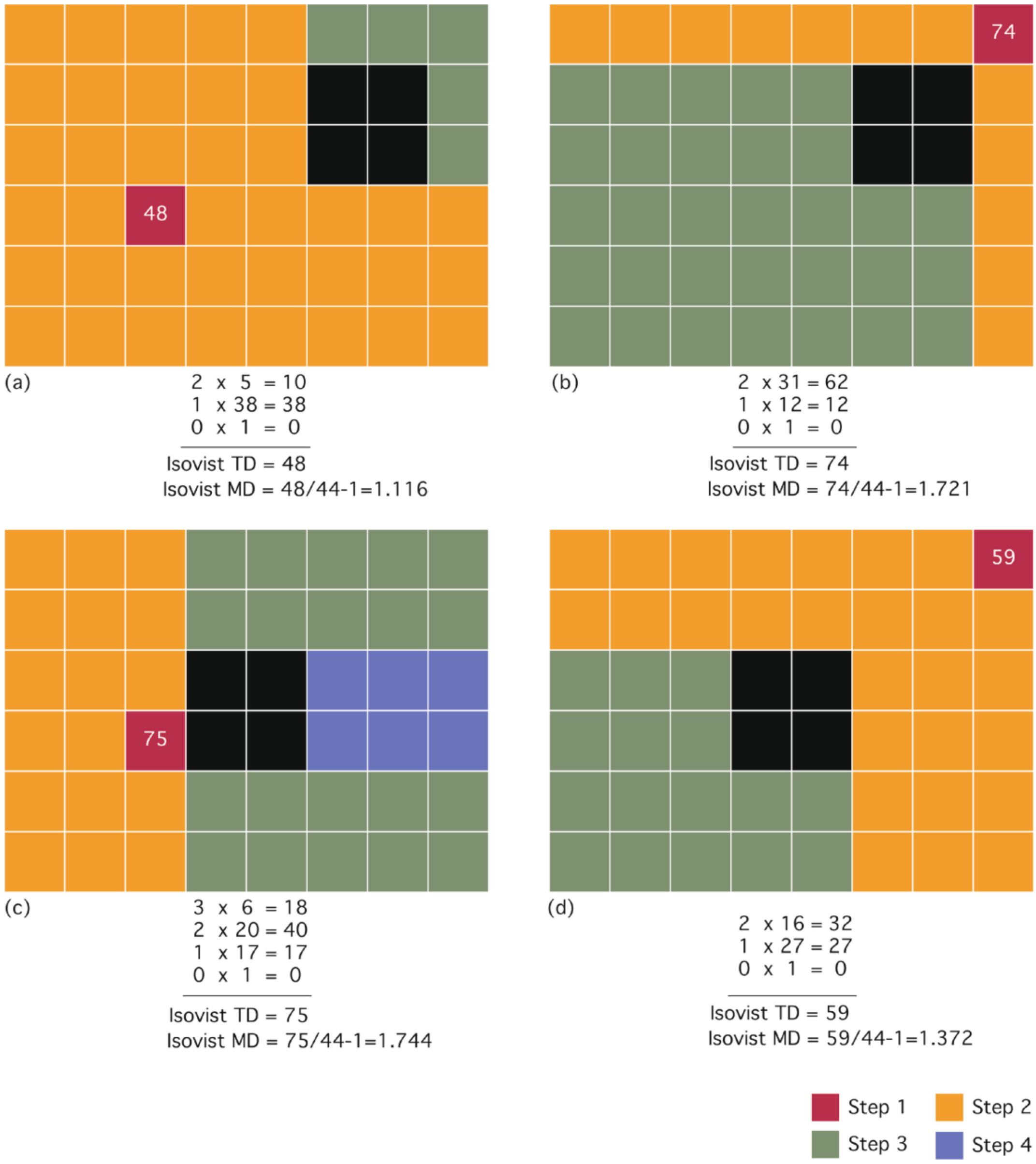



Figure 3.17: "Through vision" analysis. Mean depth (MD) calculation via four different positions (van Nes & Yamu, 2021, p. 97)

According to Van Nes & Yamu (2021, p. 97), the location of the root cell is step 0, which is coloured red. Step 1: All the spaces that are visible from the red root cell are shown in yellow. The places that can be seen by "turning around the corner" of the black barrier are all represented in green cells, which are step 2. Step 3 is represented by the blue cells upon rotating yet another corner.

The grid's mean depth values for the "through vision" analysis change depending on where the obstacle is placed. The mean depth value for through vision increases with the distance between the barrier and the root cell, and vice versa. The visual area appears to be more segregated around an object in the middle of a region than around one on the edge of the perimeter. Therefore, the level of visibility for long distances can be shown via "through vision" analysis from every position in a metropolitan region. With regard to Van Nes & Yamu (2021, p. 96), however, the calculation approach for either "through vision" analysis or point-depth analysis is similar, but there is a difference: the "through vision" study reveals the degree of through-visibility, whereas the point-depth analysis reveals the degree of the vicinity.

Figure 3.18: Bennelong Point, Sydney NSW is an example with a high degree of visibility (VGA) (Google Maps library)


)

Figure 3.19: Sydney Tower Eye, Sydney NSW is an example with a high degree of ‘through vision’ (Google Maps library)

While Figure 3.18 represents large open spaces such as Bennelong Point with high values on both the VGA and "through vision" analyses, figure 3.19 represents the Sydney Tower Eye as an important landmark with a high degree of "through vision" that is located at a long distance from the sightline of "through vision."

With regard to what has so far been discussed in this section, according to Trova et al. (1999, p. 53.1), the edge of vegetated areas including trees and plants, pedestrians, and walkways cause weak boundaries. With that being said, the increased field of vision caused by the weak boundaries minimizes navigation in the street.

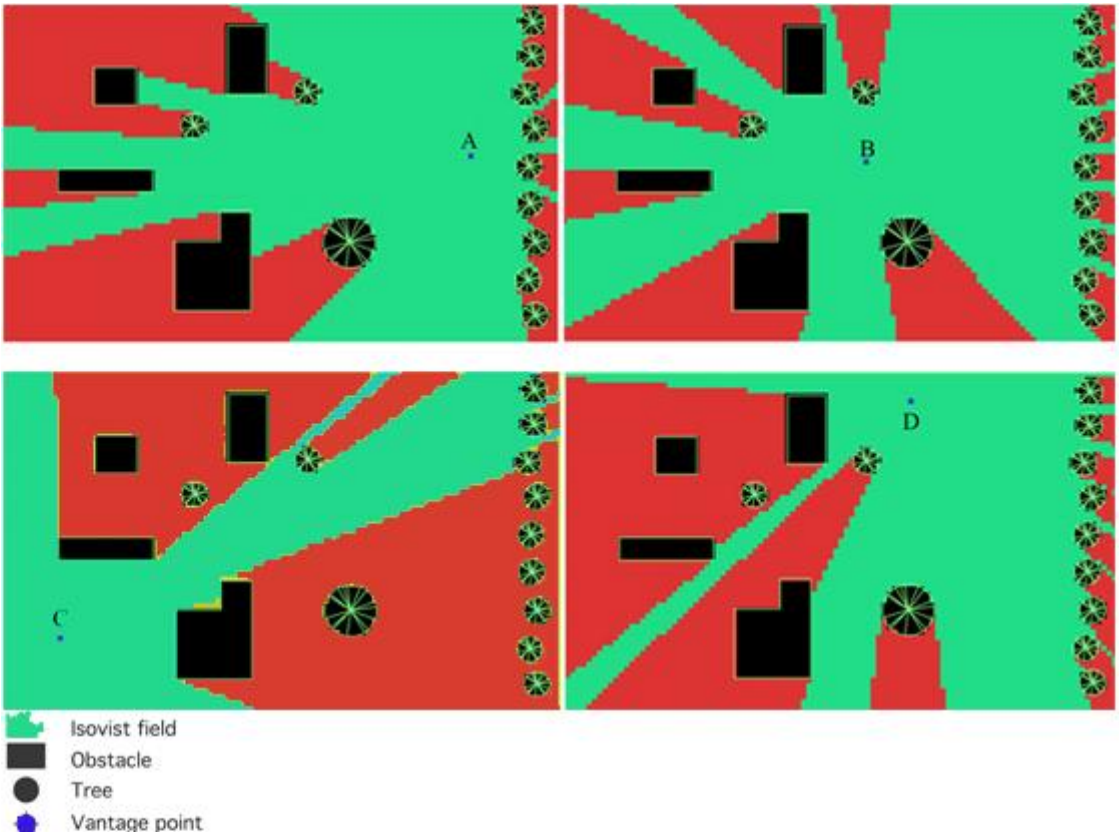



Figure 3.20: An example of one-point isovist step depth analysis for four different locations (by author)

This study with a one-point isovist step-depth analysis of VGA explores the opportunity for experimenting at multiple locations to distinguish optimum locations. Accordingly, it provides the possibility to comprehend how the sight would change in adjacency by positioning in different places, which also shows the relation of the changing of the degree of visibility on where the isovist root is. Figure 3.20 represents how the degree of visibility is changing from four different points. Thus, the one-step isovists for all four sites are displayed in green, showing what can be seen right away from the isovist root. Points A and B have the highest degree of visibility, while point C has the lowest degree of visibility.

### 3.6.2. Agent-Based Modelling

This analysis let this study realises how the agents orientate and navigate across a selected place starting out from the same location in the selected region. As Dalton (2001) argues, pedestrians frequently select the root that leads to their destination with the fewest angular deviations. That is why it is important that this analysis be beneficial for comprehending the degree of orienting ability from a specified location in a region. Arguably, by analysing the current circumstances in selected regions, this study can explore the parameters that are beneficial in this regard and help shape the proposed model.

According to Van Nes & Yamu (2021, p. 105), this analysis could be included in a comparison of three different scenarios. Accordingly, the agent as an average person, as a local, and as a tourist will form the comparison. In the proposed analysis for the average person, three syntactic steps or three cells are taken onward by five thousand agents before deciding to modify their course based on their sight field. Hence, a sight field angle of 15° and three steps would be considered accordingly (Figure 3.21).

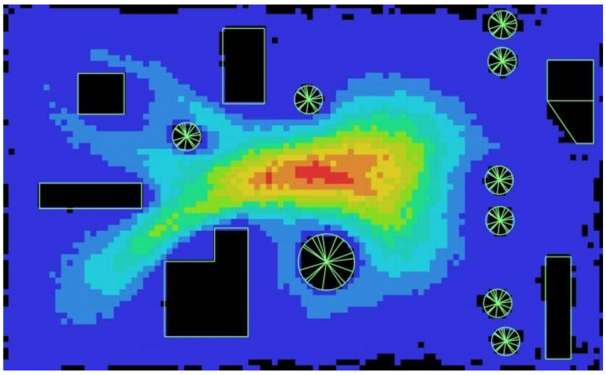


Figure 3.21: Agent-based model for an example: the agent as an average person (by author)

The analysis for the tourist gives a different outcome when the vision field becomes wider from 15° to 30° and syntactic steps reduce to one, which leads to a different movement model (Figure 3.22 (A)). The reason is that tourists tend to investigate their surroundings because they are unfamiliar with the built environment. Accordingly, a spot with the longest views into the city is picked.

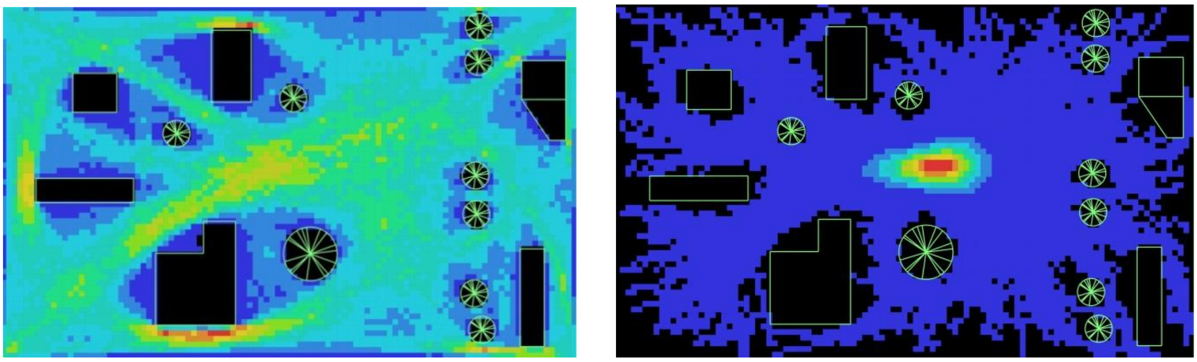


Figure 3.22: Agent-based model for an example: (A) the agent as a local person, (B) the agent as a tourist (by author)

The analysis of the local agent is quite different from the two discussed models. The sight field angle in this analysis is reduced to 7° with five syntactic steps (Figure 3.22 (B)). Hence, a movement pattern of locals appears. The reason for such a difference is the locals' familiarity with the region they live in and/or work in, and therefore, their awareness of the routes that make it easier for them to reach their destination. With that being said, locals wouldn't stop in the central spots of public spaces to explore their routes, and accordingly, they take the shortest and straightest routes. According to Van Nes & Yamu (2021, pp. 105-106), the angles of the vision field and the number of syntactic steps can be adjusted for any region or location.

In a nutshell, as the analysis for the average agent depicts the travel paths for both tourists and locals, we face a bit of an imprecise outcome. In comparison, we learn that tourists prefer to congregate in areas where they can obtain a broad perspective of the location they are visiting, while locals are already familiar with the area, which is why their patterns of movement have a distinct starting point and ending point.

### 3.7. Scenarios’ analysis

#### 3.7.1. New development of Medellin public libraries:

Almost all cities around the world have been involved in urban transformations, and accordingly, social infrastructures such as public libraries have been one of the highlighted focuses of these changes. Colombia's Medellin strategy will put together elements such as transportation infrastructure, educational facilities, and public space to optimize each intervention’s individual effects. Public libraries are the best example of this approach. The purpose of using these buildings for public use was meant to legitimize these parts of the city for more cultural and educational purposes in disadvantaged neighbourhoods. Accordingly, Dávila et al. (2013, p.50) quote Mayor Alonso Salazar as saying that the goal of these projects in the Medellin region was "to activate the power of aesthetics as a motor for social change". Arguably, the library's locations and buildings are iconic landmarks of positive social change, which would be a revolutionary idea not only on the local scale but also on the international scale.

In order to apply the proposed methods for this research study, a pilot review of a cluster of Medellin public libraries was carried out. Hence, this study intends to explore whether the libraries are spatially integrated into their urban context, which can represent how much they impact their urban regions. With that being said, this scenario analysis will be reviewed via integration and choice analysis. All of these analyses will be presented across a number of metric radii to assess all libraries’ connectivity at various urban scales. Accordingly, this review with regards to (Goodship & Capille, 2017) studies will pick three libraries for further review.

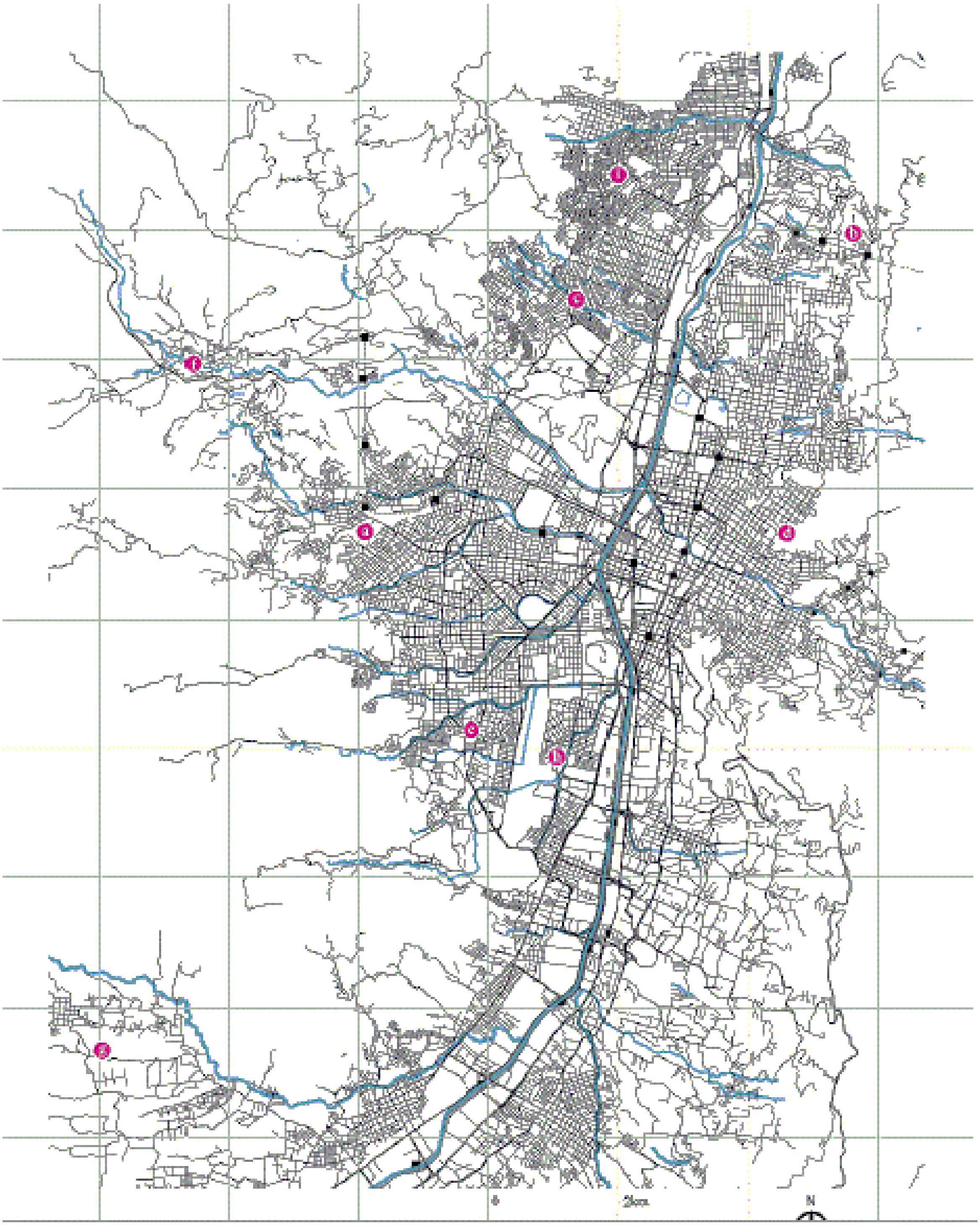


Figure 3.23: Map of location of the Library-Parks in Medellín a) San Javier, b) España, c) La Quintana, d) La Ladera, e) Belén, f) Fernando Botero, g) José Betancur, h) Guayabal, i) Doce de Octubre (Capille, 2018)

At the lowest metric range, the average integration values of each library zone have tested the highest mean values. The purpose of building the new libraries is to have the greatest impact on the local area's development process. The average integration values are gradually decreasing the higher the increase in the metric radius, where they plateau at 5000 m (Chart 3.1).

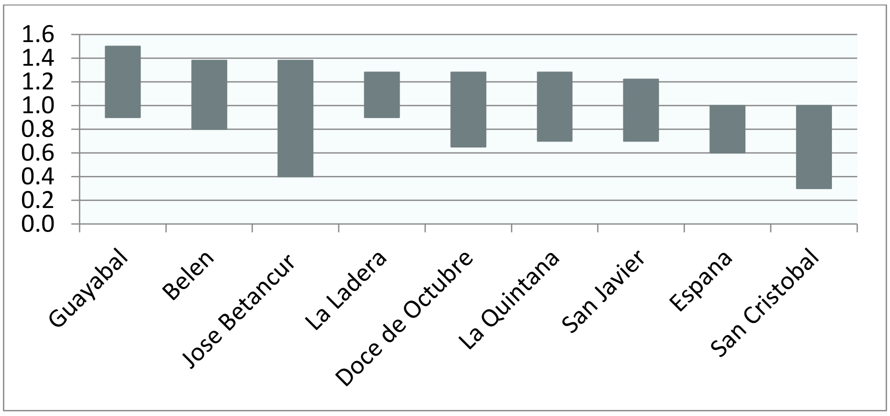



Chart 3.1: Medellin's public Libraries' Integration Values (by author)

The Guayabal has the highest average integration values, and the Belen library and La Ladera library are posited below the Guayabal, respectively, according to the graph review. The explanation for this is the central placement of such libraries in the city, and therefore a central location would promote even more powerful ideals about these locations as integration is the highest in the city centre. On the other hand, the libraries San Cristobal, Espana, and Jose Betancur meet the lowest mean values. The contrast between these three libraries, however, has shown that Jose Betancur achieves the high average values at the low metric radius and then declines rapidly as the metric radius increases, while the San Cristobal and Espana libraries have faced low values in the metric radius (Chart 3.1).

With regard to the Choice Analysis study, the average values overall were close together. Nonetheless, at the lowest metric distance between 500 m and 750 m, the highest average values have been obtained and are reversed when the metric distance is increased.

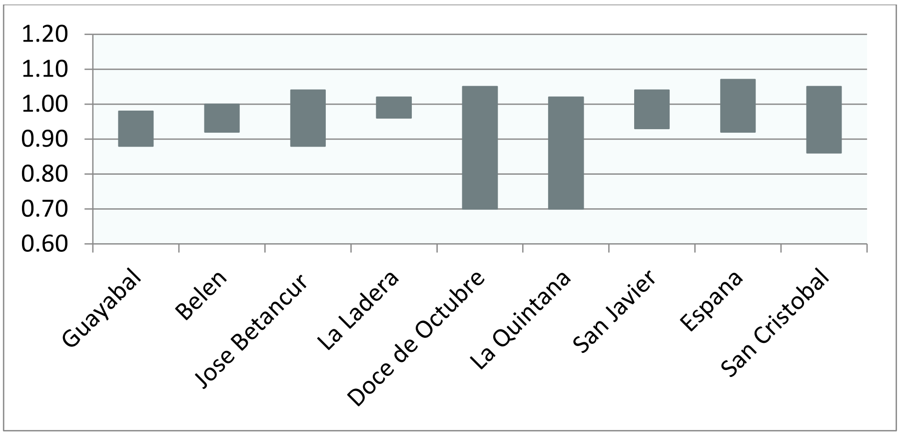



Chart 3.2: Medellin's public Libraries' Choice Values (by author)

The Choice Analysis study has shown that La Ladera, San Javier, and Belen libraries in general have the highest average values. However, the Jose Betancur library has a high average value until the metric radius increases by 3500 m, and as a result, it rapidly falls to one of the lowest. Additionally, libraries in San Cristobal, La Quintana, and Doce de Octubre faced the lowest average Choice values (Chart 3.2).

- In the following, three libraries with the highest spatial analytical values, the lowest values, and the mid-range values will be reviewed.

The **Guayabal library** is the first example with the highest spatial values. One of its most outstanding features is its location near the main roads and the highway through the city. The north-south highways make major routes through the city as well as inside and outside the city. These accesses are therefore not only beneficial but also play an important role across spaces on an urban scale. A further relevant case of the research given by the local government is the consideration of public facilities. The data provided indicate that 46 percent of the land is dedicated to public facilities within the pinpointed zone. Nevertheless, 30 percent of the land was occupied by the airport itself, and 16 percent was used for other public facilities. The total number is 45, which includes the education sector with 9 as the highest, followed by sport with 8, and community units with 7, respectively. According to Goodship and Capille, the morphology of building heights shows that 48 percent of buildings are one story high, 30 percent are two stories high, 16 percent are three stories high, and 4 percent are four stories high; the other 2 percent are five stories high or above (Figure 3.25).

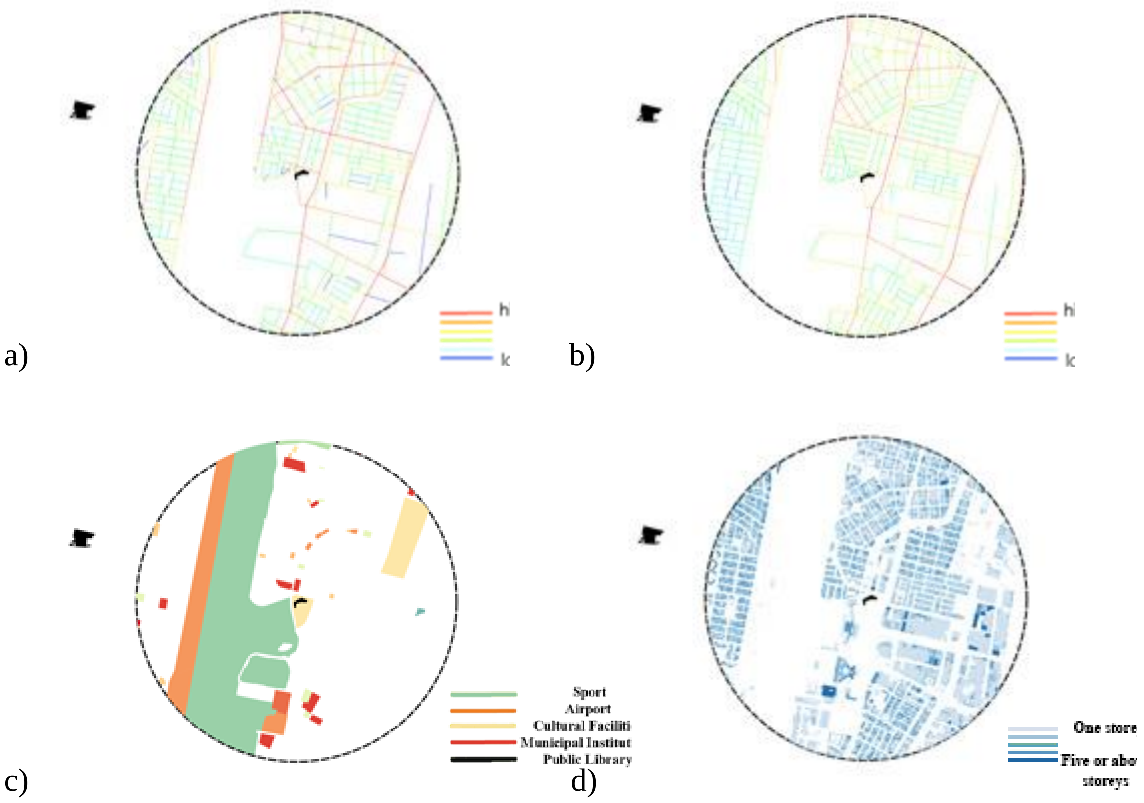



Figure 3.25: Guayabal library in 2000 m of radius, (a) Choice analysis, (b) Integration, (c) Land use, (d) building heights (Goodship & Capille, 2017)

The second example is the library of **La Quintana** with spatial midrange values. The location of the library is situated next to the main roads that run west-to-east towards the central area of the city. Unlike the Guayabal region library, most neighbouring areas around the La Quintana library aren't well-positioned for spaces. The peripheral zone in the area lies between 2000 and 5000 meters in metric radius. As for the above, the peripheral zone becomes less connected with the library surrounding it. Compared with Guayabal, this region contains more public sectors. The city has 93 public services that comprise 14 percent of overall land use around the library. The figure for educational sectors represents 43 percent, for healthcare sectors, 35 percent, and for places of worship, 8 percent. Accordingly, the analysis shows that 36 percent of the buildings have two storeys, 30 percent have three storeys, 24 percent have one storey, 5 percent have four storeys, and finally 5 percent have five storeys or more (Figure 3.26).

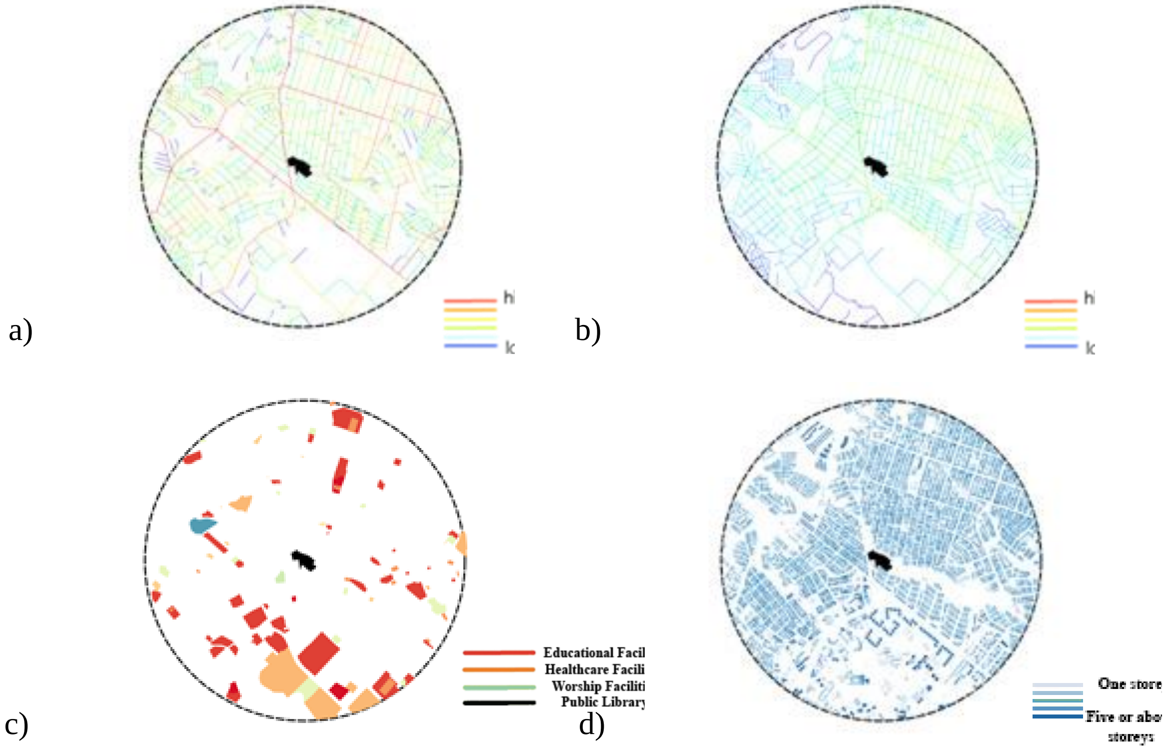
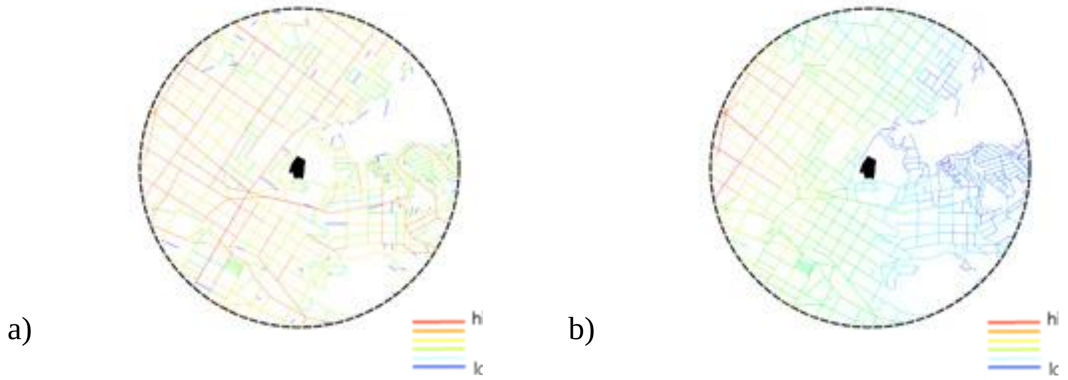
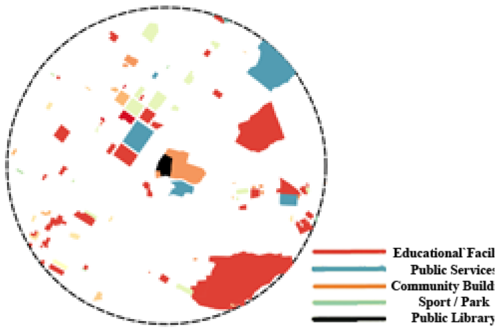



Figure 3.26: La Quintana library in 2000 m of radius, (a) Choice analysis, (b) Integration, (c) Land use, (d) building heights (Goodship & Capille, 2017)

The third example is the library **La Ladera**, with the lowest spatial values. The library's surrounding areas have sufficient space in relation to the central area of the town. But, due to the setback from the paths of the library, there is no direct link to the centre of town. The local areas of the library operate on urban scales; however, this library is situated in informal areas and is thus spatially isolated from other city formal areas. Meanwhile, the region has 21 percent of public sector facilities (Figure 3.27).



c) 

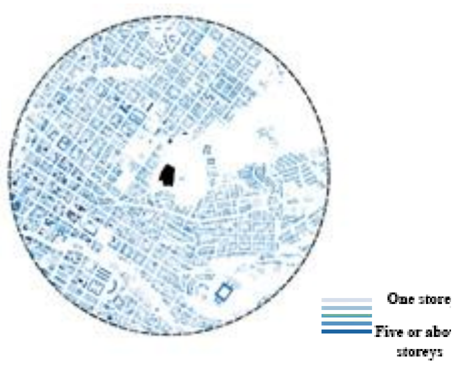

d) 


Figure 3.27: La Ladera library in 2000 m of radius, (a) Choice analysis, (b) Integration, (c) Land use, (d) building heights (Goodship & Capille, 2017)

- This inconsistent urban structure naturally contributes to different outcomes, like land values and socioeconomic conditions. These conditions thus distinguish the La Ladera region from La Quintana and Guayabal, for example.
- The study found that the three libraries being discussed have access to urban areas, which is feasible whether locally via walking or citywide via public transit such as the Metro, Metro cables, and buses. Nonetheless, integrations do have some variations. For example, Guayabal 's integration is higher than the other two libraries because of its position within the traditional urban grid and close to the centre of town. Therefore, due to the lower integration, the La Ladera and La Quintana libraries face separation between formal and informal public spaces in the urban system.
- According to Goodship and Capille, La Ladera and La Quintana libraries each have more than double the number of public facilities compared to the Guayabal library. All three libraries have a similar profile of urban density, as the vast majority of public facilities are surrounded by low-rise buildings.

With respect to Calderon's (2008) statement, there is a strategy to converge resources and projects in neighbourhood strategic areas, which causes the projects to become development "magnets" in all other fields. The urban network surrounding each pinpointed library is thus an important factor for connecting people to such public facilities. Besides this strategy, it would be learned that architecture plays an important role in creating the self-esteem and sense of belonging of the community.

The integration analysis study showed that virtually all of the above-mentioned libraries were located near local routes, making them readily available to the local community. However, the analysis shows that some libraries were confronted with the surrounding weak space. Therefore, it is unavoidable to face two different urban systems, formal and informal, which are also evident in both libraries, La Ladera and La Quintana. Meanwhile, the review of the above case studies has outlined each building's characteristics based on its spatial position within its neighbourhood and demonstrates how these characteristics contribute to the upgrading of existing neighbourhoods physically, socially, and institutionally by the community.

In a nutshell, the strategy has tried to bring a connection between community members and the existing street network; however, it seems still that these new projects didn't focus on the relation of the libraries' locations with the existing urban fabric as much as the concentration they did on libraries' building design as monuments in the selected regions.

### 3.8. Conclusion

As previously mentioned, this chapter concentrated on the theoretical and methodological framework of space syntax. The concept of the above approach was highlighted, where space-syntax contribution can assist us in understanding community members' comprehension, behaviour, and the way that pedestrians orientate themselves in built environments.

People's behaviour patterns will form a network of supporting activities for a community's members, such as Third Place. In this study, public libraries as a third place that should be social infrastructure are the key target, and it is needed to apply space syntax to realise how pedestrians explore routes to all other streets in a region to reach the location of the selected library. In this way, in Chapter 4, space syntax examines how routes' patterns are correlated with the selected location, which is needed to apply the analysis of connectivity, integration, choice, visibility graph analysis, and agent-based modelling. On the other hand, space syntax can assist with the expected proposal model in Chapter 6, which is expected to explore the potential arrangements of new routes within locations that may cause changes in buildings' forms and orientations, and whether relocating the selected library's location can increase connectivity and integration in the local network, which can increase the sense of walkability when the choice indicator is increased. Besides, the visual field would be improved if the location became a strategic one with the longest view in the region that was chosen.

According to Anuradha, Munasinghe, and Chathura (2016, p. 440), the third place's location plays a key role in affecting the urban structure. Accordingly, Swapan (2013, pp. 47-52) argues that Third Places are applied because they can be an urban regeneration strategy. That is why the role of space syntax applications is crucial to analysing the urban structure that is exposed by the route network or the urban grid. In this way, this approach can assist us in exploring how high spatial integration can generate social integration and, accordingly, create the potential for a public library to exploit such an opportunity for its sociability and permeability in the specified area. For instance, according to Van Nes and Yamu (2021, p. 192), social integration between diverse social and racial groups occurs in neighbourhoods with high spatial integration on the main thoroughfares, where all local residential streets are connected to the main paths and a high degree of intervisibility exists between entrances and windows on the ground floor level.

# Chapter 4.

## Analysis of four space syntax parameters via "DepthmapX" platform for selected public libraries' locations within the proposed multi-nodes in Auckland

# Chapter 4

## 4.1. Introduction

This chapter looks at the locations of selected public libraries mentioned in chapters 1 and 3 to explore their share in creating a sense of sociability through informal interaction, which can lead to addressing the research objectives in regard to their role in promoting public participation and also how these locations have a share in their surroundings' urban integration. Accordingly, to reach the above, as it is discussed and a road map of method analysis is planned for this research study in Chapter 3, this chapter is going to apply the space syntax method via its different parameters that are described in Chapter 3.

With regard to the above, this chapter concentrates on connectivity analysis, integration analysis, and choice analysis, and it will apply scatterplots to determine the kind of relationship between two quantitative variables. In the meantime, this chapter uses the visibility analysis isovist, which is a field vision. With that being said, Visual Graph Analysis (VGA) and Agent-Based modelling will be applied in order.

## 4.2. The focus on four nodes in view to scale and reasons

### 4.2.1. Pukekohe

#### 4.2.1.1. Connectivity analysis

As previously mentioned in Chapter 3, by connectivity analysis, all direct connections from each street to other streets that are within the street's immediate adjacency would be counted. In the following, as it is planned, one-step analysis, two-step analysis, three-step analysis, and n-step analysis. Two radii of 800m and 8000m are planned to consider the walkable distance from the selected location and vehicle access over longer distances.

- **One-Step analysis:**

In this type of connectivity analysis in an 800m radius with the centrality of the selected public library's location, it is going to be explored how Massey Street, as the origin, has connections to its immediate adjacency streets in the Pukekohe suburb in Auckland. The Massey Street is indicated in red. As it is shown, the origin street has eight direct connections to other streets. The connected streets are indicated in green. The remaining streets are all coloured grey. As it is shown, the Massey Street includes of multi axial lines with reasoning that the street is curved (Figure 4.1).


Figure 4.1: One-step connectivity analysis for Massey Street in the Pukekohe suburb in Auckland (by author).

The one-step analysis is beneficial in realizing the degree of connectivity of the selected streets to their adjacencies. Hence, the origin street is more connected to its surroundings when there are a higher number of connected axial lines to Massey Street as the origin directly.

This analysis compares Massey Street with Edinburgh Street. Edinburgh Street has the highest number of direct connections to other streets. Accordingly, the origin street is red, and its connected streets are green. The remaining streets are all coloured gray. Edinburgh Street, including multi-axial lines and fifteen direct connections to other streets, has the highest level of connectivity (Figure 4.2). However, Seddon Street and its following Queen Street, as a continuous line on the left side of Edinburgh Street, have longer visual sightlines than both Edinburgh Street and Massey Street.

The one-step analysis represents the interconnected connection between main routes and local street networks. Accordingly, it shows how the main route network of the area has a higher density in the 800m radius in comparison to the 8000m radius, which leads to a topologically 'shallow' system in the 800m and 'deep' system in the 8000m. Hence, it needs a lower number of orientation changes to reach the main route network in the smaller radius than in the bigger radius. (Figure 4.3).


Figure 4.2: One-step connectivity analysis for Edinburgh Street in the Pukekohe suburb in Auckland (by author).


Figure 4.3: The Pukekohe suburb in Auckland, 8000m radius (by author).

- **Two-Step analysis:**

As explained in Chapter 3, this type of analysis lets us explore the degree of accessibility to the nearby neighbourhood via two direction changes within the urban network from selected axial lines. In this type of analysis, the origin street is coloured in red, which is step zero'. The next step is including all immediate nearby streets that are connected to the origin route as the same as what has been experienced in one-step analysis, and accordingly, it is ‘step 1’. Hence, all these axial lines are coloured green. The next step includes all streets that are connected to the green axial lines of 'step 1'. Therefore, these axial lines with two orientation changes are coloured blue (step 2).

The 800m radius is considered in two-step analysis same as one-step analysis with the centrality of the selected public library's location in Massey Street in the Pukekohe suburb in Auckland. Accordingly, the total of all axial lines from steps one and two is the catchment area for the selected origin street (Massey Street). In contrast to the one-step analysis (Figure 4.1), the local catchment area of the two-step analysis for the Massey Street (Figure 4.4) encompasses the majority of the street network.

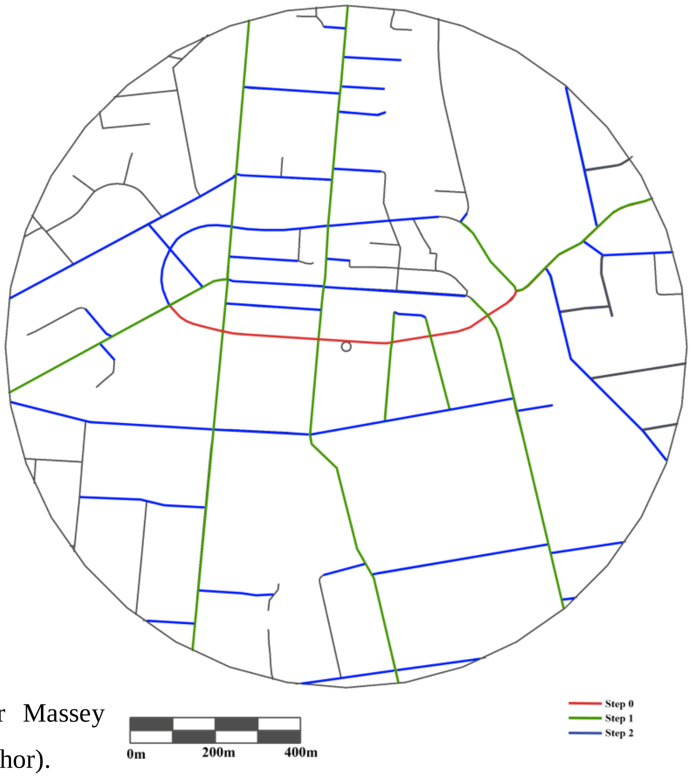



Figure 4.4: Two-step connectivity analysis for Massey Street in the Pukekohe suburb in Auckland (by author).

With regards to Hillier (1999, p. 119), those streets encompassing most of an urban's route network with a topological 'two-step grid' in a short distance are almost an urban's key local shopping streets with higher density than other streets, which also implies that Massey Street and its surrounding streets are in the same position that Hillier argued. Therefore, such analysis can be used to examine the degree of connectivity and accessibility that a key local street has in its neighbourhood. Accordingly, it gives the opportunity to realise how the selected public library's location on Massey Street is accessible in the neighbourhood.

The comparison between Massey Street and Edinburgh Street illustrates that Edinburgh Street benefits a higher degree of the linear pattern than Massey Street (Figure 4.5). With that being said, the stores, shops, and other facilities are aligned alongside the Edinburgh Street with higher connectivity to its adjacency to some more extent than Massey Street (Figure 4.6 & 4.7). Hence, there is a better friendly pedestrian and much convenience to walk and using bicycle or public transport.

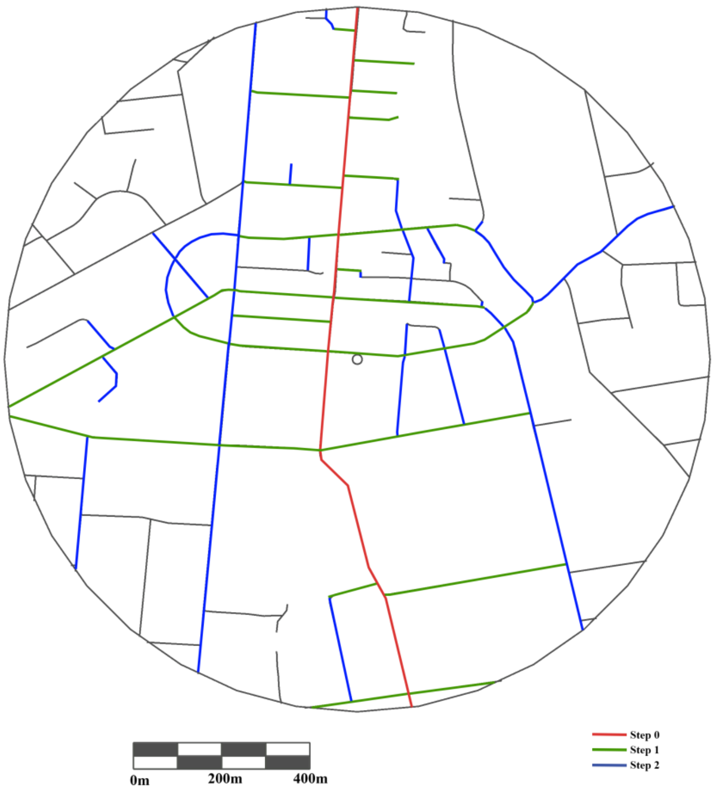



Figure 4.5: Two-step connectivity analysis for Edinburgh Street in the Pukekohe suburb in Auckland (by author).

Figure 4.6: Massey Street in the Pukekohe suburb in Auckland (Google Street View).


Figure 4.7: Edinburgh Street in the Pukekohe suburb in Auckland (Google Street View).

With regards to the above, the number and diversity of buildings and stores increase with the street network density for a two-step grid on a street such as Edinburgh Street. Accordingly, the buildings' and stores' functions might change according to how society changes.

- **Three-Step analysis:**

To sum up, the one-step and two-step studies show how a specific street or road is connected to other streets or roads in its immediate neighbourhood. By these analyses, the number of syntactic steps from a specific axial line or roadway segment might be increased.

In the three-step analysis, Massey Street in Pukekohe suburb is applied in the same radius of 800m from the selected public library's location as the centre point. As shown in Figure 4.8, the three-step grid' covers approximately most streets in the neighbourhood.

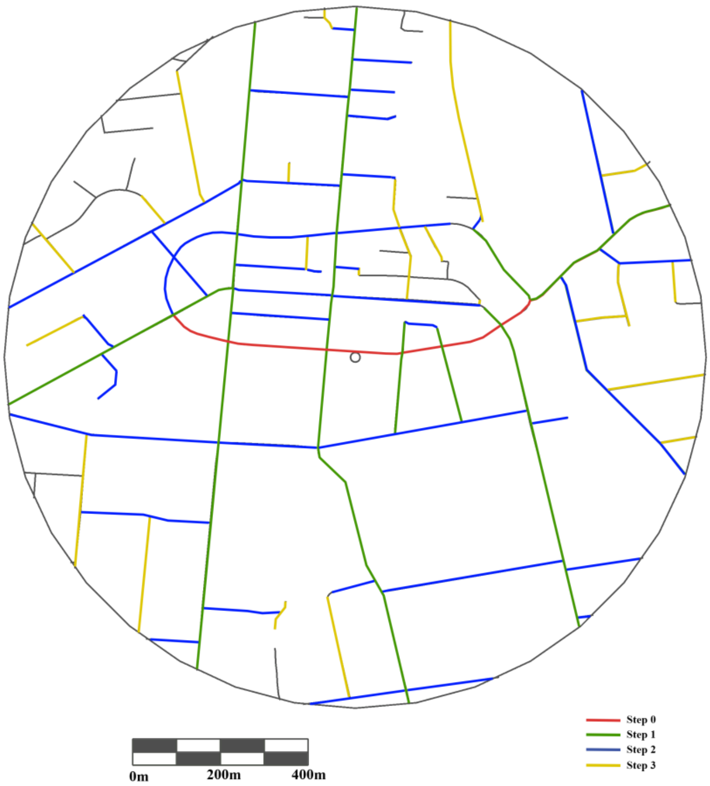



Figure 4.8: Three-step connectivity analysis for Massey Street in the Pukekohe suburb in Auckland (by author).

The comparison of Massey Street with Edinburgh Street illustrates that while Edinburgh Street faces more step 1' axial lines than Massey Street through one-step analysis, it has less coverage of streets than Massey Street via three-step analysis in the same neighbourhood (Figure 4.9). Similarly to one-step and two-step analysis, three-step analysis includes the same 'step 1' red axial lines and 'step 2' blue axial lines. In addition, the step 3' axial lines are in yellow. The remaining streets are all coloured gray.

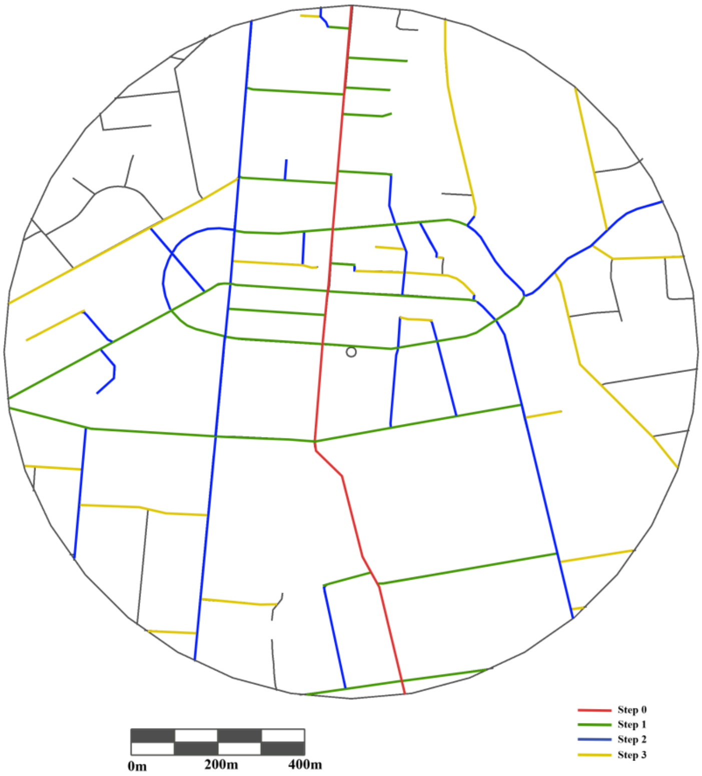



Figure 4.9: Three-step connectivity analysis for Edinburgh Street in the Pukekohe suburb in Auckland (by author).

- **N-Step analysis or Point-depth analysis:**

This analysis focuses on how topologically deep all axial lines are in relation to the selected origin street. The N-Step analysis for Massey Street is planned with six syntactic steps (Figure 4.10). As it is displayed in Figure 4.10, the N-Step analysis for the origin street shows how the 'six-step grid' covers almost every street in the neighbourhood except a few axial lines, which are coloured gray. With regard to Van Nes & Yamu (2021, p. 44), we learn that the syntactic step

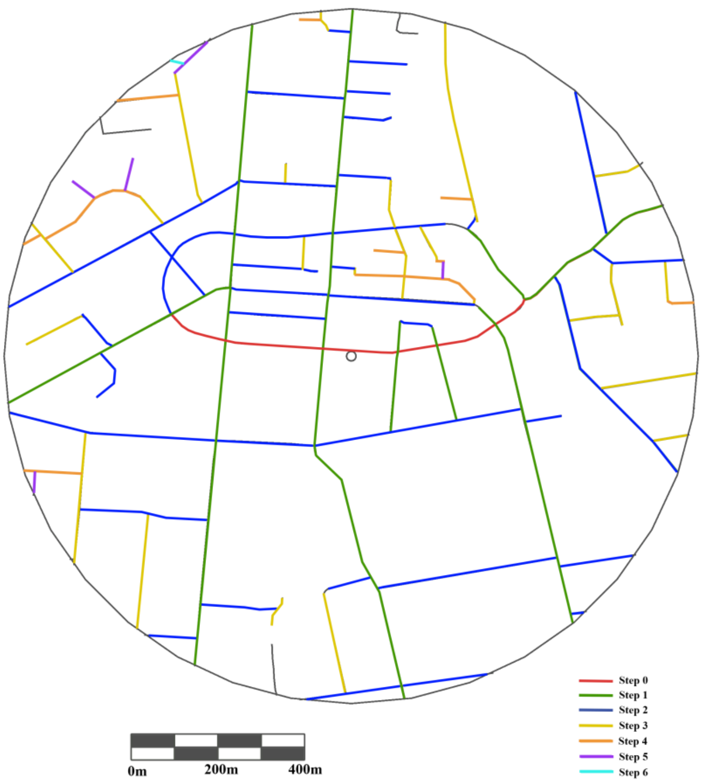



Figure 4.10: N-step connectivity analysis for Massey Street in the Pukekohe suburb in Auckland (by author).

value increases with every direction change for the street under examination and research. Accordingly, each axial line has a value attribute, and the length of the axial line or its sightline affects the depth value, as is obvious in Figure 4.10. This study exploits this analysis as it lets us measure the ease of reach of a wide range of facilities such as hospitals, schools, public libraries, public transport stops, railway stations, shopping streets, service centres, etc.

#### 4.2.1.2. Integration analysis

As explained in Chapter 3, the relationships of all lines to all others need some measures. Accordingly, the length of an axial line in an urban area is important, which affects integration value. In the meantime, integration analysis, as previously quoted from Hillier, B. et al. (1987, pp. 233–250), determines how a street segment in relation to all others is integrated or segregated spatially.

This analysis, as explained in Chapter 3, includes global integration analysis and local integration analysis. Both types of analysis give the opportunity to anticipate mobility and provide data to explain the mobility, as previously quoted from Ozbek et al. (2022, p. 51).

With regard to the above, both types of integration analysis are planned to be applied for the Pukekohe suburb, with the main street of Massey Street as the root node. In the meantime, the related attributes of both analyses will be illustrated and compared with the analyses' results for Edinburgh Street as well.

- **Global Integration Analysis**

As global integration concentrates on the relation of each street to all other streets in a predetermined urban area city in terms of the maximum possible direction changes, this type of integration analysis illustrates how Massey Street relates to all other streets in an 800-meter radius, with the centre of the public library's location on the same street in Pukekohe suburb in Auckland.

According to the global integration analysis result by depthmapX, Massey Street, as the selected main street, has not met relatively high global integration, which means that it is not relatively spatially highly integrated in relation to all other streets in the considered zone (Figure 4.11). Accordingly, it requires relatively many direction changes to reach all other locations in the specified urban zone of Pukekohe. Also, this status of Massey Street is the same for each of its nearby streets if each of them is considered a main street to be analysed in relation to all other streets (Figure 4.11). In the meantime, the most integrated axial lines are shown in red, and the most segregated are shown in dark blue.

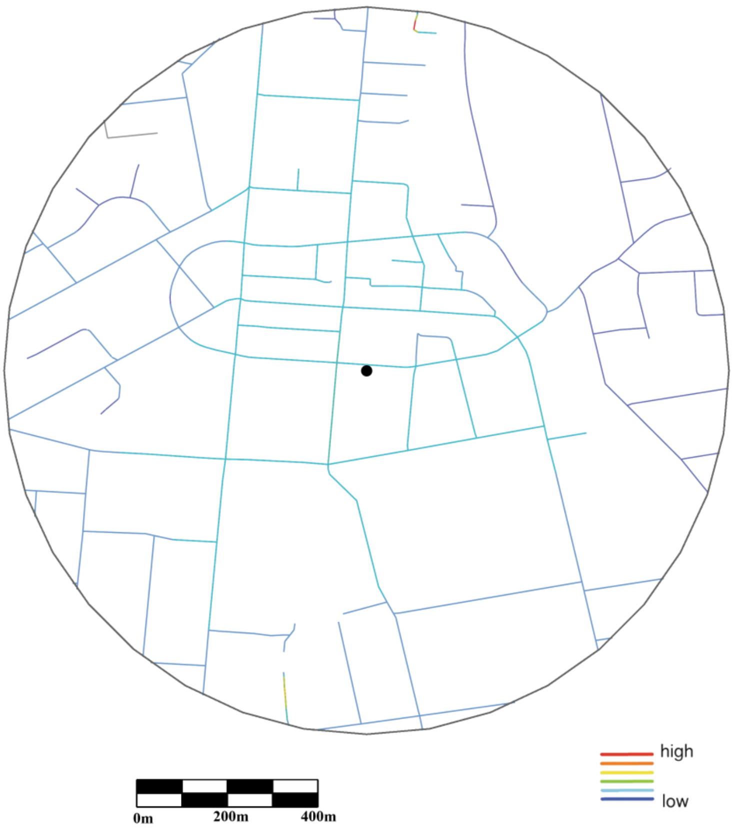



Figure 4.11: Global integration analysis for the Pukekohe suburb in Auckland with the main street of Massey Street as the root node (by author).

With regard to the global integration analysis, multiple mathematical equations are required to reach the integration value. These equations are included of mean depth (MD), real asymmetry (RA), real relative asymmetry (RRA), and finally the integration value (INT) that the details' procedure are explained in Chapter 3. Accordingly, the values of each equation are provided about Massey Street by Table 4.1.

| **Ref. number Massey St** | **Integration value - Rn** | **(MD) - Rn** | **Real Asymmetry (RA)** | **Real Relative Asymmetry (RRA)** | **(TD)** |
|---|---|---|---|---|---|
| **487** | **0.42171** | **16.5262** | **0.0698** | **2.3712** | **9139** |

Table 4.1: Global integration analysis's result for the main street of Massey Street as the root node in the Pukekohe suburb in Auckland (by author).

With regard to the analysis's result about Edinburgh Street, the street in comparison with Massey Street has a higher global integration value (0.43409), which means it is more integrated than Massey Street (Table 4.1 and 4.2). In the meantime, according to the global integration analysis via depthmapX, Edinburgh Street is the most integrated street in the selected area, which makes it reasonable to compare any selected street with Edinburgh Street. According to Hillier and Hanson (1984, pp. 108–109), relative asymmetry (RA) shows how a system is deep or shallow from a specific root. In the meantime, a high value of (RA) indicates how a space would be segregated from the system, while a low value indicates how the space would integrate the system, which makes the system shallow. Hence, the analysis's result illustrates that Edinburgh Street is shallower than Massey Street, while Massey Street is deeper than the other street (Table 4.1 and 4.2).

| **Ref. number Edinburgh St** | **Integration value - Rn** | **(MD) - Rn** | **Real Asymmetry (RA)** | **Real Relative Asymmetry (RRA)** | **(TD)** |
|---|---|---|---|---|---|
| **439** | **0.43409** | **16.0831** | **0.0678** | **2.3036** | **8894** |

Table 4.2: Global integration analysis's result for the main street of Edinburgh Street as the root node in for the Pukekohe suburb in Auckland (by author).

In the meantime, according to Van Nes and Yamu (2021, p. 49), real relative asymmetry (RRA) with high value represents the greater depth, which indicates the street with less activities and also greater segregation. Accordingly, the above analysis' result shows that Massey Street is faced with less activities and higher segregation than Edinburgh Street (Table 4.1 and 4.2).

As it is explained in Chapter 3, a street's topological distance from every other street in the urban system is inversely proportional to how integrated that street is. Conversely, the topological distance between a street and every other street in the urban system increases with a street's level of segregation. With that being said, it is obvious that how Edinburgh Street's topological distance from every other street is shorter than what is experienced between Massey Street and every other street in the purposed area. Hence, Edinburgh Street is more integrated than Massey Street in a global integration analysis.

## ➢ Local Integration Analysis

As discussed in Chapter 3, local integration analysis illustrates the connection between each street and its adjacent streets via a three-time direction change. Hence, it shows the degree of integration between each street and its immediate neighbours. Having said that, many suburbs have their own local urban centres, which are poorly highlighted in a global integration analysis, as the analysis of Pukekohe suburb concluded with similar status. As such, suburbs include busy local centres such as shopping areas, which have low global integration values while meeting high local integration values.

With regard to the local integration analysis via depthmapX, Massey Street as the root node has met a relatively high value for the local integration analysis, which illustrates that it is relatively spatially highly integrated in relation to all other streets in the considered area (Figure 4.12). However, considering Edinburgh Street as the main street shows that it meets the highest level of value for the local integration analysis in the area. Here, the most integrated axial lines are shown in red, the most segregated are shown in dark blue, and the remaining streets are all coloured grey.


Figure 4.12: Local integration analysis for the Pukekohe suburb in Auckland with the main street of Massey Street as the root node (by author).

For local integration analysis, a radius of three is considered, which means all streets beyond two topological steps away from the main street or root node should be excluded. Hence, the value of local integration differs from the value of global integration as their total depth sum values differ from each other. The total depth sum of the global integration analysis for the Pukekohe suburb with the main street of Massey Street is 9139, while the local integration analysis is 42 (Table 4.1 and 4.3).

| **Ref. number Massey St** | **Integration value – R3** | **(MD) – R3** | **Real Asymmetry (RA)** | **Real Relative Asymmetry (RRA)** | **(TD)** |
|---|---|---|---|---|---|
| **487** | **1.6734** | **2.2105** | **0.2388** | **0.5975** | **42** |

Table 4.3: Local integration analysis's result for the Pukekohe suburb in Auckland with the main street of Massey Street as the root node (by author).

Similarly to the global integration analysis, the (RA) value in the local integration analysis with Massey Street as the root node is higher than the (RA) value for the analysis with Edinburgh Street as the main street, which indicates that Edinburgh Street is shallower than Massey Street (Tables 4.3 and 4.4). In the meantime, with regard to the (RRA) values, we learn that Massey Street is faced with fewer activities and higher segregation than Edinburgh Street, as it is concluded via local integration analysis (Table 4.3 and 4.4).

| **Ref. number Edinburgh St** | **Integration value – R3** | **(MD) – R3** | **Real Asymmetry (RA)** | **Real Relative Asymmetry (RRA)** | **(TD)** |
|---|---|---|---|---|---|
| **439** | **1.8135** | **2.15** | **0.2123** | **0.5514** | **43** |

Table 4.4: Local integration analysis's result for the Pukekohe suburb in Auckland with the main street of Edinburgh Street as the root node (by author).

#### 4.2.1.3. Choice analysis

As illustrated in Chapter 3, choice is another syntactic measure. It measures the degree to which a path is likely to be used as part of a route. As previously noted, Choice analyses each space's potential for the movements that pass through it. Accordingly, angular choice analysis counts how often each street segment is on the shortest route with the least amount of angular deviation between all other pairs of segments within a predetermined range or radius. With that being said, angles influence people's choices to track the simplest path between their starting point and destination. In the meantime, there is a tendency to choose the longest path with the least angle to the direction people are aiming for. With that being said, they would take the straightest route feasible to reduce complications.

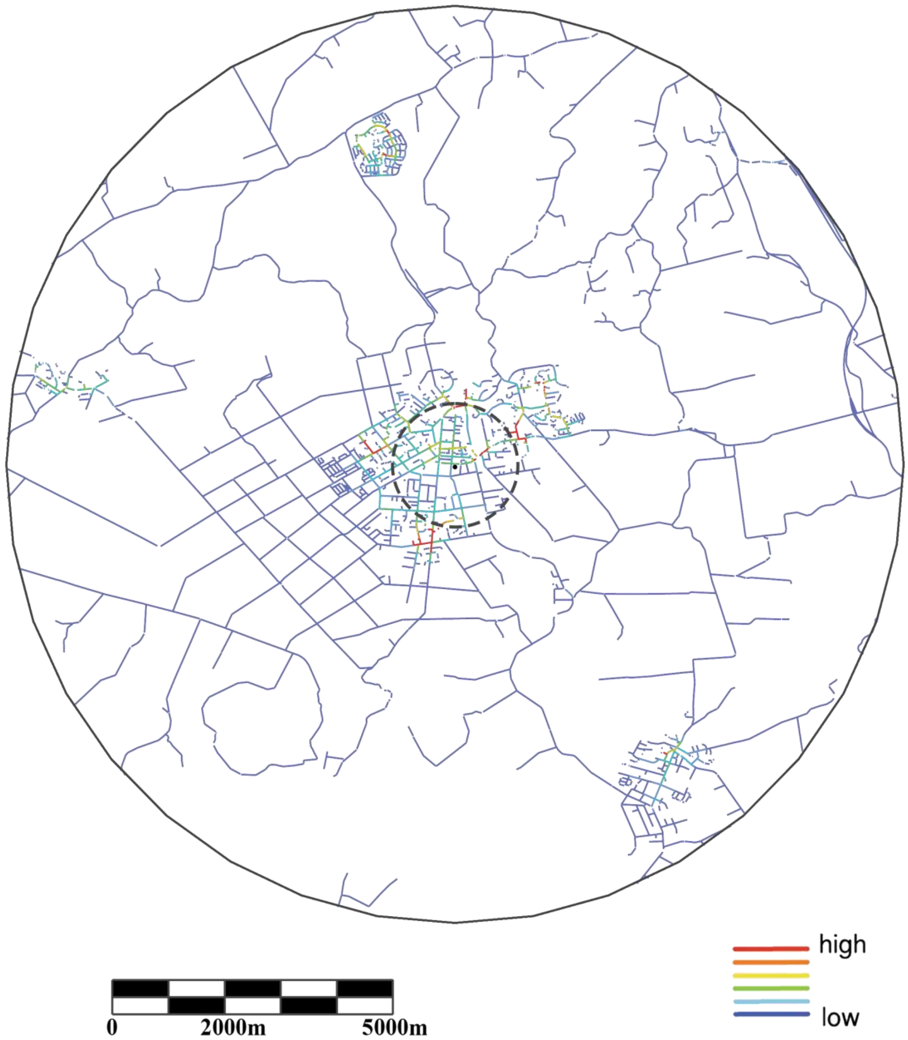



Figure 4.13: Angular Choice analysis for the Pukekohe suburb in Auckland with radius = 800 meters

“The dotted circle includes an 800m radius from the library’s location (zoomed image at figure 4.14)” (by author).

The first step in analysing the angular choice for Massey Street is to calculate the angular mean depth from Massey Street to all other streets at the predetermined distances of 800 meters and 8000 meters from the selected public library’s location at Massey Street. The reason for considering an 800-meter distance is how far pedestrians have to travel to get to the library’s location (Figures 4.13 and 4.14), and the reason for considering an 8000-meter distance is how far cycles and vehicles have to travel to get to the library's location (Figure 4.15).

To reach the value for the angular mean depth, it is necessary to use the total depth value of the angular weights from segments that is provided by depthmapX analysis, which is 24519.852, considering the radius of 800 meters. In addition, the number of segments or nodes in the system "k" is 405. Therefore, the angular mean depth value is 60.692, which is calculated via the below formula:

(MD) = total depth (TD) / k-1

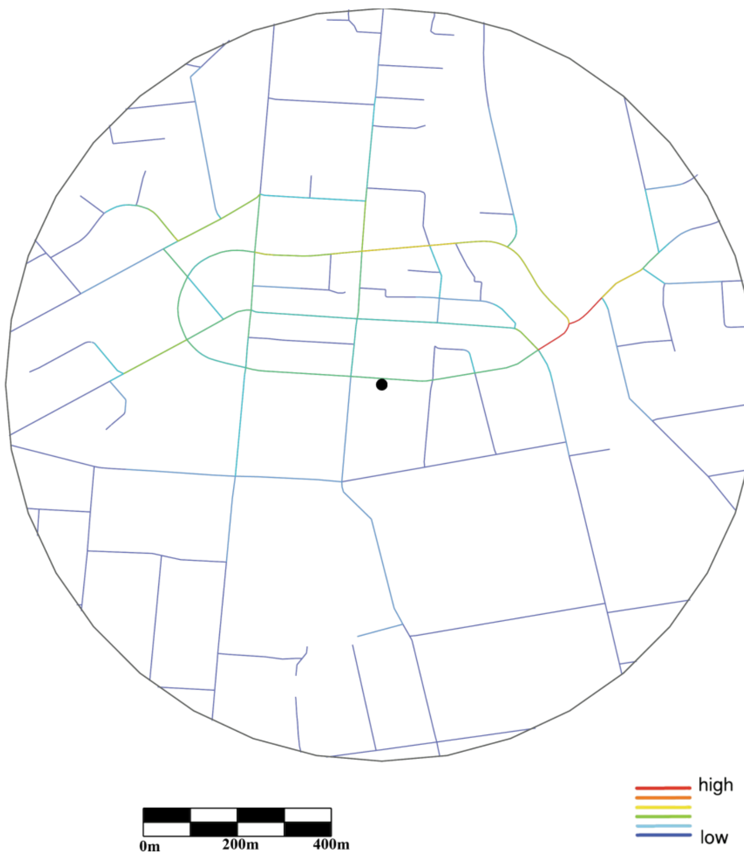



Figure 4.14: Zoomed image of figure 4.13 for angular Choice analysis for the Pukekohe suburb in Auckland with the 800m distance from the library's location (by author).

The value for angular choice is 6987966, which is provided by depthmapX by having the sum of the angular weights from segment (Massey Street) to all 404 segments divided by the total number of segments minus 1. Similarly, the total depth value of the angular weights from segments, considering the radius of 8000 meters, is 1560535.2. The number of segments or nodes in the system "k" is 5132. Accordingly, the angular mean depth value is 304.138. The value for angular choice provided by the analysis via depthmapX is 5470672400.

With regard to the previous explanation in Chapter 3, the angular choice analysis, emphasizing a street hierarchy and street choice in the predetermined distance in Pukekohe suburb, identifies the main streets as connecting people's orientation and navigational strategies via the urban system. Accordingly, the analysis's conclusion makes it noticeable that urban street networks face a dual nature, as according to Hillier et al. (2009), they include a foreground network and a background network. In comparison with the foreground network, which links centres at all scales, the background network is mostly for residential areas and contains the foreground network.

The angular choice analysis for the Pukekohe suburb in Auckland with an 8000-meter radius highlighted both foreground and background networks (Figure 4.15). According to Hillier et al. (2009, cited in Van Nes & Yamu, 2021, pp. 66–67), the foreground network is primarily made up of longer streets and roads that form extremely acute angles with one another. As it is clear in Figure 4.15, the likelihood of a nearly straight connection at the end of the street line increases with its length. The background network, on the other hand, is primarily

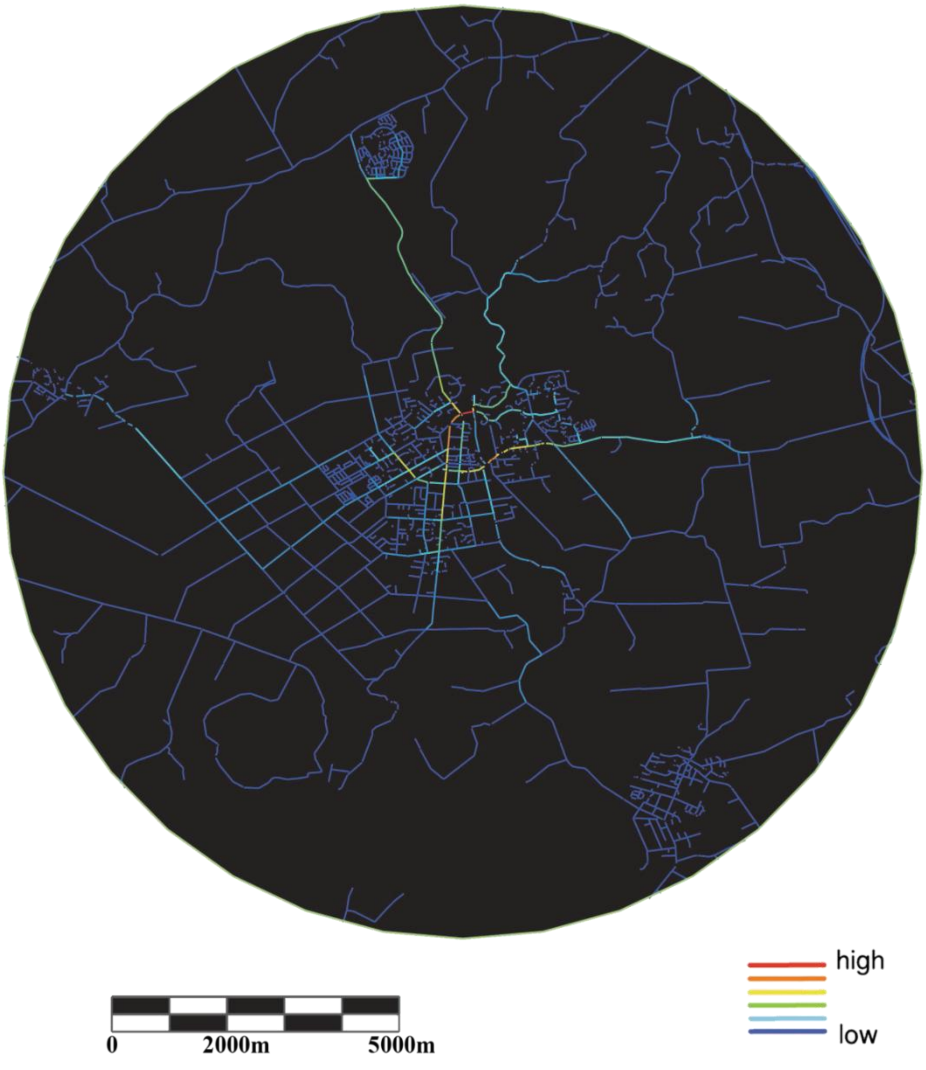



Figure 4.15: Angular Choice analysis for the Pukekohe suburb in Auckland with radius = 8000 meters (by author).

composed of short streets that typically cross other streets at almost right angles. The likelihood of a street ending at a right angle increases with its length.

The above analysis illustrates that the selected area in Pukekohe is made up of a combination of both tree structure and network structure. However, apart from the central area within an 800-meter radius of the library’s location, almost all other areas are poorly accessible from the main route network.

#### 4.2.1.4. Applying Scatterplots

So far, exploring the status of the location of the public library in Pukekohe has been analysed by different analyses that have been taken to measure;

- The number of streets instantly connecting the origin route of Massey Street within the Pukekohe,
- Distance between Massey Street as the origin and all others within the selected area of Pukekohe, and thus exploring how close the origin is to all other streets,
- The possibility of how the selected street can be passed via all shortest paths from all points to all other places, including the selected location of the public library within the designated distance.

With regard to the above, it is essential that some indices, including intelligibility, permeability, and movement interface, be considered via scatterplots. The scatterplots are needed to be considered as they are beneficial for exploring the relationship between two variables in each of the above three indices.

The first index is **intelligibility**, which is the correlation between connectivity and global integration. A strong association between the above indices causes high intelligibility, which

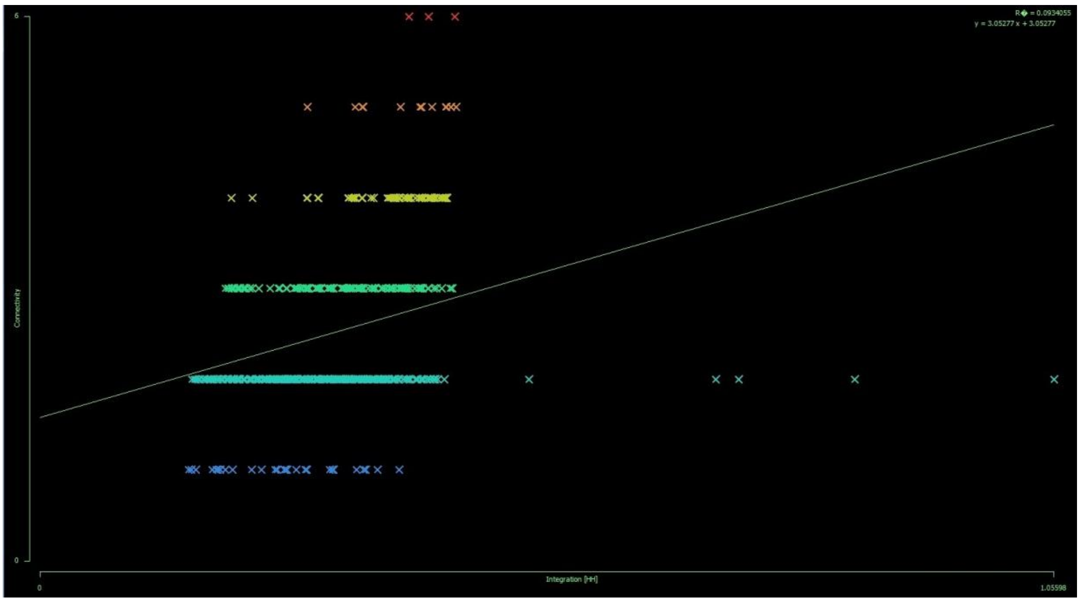





Figure 4.16: Intelligibility values at the global scale within the designated radii distance from the public library’s location in Pukekohe (by author).

indicates a tight relationship between the overall area of a selected urban area and the local building blocks that make it up. However, the analysis represents a weak linear correlation coefficient value of 0.0934055, which indicates the correlation relationship between the two syntactic measures (Figure 4.16).

The second index, **permeability** at the global scale, presents the relation between line length and connectivity, respectively, on the X and Y axes. As it is shown in figure 4.17, there are more axial lines at higher values compared to the lines that are distributed along the regression line. The correlation coefficient is low, as it is 0.108013, which indicates the axial lines' length and limited variety of alternative routes to choose from. In the meantime, large building blocks as obstacles tend to indicate lower values.

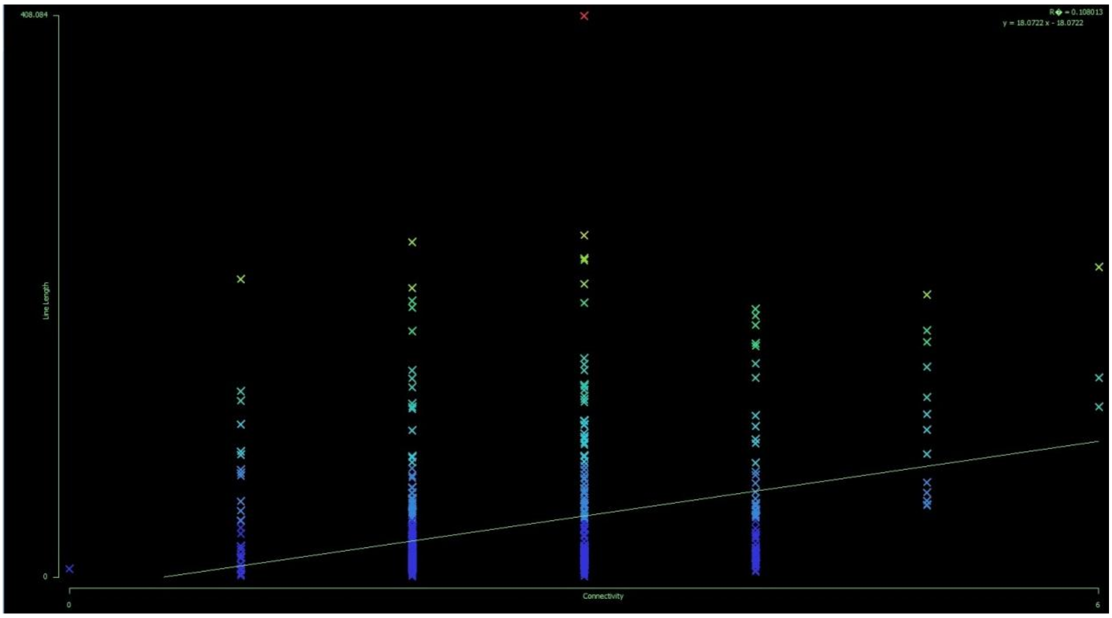


Figure 4.17: Permeability values at the global scale within the designated radii distance from the public library's location in Pukekohe (by author).

The third index is the "**movement interface**", which lets analyse the correlation between integration values and choice values. In order to assess the degree of accessibility to a specific space as a destination from various origins and the likelihood that the same place falls within the minimal paths from all spaces to all the others, both measures of network axial centrality are thus considered.

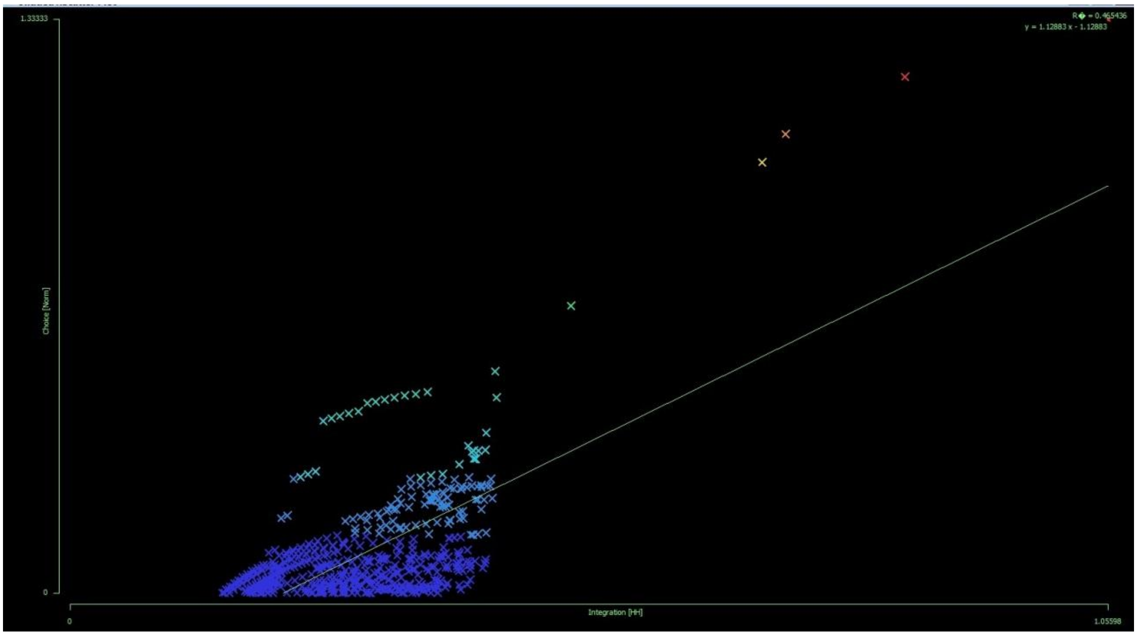



Figure 4.18: Movement interface values at the global scale within the designated radii distance from the public library's location in Pukekohe (by author).

The importance of the "movement interface" analysis for this study is its illustration of the possibility of social interactions between people in an urban area. Hence, there is a direct relationship between the correlation coefficient value and social interactions. With that being said, the higher correlation coefficient value illustrates a greater chance for meetings between community members who see the location as a destination or origin and people who pass through the spot.

This kind of study was done with respect to the present condition at both the global scale (r = n) (Figure 4.18) and the local scale (r = 3) in the selected area of Pukekohe (Figure 4.19).

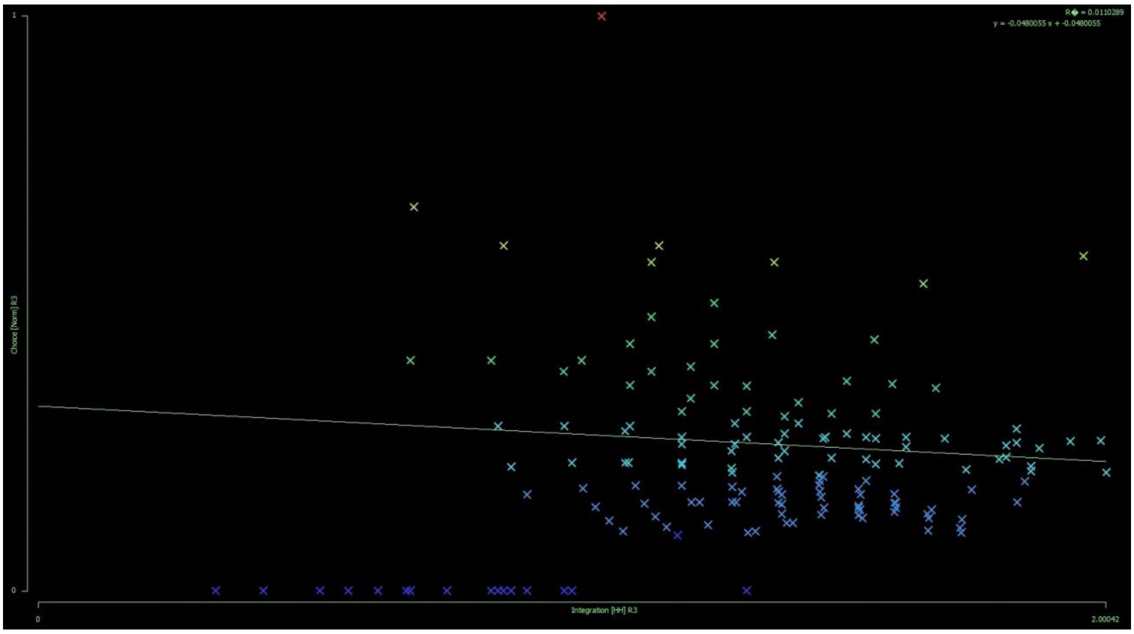



Figure 4.19: Movement interface values at the local scale within the designated radii distance from the public library's location in Pukekohe (by author).

The correlation coefficient value at the global scale (r = n) is 0.465436, which indicates a moderate correlation between global integration and choice indices, while at the local scale (r = 3), it leads to a value of 0.0110289, which indicates a weak correlation between the two indices. Hence, while there is a greater opportunity for social interactions between people in the purposed urban area within the designated global scale, there is a weak status within the local scale for social interactions between people, whether local community members or those who pass through the area.

#### 4.2.1.5. Isovist Analysis

Isovist analysis as described previously, on the one hand, it evaluates the urban interventions' impact and it also analyses how urban interventions whether increase or and decrease the visual experience from the specified location. On the other hand, it explores the ideal locations regarding the visual experience.

With regard to the above, two serial visions are applied to two different routes through the Pukekohe suburb in Auckland, which are concluded at the selected public library's location at Massey Street (Figure 4.20). As it is shown, the first route is presented below with eight photos taken from the vantage point of the isovists of the analysis. The images numbered 1 through 8 demonstrate how the surface impressions of buildings and public areas can vary from point to point through the 90-degree isovists that are carried out. Particularly in wider areas like intersections and crossroads, the vision field might drastically alter after only a few meters. Accordingly, it is beneficial that one-point and serial vision route isovists can help this study in the perception of accessibility to the public library's location in the local urban context via different distances and directions. With that being said, the analysis illustrates that one couldn't see all the way to the public library from the isovist root at an 800-meter distance. Hence, as the degree of visibility of the purposed location from one point over a long distance is important, it is needed to be analysed via "through vision" analysis, which will be considered in the VGA analysis in the next section.

With regard to figure 4.20, the isovist analysis via depthmapX shows that the proposed location is not optimal as the proposed route needs many isovist points from a long distance in the selected zone to make the destination visible.

| | |
|---|---|
|  1 |   2 |
|   3 |  4 |
|  5 |  6 |
|   7 |  8 |

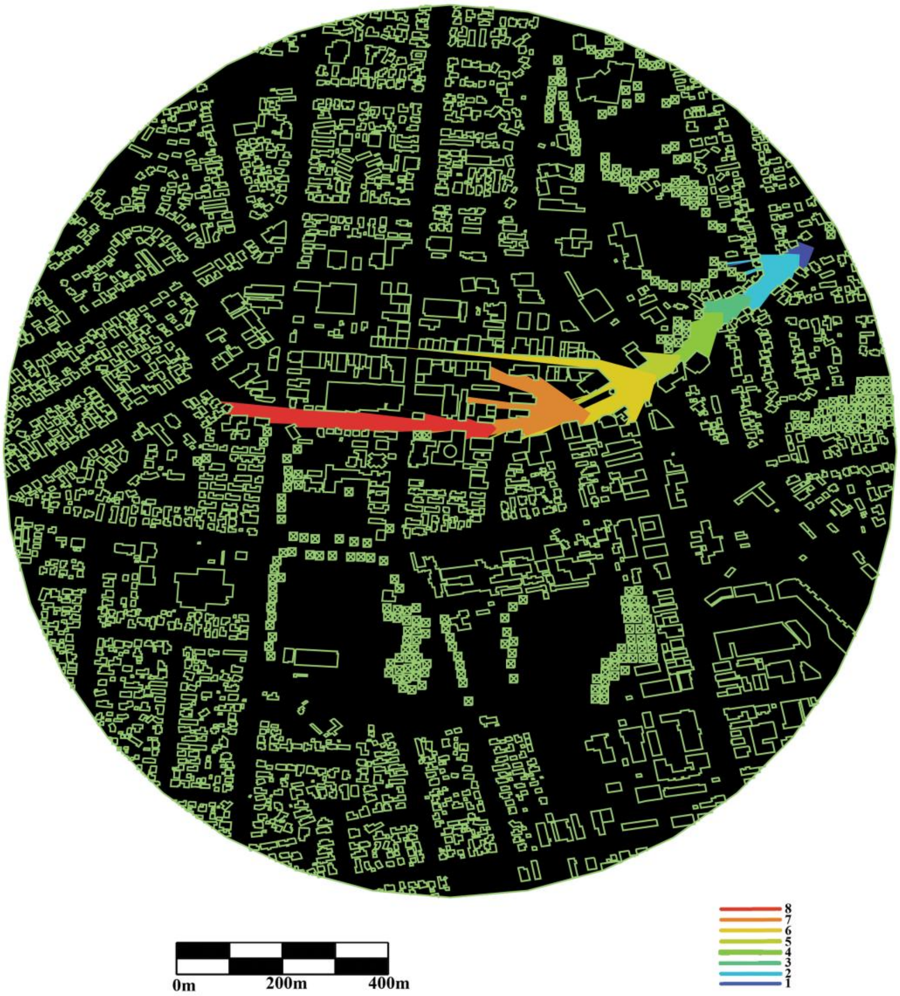



Figure 4.20: Isovist analysis with a serial vision from a route in Pukekohe suburb in Auckland applying 90° isovists (by author).

The second route is also presented in figure 4.21 with eight photos taken from the vantage point of the isovists of the analysis. Similarly, through the 90-degree isovists, the photos numbered 1 through 8 show how the surface impressions of buildings and public spaces would change from one spot to another. The vision field may significantly change after just a few meters, particularly in larger zones like intersections and crossroads. The analysis for the second route illustrates that, similarly to the first route, one couldn't see all the way to the public library from the isovist root within approximately an 800-meter distance (Figure 4.21).

With regard to figure 4.21, the purposed location is not an optimal location as it is not visible from a long distance through the proposed route; specifically, there is zero visibility from the origin isovist to the isovist close to the crossroad at Massey Street.

1

2

3


KFC
Entry

4


CHINESE
RESTAURANT
AND TAKEAWAYS
Edinburgh S

5

6


Farmers
Edinburgh S

7


ADE STATION

8

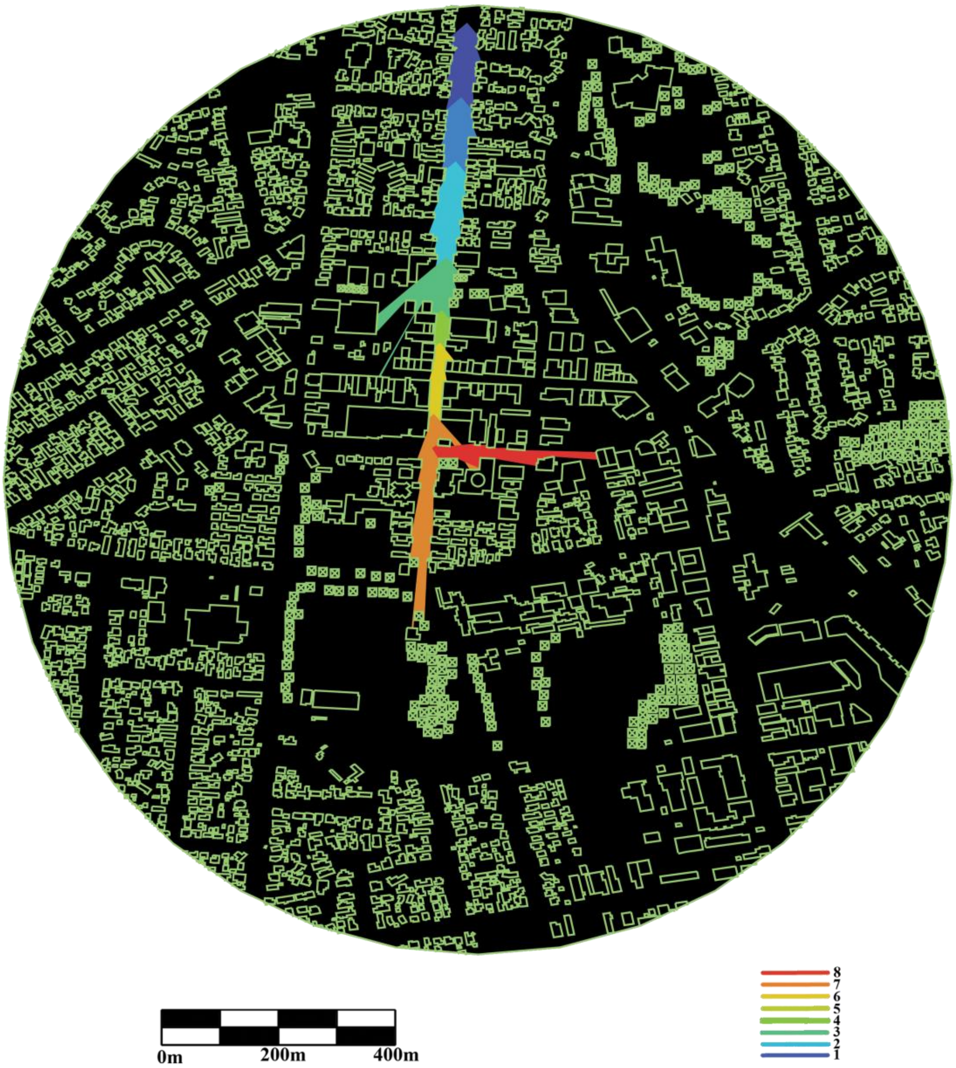



Figure 4.21: Isovist analysis with a serial vision from a route in Pukekohe suburb in Auckland applying 90° isovists (by author).

The two examples from two different routes illustrate that the Pukekohe public library is not located within a central meeting destination for local people. Hence, it could not be recognized as a defining feature to draw an image as part of the social identity of the Pukekohe area.

### 4.2.1.6. Visual Graph Analysis (VGA)

As this analysis is based on a raster method, each cell includes an isovist in the grid, and the topological visibility of that cell in respect to every other cell is computed in an urban space. Hence, it calculates how a cell associates with all other cells in the grid.

This analysis is carried out for the selected area of Pukekohe with the centrality of the selected public library. As the area for VGA study cannot be too big, a rectangle with dimensions of 500 meters × 500 meters is considered Figure 4.22.

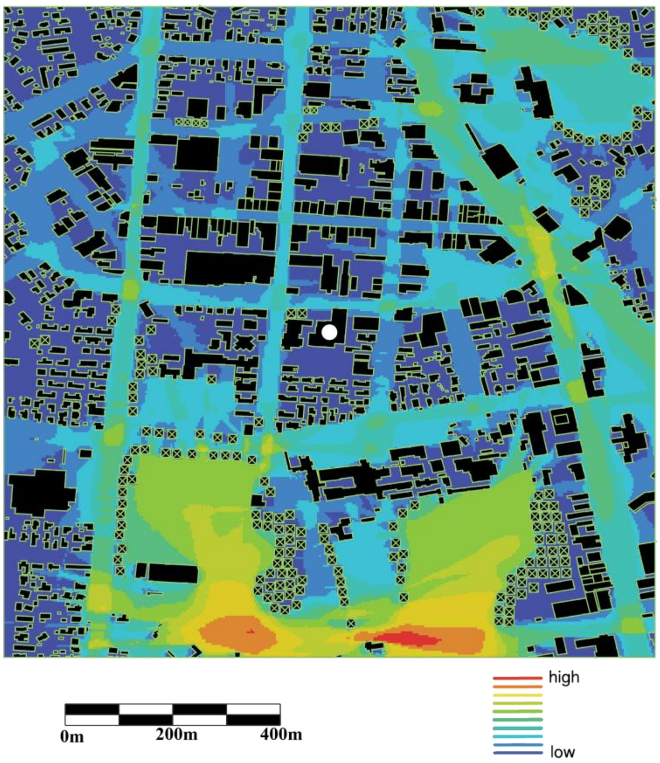


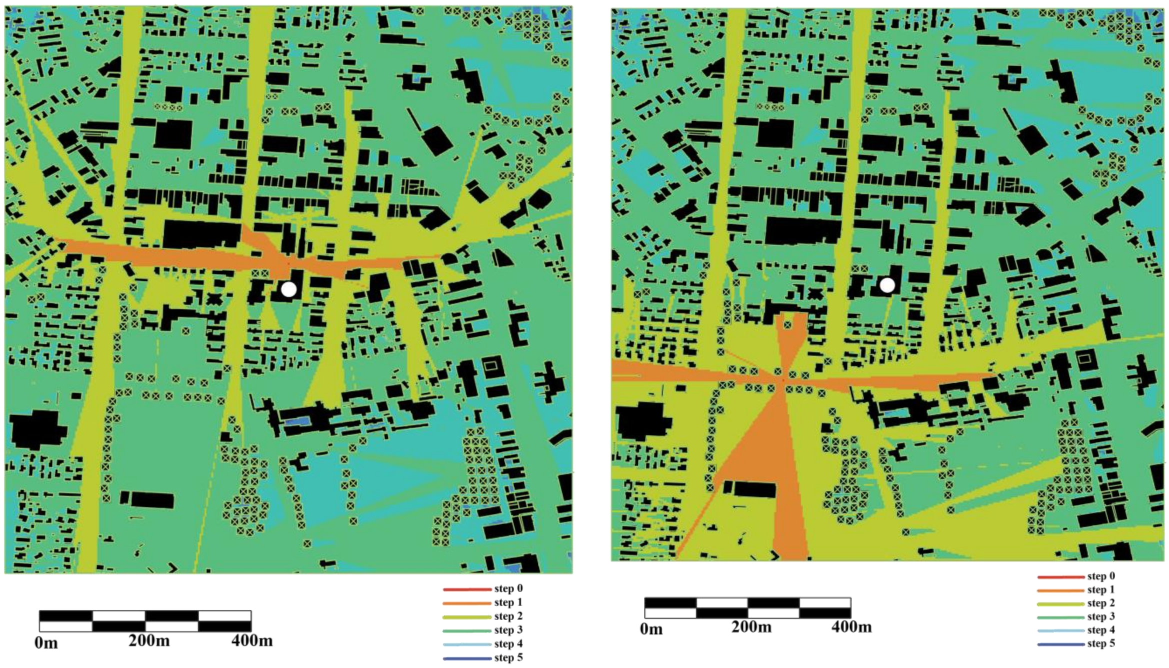
Figure 4.22: VGA study for the Pukekohe suburb in Auckland (By author).

In further stages, this analysis concentrates on two different cells in Pukekohe suburb, which are the roots in different locations. On the one hand, it would be analysed how the first root close to the selected public library is well connected to other cells in the area compared to the second root. On the other hand, it illustrates how each system is deeper. Accordingly, it explores how it is easier to reach all cells from two different roots.

With regard to the above and Figure 4.22, we learn that the root cell close to the junction of Harris Street and Edinburgh Street is well connected to its most adjacent cells compared to the root cell close to the Pukekohe public library. The most well-connected cells are shown in red, and the cells with the weakest visual connections in relation to the root cell at the purposed junction are shown in dark blue.

The raster-based method of VGA via depthmapX illustrates that people in red and orange areas orient and move through the local area easier, while people in dark blue zones face challenges; they need to go through several visual steps to identify possible locations for social contact in streets and public spaces, among other stationary activities (Figure 4.22).

By following further parts of this section, “through vision” analysis will be taken into consideration. However, “visibility step” analysis is considered in advance to compare to what extent all cells can be observed from two different root cells that are described previously. It is noteworthy that the visible cells receive the same value within each step.




**Root cell (A) in Massey Street** **Root cell (B) in Harris Street**

Figure 4.23: Visibility step analysis for two different points within the Pukekohe suburb in Auckland (By author)

The comparison between these two root cells represents that the number of visibility steps from root cell (B) is lower than root cell (A) because there are a higher number of cells that can be seen directly from root cell (B) compared to root cell (A) (Figure 4.23). In this way, respectively, from location (A), the red colour represents where the space (A) is located with step 0. The orange colour represents all the cells that can be seen from the red cell (A) or the root cell in step 1. The light green cells with step 2 represent all cells that can be seen when changing orientation occurs from orange cells. Step 3 includes the dark green that can be seen when changing orientation occurs in light green colour spaces. The cells in light blue are step 4, which can be seen by changing orientation from dark green cells. Finally, the dark blue cells in step 5 can be seen by changing orientation from light blue spaces. As there is a lower number of steps from location (B), there are 4 steps from the root cell. The root cell (B) with step 0 is red. The cells in yellow with step 1 can be seen from the root cell directly. The step 2 cells in green colour with step 2 can be seen when changing orientation occurs from yellow colour cells. Light blue colour spaces are steps 3 that can be seen by changing orientation from green colour cells. Finally, the dark blue-coloured cells are visible from the light blue-coloured cells by changing orientation. This illustrates how the degree of visibility can be varied depending on the root cell’s location. Accordingly, as there are many building blocks in the proposed raster system, the mean depth value is influenced by these obstacles’ positions. Hence, the calculation of the mean depth value lets us explore which raster system is deeper from its proposed root cell's location. As it is described in Chapter 3, the calculation for the mean depth of each of the two proposed root cells is computed by the total depth divided by the number of cells minus one.

$$MD = TD / K - 1$$

With regard to the above, the mean depth calculation for locations (A) and (B) is computed separately below:

| **Mean depth for location (A)** | **Mean depth for location (B)** |
|---|---|
| TD = 245655<br>K = 83948<br>MD = 245655 / 83948 – 1<br>MD = 2.92 | TD = 228879<br>K = 83948<br>MD = 228879 / 83948 - 1<br>MD = 2.72 |

Table 4.5: mean depth calculation for locations (A) and (B) within Pukekohe (by author).

With regard to table 4.5, the mean depth calculation results illustrate that location (A) faces a higher mean depth value compared to location (B), which means the raster-based system is deeper from location (A) than location (B). Accordingly, unlike the status of location (B)’s connection with all other cells in the system, location (A) is not well connected to all other cells in the system. Hence, all cells or spaces from location (B) in the system are reachable easier compared to status with location (A).

According to the visibility step analysis and mean depth calculation results, we learn that location (B) close to the junction of Harris Street and Edinburgh Street has a longer continuous view than location (A) close to the Pukekohe public library. In other words, the number of spaces or cells with the same value within the first step that can be seen from location (B) is higher than the number of spaces that can be seen from location (A) in the first step (Figure 4.23).

With regard to the above, a “through vision” analysis on the raster-based system takes all spaces or cells into account to explore longer lines of vision (Figure 4.24). With that being said, the area from the northern side of Glasgow Road toward the southern side of Harris Street next to the junction of Harris Street and Edinburgh Street meets the highest degree of longer lines of vision, which are represented in figure 4.24, from red-coloured spaces to light green-coloured spaces. The level of through vision varies, which depends on the locations of the building blocks in the grid, as is obvious in figure 4.24. That is why "through vision" analysis explores the degree of visibility that is necessary for long distances from a proposed cell in a purposed urban space. Accordingly, the mean depth value is also varying, as we previously examined the previous two selected locations that are represented in figure 4.23.

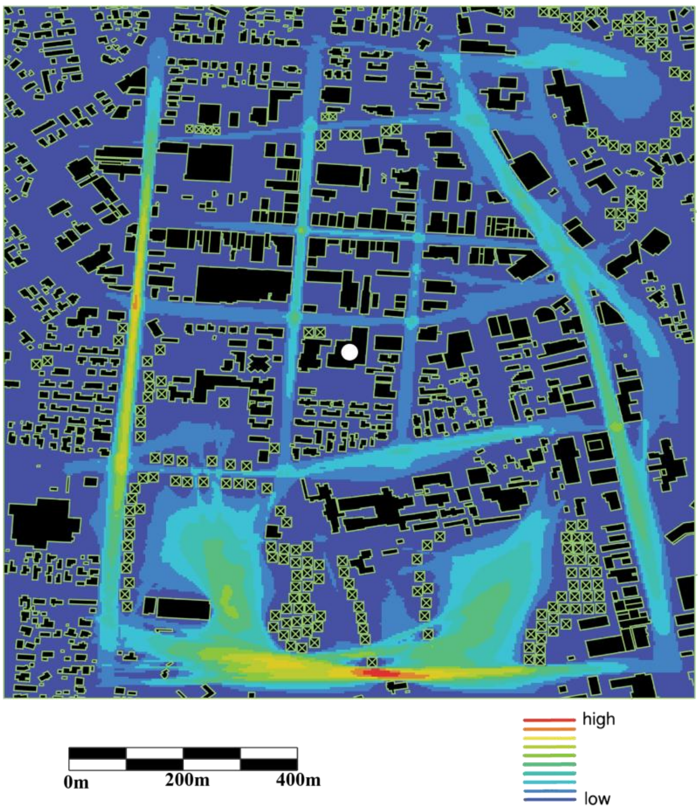


Figure 4.24: Through vision analysis within the Pukekohe suburb in Auckland (By author)

The "through vision" analysis via depthmapX shows that 676 cells in the red-coloured area, which are the ‘hotspots’ for orientation and navigation (Van Nes & Yamu, 2021, p. 99), have longer continuous views or the longest total “through vision” than all other cells in the system, and the cell in the red-coloured zone with the through vision of 4400587 has the longest continuous view in the system. The comparison between the noted cell in the red-coloured area in figure 4.24 and the cell in location (A) in figure 4.23, which is close to the public library of Pukekohe, shows the considerable difference in “through vision” value between these two spaces. With that being said, the location (A) faces an 187925 value, while the other noted cell in figure 4.24 represents a value of 4400587. Hence, the second point from figure 4.24, with other cells in the large visible red zone as a whole that were taken as one syntactic step, have very longer continuous views than the location (A) because there are not many building blocks in the red zone as there are many close to the location (A). Accordingly, this “through vision”, according to Van Nes & Yamu (2021, p. 101), influences orientation, wayfinding, and people’s behaviour, which has a direct impact on the level of sociability regarding a location in an urban context.

### 4.2.1.7. Applying the Agent-Based Modelling

With regard to the previous description in Chapter 3, this analysis is carried out via the space syntax depthmapX software. This analysis, as with the VGA study, is a raster-based analysis.. With regard to Dalton's (2003, p. 108) argument, this analysis can assist this study in the selected zone within Pukekohe by showing how people tend to choose linearity through their paths toward their destination with the fewest angular deviations. Accordingly, by applying the depthmapX, a specified number of agents that are evenly scattered within the selected area under precise investigation for a determined time frame collect their travel paths. With that being said, three scenarios are considered to implement the analysis as described in Chapter 3. In the first-case scenario in Figure 4.25(a), the agent as an average

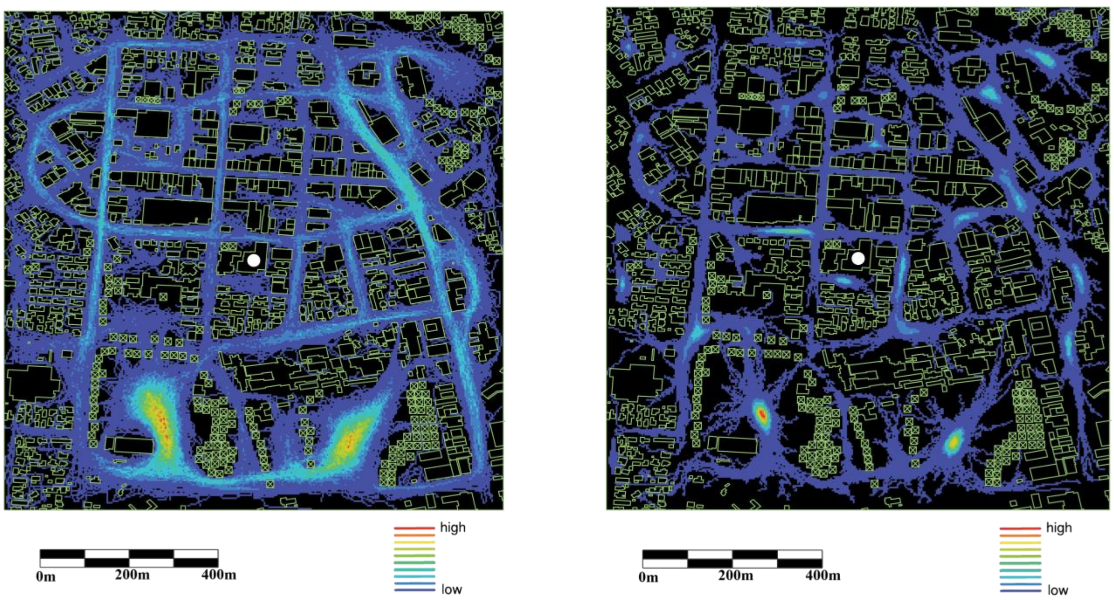



Figure 4.25 (a): The agent as an average person Figure 4.25 (b): The agent as a tourist or visitor
(By author)

person is considered. Accordingly, five thousand agents who take a walk of three syntactic steps are considered. This movement occurs by agents prior to their direction change, which is based on their vision field. The vision field is placed at 15°. The second-case scenario in figure 4.25 (b) represents the agent as a visitor or tourist. The number of agents is the same as in the first scenario, but with one syntactic step, which causes a different movement pattern. The vision field is placed at 30°. As visitors are not familiar with the built environment but would like to explore the area, they thus chose a location with the longest vision into the selected area of Pukekohe. The third-case scenario is shown in figure 4.26, which is the agent as a local. The vision field is placed at 7°. The syntactic steps have been increased to five steps that have been taken by five thousand agents to move. This movement illustrates that the local urban area is familiar to the local community members. Hence, locals know which route leads to their destination. Accordingly, they do not congregate in the middle of the public area, and their movement line patterns are straightened, as is obvious in figure 4.26.

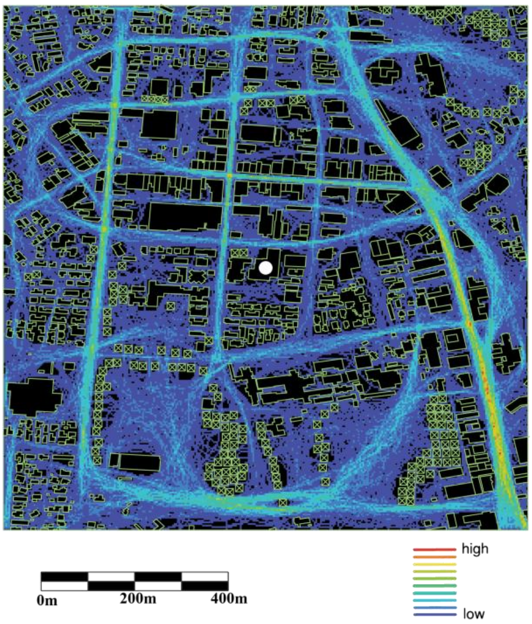


Figure 4.26: The agent as a local person (By author)

As principles of this type of analysis apply to visual fields and syntactic steps, which are based on Dalton's research in 2001, the comparison of results for the selected area in Pukekohe between agent-based modelling, VGA, and through vision analysis illustrates that visitors or tourists would attend within the locations with the greatest integration of the through vision, while the local community members' movements are based on the angular choice analysis's results. With that being said, it is obvious that visitors from outer regions like to flock to locations where they are able to get a wide visual field of the location they are visiting.

### 4.2.2. Parnell

#### 4.2.2.1. Connectivity analysis

As in the previous section, the connectivity analysis encompasses all direct connections from each street to other streets that are within the street’s immediate adjacency. Accordingly, one-step analysis, two-step analysis, three-step analysis, and n-step analysis will be considered. The radii of 800m and 8000m are considered the two reference scales regarding the walkable distance and vehicle access at longer distances.

- **One-Step analysis:**

The selected public library's location is considered in an 800m radius at the Parnell zone. Accordingly, Stanley Street is considered the main street, and it would be analysed to see how it has connections to its immediate adjacency streets in this suburb of Auckland. Hence, Stanley Street is marked in red, which is the main street in this scenario analysis. As it is shown in Figure 4.27, Stanley Street has fourteen direct connections to its immediate adjacent streets. These connected streets are shown in green.

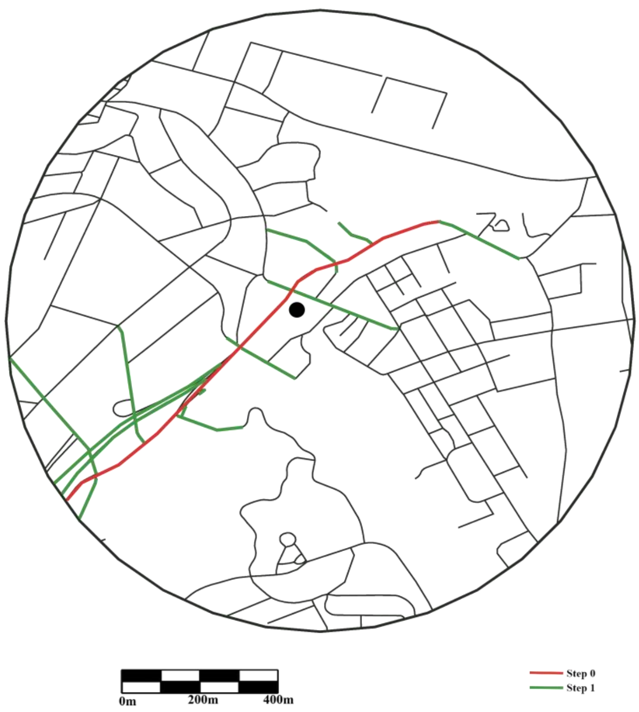



Figure 4.27: One-step connectivity analysis for Stanley Street in the Parnell suburb in Auckland (by author).

As directly connected streets to the main street show the degree of connectivity of the selected main street to its adjacencies, the higher the number of connected axial lines to Stanley Street, the more connected it is to its adjacencies.

Parnell Rise Street is also selected as the main street, which gives a comparison opportunity between its degree of connectivity and the degree of connectivity of Stanley Street. Parnell Rise Street has a lower number of direct connections to its immediate streets compared to Stanley Street (Figure 4.28). However, the green space between Parnell Rise Street and Parnell Road gives Parnell Rise Street a great opportunity with wider visual sightlines.

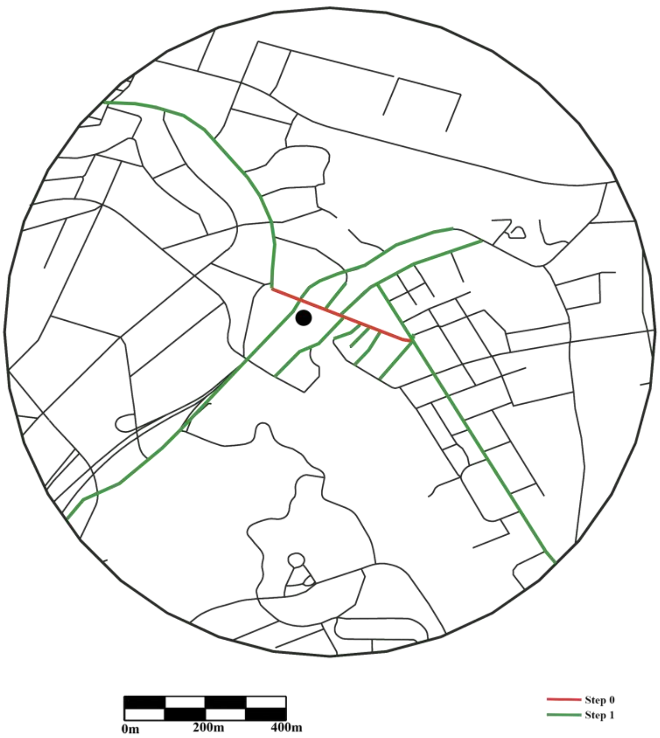


Figure 4.28: One-step connectivity analysis for Parnell Rise Street in the Parnell suburb in Auckland (by author).

While one-step analysis shows the connections between the main street and its immediate adjacent streets, the two-, three-, and N-step analyses complete the interlinked connection between main routes and local street networks. Unlike the outside of the core urban areas such as Warkworth and Pukekohe, the Parnell suburb as part of the city's central node has a higher density, not just in the selected 800m radius with the centrality of the National Library's location but also in a

Figure 4.29: The City centre node in Auckland, 8000m radius (by author).

wider radius of 8000m. Thus, there is a topologically shallow system in both scales of 800m and 8000m radius because of the high density and the well-interconnected connection between main routes and local street networks (Figure 4.29).

- **Two-Step analysis:**

In this type of analysis, Stanley Street as the main route in red is considered to assess how it accesses the adjacent neighbourhood by two direction changes within the selected zone from selected axial lines. This analysis, with one more step, includes all immediate adjacent axial lines that are connected to the origin route from step zero in red to step one in green, and finally to step two in blue. Hence, the catchment area for Stanley Street (main route), including the total of all axial lines from steps one and two in the selected 800m radius with the centrality of the National Library's location (Figure 4.30).

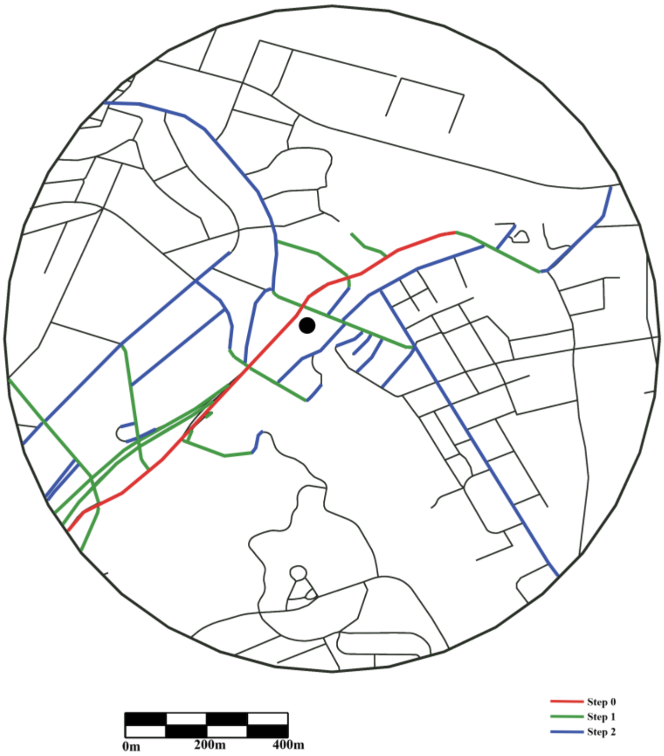


Figure 4.30: Two-step connectivity analysis for Stanley Street in the Parnell suburb in Auckland (by author).

Stanley Street plays an urban key local street as it makes it possible for the urban route network in the area to be accessible to Stanley Street in a short distance by a topological 'two-step grid'. Accordingly, this street, via the continuous line with Strand Street and Northwestern Motorway, embraces a considerable density because of the abundance of commercial, low-rise, and mid-rise residential buildings. Thus, there is an opportunity to explore how the National Library is accessible in the neighbourhood, as it is located on a key local street.

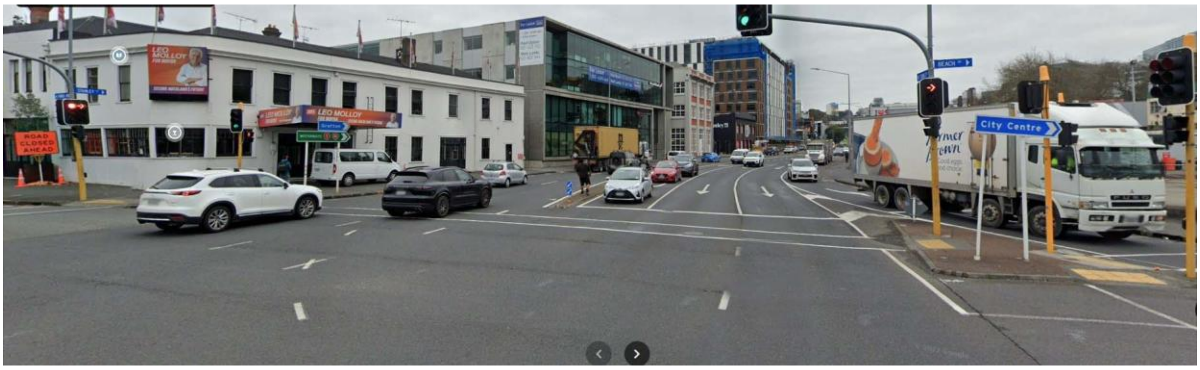


Figure 4.31: Stanley Street in the Parnell suburb in Auckland (Google Street View).

Although Parnell Rise Street has a shorter length than Stanley Street, it includes many residential buildings, offices, and a three-angle green space with a wide visual sightline. In the meantime, it has immediate access to Stanley Street, which is a strong advantage (Figure 4.32). Having said that, it facilitates a friendly pedestrian with a wider visual sightline, which makes it pleasant to walk and bike along the street (Figure 4.33).

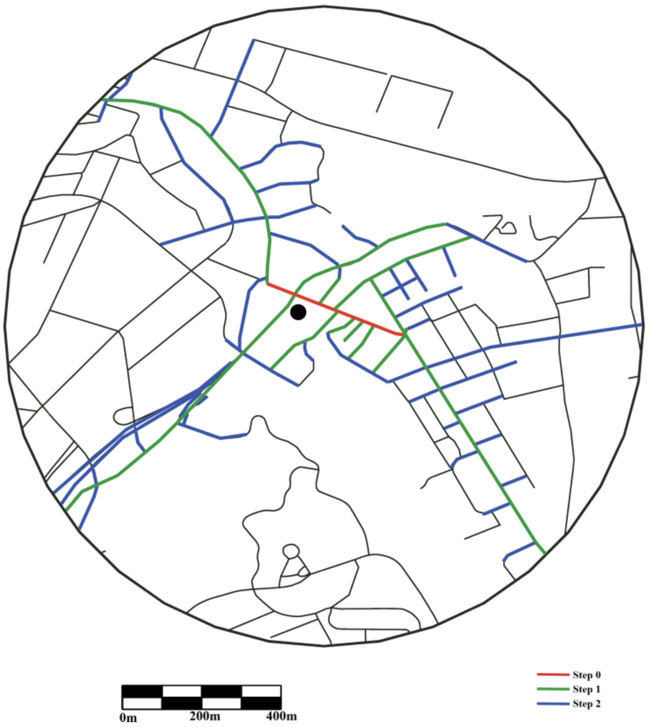



Figure 4.32: Two-step connectivity analysis for Parnell Rise Street in the Parnell suburb in Auckland (by author).


Figure 4.33: Parnell Rise Street in the Parnell suburb in Auckland (Google Street View).

➢ **Three-Step analysis:**

The three-step analysis is applied with one more step on the same scale of 800m radius with the centrality of the National Library. By this type of analysis, most streets that are accessed with three direction changes from Stanley Street cover almost 70% of the selected urban network (Figure 4.34). Besides, the different topological steps are shown in four colours. Zero-step is red, one-step is green, two-step is blue, three-step is yellow, and the remaining axial lines are gray.

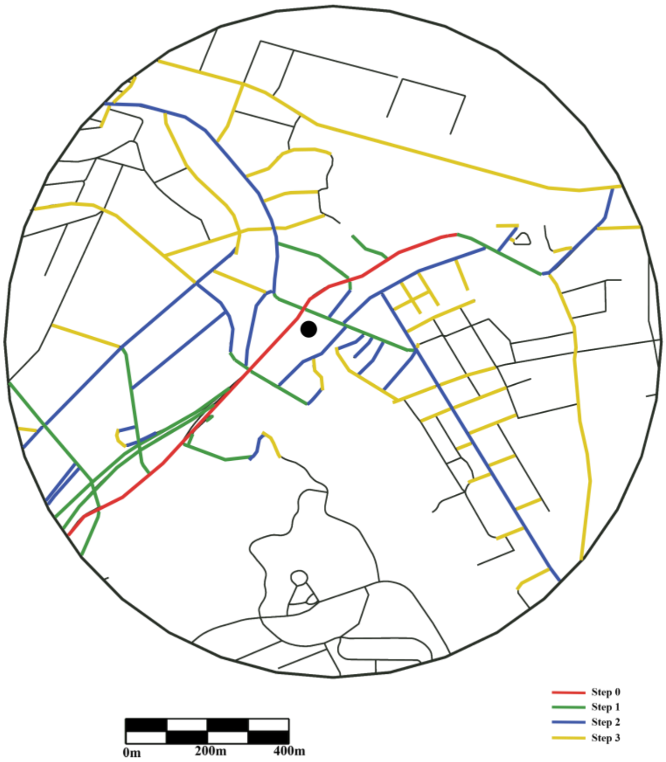



Figure 4.34: Three-step connectivity analysis for Stanley Street in the Parnell suburb in Auckland (by author).


Figure 4.35: Three-step connectivity analysis for Parnell Rise Street in the Parnell suburb in Auckland (by author).

Although the three-step analysis indicates that Stanley Street as the main route embraces more step 1 axial lines than Parnell Rise Street as the main route, there is higher coverage by three direction changes from Parnell Rise Street to other streets in the 800m radius (Figure 4.34 & 4.35).

➢ **N-Step analysis:**

This type of connectivity analysis lets us explore how topologically deep all axial lines are in relation to Stanley Street as the main route. As shown in Figure 4.36, there are twelve syntactic steps, which cover almost all streets except a few routes that are shown in gray. Hence, a street with the value of step 12 is accessible from Stanley Street via 12 direction changes, as the syntactic step value would be increased with every direction change, according to Van Nes & Yamu (2021, p. 44). Accordingly, the street with step 12 faces a high depth value (Figure 4.36).

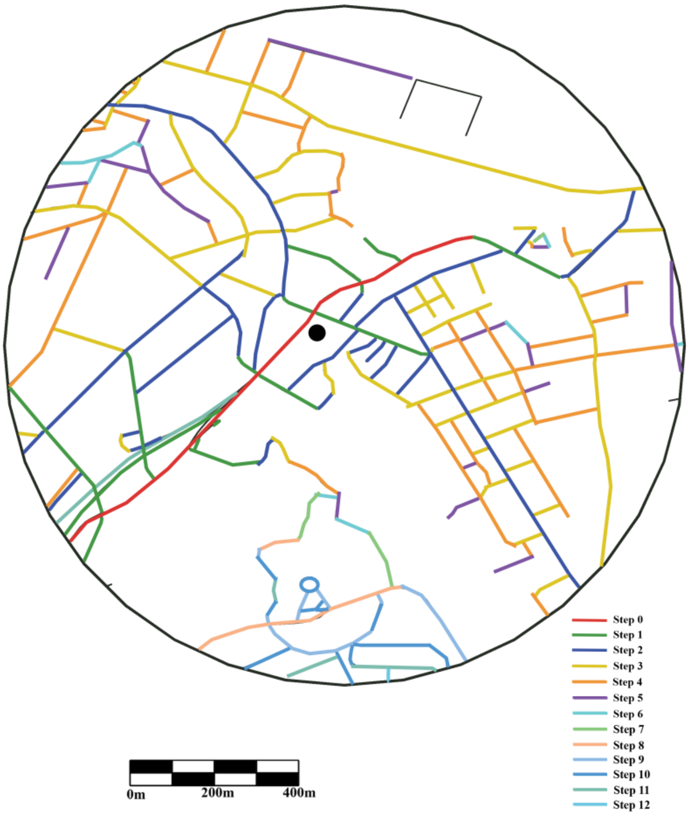



Figure 4.36: N-step connectivity analysis for Stanley Street in the Parnell suburb in Auckland (by author).

#### 4.2.2.2. Integration analysis

In this section, the integration value of Stanley Street will be analysed, and its length plays a key role in determining how a street segment in relation to all other streets is integrated or segregated spatially on the selected scale. Accordingly, global integration analysis and local integration analysis are considered in this part.

➢ **Global Integration Analysis**

A global integration analysis in the selected 800m radius with the centrality of the National Library's location lets us assess how Stanley Street relates to all other streets, which highly demands considering possible direction changes

The global integration analysis via depthmapX indicates that Stanley Street is not highly integrated spatially with all other streets in the selected zone (Figure 4.37). With that being said, it takes many direction changes to reach many streets within the 800m distance. However, Stanley Street has a slightly higher global integration value than Parnell Rise; both are at a low level of global integration analysis (Figure 4.37). Meanwhile, the majority of streets in the selected 800m radius experience the same status as Stanley Street if each of them is observed as a main street in relation to all other streets.

Figure 4.37: Global integration analysis for the Parnell suburb in Auckland with the main street of Stanley Street as the root node (by author).

In the following analysis, multiple mathematical equations are used to assess the integration value of Stanley Street. These equations are as follows: mean depth (MD), real asymmetry (RA), real relative asymmetry (RRA), and finally the integration value (INT) (Table 4.6).

| Ref. number Stanley St | Integration value - Rn | (MD) - Rn | Real Asymmetry (RA) | Real Relative Asymmetry (RRA) | (TD) |
|---|---|---|---|---|---|
| **656** | **0.12942681** | **62.834641** | **0.080882** | **7.726375** | **96137** |

Table 4.6: Global integration analysis's result for the main street of Stanley Street as the root node in the Parnell suburb in Auckland (by author).

The comparison of global integration analysis between Stanley Street and Parnell Rise Street indicates that Stanley Street embraces a higher global integration value than Parnell Rise (Tables 4.6 and 4.7). Therefore, Stanley Street is more integrated by global system analysis. Accordingly, the relative asymmetry (RA) value indicates that there is a lower value for

Stanley Street than Parnell Rise, which means Stanley Street is shallower while Parnell Rise is deeper. With that being said, a shallower street makes the space more integrated.

| **Ref. number Parnell Rise** | **Integration value - Rn** | **(MD) - Rn** | **Real Asymmetry (RA)** | **Real Relative Asymmetry (RRA)** | **(TD)** |
|---|---|---|---|---|---|
| **468** | **0.12588991** | **64.571892** | **0.083155** | **7.943449** | **98795** |

Table 4.7: Global integration analysis's result for the main street of Parnell Rise as the root node in the Parnell suburb in Auckland (by author).

In continuing to compare the indicators in Tables 4.6 and 4.7, the real relative asymmetry (RRA) value for Stanley Street with a lower value than Parnell Rise indicates more activities and also a lesser segregation, which means that Stanley Street represents lower depth. Meanwhile, the topological distance between Stanley Street and every other street is less than the distance between Parnell Rise and every other street in the urban system. Hence, Stanley Street is more integrated and embraces lower segregation than Parnell Rise in the system.

- **Local Integration Analysis**

As previously noted, there is the possibility of opposite outcomes between global integration and local integration, as many suburbs have their own local urban centres, which meet poor values of global integration while embracing high local integration values. Thus, such local centres are busy. With that being said, in local integration, the relationship between a main street, such as Stanley Street, and its adjacent streets would be analysed by three-direction changes.

As noted above, Stanley Street has a higher local integration value than its global value, which means there is a relatively higher local integration from Stanley Street to all accessible other streets by three direction changes. However, Parnell Rise represents a higher local integration value than Stanley Street (Figure 4.38). Besides, in this analysis, red displays the most integrated streets, and dark blue shows the most segregated streets.


Figure 4.38: Local integration analysis for the Parnell suburb in Auckland with the main street of Stanley Street as the root node (by author).

With regard to the above, the reason for the difference between global integration and local integration relies on the topological distance, which means that streets with two topological steps away from the main street, such as Stanley Street in this analysis, would not be counted in the local integration analysis, while in the global integration analysis, there is no restriction. Accordingly, the total depth sum values differ between these two types of analyses, as the total depth value in global integration analysis for Stanley Street is 96137, while the value for the same indicator in local integration is 30 (Tables 4.6 and 4.8).

| Ref. number Stanley St | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA) | Real Relative Asymmetry (RRA) | (TD) |
|---|---|---|---|---|---|
| **656** | **1.0102814** | **2.5** | **0.272727** | **0.989823** | **30** |

Table 4.8: Local integration analysis's result for the main street of Stanley Street as the root node in the Parnell suburb in Auckland (by author).

The comparison of local integration analysis between Stanley Streets and Parnell Rise illustrates that Parnell Rise meets lower values of (RA) (0.154412) and (RRA) (0.650852) than Stanley Street with values for the same indicators, respectively (0.272727) and (0.989823). Thus, Parnell Rise indicates a shallower system than Stanley Street, and therefore, Parnell Rise is more integrated than Stanley Street (Tables 4.8 and 4.9). Having said that, Parnell Rise, with more activities in the local system analysis, such as nearby cafes, a park, and offices, represents more integration than Stanley Street.

| Ref. number Parnell Rise | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA) | Real Relative Asymmetry (RRA) | (TD) |
|---|---|---|---|---|---|
| **468** | **1.5364467** | **2.2352941** | **0.15441176** | **0.65085238** | **38** |

Table 4.9: Local integration analysis's result for the main street of Parnell Rise as the root node in the Parnell suburb in Auckland (by author).

#### 4.2.2.3. Choice analysis

By choice analysis, Stanley Street will be examined as to how it is likely to be chosen as part of a route. Accordingly, the potential of Stanley Street will be analysed for the travels that pass through it. Thus, an angular choice analysis is considered to explore how angles influence people's choices to follow-out the straightest path between their starting spot and destination. Hence, as the longest path with the least angle to the direction people are aiming for is the priority for people, the status of Stanley Street is important.

The angular mean depth is a key that needs to be calculated in the first place from Stanley Street to all other streets at the selected radius of 800 meters and 8000 meters, and of course with the centrality of the National Library's location at Stanley Street. With that being said, respectively, access to the library's location by traveling in pedestrian distance and traveling via cycles and vehicles are two main reasons for selecting the above radii (Figures 4.39, 4.40 and 4.41).

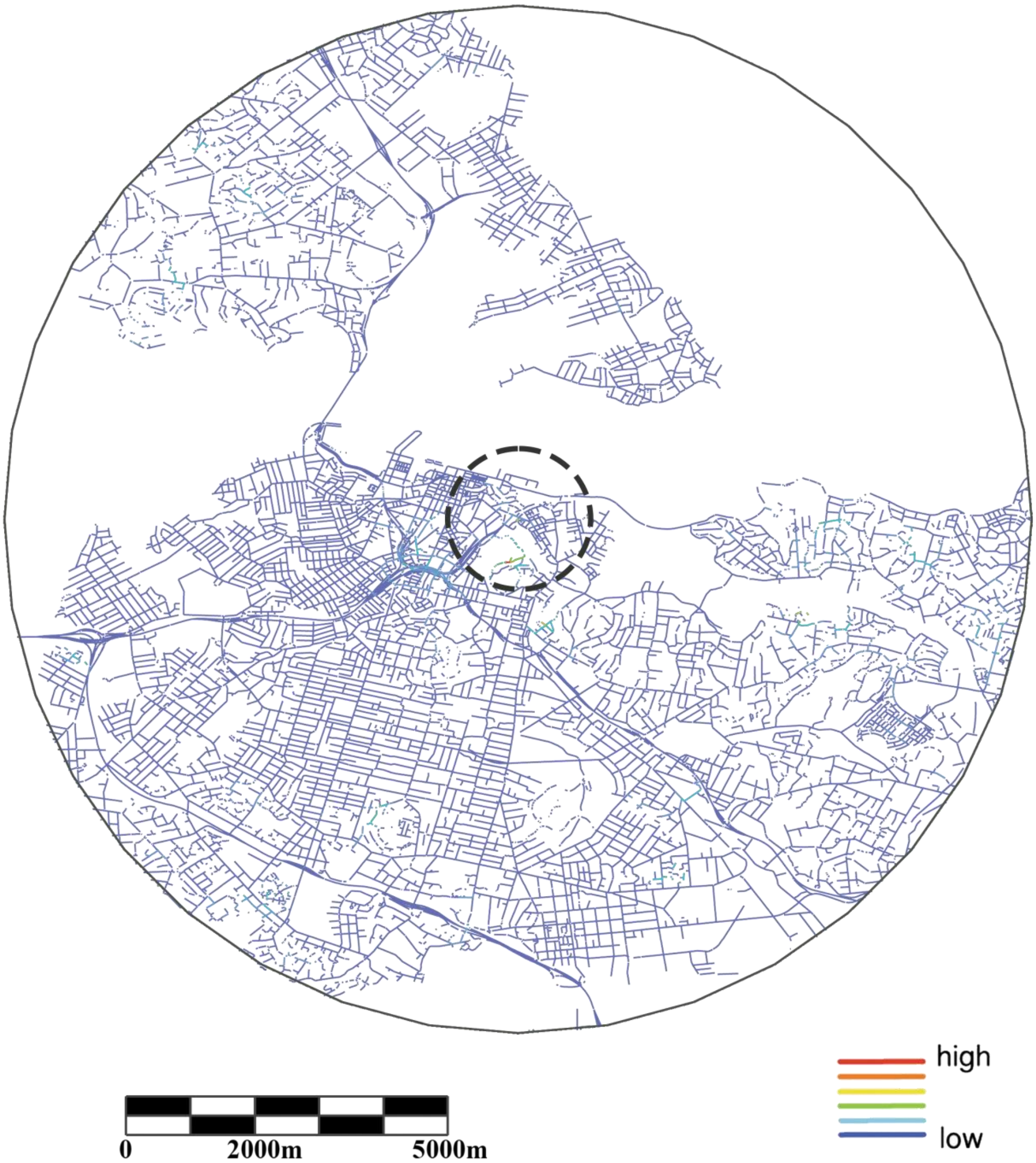



Figure 4.39: Angular Choice analysis for the Parnell suburb in Auckland with radius = 800 meters

“The dotted circle includes an 800m radius from the library’s location (zoomed image at figure 4.40)” (by author).

The value of total depth (TD) of the angular weights from segments and number of segments or nodes (K) are necessary to calculate the mean depth, which is accessible through the depthmapX analysis. The total depth is 41593.918, and "K" is 668 in the selected 800-meter dotted radius in the centre of 8000-meter radius. Accordingly, the angular mean depth can be calculated via the below formula:

(MD) = total depth (TD) / k-1

(MD) = 62.36

Accordingly, the value of angular choice is 18829590 with regard to the analysis through depthmapX, which is derived by the total of the angular weights from the segment (Stanley Street) to all 668 segments, which should be divided by the total number of segments minus 1. In a similar procedure, the same analysis is taken over an 8000-meter radius. In order, the outcomes consist of (TD = 4220691), (k = 21758), (MD = 194), and the angular choice value equals 5939720200.

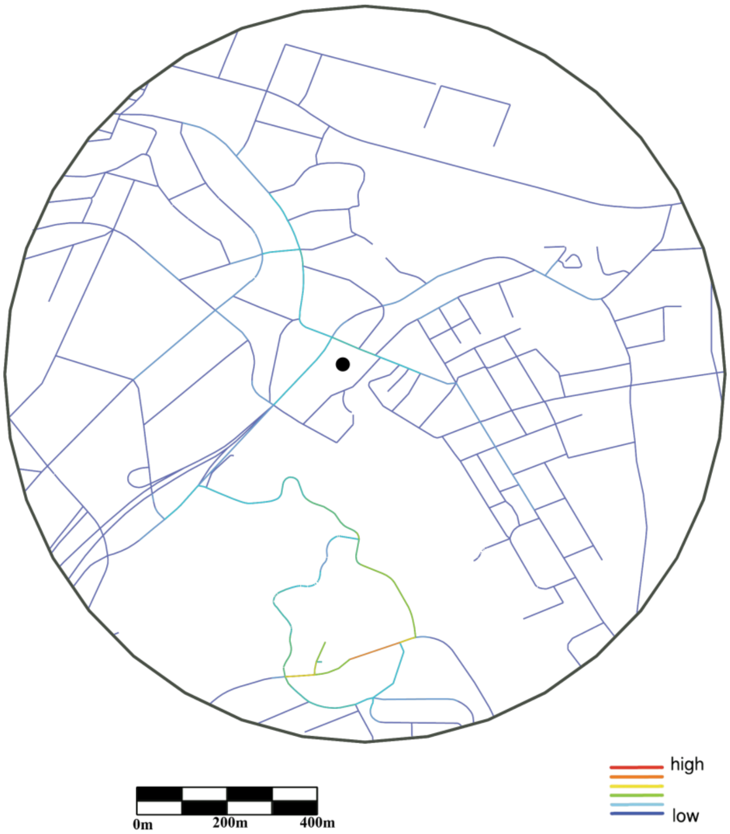



Figure 4.40: Zoomed image of figure 4.39 for angular Choice analysis for the Parnell suburb in Auckland with the 800m distance from the library's location (by author).

The angular choice analysis in the 8000-meter radius highlights both foreground and background networks (Figure 4.39). As previously noted, the foreground system consists of longer streets and roads that form extremely acute angles with each other. Differently, the background system includes short streets that typically cross other streets at almost ninety degrees.

The angular choice analysis represents that the background network, including short streets, is well connected to the foreground network within selected areas in both scales of 800 meters and 8000 meters at Parnell zone. Likewise, almost the majority of the areas embrace a network structure rather than a tree structure, which causes stronger access between most areas and the main route network.

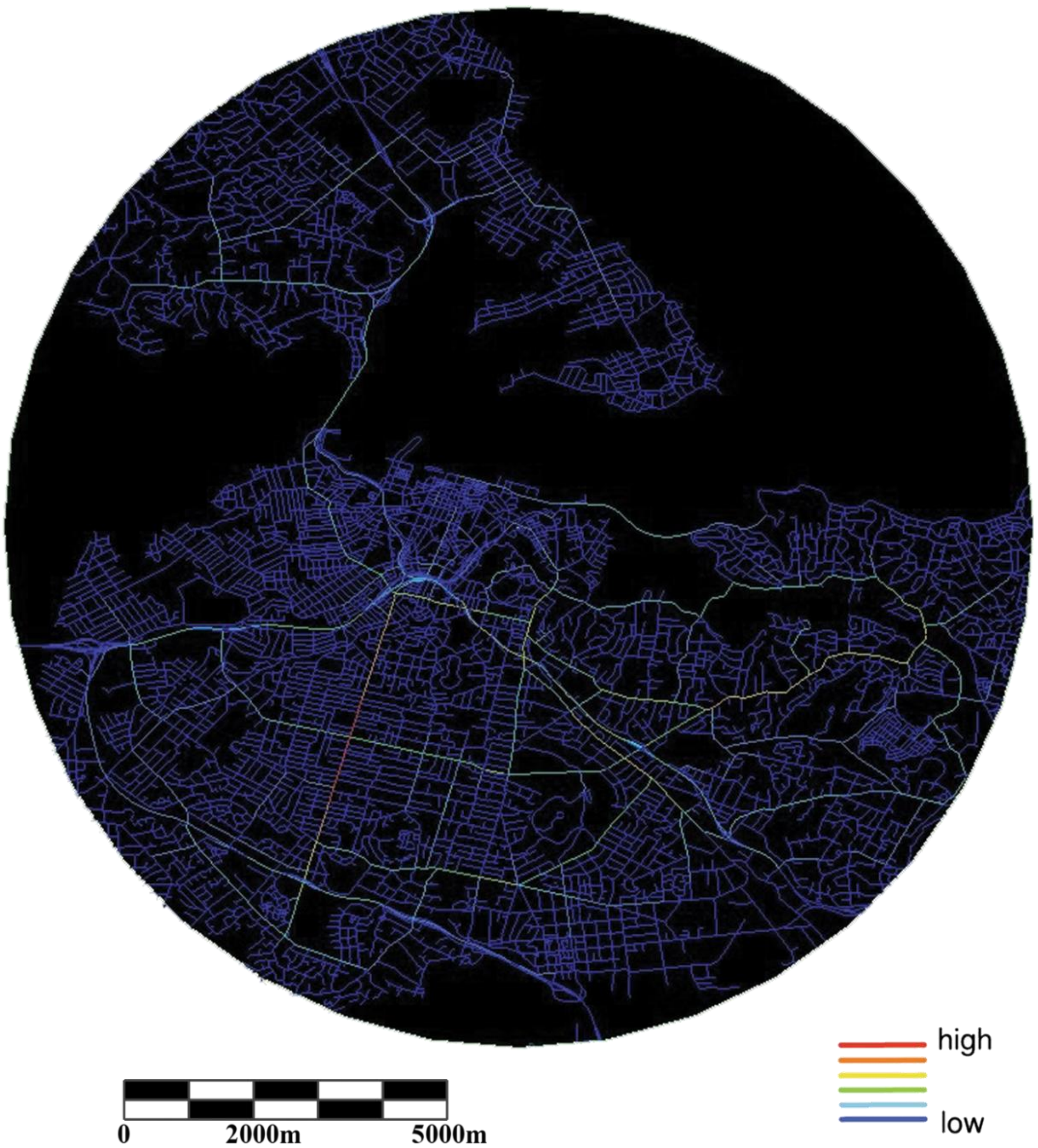



Figure 4.41: Angular Choice analysis for the Parnell suburb in Auckland with radius = 8000 meters (by author).

### 4.2.2.4. Applying Scatterplots

Similar to the procedure of the last scenario analysis (Pukekohe), three indicators of intelligibility, permeability, and movement interface are necessary to explore the relationship between two variables in each of the above indices via scatterplots for the scenario analysis in the selected area of the **Parnell** suburb.

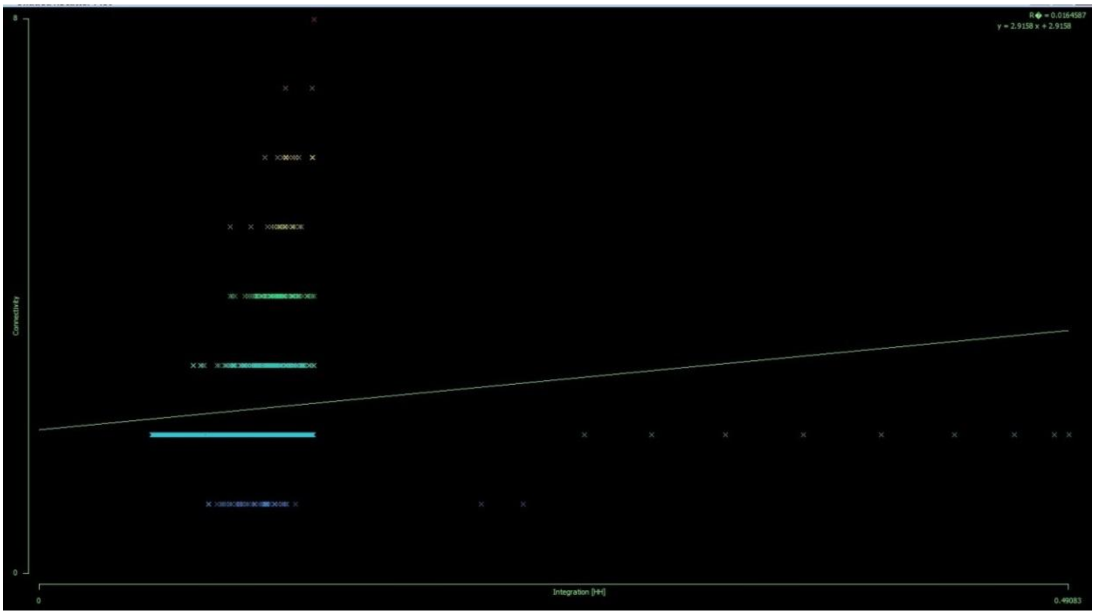



Figure 4.42: Intelligibility values at the global scale within the designated radii distance from the public library's location at Parnell Rise within Parnell suburb (by author).

Intelligibility is the first indicator to be analysed to explore the relationship between the overall area of the selected area in Parnell and the local building blocks that make it up. The linear correlation coefficient value is 0.0164587, which is a weak value representing the correlation status between the syntactic measures in Figure 4.42.

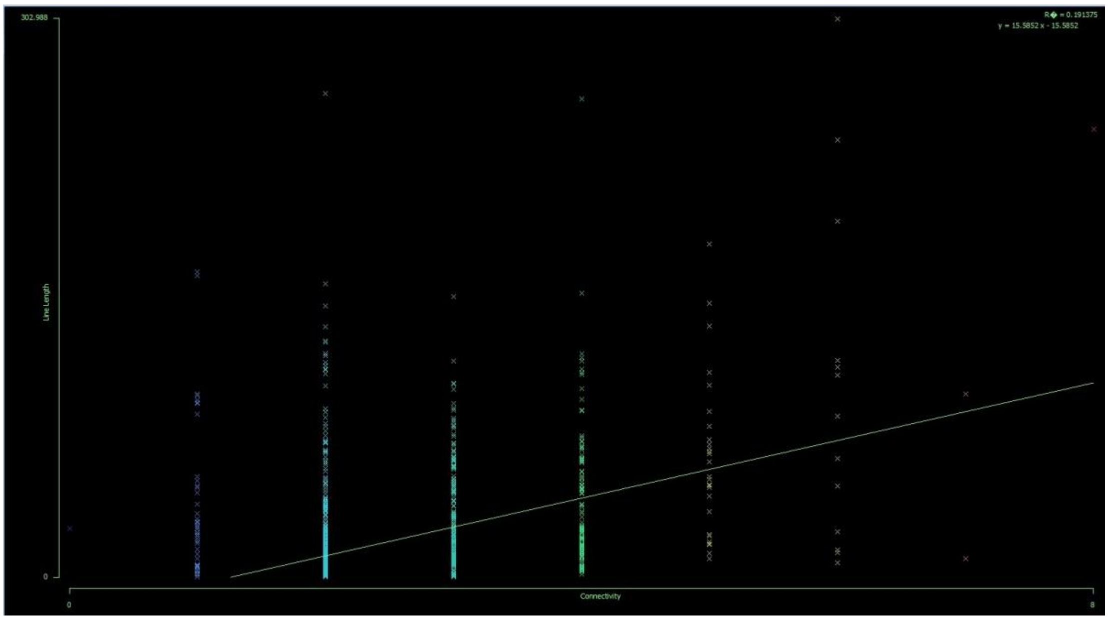



Figure 4.43: Permeability values at the global scale within the designated radii distance from the public library's location in Parnell suburb (by author).

Permeability is the other indicator that exposes the relationship between line length and connectivity. As shown in the scatterplot (Figure 4.43), more axial lines are placed at higher values, while fewer lines are posited along the regression line. The correlation coefficient is

0.191375, which is provided by the scatterplot to display the axial lines' length and the limited variety of alternative routes to choose from.

"Movement Interface" is the third indicator that is considered, which would be focused on the correlation between integration values and choice values (Figure 4.44). Both measures of network axial centrality are considered to evaluate the degree of accessibility to Stanley Street, where the National Library's location is located, and where it is the destination from different origins. In the meantime, the measures are applied to explore the possibility that the same space is within the shortest route from all spaces to all others.

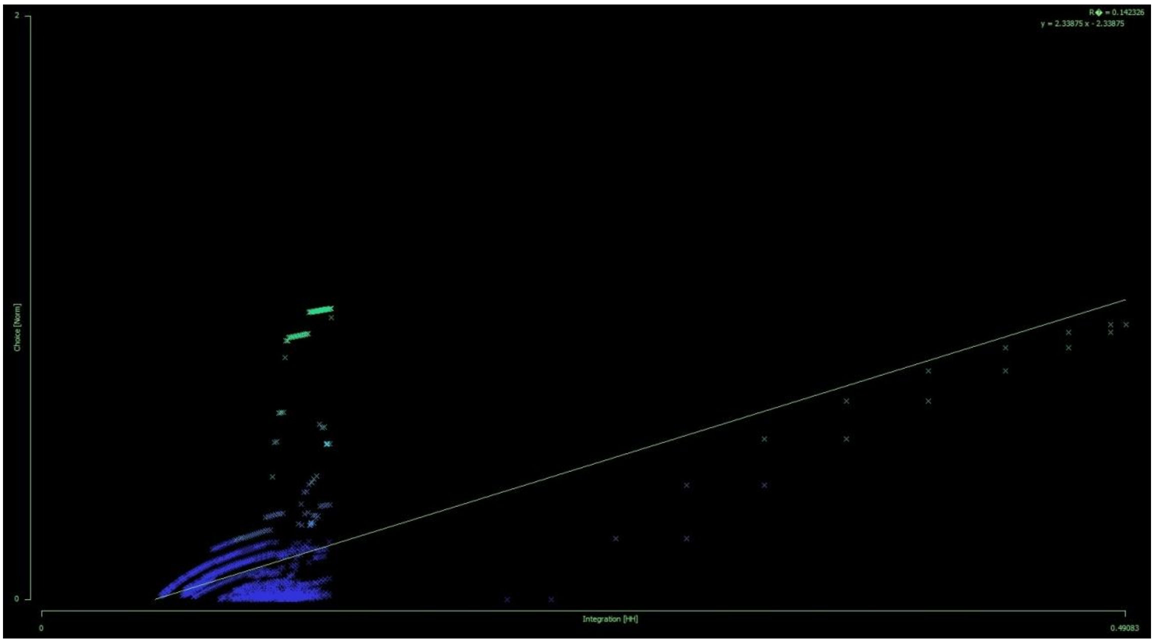



Figure 4.44: Movement interface values at the global scale within the designated radii distance from the public library's location in Parnell suburb (by author).

With regard to the objectives of this research study, "movement interface" lets expose the possibility of social interactions between people in the selected zone. Since there is a straight relationship between the correlation coefficient value and social interactions, the correlation coefficient value causes a better chance for local people and visitors to encounter one another, as well as for those who cross the zone.

According to the scatterplot (Figure 4.44) on the global scale (r = n), the correlation coefficient value is 0.142326, which is a weak value between global integration and choice indices.

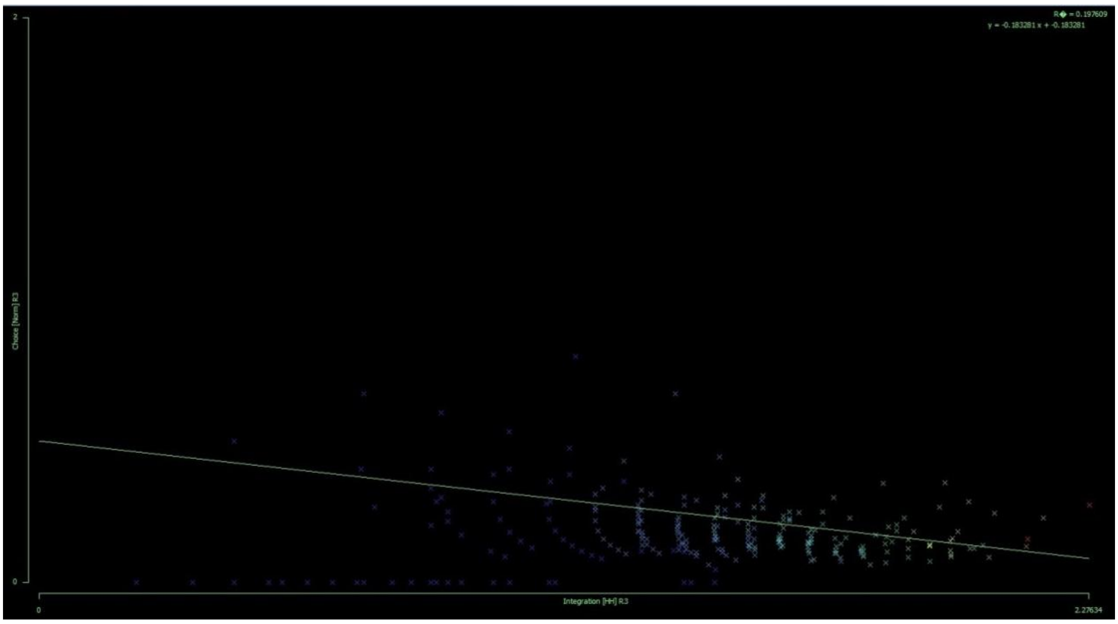



Figure 4.45: Movement interface values at the local scale within the designated radii distance from the public library's location in Parnell suburb (by author).

In addition, the correlation coefficient value on the local scale (r = 3) equals 0.197609, which is also a weak value. Thus, Stanley Street is deprived of being very active in social interactions on both scales within the selected zone.

#### 4.2.2.5. Isovist Analysis

Similar to the procedure that was taken for the selected area in Pukekohe, Isovist analysis is considered to be applied for the selected area in the Parnell suburb. Thus, it is evaluated how urban interventions increase or reduce visual experience from a chosen location, which lets us explore the ideal spots regarding the visual aspect.

Two serial visions are chosen for two different paths in the selected area in Parnell, which end at the library's location at Stanley Street (Figure 4.46). The first scenario includes four images from the vantage spot of the isovists of the analysis. Isovists from the first image to the last image illustrates how the surface impressions of buildings and public areas can change from point to point by the 90-degree isovists that are applied. Hence, point and serial vision route isovists are beneficial to assist this study in the understanding of accessibility to the National library's location in the selected zone via different distances and directions.

With regard to the above, "through vision" analysis is needed to explore the longest vision to lowest visions that will be applied in the next section (VGA analysis).

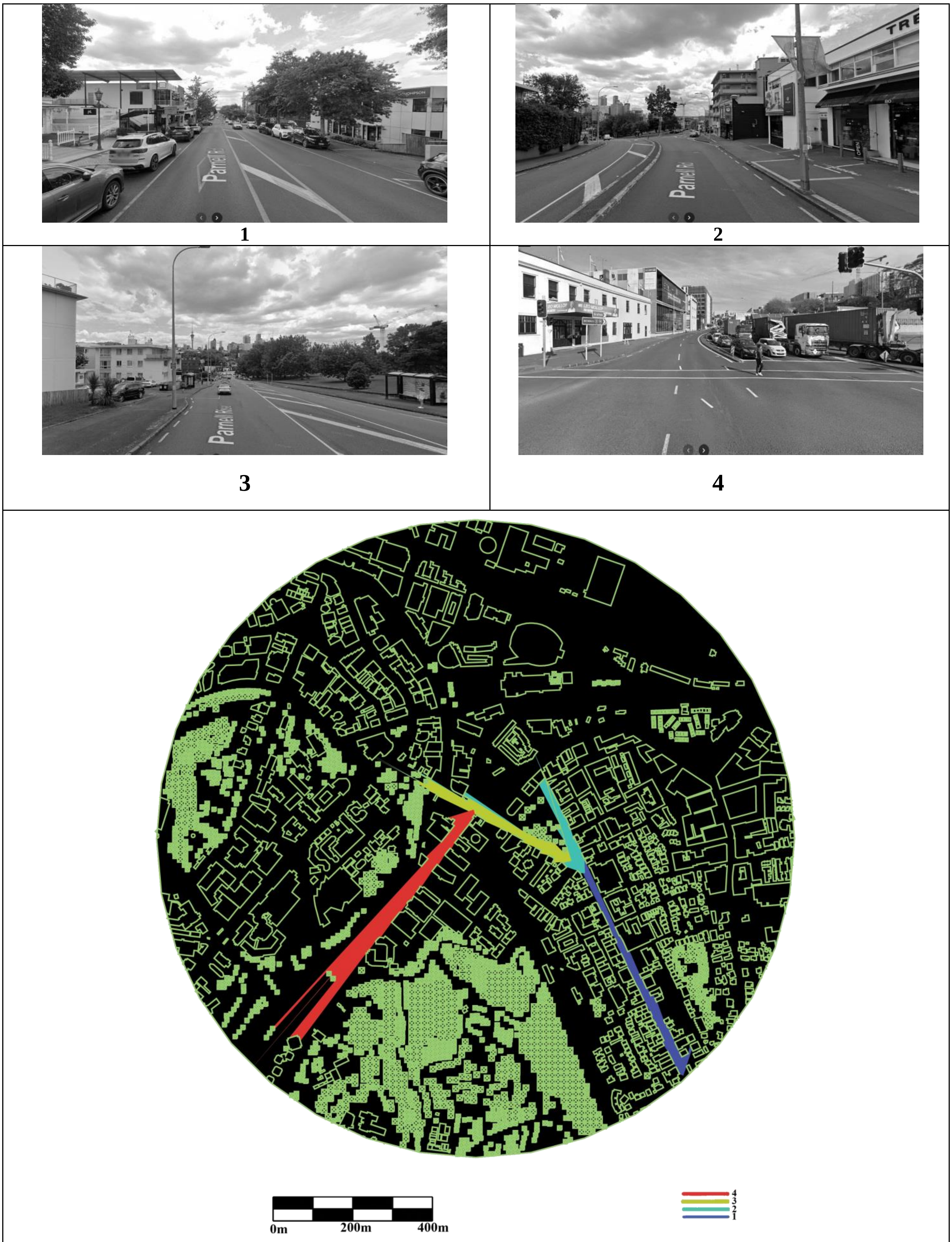
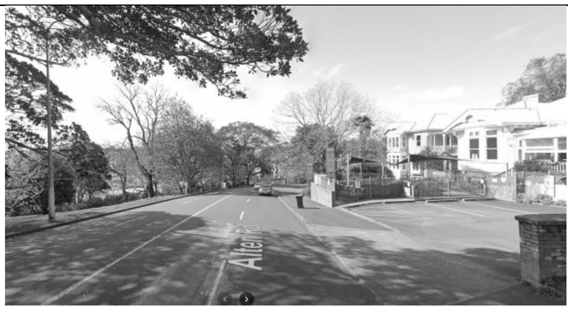
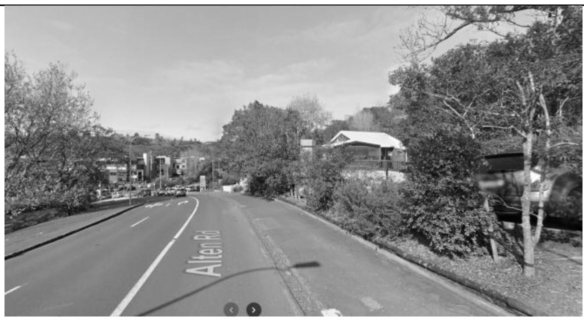



Figure 4.46: Isovist analysis with a serial vision from a route in Parnell suburb applying 90° isovists (by author).

The isovist analysis on the first proposed route, which started at the edge of the selected 800-meter radius, as shown in Figure 4.46, illustrates that while we face significant change from one isovist point to another, by embracing a few isovist points, the library's location could be visible.

| | |
|---|---|
| <br>**1** | <br>**2** |
| <br>**3** | <br>**4** |
| <br>**5** | <br>**6** |
| <br>**7** | <br>**8** |


9


10

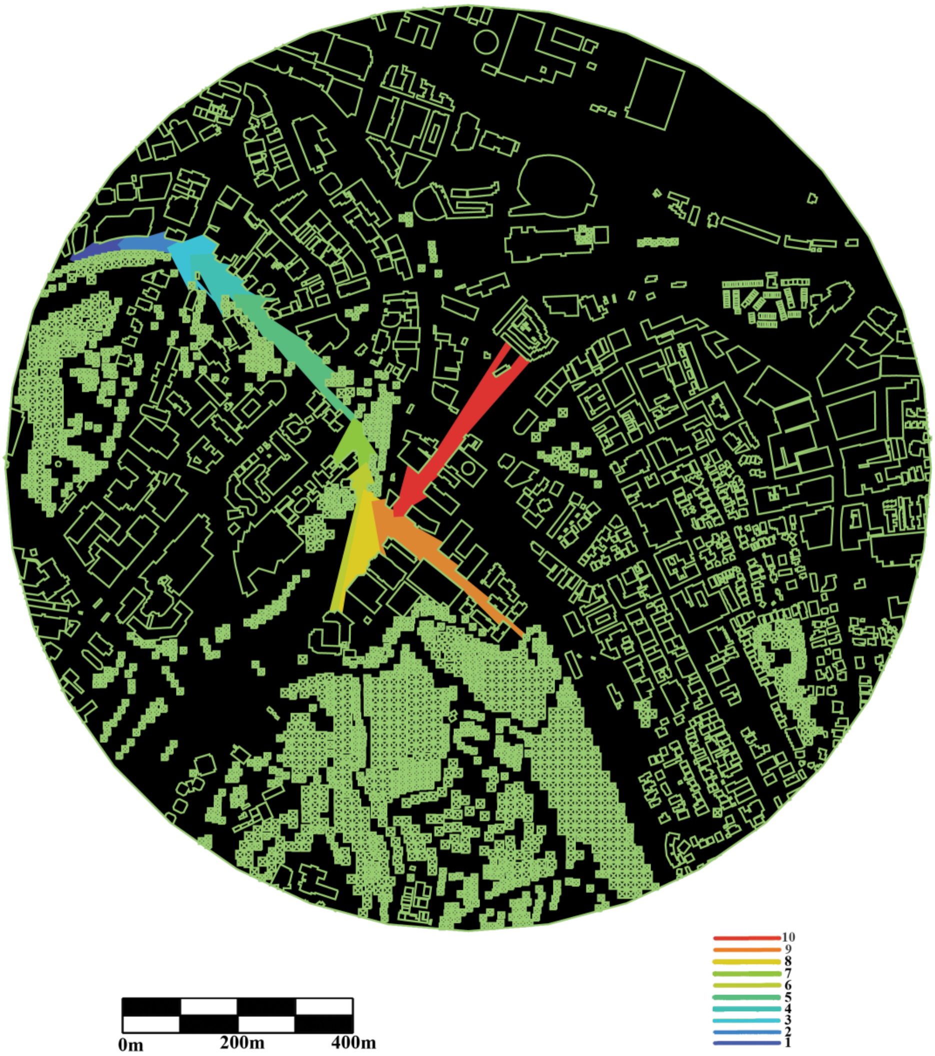



Figure 4.47: Isovist analysis with a serial vision from a route in Parnell suburb in Auckland applying 90° isovists (by author).

The second proposed route includes ten spots, as shown in Figure 4.47. Likewise, the images represent 90-degree isovists that, one by one, change because they cross the surface impressions of buildings and public spaces. Hence, as with the previous routes, we face significant change once reaching a vision field from the last one, specifically in larger spots like intersections and crossroads. Unlike the first proposed route, the second route, which begins at the edge of the selected 800-meter radius, took more isovist points, which accordingly demanded more serial vision in the route to make the library's location visible.

#### 4.2.2.6. Visual Graph Analysis (VGA)

As previously described in the procedure of this analysis, the selected area with the centrality of the National Library's location will be analysed in a rectangle frame with dimensions of 500 meters × 500 meters, as VGA is a raster-based method (Figure 4.48).

In further stages, similar to the procedure that was taken in Pukekohe, two root cells in the selected area in different locations in Parnell are taken for this analysis. Thus, this analysis represents the comparison between the first root nearby the library's location and the second root, showing how each system is well-connected to other cells in the selected area. In the meantime, it clarifies how each system, based on the selected root cells' locations, is deeper.

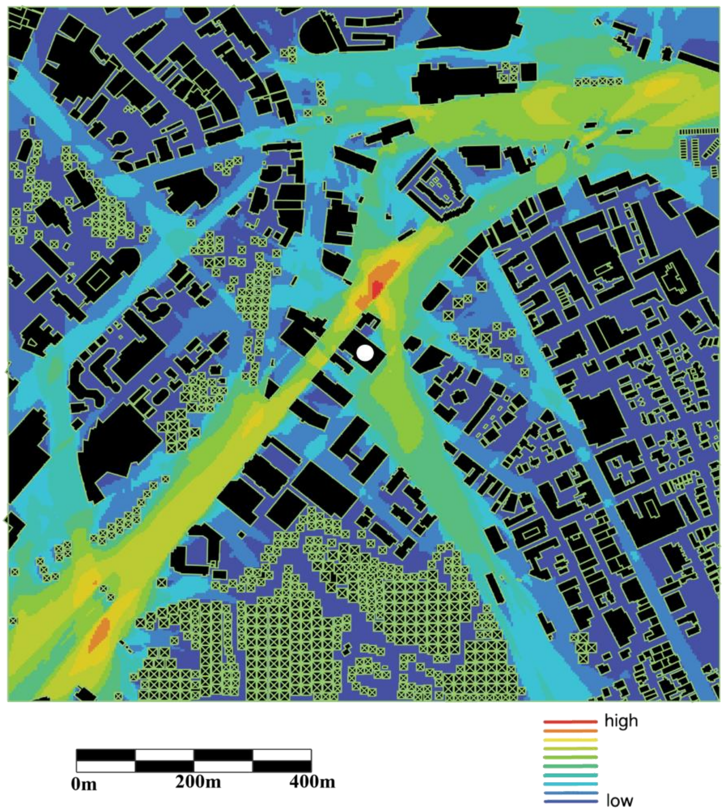
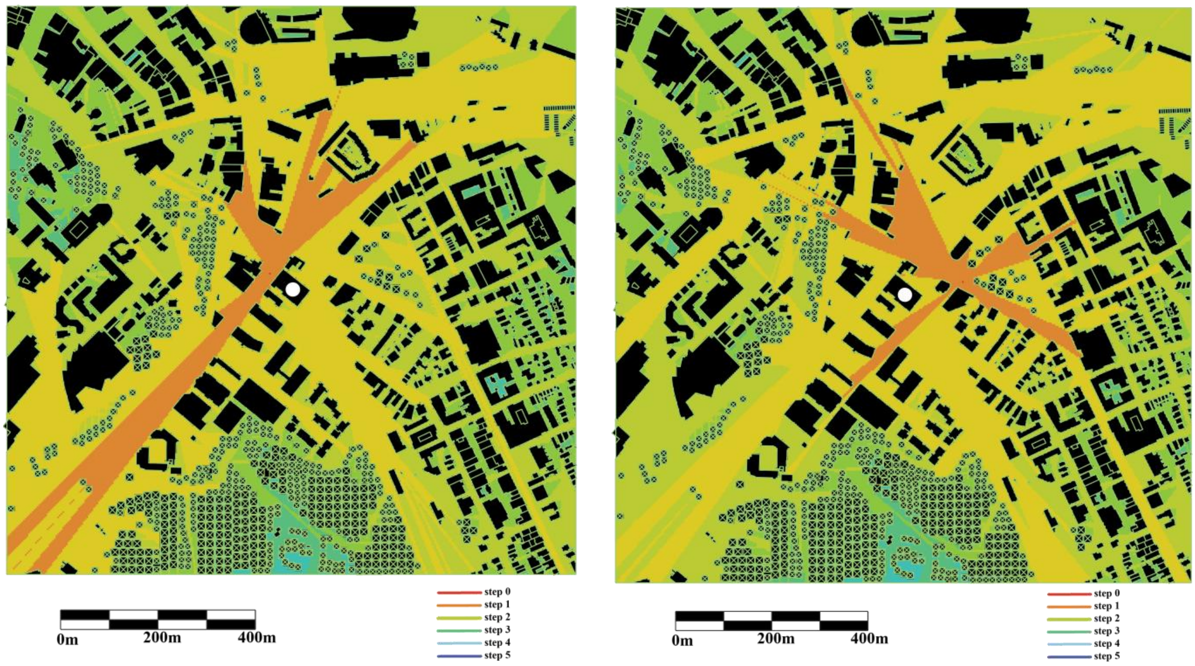



Figure 4.48: VGA study for the Parnell suburb in Auckland (By author).

As shown in Figure 4.48, the root cell near the National Library's location has a better connection than the root cell at Parnell Rise. The most well-connected cells to cells with the weakest visual connections are displayed in red to dark blue.

As previously mentioned, the characteristic of dark blue cells illustrates that there is a need to take multiple visual steps to reach social spots on streets or public locations, among other stationary activities, while it is much easier to reach the same spots for people who are located in red or orange areas (Figure 4.48).

In the next stage, the “visibility step” is considered, which lets the analysis compare the two selected cells to explore the extent to which the cells can be seen from each of the two selected cells. In the meantime, each step includes the same value for all visible cells (Figure 4.49).




**Root cell (A) in Stanley Street** **Root cell (B) in Parnell Rise**

Figure 4.49: Visibility step analysis for two different points within the Parnell suburb in Auckland (By author)

The “visibility step” analysis indicates that the number of visibility steps from both root cells is the same. However, the number of orange cells that can be seen directly from the root cell (A) is slightly higher than the root cell (B). Root cells are red in step 0, and all other cells are valued from step 1 to step 5, which are shown in different colours from orange to dark blue. With that being said, changing orientation occurs from cells in a colour to cells with another colour, which means moving from one step with the same value to another step with a different value. With regard to the above, this analysis lets us find out how the root cell's location makes the degree of visibility change. In the meantime, obstacles such as building blocks and trees within the selected raster system influence on mean depth value, which can impact how the proposed raster system in the Parnell suburb is deeper from the root cell's locations at Stanley Street and Parnell Rise. As previously explained, the mean depth for the proposed root cells is calculated by the below formula:

$$MD = TD / K - 1$$

| Mean depth for location (A) | Mean depth for location (B) |
|---|---|
| TD =<br>K = 72916<br>MD = 193436 / 72916 - 1<br>MD = 2.65 | TD =<br>K = 72916<br>MD = 194030 / 72916 - 1<br>MD = 2.66 |

Table 4.10: Mean depth calculation for locations (A) and (B) within Parnell (by author).

The provided result in Table 4.10 illustrates that the mean depth values for both locations are very close to each other with a minor difference, as location (B) faces a slightly higher value of mean depth than location (A). Accordingly, location (B) is slightly deeper than location (A). Therefore, however, location (A) at Stanley Street has an easier connection with all other cells in the system; there is a minor difference between both locations in this matter.

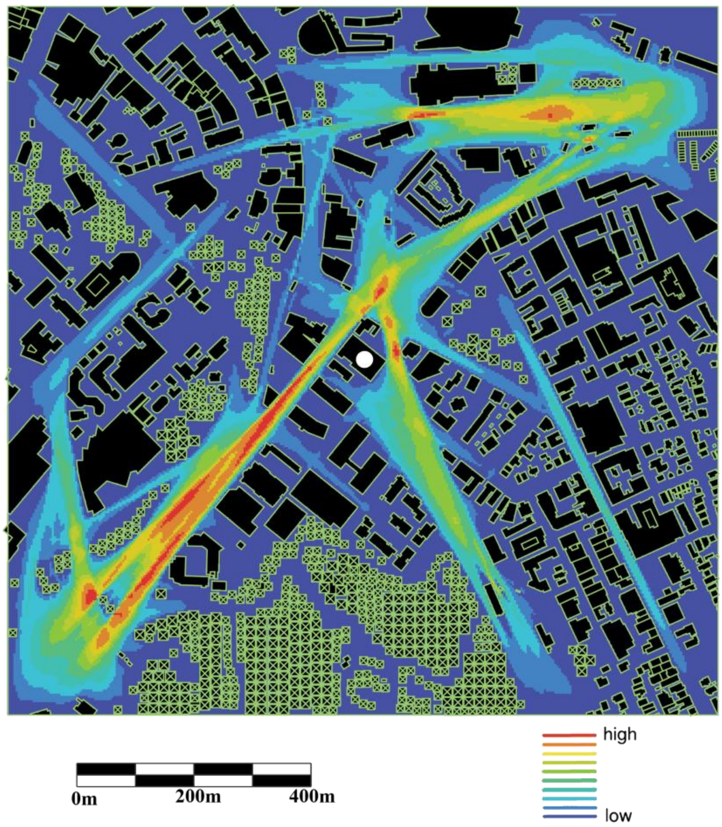



Figure 4.50: Through vision analysis within the Parnell suburb in Auckland (By author)

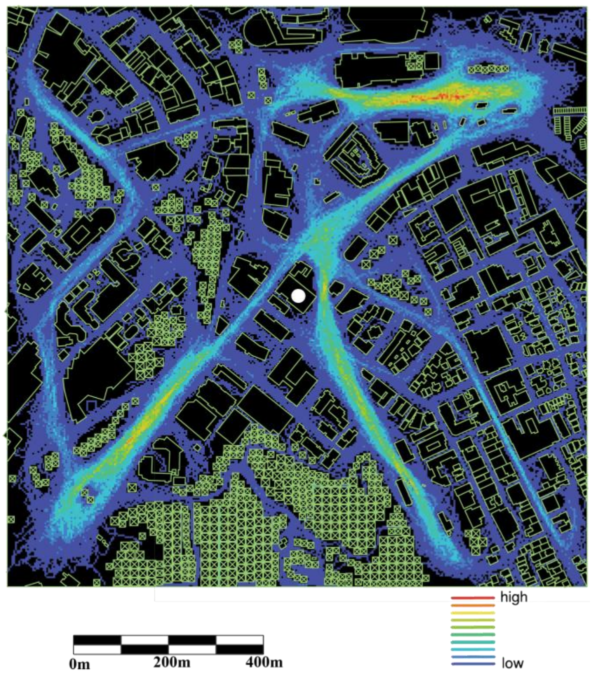
Both visibility step analysis and mean depth values are witnesses to the claim that location (A) has a longer continuous view than location (B). With that being said, there are 5781 cells in Step 1 that are visible directly from location (A), while there are 3884 cells in Step 1 that are visible directly from location (B) (Figure 4.49).

As “through vision” analysis evaluates all cells to find out longer lines of vision (Figure 4.50), the area from Stanley Street toward Northwestern Motorway meets the longer lines of vision, which is displayed by red to light green (Figure 4.50). Obstacles such as building blocks and trees vary the level of "through vision," which makes the analysis indispensable in exploring the longest view from the root cell on the proposed urban scale.

As previously mentioned, cells in red are the ‘hotspots’ for orientation and navigation (Van Nes & Yamu, 2021, p. 99), and compared to all other cells in the system, they have the longest total "through vision" or longer continuous views. Having said that, the longest continuous view is for the red-coloured cell with a "through vision" value of 713632. In the meantime, the "through vision" value for the proposed root cell close to the National Library's location on Stanley Street is 529351, and the value for the root cell at Parnell Rise is 235942 (Figure 4.49). The reason for the above result is the noted obstacles, which can affect the length of continuous vision. Thus, a key player in the connection between visitors' vision field and social infrastructure such as public libraries is "through vision."

#### 4.2.2.7. Applying the Agent-Based Modelling

According to the previous description, this analysis is beneficial for the selected zone in Parnell with regard to Dalton's (2003, p. 108) argument that people's tendency to take linearity through their track toward their destination with the lowest angular deviations. Thus, according to the depthmapX procedure, a specified number of agents that are evenly scattered within the selected area under precise investigation for a determined time frame collect their travel paths. Accordingly, there are three scenarios, including the agent as an average person (Figure 4.51), the agent as a visitor or tourist (Figure 4.52), and the agent as a local (Figure 4.53). There are the same number of agents, which is five thousand. In the first scenario, the agents take a walk of three syntactic steps with a 15° vision field; in the second scenario, agents with a 30° vision field take a walk of one syntactic step that makes a different movement pattern; and in the third scenario, agents with a 7° vision field take a walk of five syntactic steps, which also causes another different movement pattern.



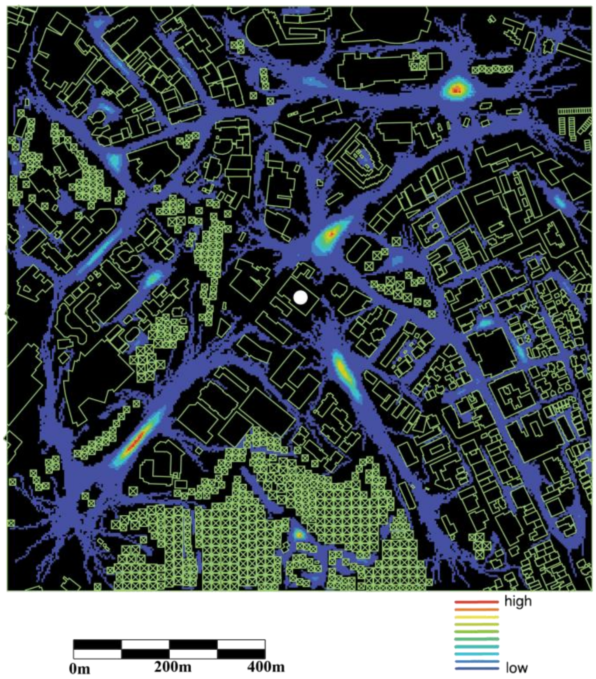




Figure 4.51 The agent as an average person Figure 4.52 The agent as a tourist or visitor (By author)

The visitors or tourists are not familiar with the area; however, they explore the area as much as they can. That is why they select the spot with the longest vision field, as shown in Figure 4.52. Unlike the second scenario, the local agents in the third scenario are familiar with the urban context. Accordingly, it is convenient for them to choose the route that leads to their destination. As it is shown in Figure 4.53, their movement line pattern looks straightened. By considering Dalton's research in 2001 as it is described previously, the comparison of outcomes between each of the three types of analysis in this section shows that visitors tend to gather within the spots with the highest integration of "through vision," while local people tend to choose the movement pattern that is eventuated on angular choice analysis.

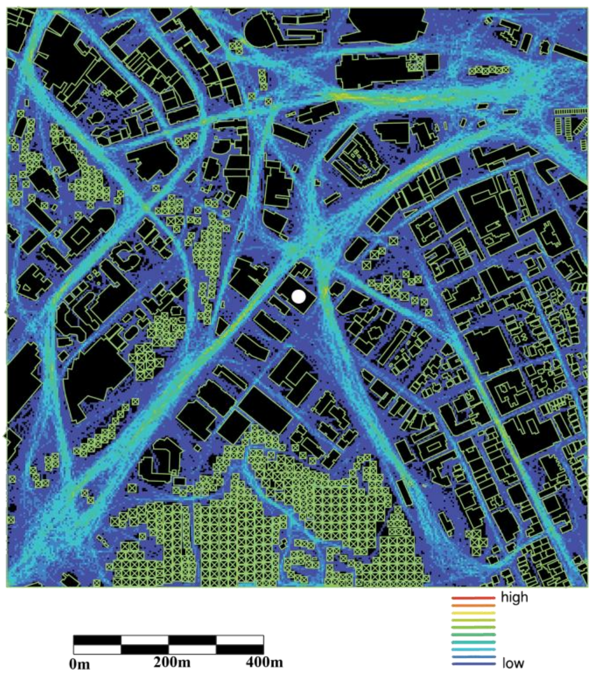



Figure 4.53: The agent as a local person (By author)

### 4.2.3. Albany

#### 4.2.3.1. Connectivity analysis

Similar to the last two areas, the connectivity analysis is applied to embrace all direct connections from each street to other streets that are located in the street's immediate adjacency. Having said that, four types of topological steps will be applied within the radii of 800- and 8000-meters as to the walkable distance and vehicle access within longer distances.

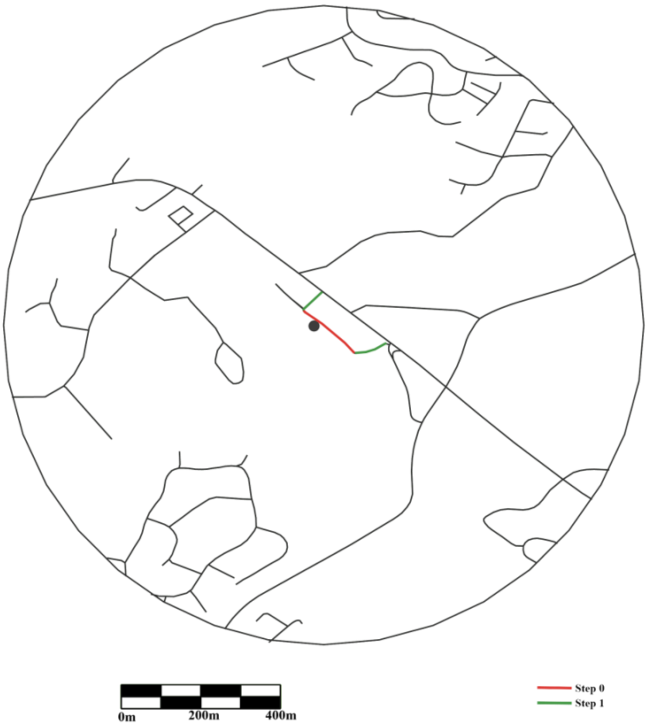



Figure 4.54: One-step connectivity analysis for Kell Drive in the Albany suburb in Auckland (by author).

- **One-Step analysis:**

The Albany Village Library's location is considered the centre of the selected 800-meter area within the Albany suburb. As the library's location is at Kell Drive, the street is taken as the main street to analyse how it has connectivity to its immediate adjacency streets within the Albany suburb. The main street is red, and it has only two direct connections to its immediate adjacent axial lines, which are green (Figure 4.54).

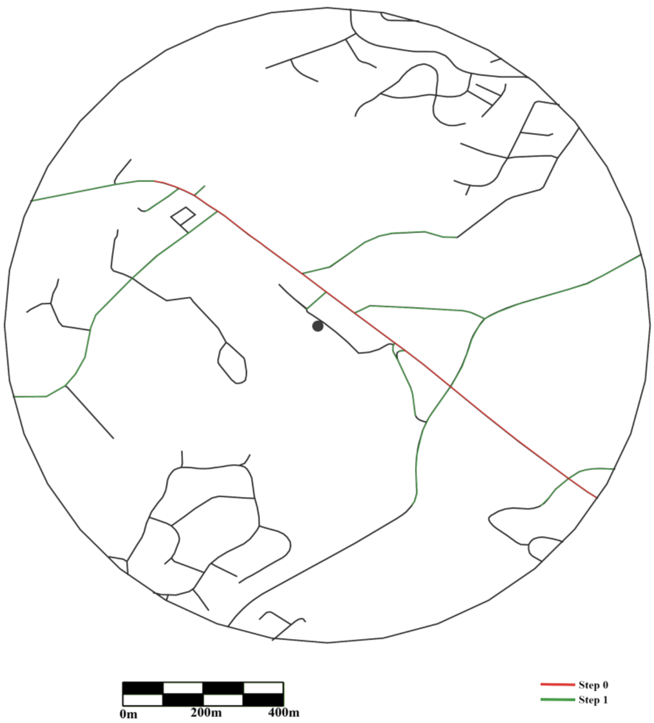



Figure 4.55: One-step connectivity analysis for Dairy Flat Highway in the Albany suburb in Auckland (by author).

The degree of connectivity of Kell Drive to its adjacencies in one-step analysis illustrates a weak status, as there are only two direct axial line connections to Kell Drive.

Dairy Flat Highway as a secondary opportunity is considered to be a main street, which lets a comparison be applied between its connectivity analysis result and the result for Kell Drive. Accordingly, the analysis shows that Dairy Flat Highway embraces a higher number of connections to its immediate adjacent streets compared to Kell Drive's connections (Figure 4.55).


Figure 4.56: The Albany node in Auckland, 8000m radius (by author).

The one-step analysis indicates that Albany suburb is not located at the central node with high density, but the eastern side of Albany has a higher density than the western side. Hence, the selected 8000-meter radius includes the density on the eastern side, while the 800-meter radius lacks a high density. Accordingly, the 8000-meter radius has a combination of a deep system in the west and a shallow system in the east, which includes a well-connected connection between main roads and local street networks (Figure 4.56).

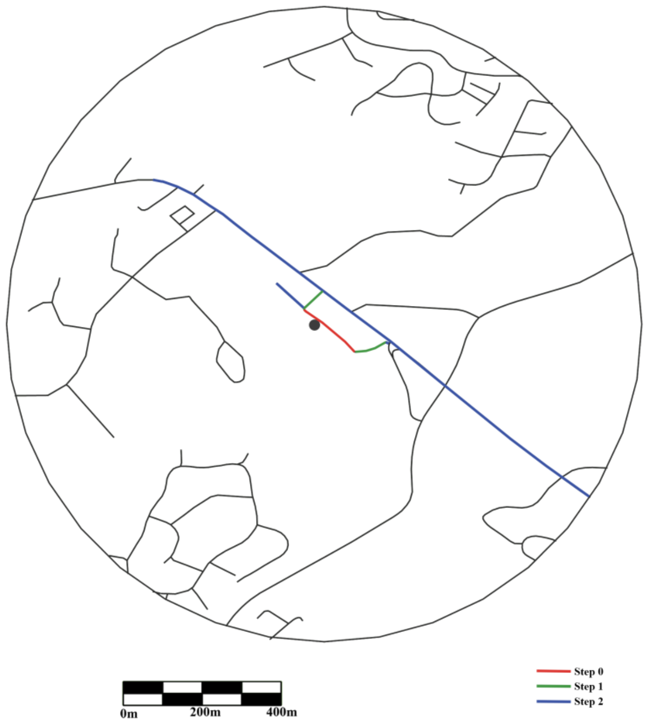



Figure 4.57: Two-step connectivity analysis for Kell Drive in the Albany suburb in Auckland (by author).

## ➢ Two-Step analysis:

Similar to one-step analysis, two origin streets are considered to be analysed separately by a two-step procedure. Accordingly, two direction changes are taken from the origin route within the selected area. As shown in figure 4.57, Kell Drive by step zero in red is connected to its immediate adjacent street in green by one direction change, and accordingly, the axial lines by one more direction change are connected to the step two valued streets, which are blue. Therefore, the two-step analysis embraces all streets from steps one and two in the selected 800-meter radius with the centrality of Albany Village Library's location at Kell Drive.

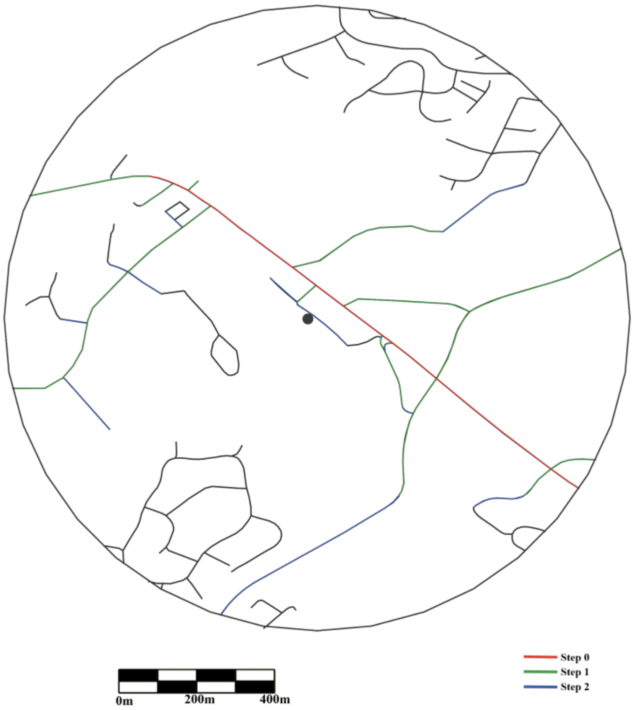


Figure 4.58: Two-step connectivity analysis for Dairy Flat HWY in the Albany suburb in Auckland (by author).

Kell Drive is not a key street in the area, but it has the opportunity to be connected to the urban network via Dairy Flat Highway, which is possible by two short streets. Although there are many commercial, hospitality, and residential buildings in the selected area, the Albany Village Library's location is not located in a social urban centre (Figures 4.58 and 4.59). That is why the library's location is left unknown to many people in the area.


Figure 4.59: Kell Drive in the Albany suburb in Auckland (Google Street View).

The Dairy Flat Highway is the second main street for the two-step analysis, which plays a key route in the area. The southern part of the highway connects to the central zone of Albany suburb with a higher density area than other parts of the area, which includes shopping, commercial, and residential areas (Figures 4.56, 4.59, and 4.60). That is why this route provides a great opportunity for access to social public centres.


Figure 4.60: Dairy Flat HWY in the Albany suburb in Auckland (Google Street View).

- **Three-Step analysis:**

In this analysis, three steps are applied to the selected area. Although three direction changes are carried out from Kell Drive, considerable coverage of the selected urban network has not occurred by the accessed streets, which is clear by the remaining axial lines in gray (Figure 4.61). Thus, this analysis represents the lack of a good connection between Kell Drive and the urban network in the selected 800-meter radius.

Unlike the Kell Drive status, there is a better connection between Dairy Flat Highway and the urban network by three direction changes; however, still, there is not a maximum coverage in the same selected area by accessed streets via the three-step analysis (Figures 4.61 and 4.62).

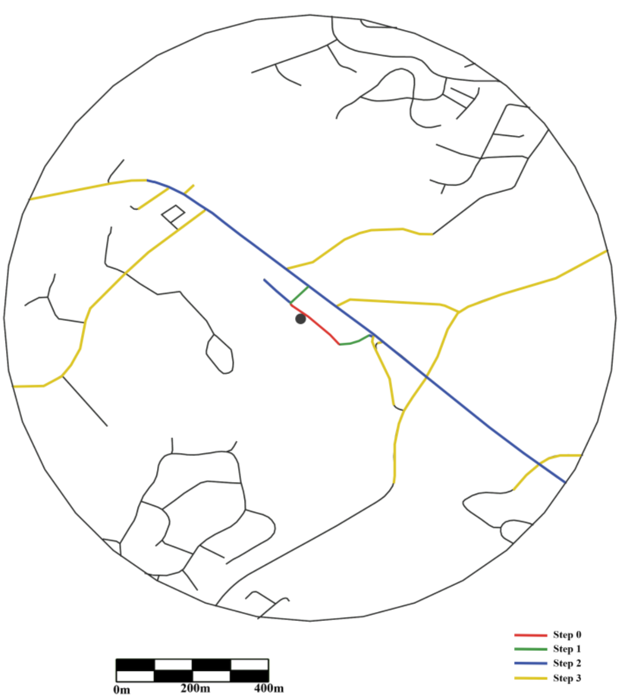



Figure 4.61: Three-step connectivity analysis for Kell Drive in the Albany suburb in Auckland (by author).

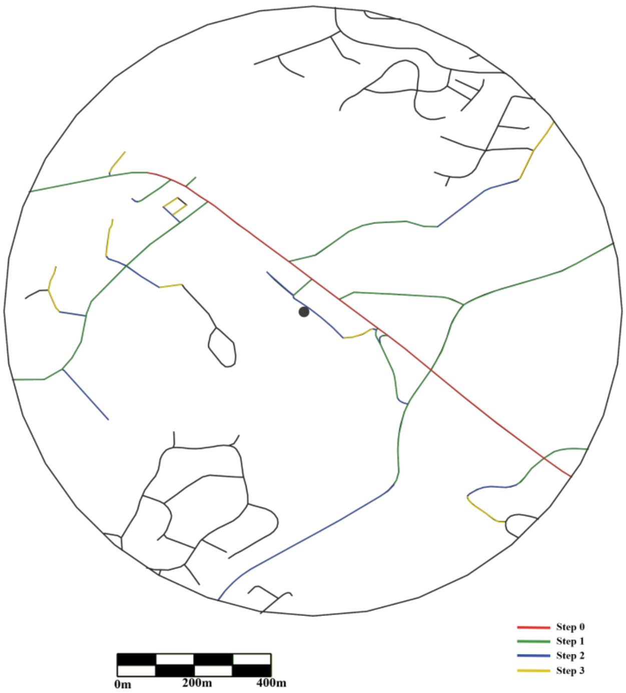



Figure 4.62: Three-step connectivity analysis for Dairy Flat HWY in the Albany suburb in Auckland (by author).

- **N-Step analysis:**

The N-step analysis illustrates the maximum number of accessed streets from the origin street. Hence, the comparison between Kell Drive, where Albany Village Library is located, and Dairy Flat Highway shows that there are nine direction changes needed to the deepest accessible street from Kell Drive, while there are a lower number of seven direction changes needed to the deepest accessible street from Dairy Flat Highway. The N-step analysis shows that Kell Drive, as the origin street, causes a deeper system than Dairy Flat Highway in the same selected 800-meter radius in Albany (Figures 4.63 and 4.64).

#### 4.2.3.2. Integration analysis

As mentioned previously, the integration analysis assesses how close Kell Drive (the origin street or space) is to all other streets or spaces. Hence, the origin street's length is important as it explores how the street is integrated with all other streets or segregated spatially on the selected scale. Having said that, both global integration analysis and local integration analysis are applied to this section.

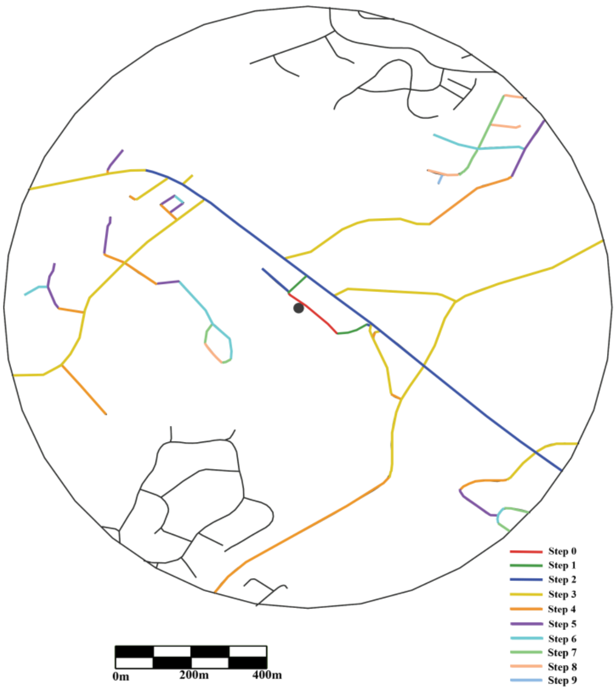



Figure 4.63: N-step connectivity analysis for Kell Drive in the Albany suburb in Auckland (by author).

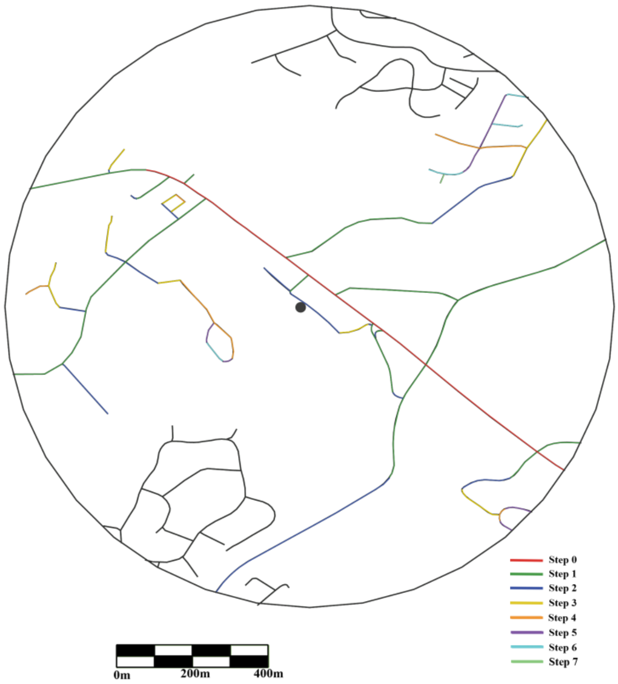



Figure 4.64: N-step connectivity analysis for Dairy Flat HWY in the Albany suburb in Auckland (by author).

- **Global Integration Analysis**

The global analysis for the integration in the selected 800-meter radius in the Albany suburb illustrates that Kell Drive lacks a high integration value in relation to all other streets in the selected area. Having said that, the integration value by blue colour witnesses the lowest value for Kell Drive (Figure 4.65). This analysis shows that many direction changes are needed to reach many axial lines from Kell Drive in the selected zone. Unlike Kell Drive, Dairy Flat Highway meets a slightly higher global integration value (Figure 4.65). In a nutshell, almost most streets face similar status to the two analysed streets.

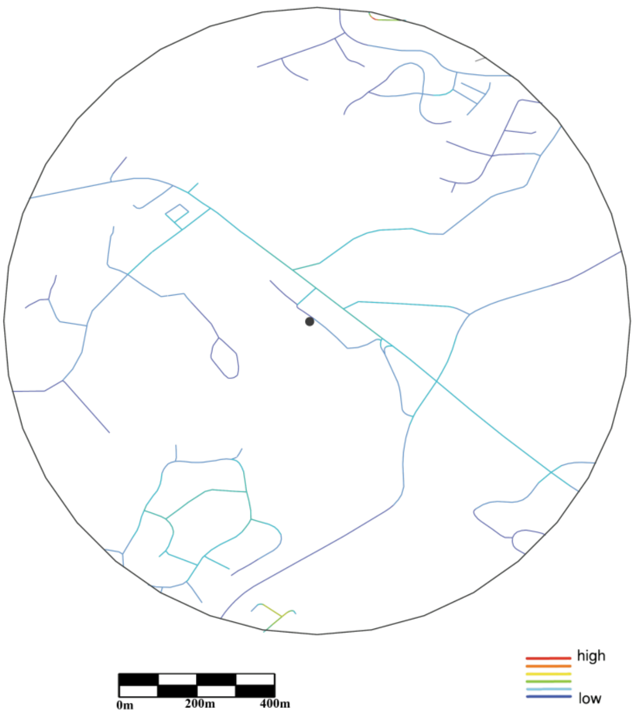



Figure 4.65: Global integration analysis for the Parnell suburb in Auckland with the main street of Kell Drive as the root node. (by author).

Four indicators of mean depth (MD), real asymmetry (RA), real relative asymmetry

(RRA), and finally the integration value (INT) are expected to be assessed in the integration analysis for the selected street (Table 4.11).

| **Ref. number Kell Drive** | **Integration value - Rn** | **(MD) - Rn** | **Real Asymmetry (RA)** | **Real Relative Asymmetry (RRA)** | **(TD)** |
|---|---|---|---|---|---|
| **560** | **0.20594621** | **28.650166** | **0.18311368** | **4.8556371** | **8681** |

Table 4.11: Global integration analysis's result for the main street of Kell Drive as the root node in the Albany suburb in Auckland (by author).

According to the results of the global integration analysis, Dairy Flat Highway meets a higher value than Kell Drive (Tables 4.11 and 4.12). With that being said, the Dairy Flat Highway is more integrated into the system. The relative asymmetry (RA) value shows a lower value for Dairy Flat Highway than Kell Drive, which makes the highway shallower and, accordingly, makes it more integrated into the global system.

| **Ref. number Dairy Flat HWY** | **Integration value - Rn** | **(MD) - Rn** | **Real Asymmetry (RA)** | **Real Relative Asymmetry (RRA)** | **(TD)** |
|---|---|---|---|---|---|
| **407** | **0.33254325** | **17.80427** | **0.1200305** | **3.0071275** | **5003** |

Table 4.12: Global integration analysis's result for the main street of Dairy Flat HWY as the root node in the Albany suburb in Auckland (by author).

The real relative asymmetry (RRA) value of Dairy Flat Highway is the same as its RA value, which meets a lower value than Kell Drive, which is the witness to the highway's lower depth and, accordingly, its more activities and lower segregation (Tables 4.11 and 4.12). In the meantime, there is a lower topological distance between the highway and most other streets than between Kell Drive and most other streets.

## ➢ Local Integration Analysis

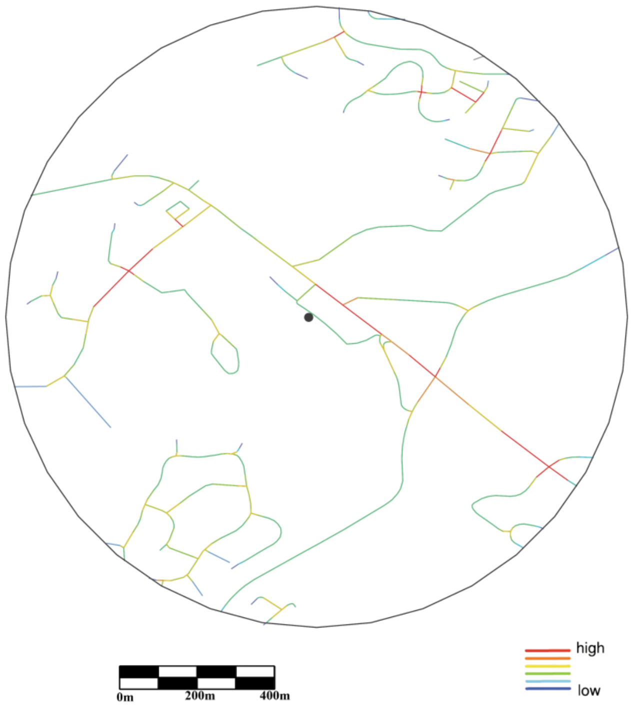



Figure 4.66: Local integration analysis for the Albany suburb in Auckland with the main street of Kell Drive as the root node (by author).

There are different outcomes between the global system and the local system because, by local system analysis, there are three direction changes from Kell Drive to its adjacent streets. In the meantime, as the local centres of most suburbs are highlighted in the local integration analysis, there is a higher value than the global integration value.

With regard to the above, Kell Drive by three-direction changes meets a relatively higher local integration to all accessible streets within two topological steps than global integration. Meanwhile, as shown in Figure 4.66, there is a higher local integration value for Dairy Flat Highway than Kell Drive. In this way, the most integrated streets to the most segregated streets are presented by red to dark blue in the map legend.

In a nutshell, the reason that Kell Drive faces a lower global integration value than local integration value is the "no restriction" of taking topological steps into account, while there is a different reason that local integration value is higher than global integration: streets with two topological steps away from Kell Drive wouldn't be assessed in this analysis. The above argument is also true for Dairy Flat Highway.

| **Ref. number Kell Drive** | **Integration value – R3** | **(MD) – R3** | **Real Asymmetry (RA)** | **Real Relative Asymmetry (RRA)** | **(TD)** |
|---|---|---|---|---|---|
| **560** | **0.84912294** | **2** | **0.4** | **1.1776857** | **12** |

Table 4.13: Local integration analysis's result for the main street of Kell Drive as the root node in the Albany suburb in Auckland (by author).

An overview of both Tables 4.13 and 4.14 illustrates that Dairy Flat Highway meets lower values of (RA) (0.186813) and (RRA) (0.72225159) than Kell Drive, with values of (RA) (0.4) and (RRA) (1.1776857). With that being said, Dairy Flat Highway indicates a shallower system than Kell Drive, which means that Dairy Flat Highway is more integrated than Kell Drive. Accordingly, there is a higher value of local integration for Dairy Flat Highway than Kell Drive.

| **Ref. number Dairy Flat HWY** | **Integration value – R3** | **(MD) – R3** | **Real Asymmetry (RA)** | **Real Relative Asymmetry (RRA)** | **(TD)** |
|---|---|---|---|---|---|
| **407** | **1.3845592** | **2.2142856** | **0.186813** | **0.72225159** | **31** |

Table 4.14: Local integration analysis's result for the main street of Dairy Flat HWY as the root node in the Albany suburb in Auckland (by author).

### 4.2.3.3. Choice analysis

The choice analysis allows for exploring how probable it is that people choose Kell Drive as part of their travel. Hence, an angular choice analysis makes clear how people's choices will be impacted by angles to track the straightest route between their departure from the start spot and arrival at the destination. As previously mentioned, the longest route with the least angle toward the destination is the preference, which can be a judgment reference to examine Kell Drive.

The priority step is the angular mean depth calculation, which is considered from Kell Drive to all streets at the selected zones of 800-meters regarding pedestrian distance and 8000-meters regarding traveling via cycles and vehicles (Figures 4.67, 4.68, and 4.69). As usual, like the last two analysis types, the Albany Village Library's location is considered the centre of the selected zones.

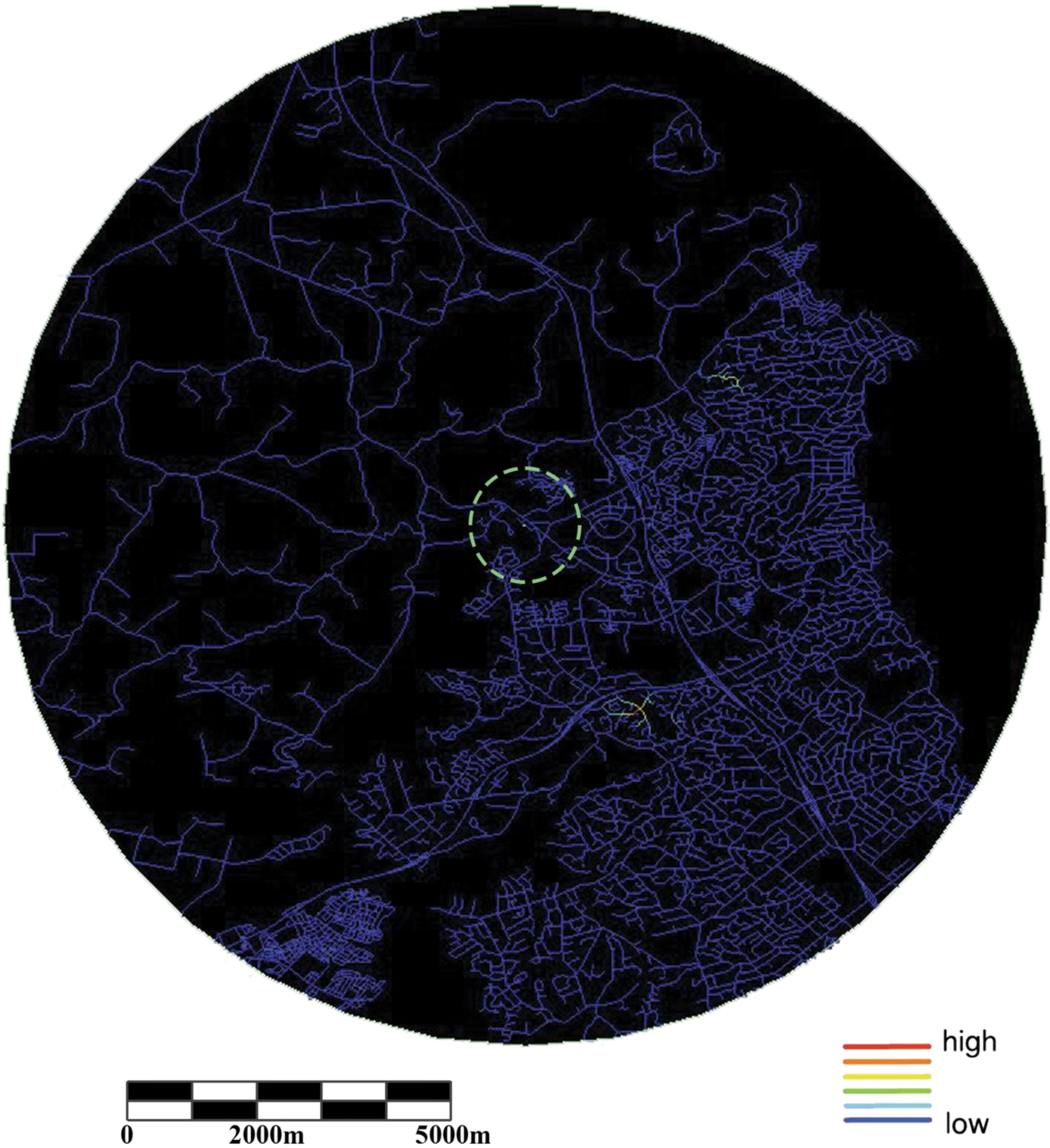



Figure 4.67: Angular Choice analysis for the Albany suburb in Auckland with radius = 800 meters

“The dotted circle includes an 800m radius from the library’s location (zoomed image at figure 4.68)” (by author).

By following the procedure of mean depth calculation, two indicators of total depth (TD) and the number of segments or nodes (K) are substantial, which are accessible by depthmapX analysis. In order, the total depth of the angular weights from segments and "K" are 12707.582 and 120 in 800-meters. Thus, the angular mean depth is:

(MD) = total depth (TD) / k-1

(MD) = 106.786

According to the analysis through depthmapX, the angular choice value is 431403.25. In the meantime, the same procedure in the 8000-meter radius concludes with (TD of the angular weights from segments = 5304872), (k = 29784), (MD = 178.117), and the angular choice value equals 68209104.

The foreground and background networks within the 8000-meter radius represent the connection status. With that being said, the foreground system consists of longer streets and roads, which make acute angles, while the background system consists of shorter streets, which pass other roads at about ninety degrees.

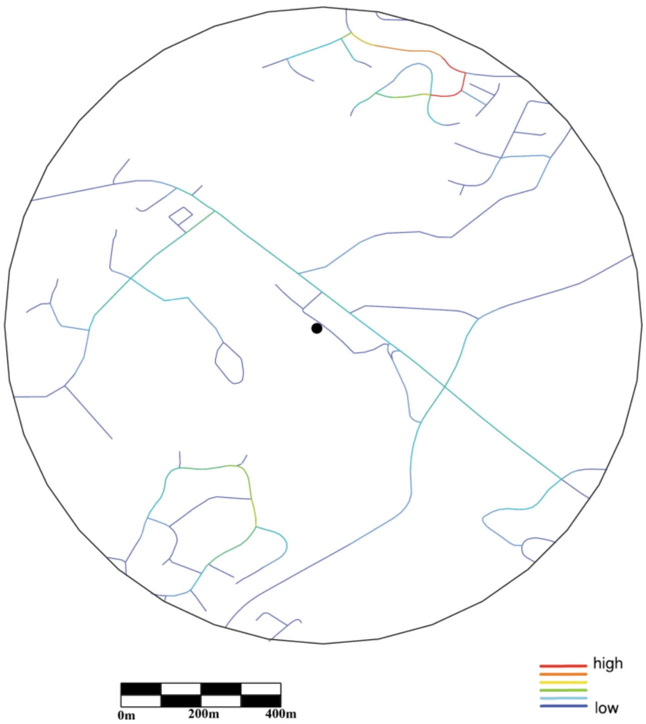


Figure 4.68: Zoomed image of figure 4.67 for angular Choice analysis for the Albany suburb in Auckland with the 800m distance from the library's location (by author).

With regard to the above, the background network, including short streets, is not well connected to the foreground network within selected areas (Figure 4.69). Accordingly, nearly the majority of the areas look more like a tree structure than a network structure, which includes more density on the eastern side than the western side. Thus, accessibility faces weaker status between most areas and the main route network.

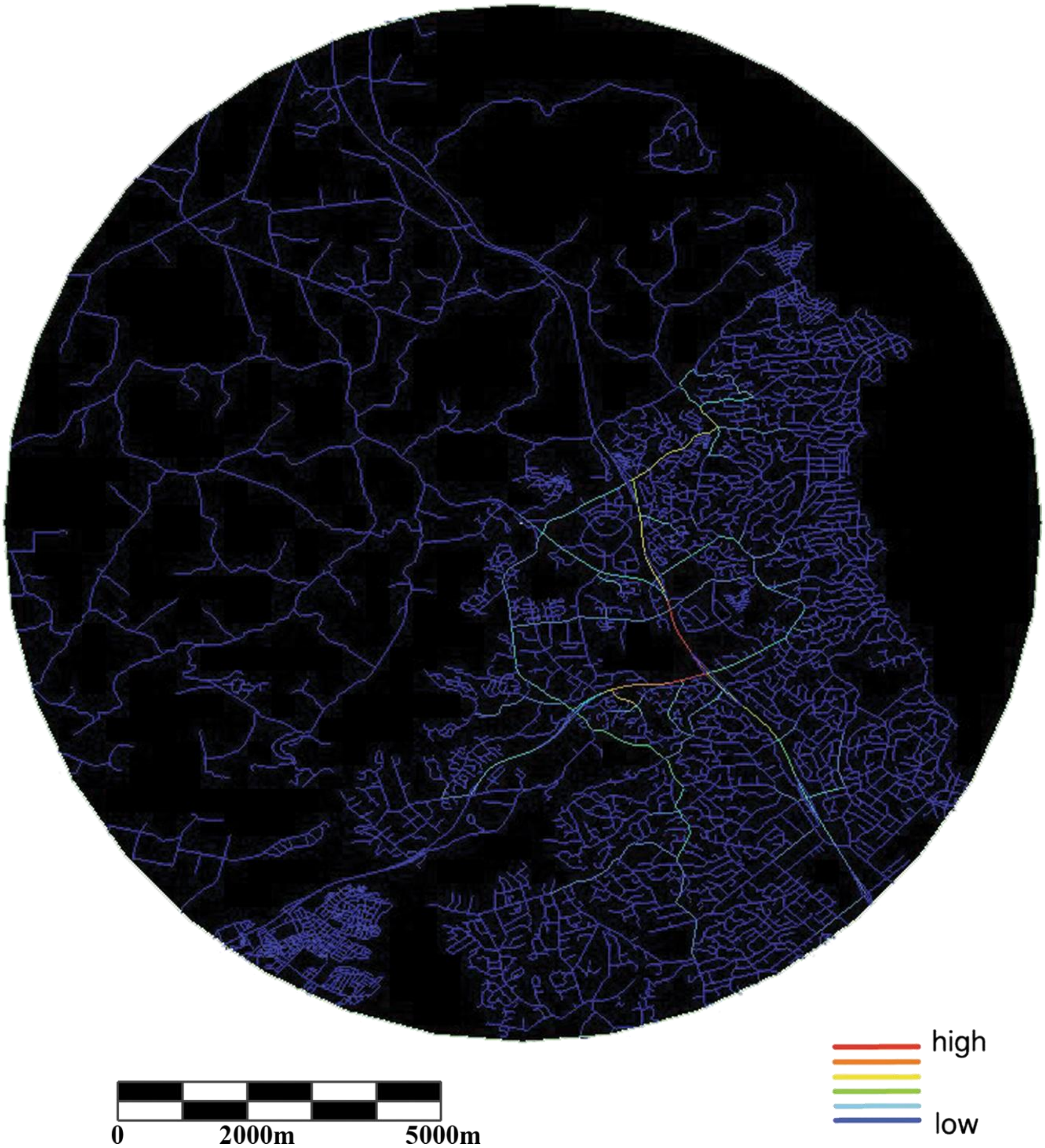



Figure 4.69: Angular Choice analysis for the Parnell suburb in Auckland with radius = 8000 meters (by author).

#### 4.2.3.4. Applying Scatterplots

Three indicators, including intelligibility, permeability, and movement interface, will be applied via scatterplots to assess the relationship between two variables in each of the above indicators.

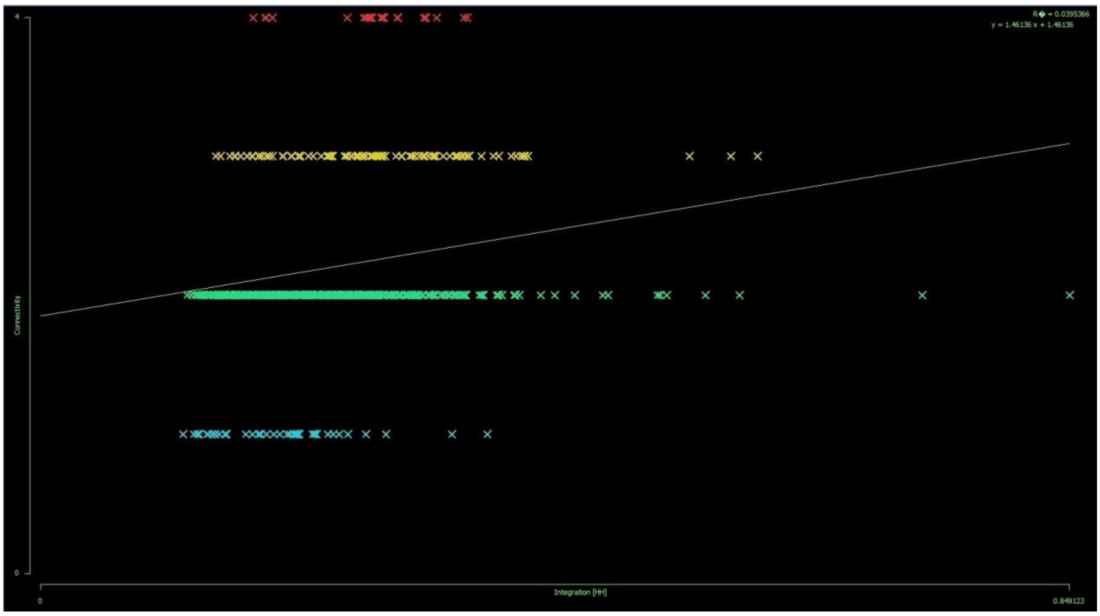



Figure 4.70: Intelligibility values at the global scale within the designated radii distance from the public library's location at Kell Drive within Albany suburb (by author).

The aim of intelligibility analysis through scatterplots is to explore the relationship between the overall selected urban space and local features, such as the local building blocks that make it up. The scatterplot represents the linear correlation coefficient value with a weak value: 0.0395366, which indicates the correlation between the syntactic measures (Figure 4.70).

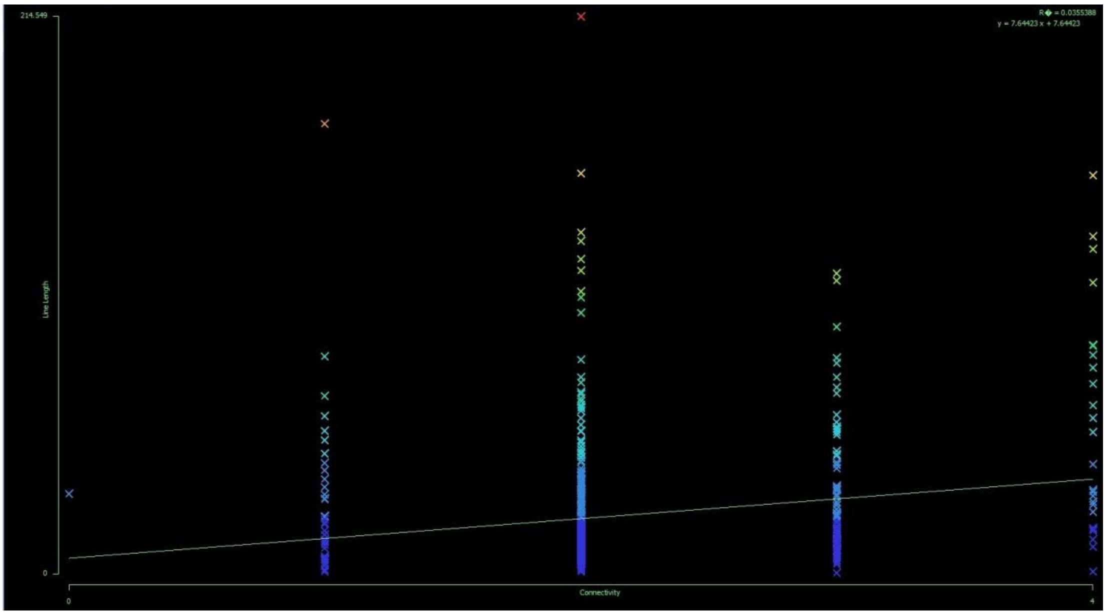



Figure 4.71: Permeability values at the global scale within the designated radii distance from the public library's location in Albany suburb (by author).

The relationship between line length and connectivity is represented by permeability. More than half of the axial lines in the selected area are placed at lower values, and the formation of the regression line meets a shallow slop on the scatter plot of line length to connectivity (Figure 4.71). The correlation coefficient is 0.0355388, which is a weak value, and accordingly, it means that there is not a diversity of alternative routes to choose from.

The last indicator assesses the correlation between integration values and choice values (Figures 4.72 and 4.73). Having said that, the measures of network axial centrality are considered to evaluate the degree of accessibility to Kell Drive, where the Albany Village Library's location is placed, which is the destination from many beginning spots. Additionally, the two measures are considered to explore the feasibility of ensuring that the same location or space is within the shortest path from all places to all others.

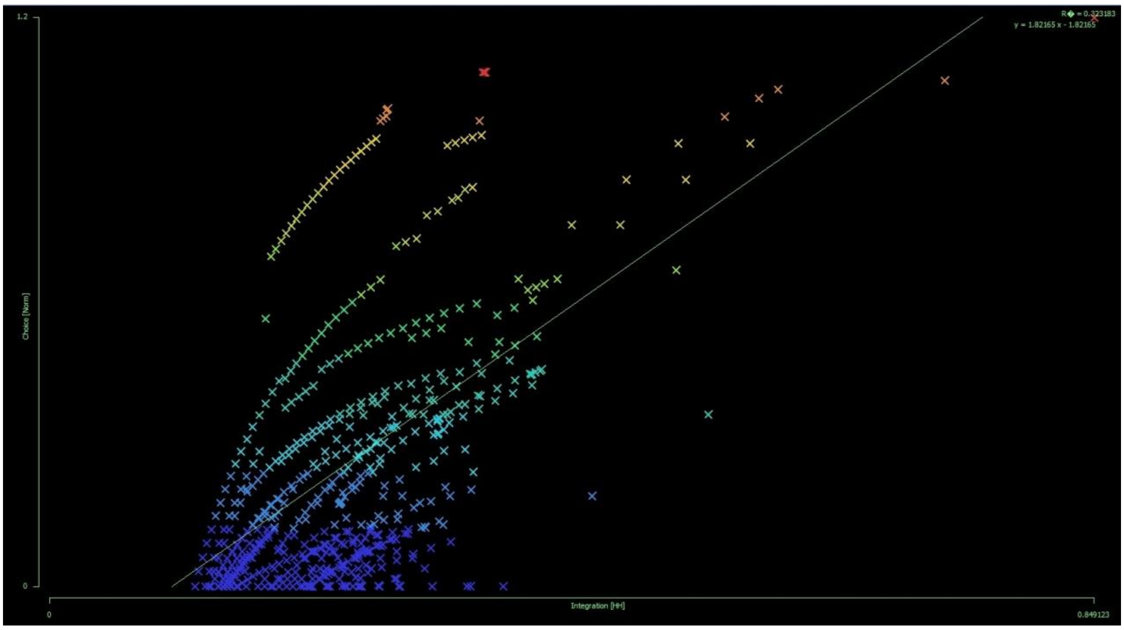



Figure 4.72: Movement interface values at the global scale within the designated radii distance from the public library’s location in Albany suburb (by author).

The reason for considering "movement interface" is the social interactions among community members in the area, which is directed to the aims of this research study. The correlation coefficient value represents the extent of social interactions in the selected area among people, including local community members and visitors.

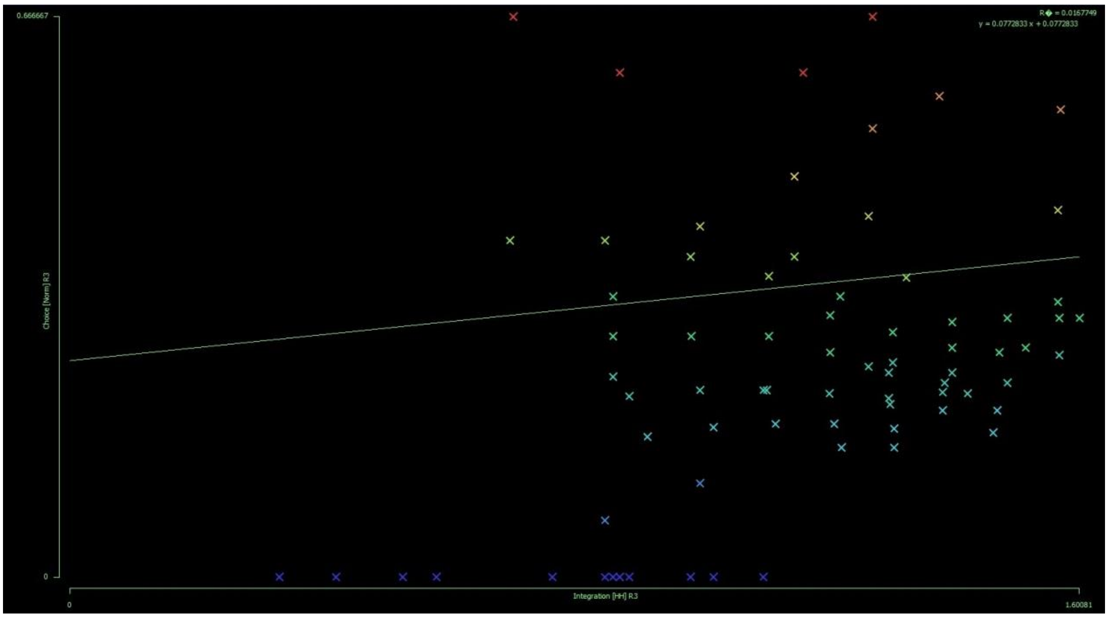


Figure 4.73: Movement interface values at the local scale within the designated radii distance from the public library's location in Albany suburb (by author).

The correlation coefficient value on the global scale (r=n) is 0.323183, which is close to a moderate value; however, it is still a weak value for the relationship between global integration and choice indices (Figure 4.72). Besides, the correlation coefficient value on the local scale (r = 3) is 0.0167749, which is a much weaker value than the value on the global scale (Figure 4.73). Meanwhile, in both systems, there are more axial lines at the lower values. Hence, Kell Drive is indicated as a very low-active space in social interactions on the local scale and relatively low-active on the global scale.

#### 4.2.3.5. Isovist Analysis

In this part, it is expected to explore how the visual experience would be increased or reduced by urban interventions from a selected spot as an origin within the selected area at Albany suburb, which accordingly leads to exploring the ideal locations regarding the visual viewpoint.

With regard to the above, two scenario analyses by two serial visions are planned in the selected area, and they will end at the library's location at Kell Drive (Figure 4.74). The first serial vision with twelve images from vantage point to the last image represents how the superficial impressions of buildings, trees, and public areas can change from one point to another by the 90-degree isovists that are employed. The isovist analysis, which exploits point and serial vision path isovists, is an efficient way to perceive the opportunities to access the Albany Village Library's location in the predetermined area through different routes and distances.

| | |
|---|---|
|  1 |  2 |
|  3 |  4 |
|  5 |  6 |
|  7 |  8 |

| | |
|---|---|
|  **9** |  **10** |
|  **11** |  **12** |

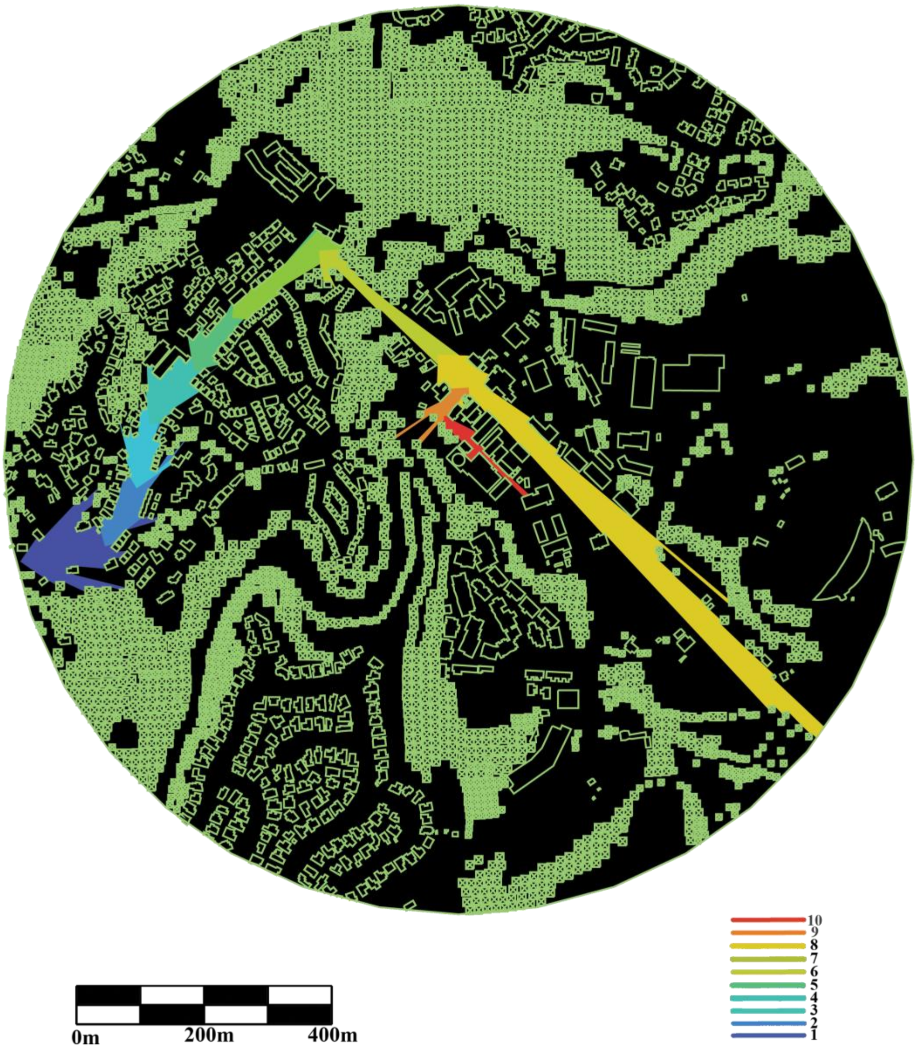



Figure 4.74: Isovist analysis with a serial vision from a route in Albany suburb in Auckland applying 90° isovists (by author).

The first proposed path takes more isovist points compared to the second proposed route (Figures 4.74 and 4.75). This means that the first route takes longer with many changes in the superficial impressions that are captured because of the variety of vision fields from one isovist spot to another, while the second route, with seven images from the vantage point to the last image, represents a shorter distance, keeping into account that both routes began at the edge of the same 800-meter radius. With regard to the above, apart from the length of each of the two routes, there are many significant changes, specifically in larger spots like intersections and crossroads (Figures 4.74 and 4.75).

**1**

**2**

**3**


**4**


**5**


**6**

**7**

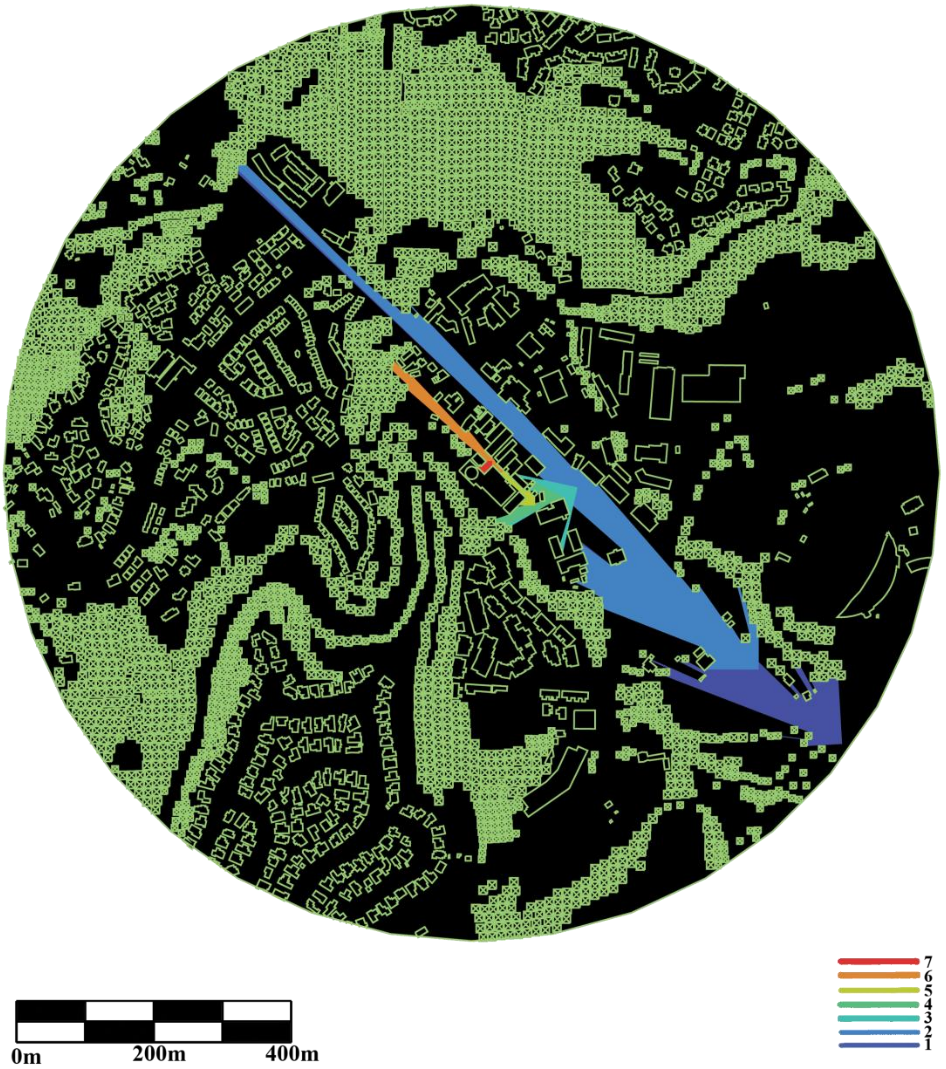



Figure 4.75: Isovist analysis with a serial vision from a route in Albany suburb in Auckland applying 90° isovists (by author).

#### 4.2.3.6. Visual Graph Analysis (VGA)

As the VGA analysis is based on a raster-based method, a rectangle is considered to be 500 meters × 500 meters (Figure 4.76). Two root cells are considered in different locations in the selected zone. Accordingly, a comparison is considered between two origin spots: one cell is located near the Albany Village Library's location, and the second is located near Dairy Flat Highway and Albany Highway. With that being said, the comparison as it results in Figure 4.76 shows how each is well-connected to other cells in the predetermined zone, which is a scale of how each location is deeper.

The comparison illustrates that the second cell's location near Dairy Flat Highway and Albany Highway had a better and stronger connection to other cells in the system than the first cell's location. The most well-connected cell to other cells and the weakest position in connection with other cells are shown in red to dark blue (Figure 4.76). Accordingly, people who are located in red or orange spots, have easier access to social spots on streets or public locations, among other stationary activities; however, it needs multiple visual steps to reach the same areas, which causes longer distances for those located in dark blue.

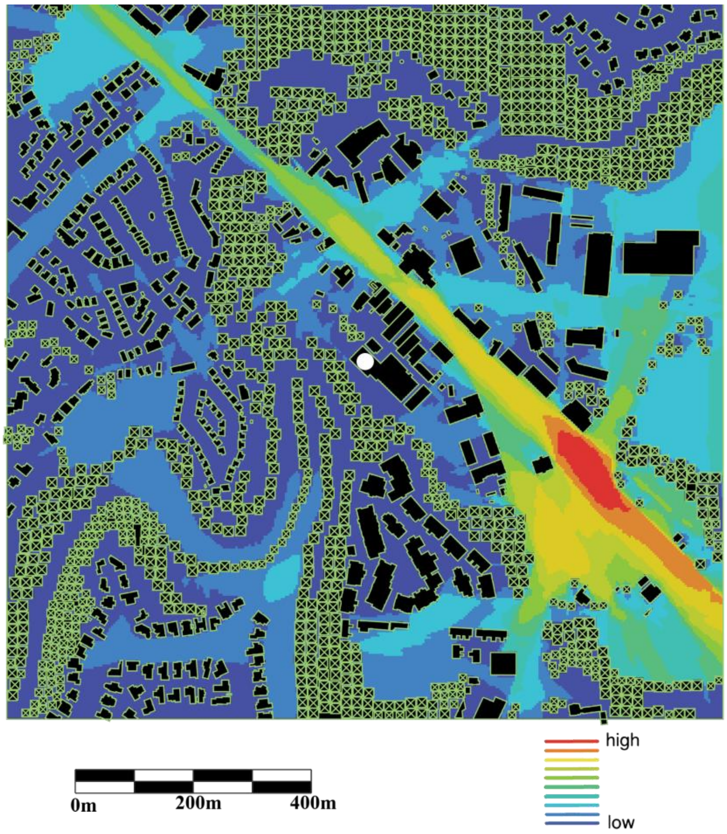
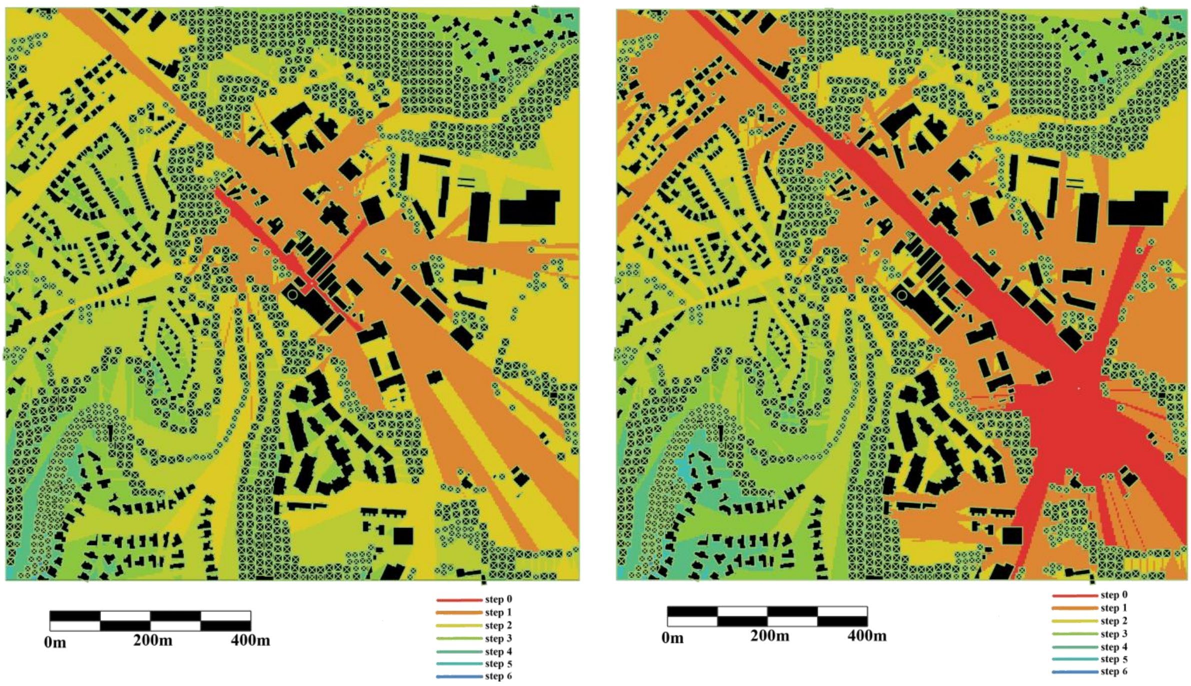



Figure 4.76: VGA study for the Albany suburb in Auckland (By author).

The "visibility step" analysis is planned to compare the extent of the sight toward the cells from the two root cells' location in the selected area. Meanwhile, each step meets the same




**Root cell (A) in Kell Drive** **Root cell (B) in Dairy Flat HWY**

Figure 4.77: Visibility step analysis for two different points within the Albany suburb in Auckland (By author)

value for all visible cells (Figure 4.77).

The analysis of the "visibility step" illustrates that there is a higher number of directly visible cells from the root cell (B) than the root cell (A), while both analyses face the same number of visibility steps within the same selected zone (Figure 4.77). As mentioned, the same value is given to cells with one colour by moving from one step to another, which means one direction change happened. Hence, a root cell's location makes it clear how the extent of visibility changes. Meanwhile, local features, buildings, and trees impact the mean depth value, and accordingly, they determine how the raster area is deeper from each selected root cell's location. In this way, the calculation of the mean depth is needed for each of the two scenario analyses:

$$\mathbf{MD = TD / K - 1}$$

| **Mean depth for location (A)** | **Mean depth for location (B)** |
|---|---|
| TD = 249644<br>K = 74268<br>MD = 249644 / 74268 - 1<br>MD = 3.36 | TD = 240401<br>K = 74268<br>MD = 240401 / 74268 - 1<br>MD = 3.23 |

Table 4.15: Mean depth calculation for locations (A) and (B) within Albany (by author).

There is a difference in mean depth values between the two selected locations (A) and (B). Hence, location (A) with a higher value of mean depth faces a deeper status than location (B) (Table 4.15). Accordingly, it is clear how location (B) has an easier connection with all other cells in the selected zone.

With regard to the "visibility step" analysis and mean depth values, it is obvious that location (B) near Dairy Flat Highway and Albany Highway meets a longer continuous view than location (A) at the front of Albany Village Library on Kell Drive. Accordingly, location (B) has direct sight to 10046 cells within step 1, while location (A) has direct vision to 710 cells in step 1.

The "through vision" analysis in Figure 4.78 represents the cells with the longest sightlines. Hence, as it is clear, most cells with longer sightlines are located on Dairy Flat Highway, which is shown in red and orange (Figure 4.78). Considering the local features in the area, "through vision" analysis is essential to exploring the cell with the longest sightline. As previously mentioned, the cells in red, or "hotspots," are very important in orientation and navigation because they have longer continuous visions compared to other cells in a selected area. Accordingly, the cell at location (B) within the Dairy Flat Highway with the value of 1157778 has the longest continuous vision, while the cell at location (A) meets a considerably lower value of 27125. As noted, this "through vision" has a significant role regarding the connection between community members' sightlines and social infrastructure such as public libraries.

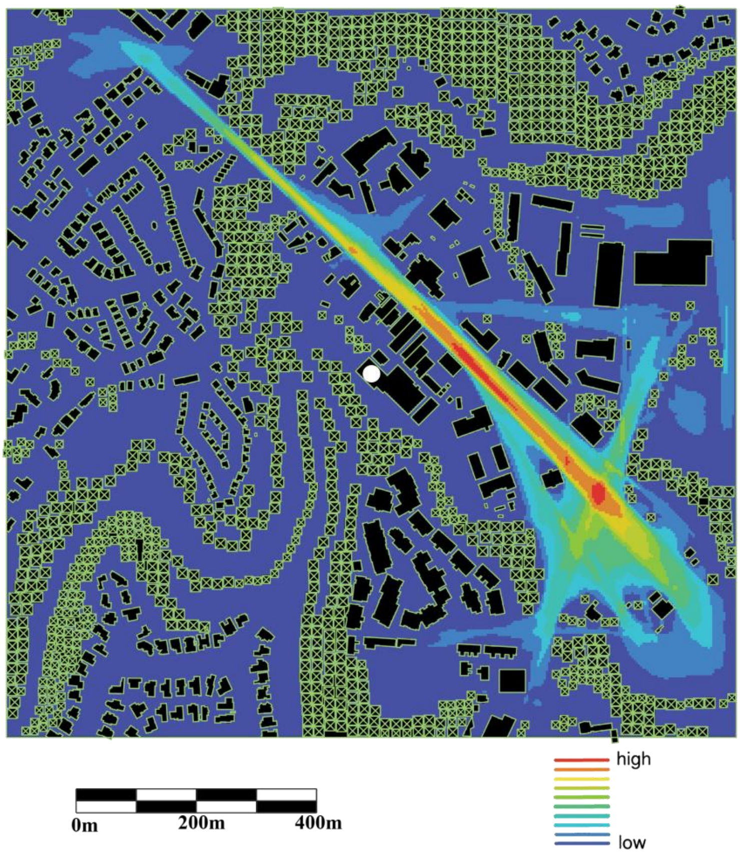
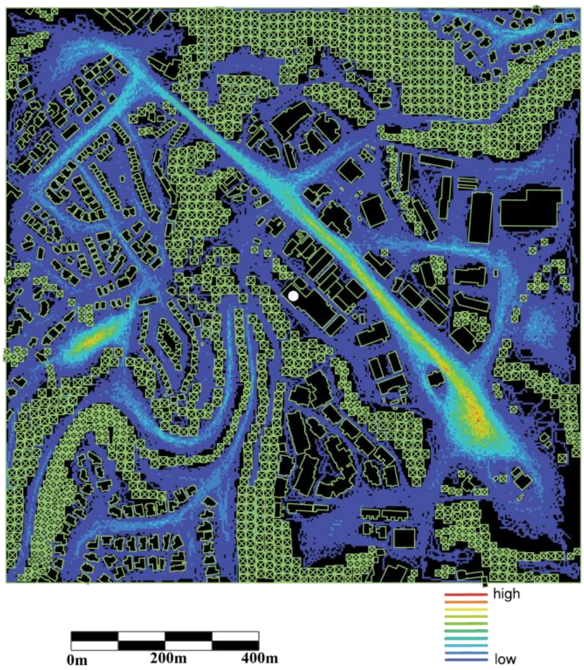



Figure 4.78: Through vision analysis within the Albany suburb in Auckland (By author)

#### 4.2.3.7. Applying the Agent-Based Modelling

As previously noted, people tend to follow linearity through their route toward their destination with the lowest angular deviations. Accordingly, agent-based modelling is considered through the depthmapX procedure, which provides a determinate number of agents that are identically distributed within a time frame to collect their travel routes in the selected zone in the Albany suburb. With regard to the usual format of the analysis, three scenarios are considered: the agent as an average person (Figure 4.79), the agent as a visitor or tourist (Figure 4.80), and the agent as a local (Figure 4.81). The same number of five thousand agents are considered for each scenario analysis; however, the syntactic steps and vision field are different in each scenario. In other words, a 15° vision field on three syntactic steps is considered for the first scenario, a 30° vision field on one syntactic step makes the second scenario, and a 7° vision field on five syntactic steps makes the third scenario analysis. Hence, there are three different movement patterns.



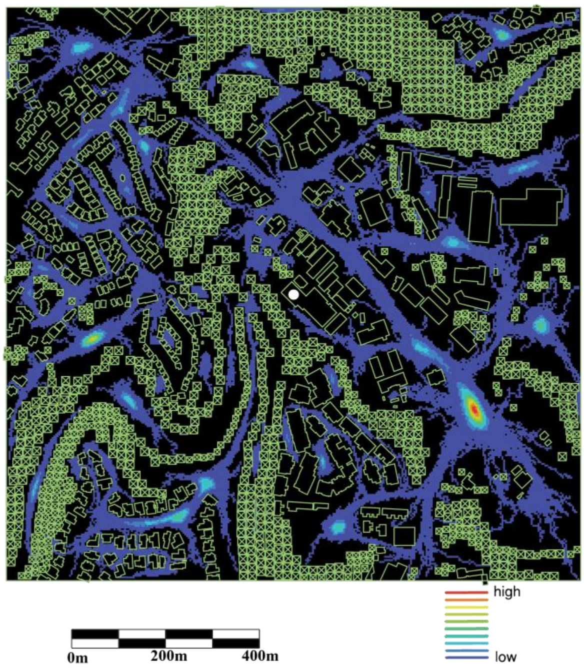




Figure 4.79 The agent as an average person Figure 4.80 The agent as a tourist or visitor (By author)

The differences between visitors or tourists and local agents in this type of analysis illustrate that, as the second group of agents in the second scenario are not familiar with the local urban area, they would select a location with the longest vision (Figure 4.80). However, local agents in the third scenario analysis would like to track the movement line pattern that is more straightened, which is derived from their familiarity with the local urban spaces (Figure 4.81).

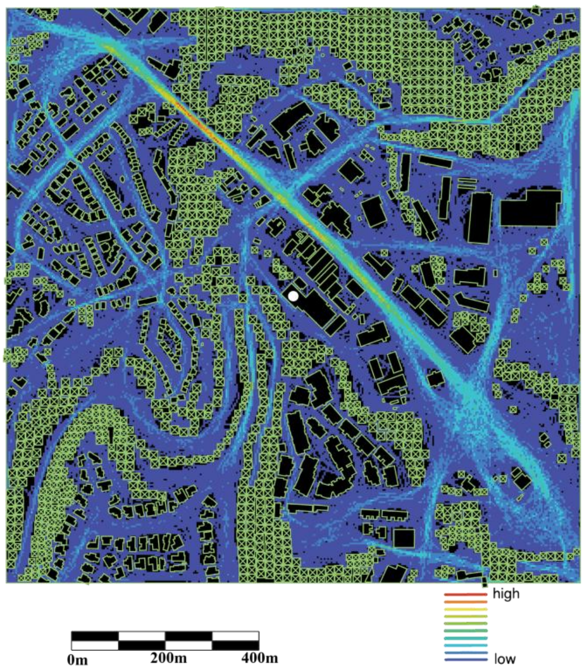



Figure 4.81: The agent as a local person (By author)

With regard to the above and the noted previous description of Dalton's research in 2001, the analogy of results between the VGA, "through vision," and agent-based modelling in this section represents that while local community members' movement patterns are aligned with angular choice analysis, visitors or tourists follow the highest integration location of "through vision.".

### 4.2.4. Warkworth

#### 4.2.4.1. Connectivity analysis

By concentrating on connectivity analysis on Baxter Street, where the Warkworth Library is located, all direct relations from Baxter Street to its immediate adjacent streets on the specified scale will be considered. With that being said, four types of connectivity analysis, including one-step analysis, two-step analysis, three-step analysis, and n-step analysis, are planned. There are two reference scales consisting of 800m and 8000m radii for, respectively, the walkable distance and vehicle access at longer distances. In the meantime, Twin Coast Discovery Highway as the second main street will be considered to compare its status with Baxter Street in the same selected area.

- **One-Step analysis:**

Warkworth Library is considered the centre of an 800-meter radius in the Warkworth suburb. As previously mentioned, Baxter Street, as the main street in the one-step analysis, is connected to its immediate adjacent streets by one topological step (Figure 4.82). The analysis outcome


Figure 4.82: One-step connectivity analysis for Baxter Street in the Warkworth suburb in Auckland (by author).

illustrates that the main street in red has seven direct connections to its immediate streets in green. Accordingly, the higher the number of connected green streets to the main street, the more connected it is to the main street's adjacencies, which is the degree of Baxter Street's connectivity to its adjacencies in one-step analysis.


Figure 4.83: One-step connectivity analysis for Twin Coast Discovery Highway in the Warkworth suburb in Auckland (by author).

The second main street, compared to Baxter Street, has a lower degree of connectivity in one-step analysis. As the analysis shows, Twin Coast Discovery has only three direct connections to its immediate adjacent streets, which is a lower number than Baxter Street (Figure 4.83).

So far, the one-step analysis highlights the relations between the two main streets and their immediate adjacent streets in two separate analyses, while in further analyses of two-step, three-step, and N-step, the interconnected connections between the two main streets and local street network in the same selected area are the matter, which will be implemented by separate analyses due to the different main streets. Unlike central suburbs such as Parnell,


Figure 4.84: Warkworth node in Auckland, 8000m radius (by author).

the suburbs and nodes such as Warkworth with lower density and far from the central area have a considerably deeper system, which is obvious in both selected 800-meter and 8000-meter areas in Warkworth (Figure 4.84). Accordingly, the area is deprived of well-interconnected connections between main routes and local street networks.

- **Two-Step analysis:**

The two-step analysis is accompanied by two direction changes from the two selected main streets to their adjacent neighbourhoods via selected axial lines. In this way, the two-direction changes from a main street such as Baxter Street in Step Zero to any street in Step Two are coloured red to yellow and then blue, and accordingly, the catchment zone for Baxter Street includes the total of all streets from steps one and two in the selected 800-meter radius with the centrality of the Warkworth Library's location (Figure 4.85).


Figure 4.85: Two-step connectivity analysis for Baxter Street in the Warkworth suburb in Auckland (by author).

Although Baxter Street is not a key player in the area as it is a dead-end street (Figure 4.86), it is close to the local shopping streets by two streets: Neville Street and Percy Street (Figure


Figure 4.86: Baxter Street in the Warkworth suburb in Auckland (Google Street View).

4.85). In the meantime, the relation between connectivity and Baxter Street's length illustrates weak permeability, as the analysis represents the low diversity of axial lines within the selected area and along the selected main street (Figure 4.85).


Figure 4.87: Two-step connectivity analysis for Twin Coast Discovery HWY in the Warkworth suburb in Auckland (by author).

While Twin Coast Discovery has a similar connectivity status to Baxter Street by two-step analysis, Twin Coast Discovery, compared to Baxter Street, has a more prominent role as it embraces a key local shopping centre (Figure 4.88). Meanwhile, it connects the areas on both sides of the Mahurangi River, which highlights the role of the street in the Warkworth suburb (Figure 4.87) and accordingly raises the permeability degree that impacts each location within the street.


Figure 4.88: Twin Coast Discovery HWY in the Warkworth suburb in Auckland (Google Street View).

- **Three-Step analysis:**

By applying this type of connectivity analysis, 60% to 65% of the selected streets' network is roughly covered as they are accessible by three direction changes from both selected main streets (Figures 4.89 and 4.90). Accordingly, the accessed streets are shown in the same figures in four colours, which indicate the different topological steps.


Figure 4.89: Three-step connectivity analysis for Baxter Street in the Warkworth suburb in Auckland (by author).


Figure 4.90: Three-step connectivity analysis for Twin Coast Discovery HWY in the Parnell suburb in Auckland (by author).

While the Twin Coast Discovery Highway has a less direct connection to its immediate streets than Baxter Street by one direction change, there is a similarity between both streets' status as the main streets in separate three-step analyses in the same area (Figures 4.89 and 4.90).

- **N-Step analysis:**

The target of this analysis within the selected area of the Warkworth suburb is the most-accessed axial lines from the predetermined main streets. The N-step analysis displays that there is a similar result, which indicates that eight direction changes are required to the deepest accessible axial line from each of two selected main streets within the same 800-meter radius in the Warkworth suburb (Figures 4.91 and 4.92). Hence, the analysis illustrates how both systems on the same scale meet the same topological depth. Meanwhile, the low density in the area shows how deep the system is.

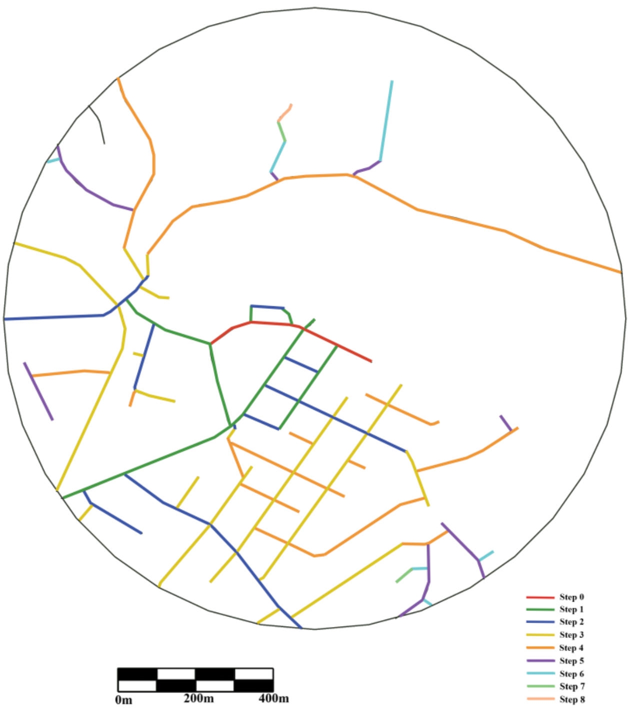


Figure 4.91: N-step connectivity analysis for Baxter Street in the Warkworth suburb in Auckland (by author).

Figure 4.92: N-step connectivity analysis for Twin Coast Discovery HWY in the Warkworth suburb in Auckland (by author).

### 4.2.4.2. Integration analysis

By precedent that has resulted via integration analysis within the last three nodes, two matters are the most important. On the one hand, it matters how close the selected origin street or space is to all other axial lines or spaces. On the other hand, the main street's length also matters as the analysis assesses the degree of integration or segregation that the main street faces with all other streets within the selected area. As with the last three nodes, both global integration analysis and local integration analysis are considered for the Warkworth suburb.

- **Global Integration Analysis**

The Baxter Street status indicates weak global integration, which means that there is not a high integration value in relation to all other axial lines in the selected 800-meter zone, as it resulted from the analysis. The integration value is one degree higher than the weakest value shown in light blue (Figure 4.93). The analysis shows that both Baxter Street and Twin Coast Discovery Highway face similar integration statuses, which are needed to take many direction changes to reach many streets from each of these two selected origin streets within the same scale. Similarly, almost all axial lines meet weak integration status in the global system analysis.

By integration analysis, four indicators should be assessed, which include mean depth (MD), real asymmetry (RA), real relative asymmetry (RRA), and finally the integration value (INT) (Table 4.16).


Figure 4.93: Global integration analysis in the Warkworth suburb in Auckland (by author).

| Ref. number Baxter St | Integration value - Rn | (MD) - Rn | Real Asymmetry (RA) | Real Relative Asymmetry (RRA) | (TD) |
|---|---|---|---|---|---|
| **18** | **0.26662797** | **23.373297** | **0.12225845** | **3.7505443** | **8578** |

Table 4.16: Global integration analysis's result for the main street of Baxter Street as the root node in the Warkworth suburb in Auckland (by author)

The global integration result shows that Twin Coast Discovery Highway faces a slightly higher value than Baxter Street (Tables 4.16 and 4.17). Thus, Twin Coast Discovery Highway is a little more integrated than Baxter Street. The reason that the relative asymmetry (RA) value for Twin Coast Discovery Highway is less than the same indicator for Baxter Street is the shallower status of the above highway in the system than Baxter Street. Having said that, the real relative asymmetry (RRA) value also shows that Twin Coast Discovery Highway faces a lower value than Baxter Street's (RRA) value, which represents lower activities and more segregation for Baxter Street.

| Ref. number<br>Twin Coast Discovery | Integration value - Rn | (MD) - Rn | Real Asymmetry (RA) | Real Relative Asymmetry (RRA) | (TD) |
|---|---|---|---|---|---|
| **254** | **0.29105055** | **21.495913** | **0.11199953** | **3.4358294** | **7889** |

Table 4.17: Global integration analysis's result for the main street of Twin Coast Discovery HWY as the root node in the Warkworth suburb in Auckland (by author)

- **Local Integration Analysis**

By experiencing differences between local integration analysis and global integration by the topological step and number of direction changes from both selected origin streets to their immediate axial lines and all other accessible axial lines, local integration analysis indicates different outcomes than what has resulted from global integration analysis. In the meantime, local integration analysis has a higher value than global integration, which also accompanies the highlighting of the local centres in the area.

The local integration analysis shows that Baxter Street has a relatively higher local integration value than its global integration status. The reason is the three-direction changes to all accessible axial lines by two topological steps in the local system (Figure 4.94). The above argument is also true for Twin Coast Discovery Highway. Unlike the global integration analysis, Twin Coast Discovery Highway meets a weaker status compared to Baxter Street, which is respectively shown in light blue and green (Figure 4.94).


Figure 4.94: Local integration analysis in the Warkworth suburb in Auckland (by author).

| Ref. number<br>Kell Drive | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA)-R3 | Real Relative Asymmetry (RRA)-R3 | (TD)-R3 |
|---|---|---|---|---|---|
| **18** | **1.4644111** | **2.2** | **0.17142858** | **0.68286836** | **33** |

Table 4.18: Local integration analysis's result for the main street of Baxter Street as the root node in the Warkworth suburb in Auckland (by author)

To sum up, the comparison between the outcomes of Tables 4.18 and 4.19 shows that while Baxter Street has a higher local integration value (1.4644111) than Twin Coast Discovery Highway with a value of 0.8619656, Baxter Street meets lower values of both RA (0.17142858) and RRA (0.68286836) than the highway with values of RA (0.38095239) and RRA (1.1601391), which indicates that Baxter Street meets a shallower system than Twin Coast Discovery HWY. Hence, Baxter Street is more integrated than the highway in the local system analysis.

| Ref. number<br>Twin Coast Discovery | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA)-R3 | Real Relative Asymmetry (RRA)-R3 | (TD)-R3 |
|---|---|---|---|---|---|
| **254** | **0.8619656** | **2.1428571** | **0.38095239** | **1.1601391** | **15** |

Table 4.19: Local integration analysis's result for the main street of Twin Coast Discovery HWY as the root node in the Warkworth suburb in Auckland (by author)

### 4.2.4.3. Choice analysis

This type of analysis for the selected area in Warkworth follows the same procedure as the last three suburbs. Accordingly, the possibility of choosing Baxter Street in daily travel will be evaluated. Besides, the angular choice analysis lets us realise how the choices of local community members and passengers could be affected by angles that follow the straightest direction from the beginning location to the destination. Following the above, there are two priorities: the longest route and the least angle toward the destination.

The angular mean depth calculation is highlighted as it is a priority regarding identifying the main route, and in this section, it is considered from Baxter Street to all streets at the selected area of 800-meters regarding pedestrian distance and 8000-meters regarding commuting by bicycle and vehicle (Figures 4.95, 4.96, and 4.97). The centrality of the selected area is located at the Warkworth Public Library's location.

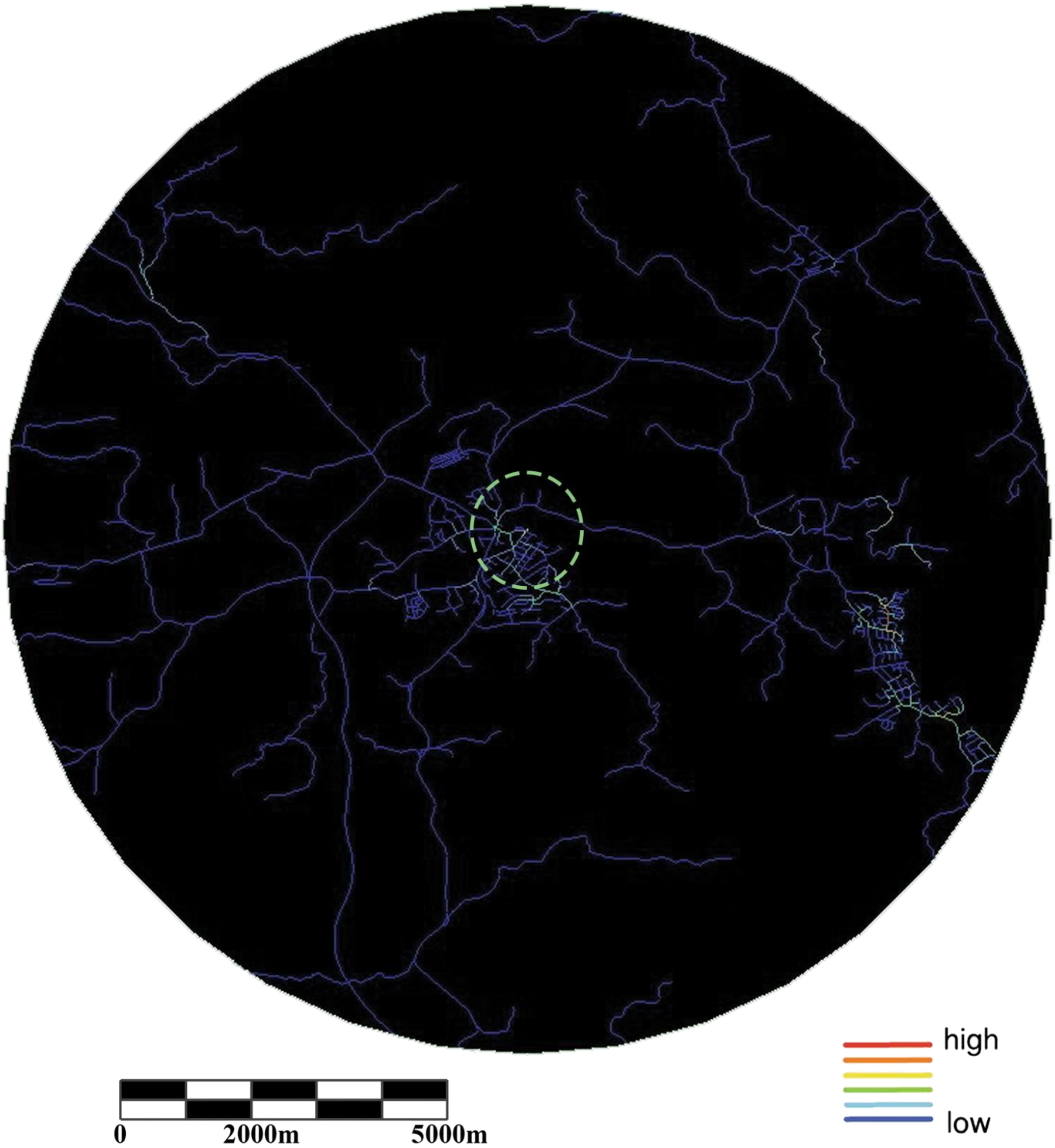



Figure 4.95: Angular Choice analysis for the Warkworth suburb in Auckland with radius = 800 meters

“The dotted circle includes an 800m radius from the library’s location (zoomed image at figure 4.96)” (by author).

By following the angular mean depth calculation, total depth (TD) of the angular weights from segments and the number of segments or nodes (K) are two indicators that could be found through depthmapX analysis. Regarding Baxter Street the (TD) is 23413.252 and "K" is 234 in the selected area radius of 800 meters.

$$(MD) = \text{total depth } (TD) / k\text{-}1$$

$$(MD) = 100.486$$

The angular choice value is 2190933.8 through depthmapX analysis. Meanwhile, (TD) and "K" in the 8000-meter radius are respectively 1334543.6 and 3402. Accordingly, angular mean depth is 392.397, and the angular choice value equals 66336456.

With a concentration on the 8000-meter area, foreground and background networks are identified, which are accompanied by longer streets and roads that cause acute angles in the foreground system and shorter streets that cross other routes at about ninety degrees.

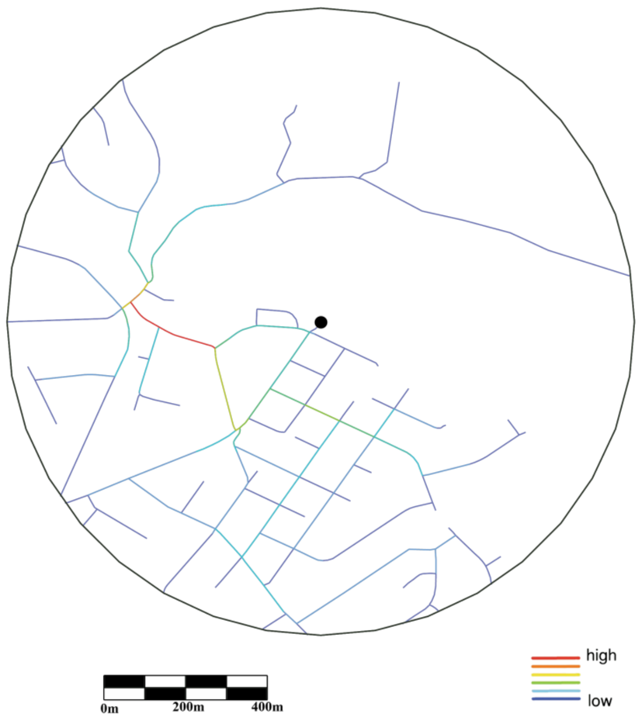


Figure 4.96: Zoomed image of figure 4.95 for angular Choice analysis for the Warkworth suburb in Auckland with the 800m distance from the library's location (by author).

The analysis of the 8000-meter radius shows that there is no well connectivity between the background system and the foreground system (Figure 4.97). With that being said, mostly tree structures, low density, and accordingly deep street networks cause the above argument. Therefore, there is highly weak accessibility between different areas and the main street network.

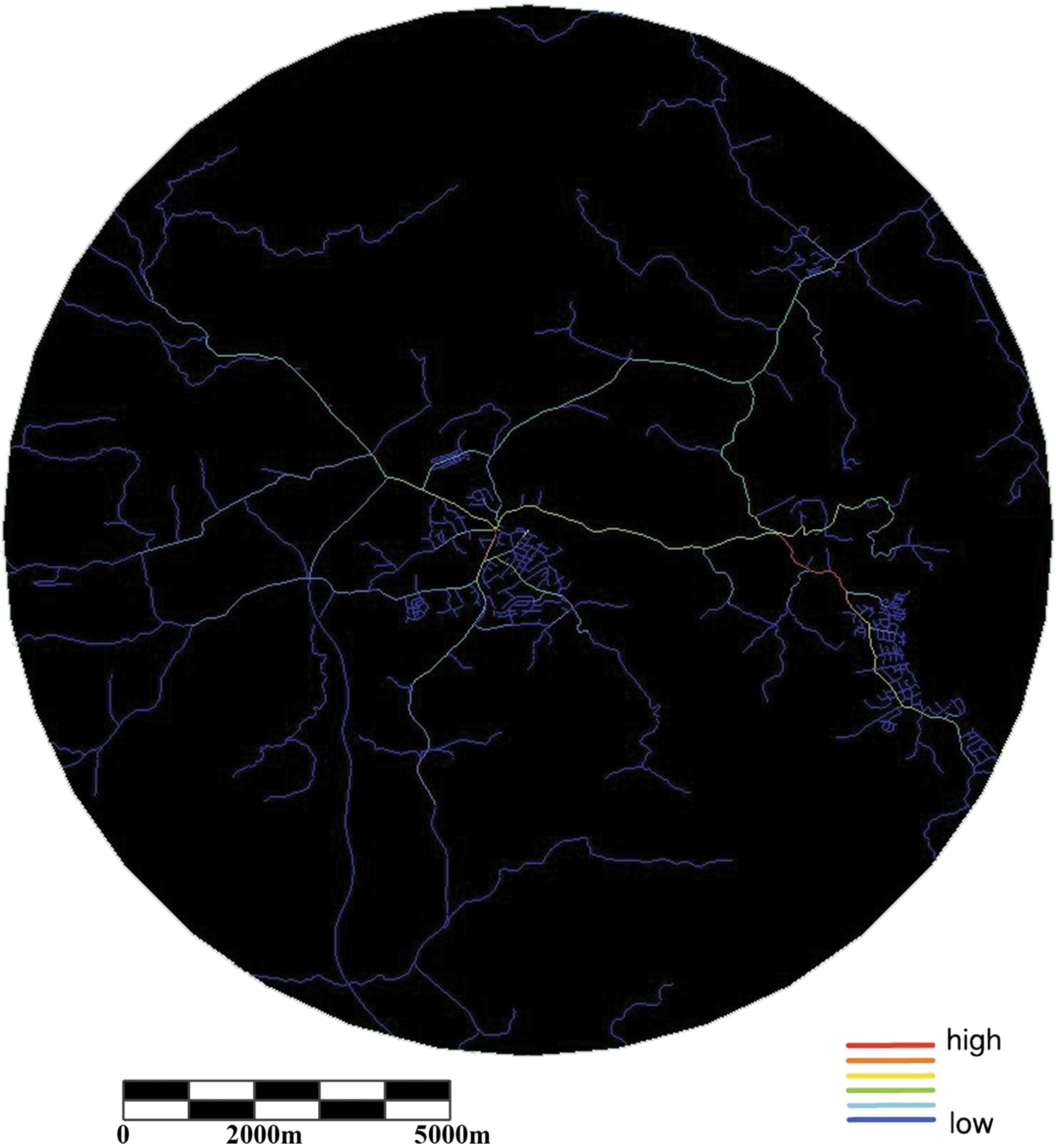


Figure 4.97: Angular Choice analysis for the Warkworth suburb in Auckland with radius = 8000 meters (by author).

#### 4.2.4.4. Applying Scatterplots

In scatterplots, three indicators, including intelligibility, permeability, and movement interface, are planned to evaluate two variables in each of the above.

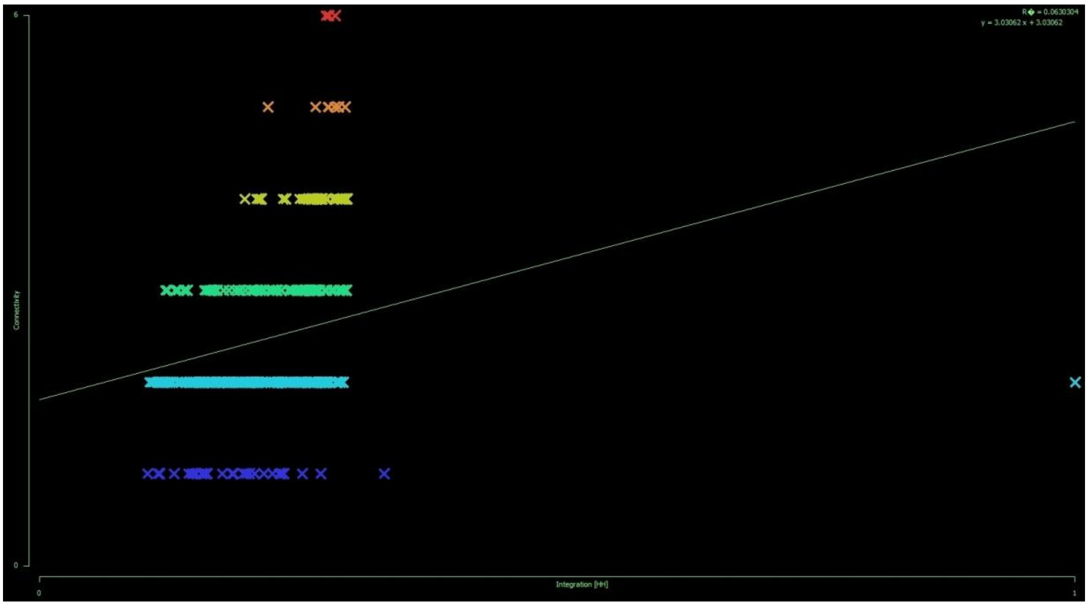



Figure 4.98: Intelligibility values at the global scale within the designated radii distance from the public library's location at Baxter Street within Warkworth suburb (by author).

The relationship between the whole selected zone in Warkworth and local features is assessed by intelligibility analysis. The correlation between the syntactic measures, including topological connectivity and axial global topological integration, is weak, and accordingly, the linear correlation coefficient value meets a weak value: 0.0630304 (Figure 4.98).

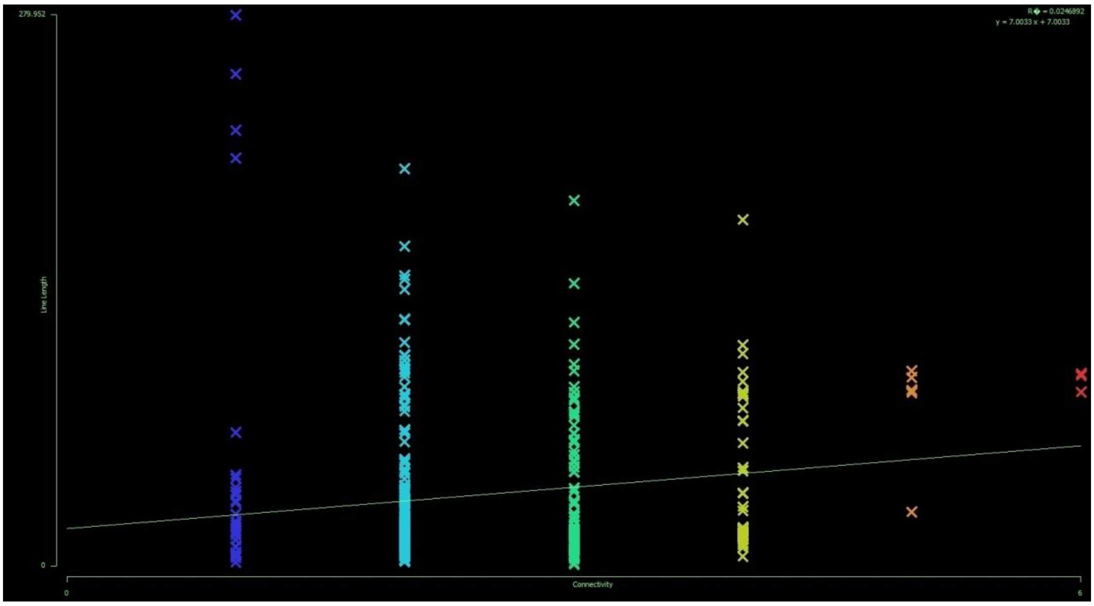



Figure 4.99: Permeability values at the global scale within the designated radii distance from the public library's location in Warkworth suburb (by author).

With consideration of permeability, the relationship between line length and connectivity is taken into account. In this way, the scatterplot illustrates that almost likely, over half of the axial lines are faces with lower values. In addition, the regression line meets a shallow slope between two indicators of line length and connectivity (Figure 4.99). Accordingly, the correlation coefficient faces a weak value of 0.0246892, which illustrates that there is no variety of alternative paths to choose from.

The correlation between integration values and choice values forms the Movement Interface indicator on both global and local scales (Figures 4.100 and 4.101). In this analysis, the degree of accessibility from all spaces to Baxter Street is evaluated. In the meantime, it is also considering the possibility of placing Baxter Street on the shortest route from all locations to all others.

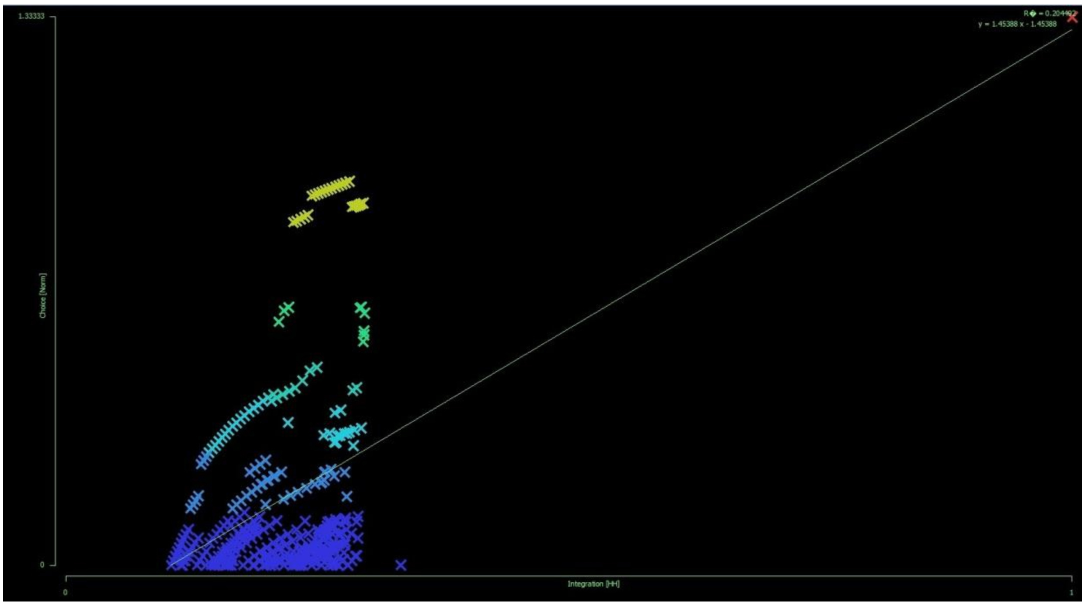



Figure 4.100: Movement interface values at the global scale within the designated radii distance from the public library’s location in Warkworth suburb (by author).

The social interactions among people in the selected area in Warkworth are the reason for considering the "movement interface" that matters to the objectives of this study. Accordingly, the correlation coefficient value illustrates the extent of social interactions within the above zone among people, whether locals or visitors.

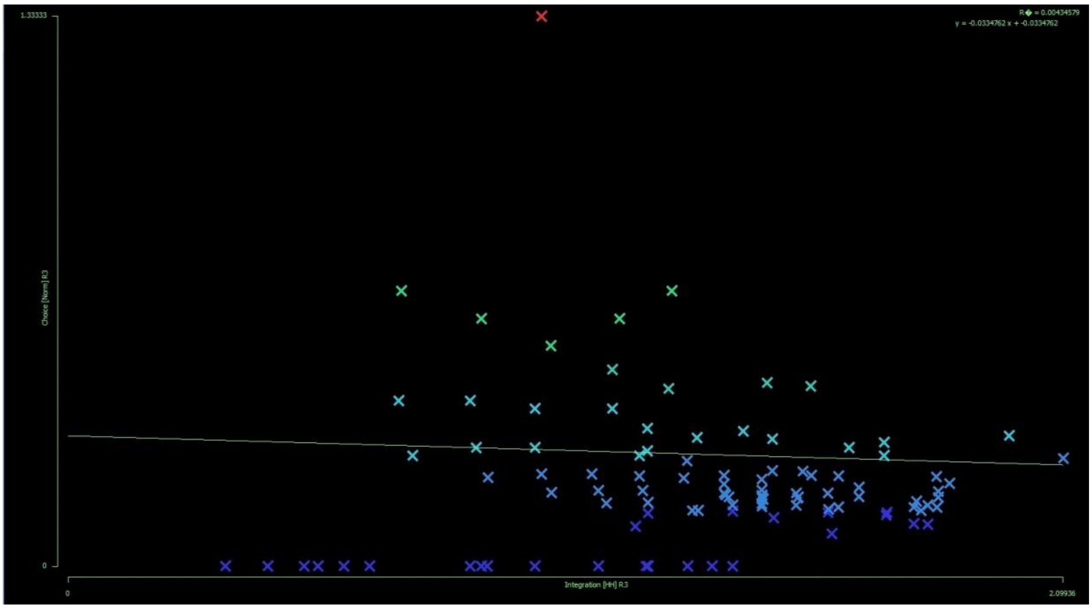



Figure 4.101: Movement interface values at the local scale within the designated radii distance from the public library's location in Warkworth suburb (by author).

The correlation coefficient value represents the extent of social interactions in the selected area among people, including local community members and visitors. The correlation coefficient value on the global scale (r=n) is 0.204492, which is less than a moderate value (Figure 4.100). In addition, the correlation coefficient value on the local scale (r = 3) is 0.00434579, which represents a weak value (Figure 4.101).

Almost the majority of axial lines meet the lower values on both indices of choice and integration within the global scale, except a few axial lines meet the higher choice values over the half-top. In the meantime, on the local scale, the majority of axial lines face lower values regarding choice, but over half of the lines meet higher values regarding integration. Hence, while Baxter Street faces a relatively weak status of "movement interface" on the global scale, it meets a better status of "movement interface" on the local scale because it is more integrated; however, it faces a weaker status regarding the choice.

#### 4.2.4.5. Isovist Analysis

As explained in the last three isovist analyses, this type of analysis provides the opportunity to find the ideal spots regarding visual sight. Hence, this analysis shows how visual experience could be increased and decreased by urban interventions from the origin point within the selected zone in the Warkworth suburb.

Two scenario analyses via two serial visions are considered in the chosen zone, which ends at the Warkworth Public Library's location at Baxter Street (Figure 4.102). The first scenario, through a serial vision with ten vision spots from a vantage point between the end of Old State Highway 1 and the beginning of Twin Coast Discovery Highway, and the last spot at Baster Street, indicates how the surface impressions of local features such as buildings, trees, and public areas can change from one spot to another by the 90-degree isovists that are applied. Similar to the last three isovist analyses, point and serial vision route isovists let us access the Warkworth Public Library's location within the chosen zone via diverse paths and distances.

1

2

3

4

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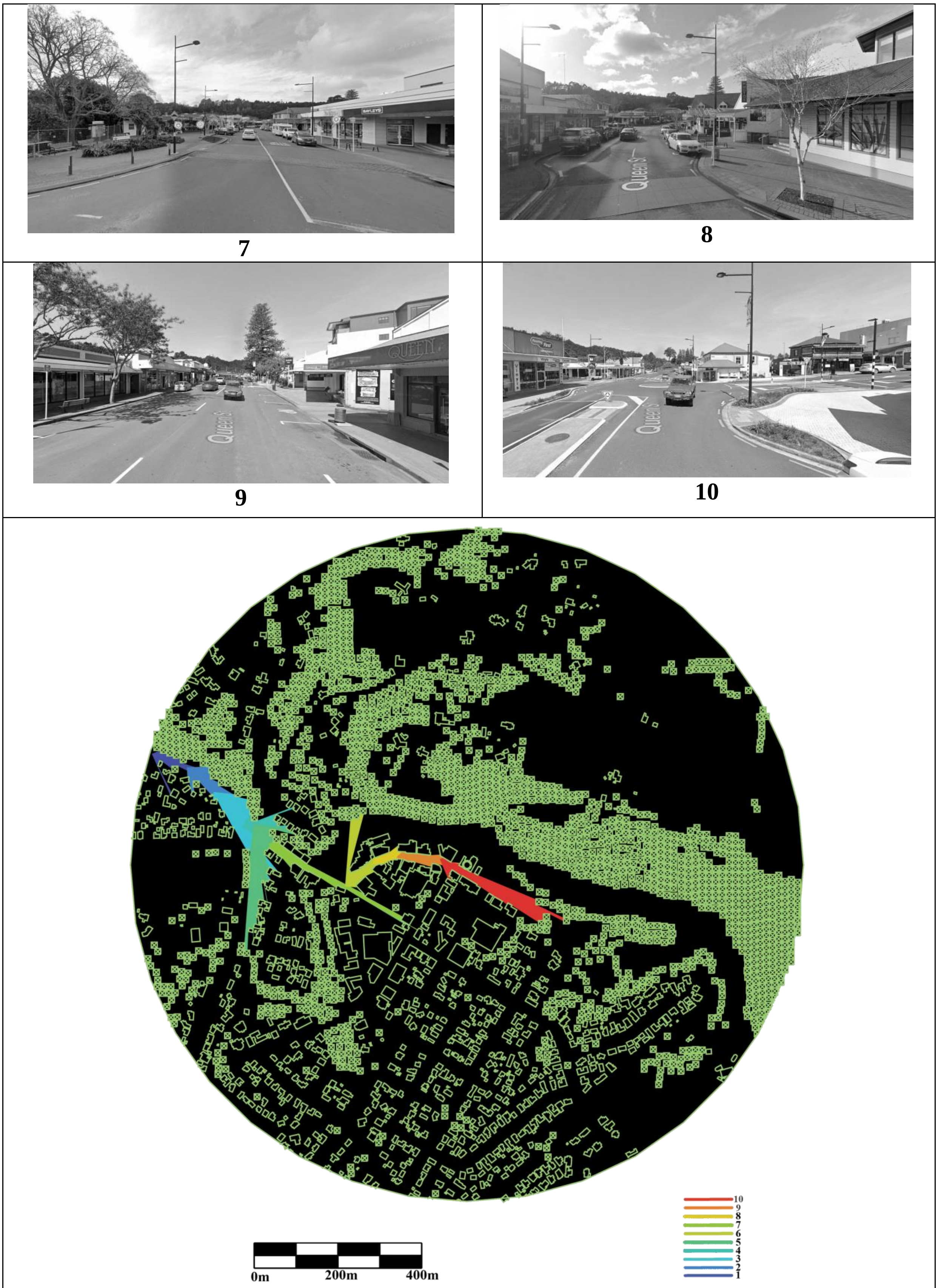
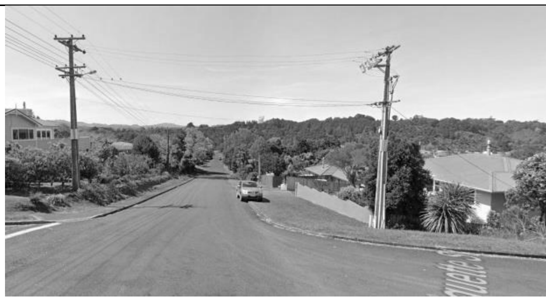



Figure 4.102: Isovist analysis by a serial vision in Warkworth suburb applying 90° isovists (by author).

The second scenario, via a serial vision with seven vision points, compared to the first scenario, takes fewer isovist points (Figures 4.102 and 4.103). Hence, the results show that while the second scenario takes a shorter path with fewer changes through the superficial impressions than the first scenario, there is a longer route by the first scenario, which starts at Coquette Street and ends at Baxter Street, making more changes via the surface impression as the diversity of vision fields from one isovist spot to another is coming through. The changes noted above are more highlighted when larger spots like intersections and crossroads are located along each route (Figures 4.102 and 4.103).

| | |
|---|---|
|  1 |  2 |
|  3 |  4 |
|  5 |  6 |

**7**

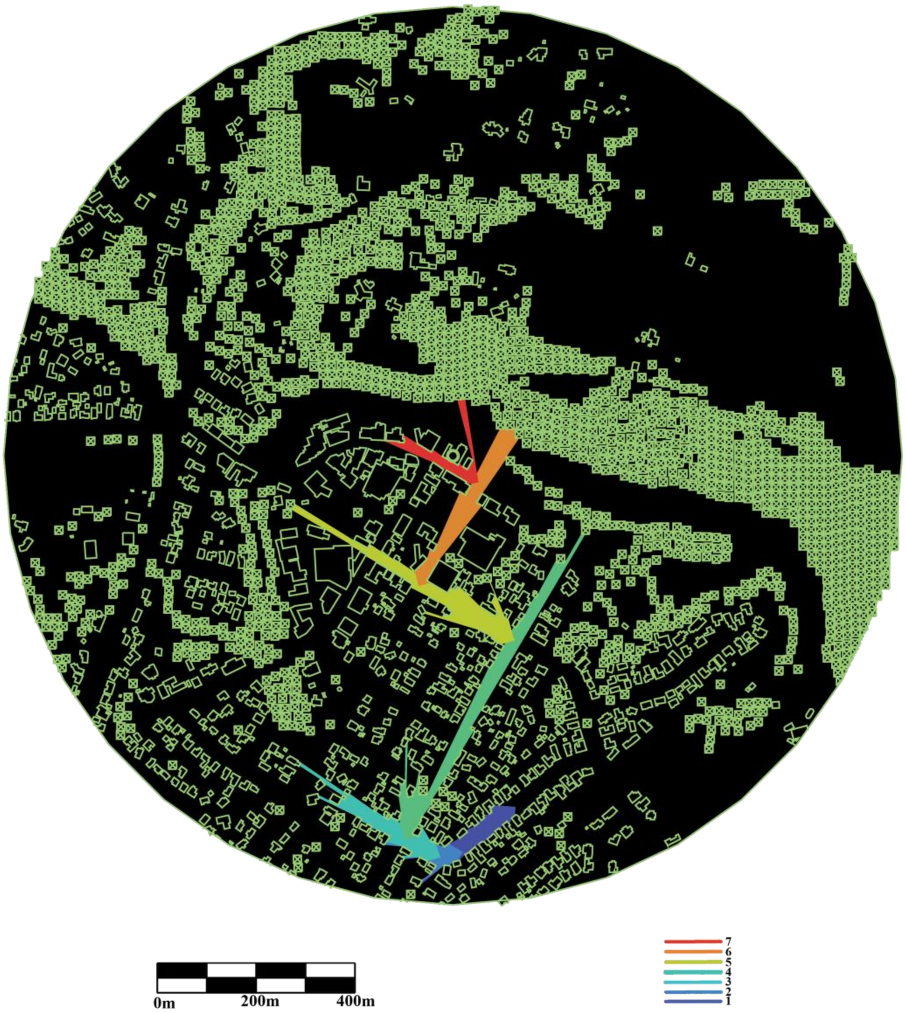



Figure 4.103: Isovist analysis by a serial vision in Warkworth suburb applying 90° isovists (by author).

#### 4.2.4.6. Visual Graph Analysis (VGA)

A rectangle with dimensions of 500 meters by 500 meters is considered a raster-based VGA analysis that is going to be implemented. As usual the procedure has been taken for VGA in this study, two origin cells are planned in different locations within the chosen radius area. The first root cell is located at Baxter Street near the Warkworth public library's location, and the other cell is located at Twin Coast Discovery Highway between Queen Street and Neville Street. Accordingly, these cells will be compared to clear how each location is deeper via each origin cell's connection to other cells in the chosen area.

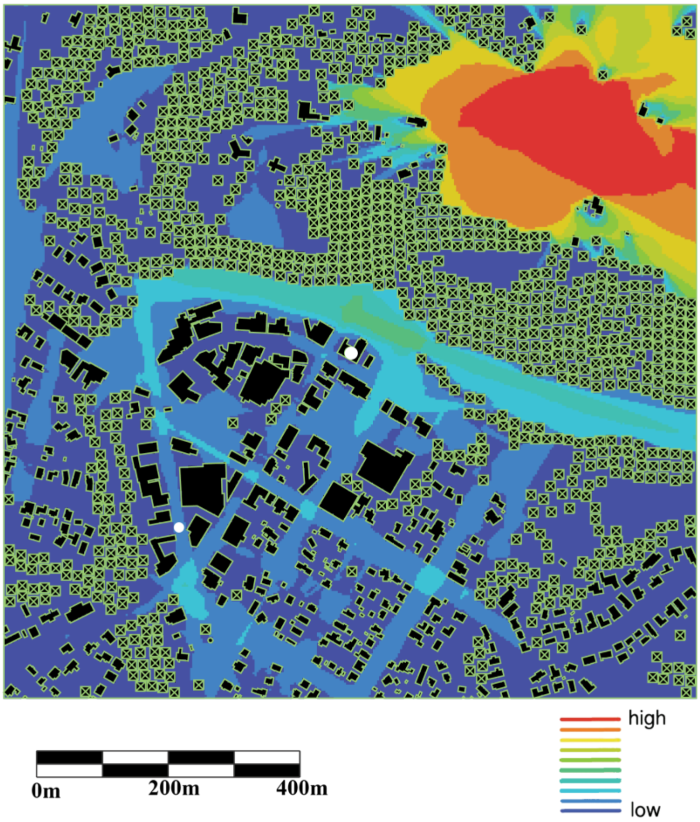
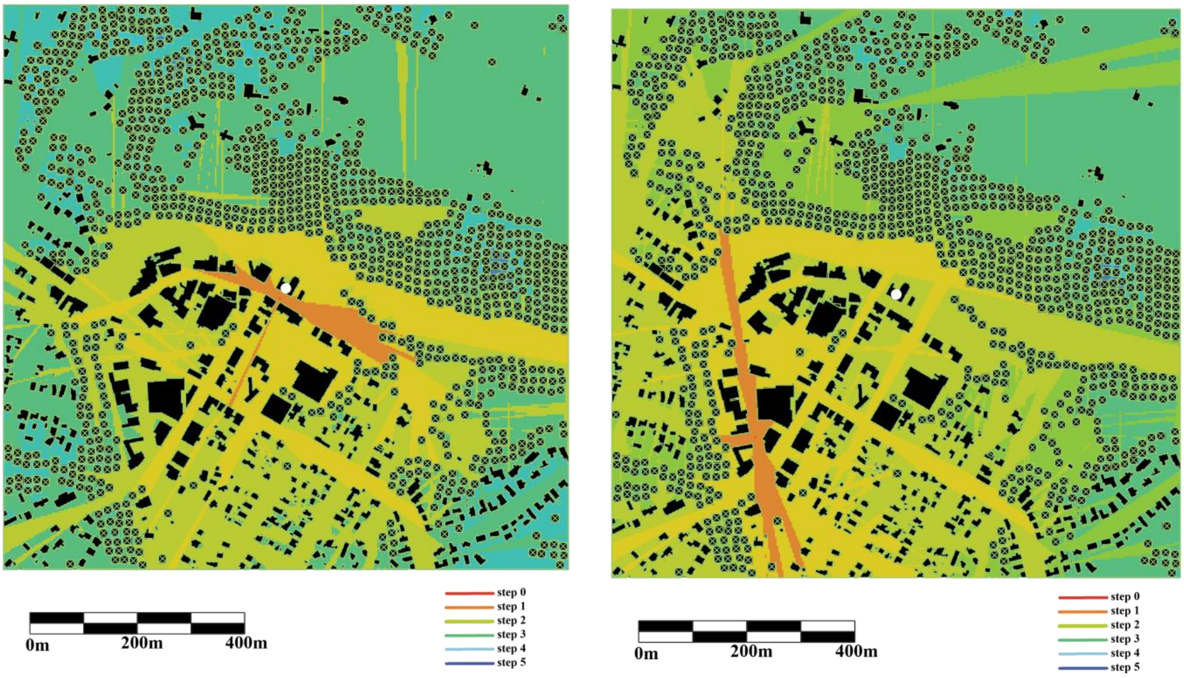



Figure 4.104: VGA study for the Warkworth suburb in Auckland (By author).

The VGA illustrates that both chosen root cells meet a similar status regarding their connection with other cells in the selected area. The weakest to the most well-connected cell in connection with other cells in the zone is shown by dark blue to red (Figure 4.104). As each cell applied an isovist accompanied by topological visibility in connection to all other cells in the selected area. Hence, a root cell in red has stronger isovist and topological visibility in relation to all other cells in the zone than a root cell in dark blue, which also shows how the dark blue area is deep while the red area is the shallowest zone.

As described previously, the "visibility step" lets us explore the extent of visibility from the origin cell's location to other cells in the selected zone. Accordingly, the analysis is applied to compare the two selected origin cells regarding the above description. With regard to the analysis, the same step value is dedicated to all cells that are visible directly.




**Root cell (A) in Baxter Street** **Root cell (B) in Twin Coast Discovery HWY**

Figure 4.105: Visibility step analysis for two different points within the Warkworth suburb in Auckland (By author)

According to the "visibility step" analysis via depthmapX, there is a higher number of directly visible cells from the origin cell (B) than the origin cell (B) (Figure 4.105). As the analysis shows, cells in one colour meet the same value, and accordingly, one step would be added once a motion is taken from one step to another. Thus, the extent of visibility would be changed because of the origin cell's position. Besides, it is needed to keep local features, buildings, and trees into account as they affect the mean depth value and also specify how the chosen zone is deeper from each of the selected origin cells. Hence, it is needed to calculate the mean depth for both scenarios (Table 4.20).

**MD = TD / K – 1**

| **Mean depth for location (A)** | **Mean depth for location (B)** |
|---|---|
| TD = 274910<br>K = 78588<br>MD = 274910 / 78588 - 1<br>MD = 3.5 | TD = 279262<br>K = 78588<br>MD = 279262 / 78588 - 1<br>MD = 3.55 |

Table 4.20: mean depth calculation for locations (A) and (B) within Warkworth (by author).

The difference in mean depth values between the two chosen spots is minor, as is obvious in Table 4.20. Hence, both main cells have a similar connection status with all other cells in the area. However, the minor difference represents that location (B) has direct visibility to 1848 cells, while location (A) has direct visibility to 1461 cells.

With regard to the result of the "through vision" analysis, cells with the longest sightlines in red are located far from the Warkworth shopping areas. Accordingly, both Baxter Street and Twin Coast Discovery Highway are deprived of the longest sightlines as both are in the blue-coloured area (Figure 4.106). The "through vision" analysis via depthmapX represents that location (A) at Baxter Street with the value of 81934 is lower than location (B)'s value of 186099; the values of both locations are highly less than the spot in the red-coloured area with the value of 1473678. Hence, having the value of "through vision" can assist in exploring how a sightline from an origin is long enough to make public locations like social infrastructure such as public libraries visible.

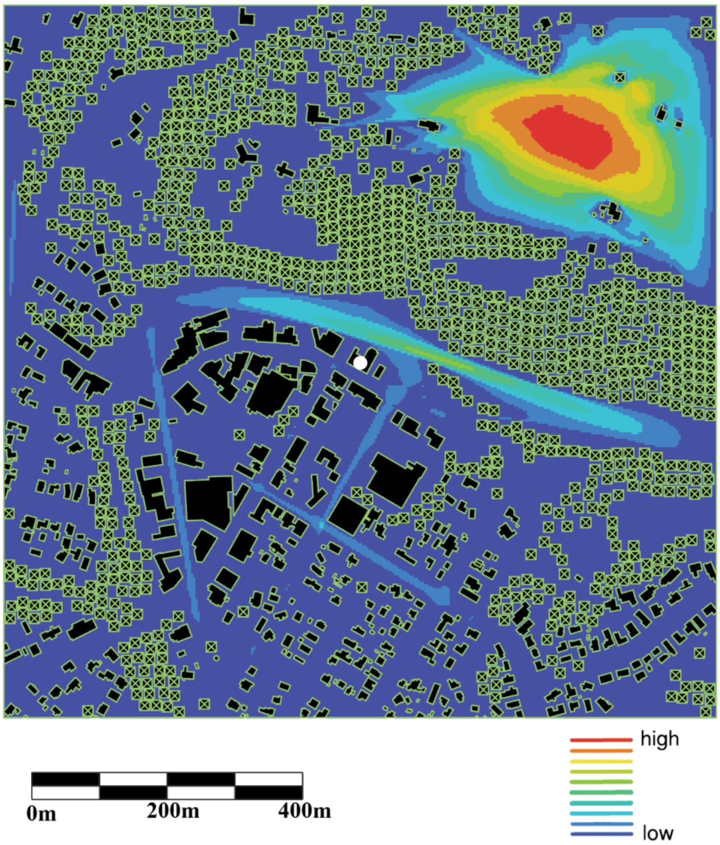
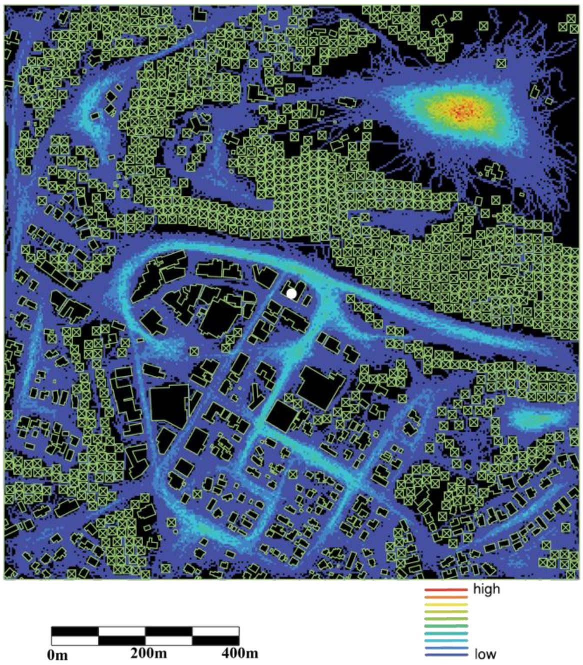



Figure 4.106: Through vision analysis within the Warkworth suburb in Auckland (By author)

#### 4.2.4.7. Applying the Agent-Based Modelling

By applying depthmapX to agent-based modelling, it would be analysed how people trace linearity on their track from where they start to their destination, accompanied by the minimum angular deviations. Similar to the last three analyses of agent-based modelling, a specified number of agents are designated via depthmapX that are distributed identically in a time frame to collect their tracks in the chosen area within the Warkworth. Three scenario analyses are planned via depthmapX: the agent as an average person (Figure 5.08), the agent as a visitor or tourist (Figure 5.09), and the agent as a local (Figure 5.10). A fixed number of



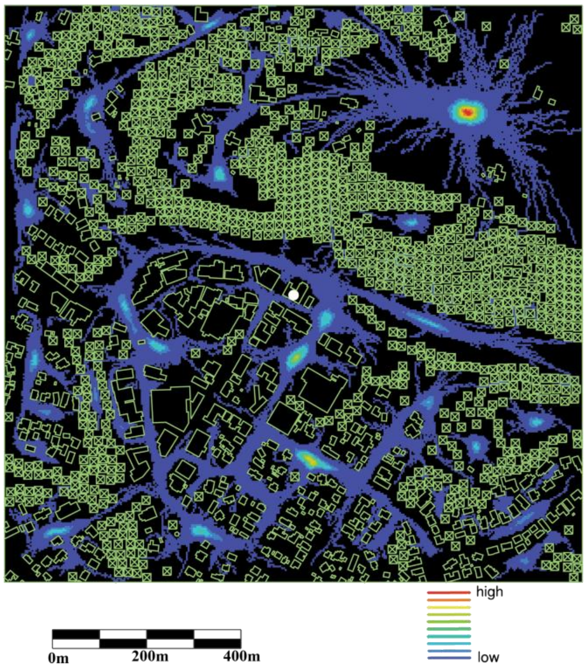




Figure 4.107 The agent as an average person Figure 4.108 The agent as a tourist or visitor (By author)

five thousand agents is planned through each scenario analysis. Meanwhile, there are different syntactic steps and vision fields for each scenario analysis, which make up three different movement patterns. Accordingly, the first scenario is accompanied by a 15° vision field on three syntactic steps; the second scenario includes a 30° vision field on one syntactic step; and finally, the third scenario takes a 7° vision field on five syntactic steps.

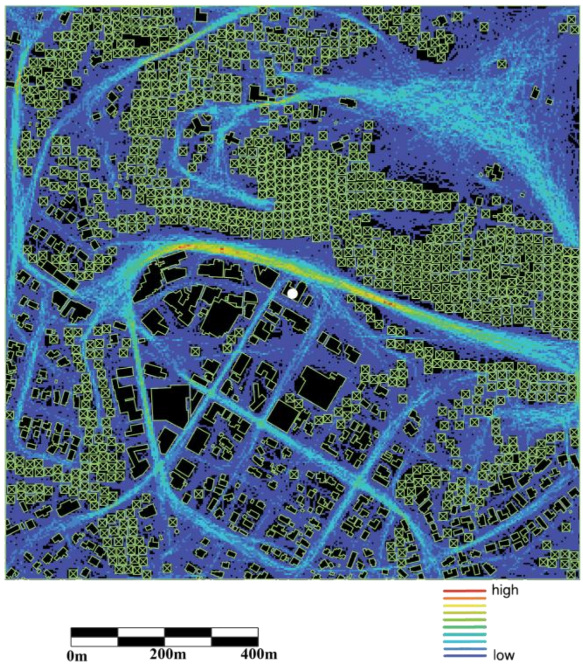



Figure 4.109: The agent as a local person (By author)

The comparison between local agents and visitors illustrates that visitors in the second scenario analysis choose a spot with the longest vision as they are not familiar with the local urban context (Figure 4.108), while local area members in the third scenario track the most straightened available travel pattern in the local zone as they are familiar with the local urban context (Figure 4.109). In a nutshell, the comparison of the above scenario analyses illustrates that while visitors concentrate on exploring the highest integration spot of "through vision" with the longest vision, local community members trace a motion pattern that is almost aligned with angular choice analysis.

### 4.3. Comparative analysis between selected regions

This section is going to concentrate on comparative analyses, including five sections: connectivity analysis, integration analysis, choice analysis, scatterplots, and VGA. The four streets of Massey Street in Pukekohe, Stanley Street in Parnell, Kell Drive in Albany, and Baxter Street in Warkworth are the main routes that will be compared, as four selected public libraries' locations are located within these streets.

#### 4.3.1. The comparative review of connectivity analysis results

In this section, four selected main streets will be compared via four different types of topological step analysis within the same selected 800-meter radius in each suburb.

##### 4.3.1.1. Comparison via One-Step Analysis

The comparative assessment via the first type of topological step analysis, which is a one-step analysis, illustrates that there are considerable differences among the four main streets regarding the number of connections between the main streets and their immediate adjacent streets.

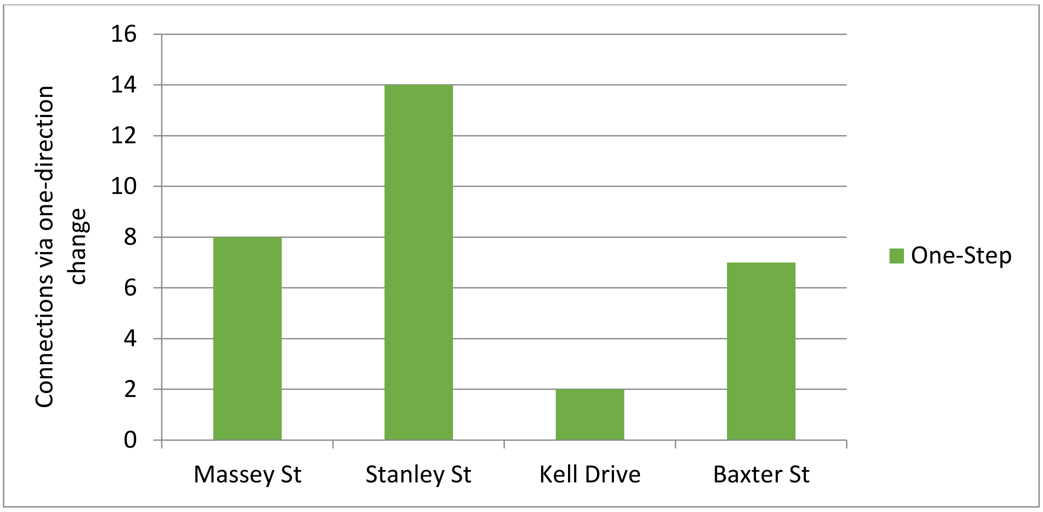



Chart 4.1: Comparative assessment over four main streets via One-Step analysis (by author).

The comparative assessment shows that Stanley Street meets the highest number of connections with its immediate adjacent axial lines, which makes it more connected to its surroundings compared with the other three main streets (Chart 4.1). Accordingly, Massey Street, Baxter Street, and Kell Drive stand on the next lower ranks, respectively. With that being said, Stanley Street in the Parnell suburb has a higher density because it is better connected than other main streets within other neighbourhoods in the selected 800-meter radius. Hence, the system in the selected zone in Parnell has a shallower status than the other three suburbs.

#### 4.3.1.2. Comparison via Two-Step Analysis

The connectivity analysis under the comparative assessment, through a two-step procedure, illustrates the most accessible axial lines via two direction changes from each of the four main streets where the four chosen public library locations are located.

Massey Street meets the highest number of connections with two direction changes (Chart 4.2). According to Hillier (1999, p. 119), streets that by ‘two-step grid’ cover an urban street network in short metric spaces are mostly a zone's local streets, including essential functions and activities such as shopping centres, community centres, medical centres, etc. Having said that, Massey Street has more connections with other streets via a ‘two-step grid' within the selected area in the Pukekohe suburb compared to the other three main streets' connections status, accompanied by more density of the streets within a 'two-step grid' including short metric distances, which is a matter for Hillier. Hence, such an evaluation makes clear the extent of the connectivity and accessibility of a local street, which includes shopping centres and social activities in its neighbourhood.

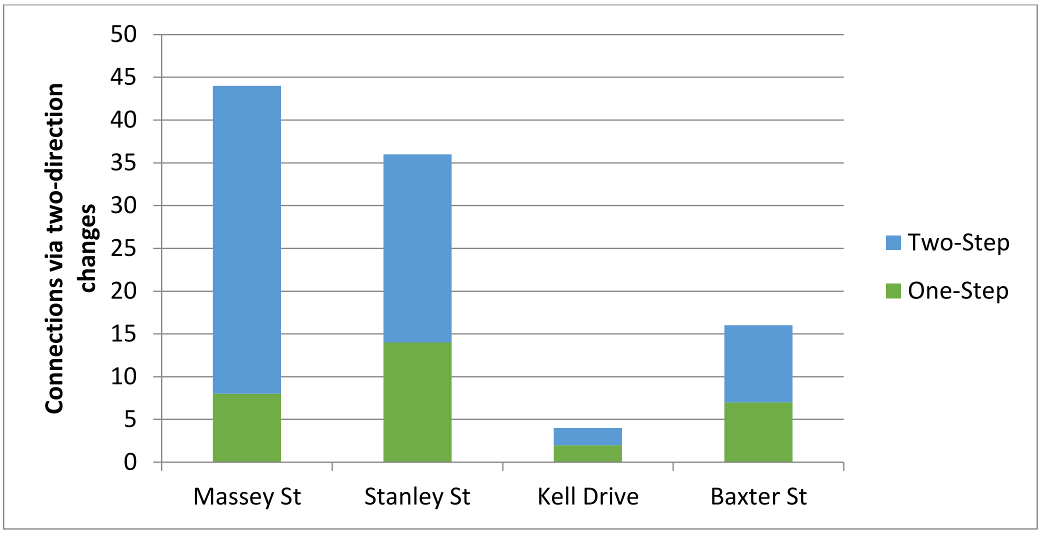



Chart 4.2: Comparative assessment over four main streets via Two-Step analysis (by author).

### 4.3.1.3. Comparison via Three-Step and N-step Analyses

With one more direction change through a 'three-step grid' analysis, the comparative assessment shows that Stanley Street at Parnell has more connections to all accessible streets within three direction changes than the other three main streets in the same 800-meter radius within the chosen suburbs (Chart 4.3). Therefore, by 'three-step grid', the specified area within the Parnell neighbourhood meets a higher density and also topologically shallower system than the other three suburbs.

As N-step analysis shows how topologically deep all accessible axial lines are in relation to a main street, Stanley Street is connected by the highest number of axial lines via N-step analysis with twelve syntactic steps. Accordingly, the comparative chart illustrates that many axial lines in the selected area within Parnell are topologically deep in relation to Stanley

Street (Chart 4.3). With that being said, although the selected area in the Parnell suburb meets a higher density than the other three suburbs, there are many streets in the chosen zone within Parnell with topologically deep status as they need six to twelve direction changes to reach Stanley Streets.

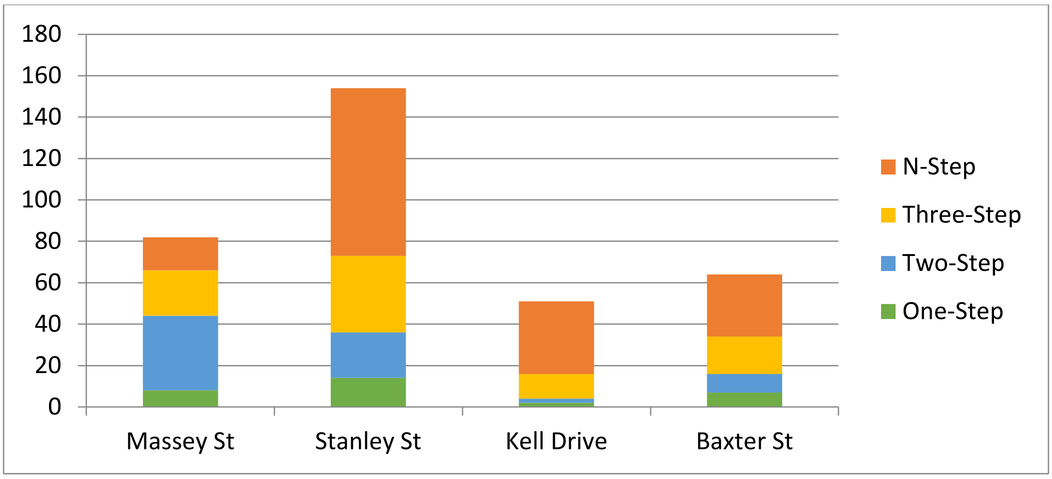



Chart 4.3: Comparative assessment over four main streets via three-step and N-step analyses (by author).

#### 4.3.2. The comparative review of Integration analysis results

As integration analysis focuses on how the origin street or space is close to all other streets or spaces, this section keeps the above background and, accordingly, spreads the analysis into two comparative analyses: global and local.

##### 4.3.2.1. The comparative review of Global Integration analysis results

The comparative scheme in global analysis considers the differences among the four selected streets regarding the degree of each street's accessibility to all other streets in the chosen urban system, taking into account the number of direction changes within that urban scale, according to Hillier (1996, p. 47). In the meantime, the above analysis shows how any of the four origin streets is spatially more integrated in relation to all other streets in its selected zone.

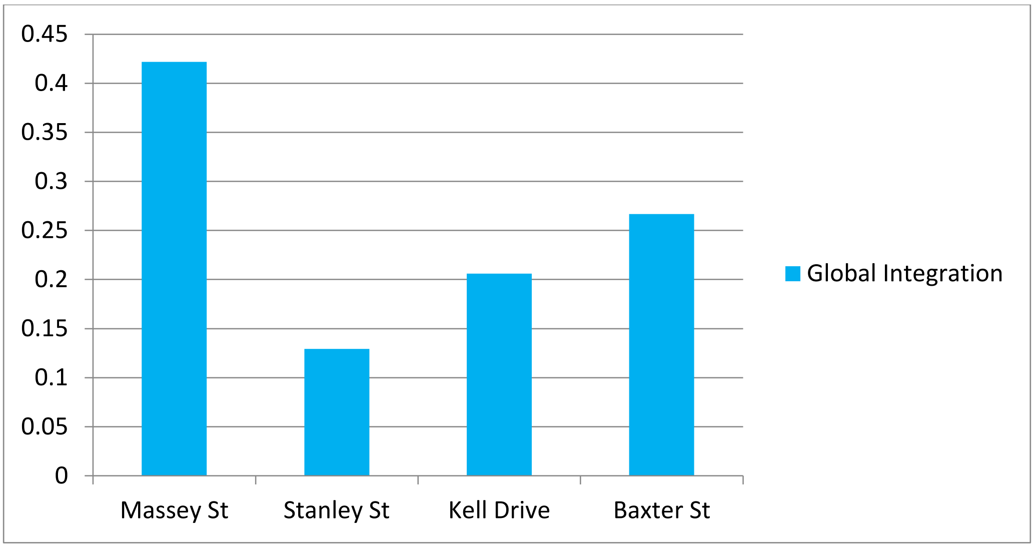



Chart 4.4: Comparative assessment of four main streets via global integration analyses (by author).

The comparative assessment illustrates that Massey Street within the Pukekohe suburb meets the highest global integration value, which means that Massey Street as a public urban space is connected more easily to other public urban spaces in its selected zone compared to the other three main streets (Chart 4.4). Hence, the assessment result shows that Massey Street has relatively lower direction changes to reach all spots in the selected area compared to the

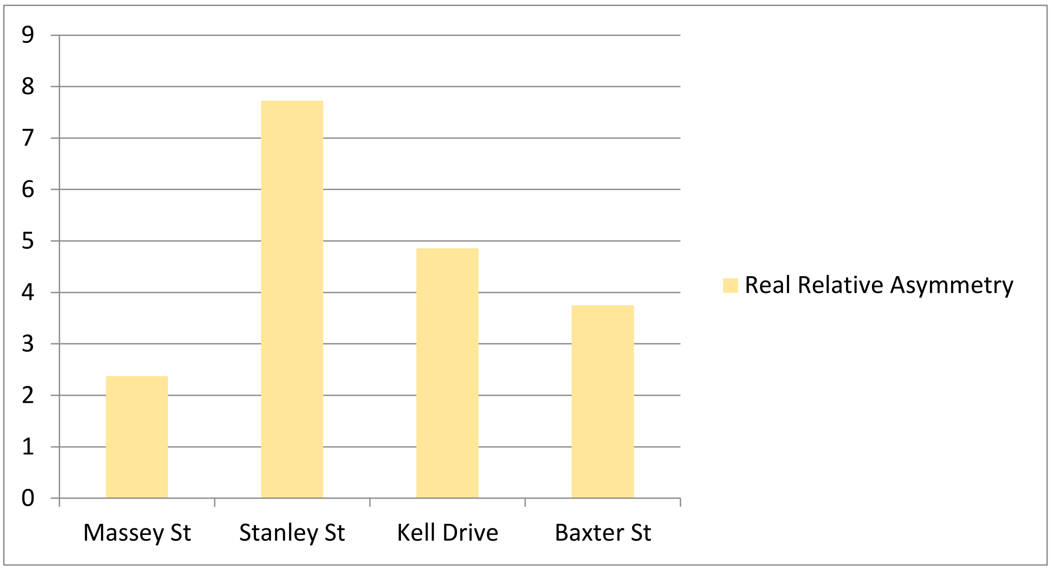



Chart 4.5: Comparative assessment of four main streets via Real Relative Asymmetry values for global integration analysis (by author).

other three streets' status. That is why Massey Street meets the highest global integration value in this comparative assessment. In contrast, Stanley Street within the Parnell suburb meets the lowest global integration value (Chart 4.4), which indicates that the street required many direction changes to reach many locations in its selected urban area. With that being said, Massey Street meets the lowest real relative asymmetry (RRA) value compared to the other three streets, which means the lowest depth and, accordingly, the highest activity and lower segregation, in contrast to the other three streets' status, specifically Stanley Street, with the highest RRA in this comparative assessment (Chart 4.5).

#### 4.3.2.2. The comparative review of Local Integration analysis results

As with the comparative assessment over four chosen main streets through the global system, the comparative assessment through the local system tracks the same procedure. However, a topological radius of three is employed, as it indicates the number of syntactic steps. Hence, three syntactic steps mean two direction changes that include the starting point for the radius of three. The reason for having the topological radius of three for the local system in the same selected 800-meter radius is the status of the local urban centres in the global system, which is almost highlighting poorly, which makes for low global integration values but higher values of local integration in the local system analysis.

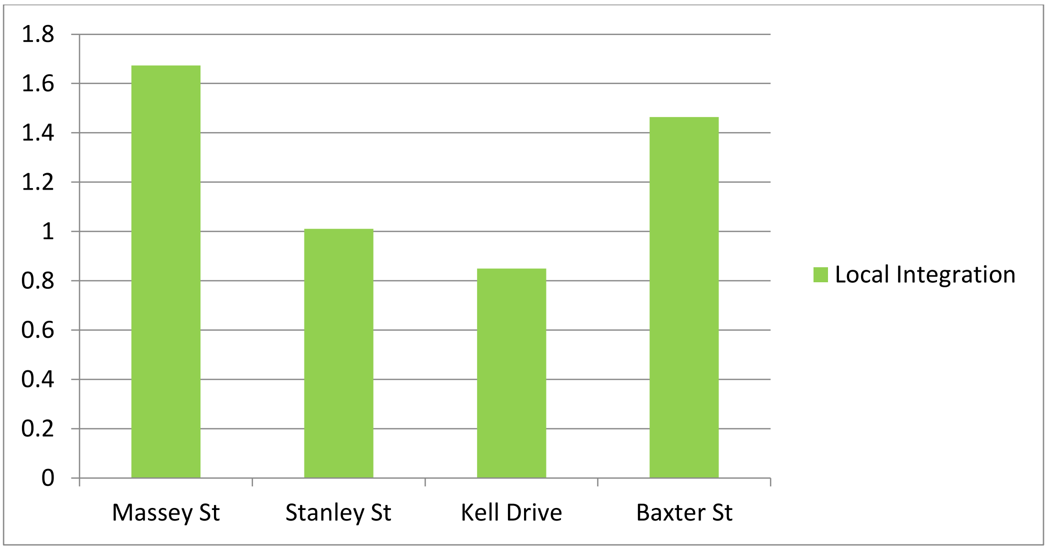



Chart 4.6: Comparative assessment of four main streets via local integration analyses (by author).

By comparative assessment, Massey Street meets the highest local integration value, which shows Massey Street is well connected to other streets or public urban spaces within the chosen area in Pukekohe compared to the other main three streets in different suburbs (Chart 4.6). In the meantime, the integration value is higher in the local system than the global system because the local urban centres are highlighted stronger in the local system than the global system, as previously mentioned. Having said that, the total depth, or the number of streets or spaces passing through Massey Street with up to two direction changes within three syntactic steps, is higher than the total depth for each of the other three main streets within their system in the same 800-meter area but within different suburbs. In contrast, Kell Drive, with the lowest total depth, has the lowest number of streets passing through it. Accordingly, Massey Street meets the lowest (RRA) value among the four selected main streets, which indicates the lowest depth for Massey Street along with the highest activity and lower segregation, while Kell Drive with the highest (RRA) value is positioned against Massey Street (Chart 4.7).

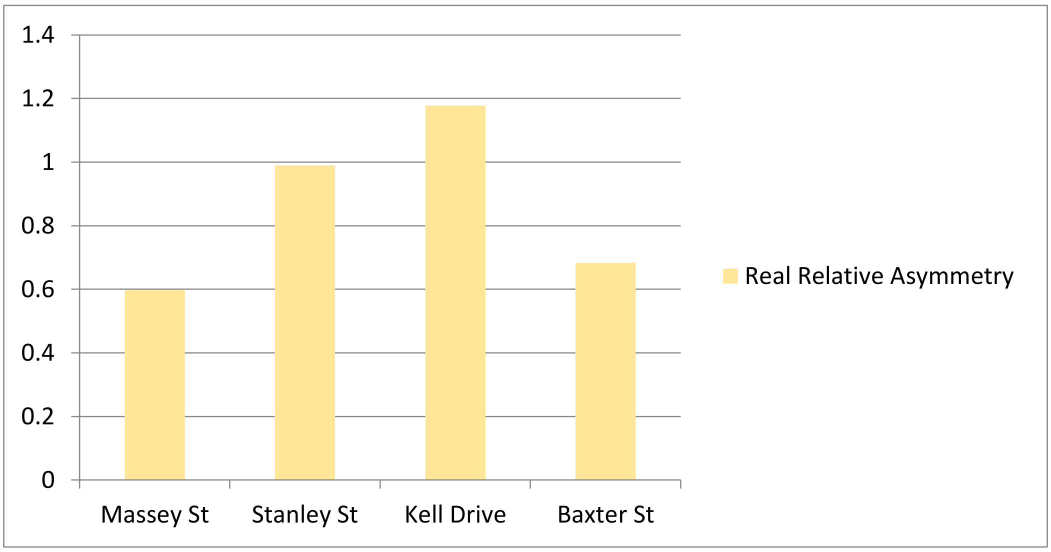



Chart 4.7: Comparative assessment of four main streets via Real Relative Asymmetry values for local integration analysis (by author).

### 4.3.3. The comparative review of Choice analysis results

A comparative review through choice analysis over the four selected nodes in Auckland with a focus on the four selected streets in each of the noted areas lets us explore how likely it is that, by a comparative procedure, any of those streets will be chosen by people as part of their travel. The value of the angular choice analysis for each street is a witness to the extent to which people have the opportunity to choose the straightest route between their departure from the start spot and arrival at the destination. Accordingly, two groups of charts, including four indicators, are considered for the area of 800-meter and 8000-meter radii (Charts 4.7 and 7.8).


Chart 4.7: Comparative assessment of four main streets via Choice analyses (800-meter radius) (by author).

The angular mean depth is the priority in the choice analysis, as it highlights the depth value of each street or space according to how many streets or spaces are away from the main street or space. With that being said, two indicators of the number of segments or nodes (K) and the total depth (TD) of the angular weights from segments are necessary for the angular mean depth value. With regard to Chart 4.7, Kell Drive in Albany suburb with the lowest number of segments (K) has the lowest total depth of the angular weights from segments, which leads to the highest value of mean depth and, accordingly, the lowest angular choice value among the other four streets in the 800-meter radius. In contrast, Stanley Street in Parnell with the highest number of segments (K) has the highest total depth of the angular weights from segments, which leads to a lower mean depth value and, therefore, the highest angular choice value on the same 800-meter radius scale. Hence, Kell Drive meets with a deeper status than the other three selected streets, and accordingly, Kell Drive is placed at the lowest position that people would choose as part of their travel in the selected area.


Chart 4.8: Comparative assessment of four main streets via Choice analyses (8000-meter radius) (by author).

By following the above procedure, the comparative assessment in the 8000-meter shows that Kell Drive with the highest number of segments (K) accompanies the highest total depth of the angular weights from segments, which leads to the lowest angular mean depth value. In the meantime, Kell Drive meets the lower angular choice value that witnesses the difference of such background streets in contrast with foreground roads. In comparison, Baxter Street with the lowest (K) and the lowest (TD), meets the highest angular mean depth. Accordingly, Baxter Street meets the lowest angular choice value. Hence, Baxter Street faces with a deeper status than Kell Drive and the other two selected streets. Accordingly, Baxter Street is not a popular street to regularly choose as part of people's travel in the selected zone of Warkworth.

### 4.3.4. The comparative review of Scatterplot analysis results

The linear correlation coefficient value is concentrated over the following comparative assessment among the four selected streets. The comparative scheme includes intelligibility, permeability, and movement interface, which were involved previously in the four analyses and were analysed individually by considering the two variables in each of the above indicators.

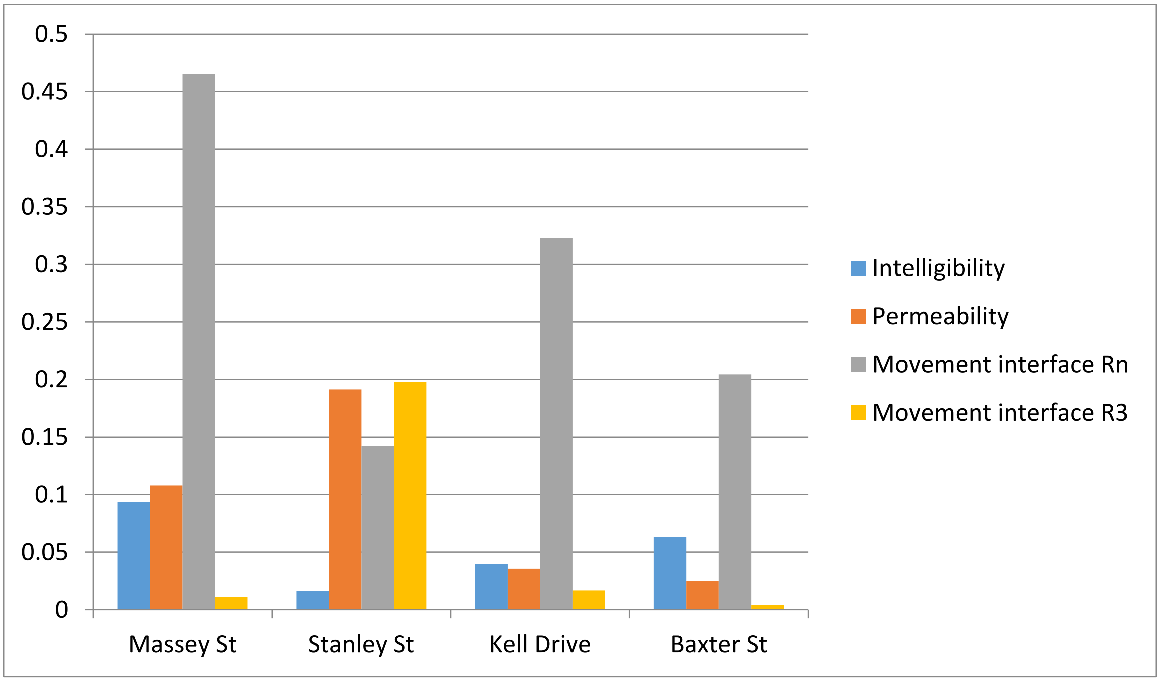



Chart 4.9: Comparative assessment of four main streets via correlation coefficient (by author).

With regard to chart 4.9, the intelligibility indicator shows that Massey Street and Baxter Street meet higher correlation coefficient values, respectively, than the other two streets. With that being said, syntactic measures of both topological connectivity and axial global topological integration meet a stronger status for Massey Street and Baxter Street than the other two streets. However, all four streets still meet relatively weak correlation coefficient values.

The indicator indicates that Massey Street and Stanley Street have higher correlation coefficient values than the other two streets (Chart 4.9). This result means that syntactic measures of line length and connectivity meet higher values for Massey Street and Stanley Street in the comparative assessment. Having said that, almost all streets still face weak correlation coefficient values.

The final assessment is focused on the "movement interface." Massey Street and Kell Drive meet higher correlation coefficient values than the other two streets on the global system (Chart 4.9), which means syntactic measures of global integration and global choice meet higher values for the noted streets compared to the other two streets. In the meantime, correlation coefficient values for both Massey Street and Kell Drive are near moderate levels; however, the other streets are still weak.

The "movement interface" on the local system indicates that Stanley Street has the highest correlation coefficient value among the four streets (Chart 4.9). In other words, syntactic measures of local integration and local choice meet higher values for the noted street in comparison with the other three streets. However, almost all four streets still have relatively weak correlation coefficient values.

As previously mentioned, the reviewed "movement interface" is an important indicator, as social interactions among people are crucial for this study's research according to its objectives. Hence, the correlation coefficient value can show the extent of social interactions in each selected area among people.

#### 4.3.5. The comparative review of “visibility step” and “through vision” analysis results

The "visibility step" analysis in a comparative assessment allows us to compare the four selected origin cells' locations in the four main streets regarding the extent of visibility from each of the noted locations to other cells' locations within the four selected areas. The results are achieved via depthmapX, as previously described for each location comprehensively. Accordingly, mean depth values are under focus through the following comparative review, as the extent of visibility would be changed because of the origin cell's position when a motion is taken from one step to another. In the meantime, local features, buildings, and trees have direct impacts on the above procedure.

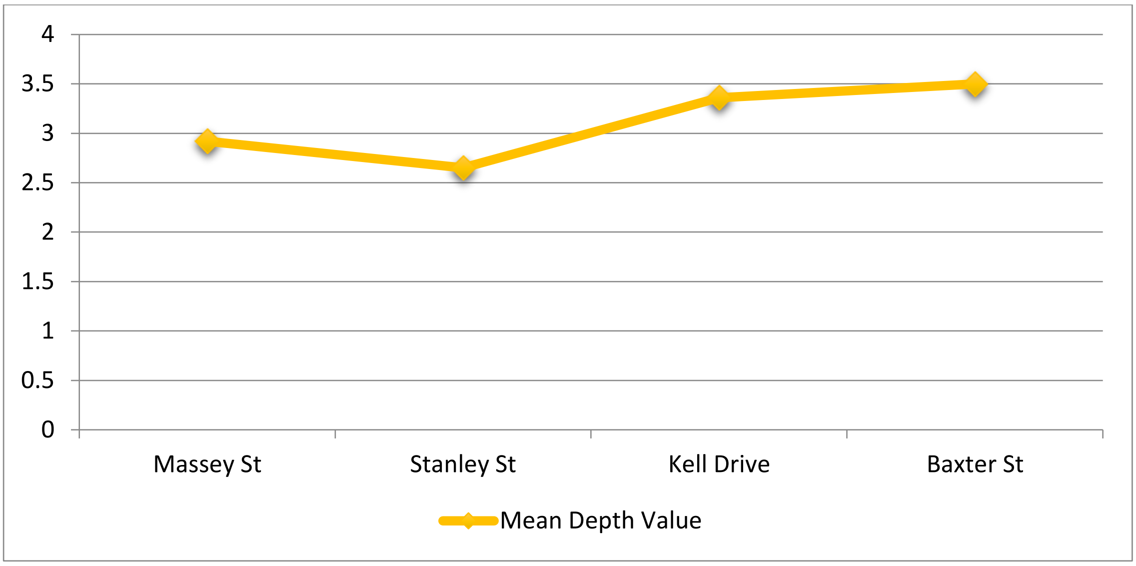



Chart 4.10: The comparative review of "Mean depth" values of selected locations within four chosen streets in the 800-meter radius (by author).

According to Chart 4.10, the selected spot at Baxter Street embraces the highest mean depth value compared to the other three origin cells' locations. In other words, the chosen area in Warkworth is deeper from the selected origin cell at Baster Street than the status of the other three locations at the other selected streets. In contrast, the cell's location at Stanley Street meets the lowest mean depth value in comparison with the other three streets, which confirms a shallower status from the origin cell to all other locations in the selected area within the Parnell suburb. With regard to the above, the location at Stanley Street is reachable more easily in the selected zone than the other three chosen locations within the areas where they are located.

Accordingly, the comparison via "through vision" values illustrates that the origin cell at Stanley Street has the highest "through vision" value compared to the other three selected cells within different areas (Chart 4.11). With that being said, the noted location at Stanley Street has the longest sightline in comparison with the other three noted locations in different areas. In contrast, Kell Drive meets the lowest value of "through vision," which means the weakest vision line compared to the other three noted cells' locations within different areas (Chart 4.11). With regard to the above, as all four specified locations within different areas are located just in front of selected public libraries, the "through vision" value is important because of the connection between the visitors and/or community members' vision lines and public libraries that has a direct relation to the objectives of this research study.

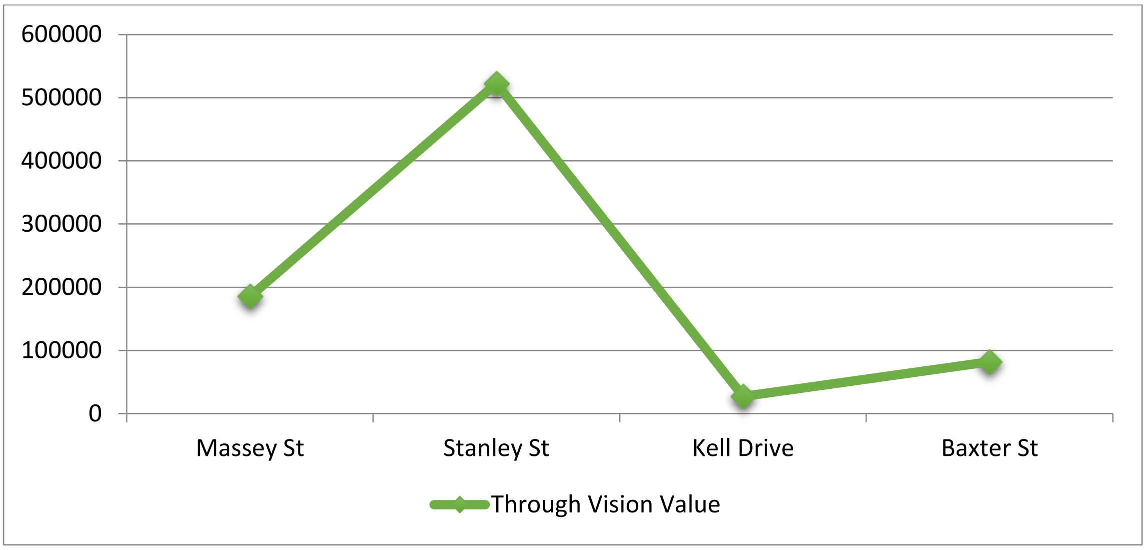



Chart 4.11: The comparative review of "Through Vision" values of selected locations within four chosen streets in the 800-meter radius (by author).

With regard to the depthmapX analysis via "through vision" analysis, a cell's location within the Warkworth suburb embraces the longest vision line. However, the location of the represented cell is not near the social activities zone within the Warkworth suburb (Chart 4.12), which was previously analysed comprehensively in the section "4.2.4.6." In contrast, a cell's location within Parnell Street meets the shortest vision line compared to the other three cells' locations (Chart 4.12). Hence, the above analysis illustrates that there is a considerable difference in "through vision" value between the selected cell's location just in front of each selected public library's location in each of the four selected areas and the cell's location with the longest vision line in the same areas.

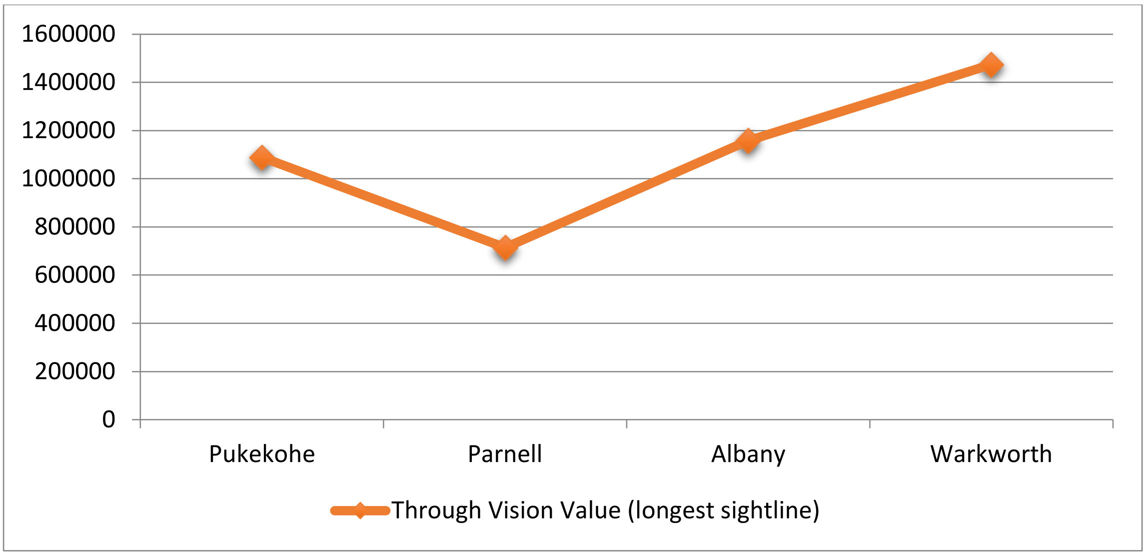



Chart 4.12: The comparative review of "Through Vision" values of longest sightlines in the 800-meter radius within four selected suburbs (by author).

According to all individual analyses, including connectivity analysis, integration analysis, choice analysis, diverse analyses of visibility, and also the comparative assessment among all four selected locations, it is necessary to explore the strengths, weaknesses, opportunities, and threat factors for all four selected locations within the four different areas in Auckland. Accordingly, the conclusion could be provided in a SWOT frame in the next chapter.

# Chapter 5.

# Urban Situational assessment of the libraries’ locations

# Chapter 5

## 5.1. Introduction

Public libraries’ spots, as locations that have the potential to boost socializing in a local context, need to be analysed and evaluated via four indicators of strengths, weaknesses, opportunities, and threats, which can provide an image of their interaction with their surrounding environment. Apart from the versatile role of the above factors' analysis in a wide range of different fields, these indicators are effective procedures for urban planning and location analysis.

The expected analysis above will be concluded in the SWOT frame. According to Grisiute et al. (2022, p. 557), SWOT analysis exposes a cognitive procedure that illustrates and evaluates the correlations between different factors of an entity across the four above-noted indicators. Accordingly, each chosen public library's location in Auckland is considered an entity, which includes internal factors associated with strengths and weaknesses. In the meantime, opportunities and threats, which are external factors, can impact the public library's location.

### 5.1.1. How is the SWOT being organized?

The SWOT analysis will consist of the four existing public libraries' locations in Auckland to provide a framework for comprehending their status, which can assist this study's objectives in forming a guideline and a model via exploring strengths and weaknesses within the selected locations, as well as opportunities and threats as external impacts to the sites' location.

The analysis of each location includes a summary of each site's location characteristics and the above-noted indicators. Accordingly, the analysis's findings for each site's location will be structured into the SWOT as a beginning stage toward creating the initial model to meet this research's objectives.

### 5.2. A general overview on different zoning within Pukekohe

The different zoning according to Figure 5.1, the opportunity sites, and the zoning within the Pukekohe illustrate the intentions toward general growth in this part of Auckland. Accordingly, with regard to the Pukekohe Area Plan, "Pukekohe will be a vibrant and dynamic satellite town offering a range of employment and residential opportunities, with transport connections, infrastructure, open space and recreation facilities, and a thriving local economy" (Auckland Council, 2014, p. 12).

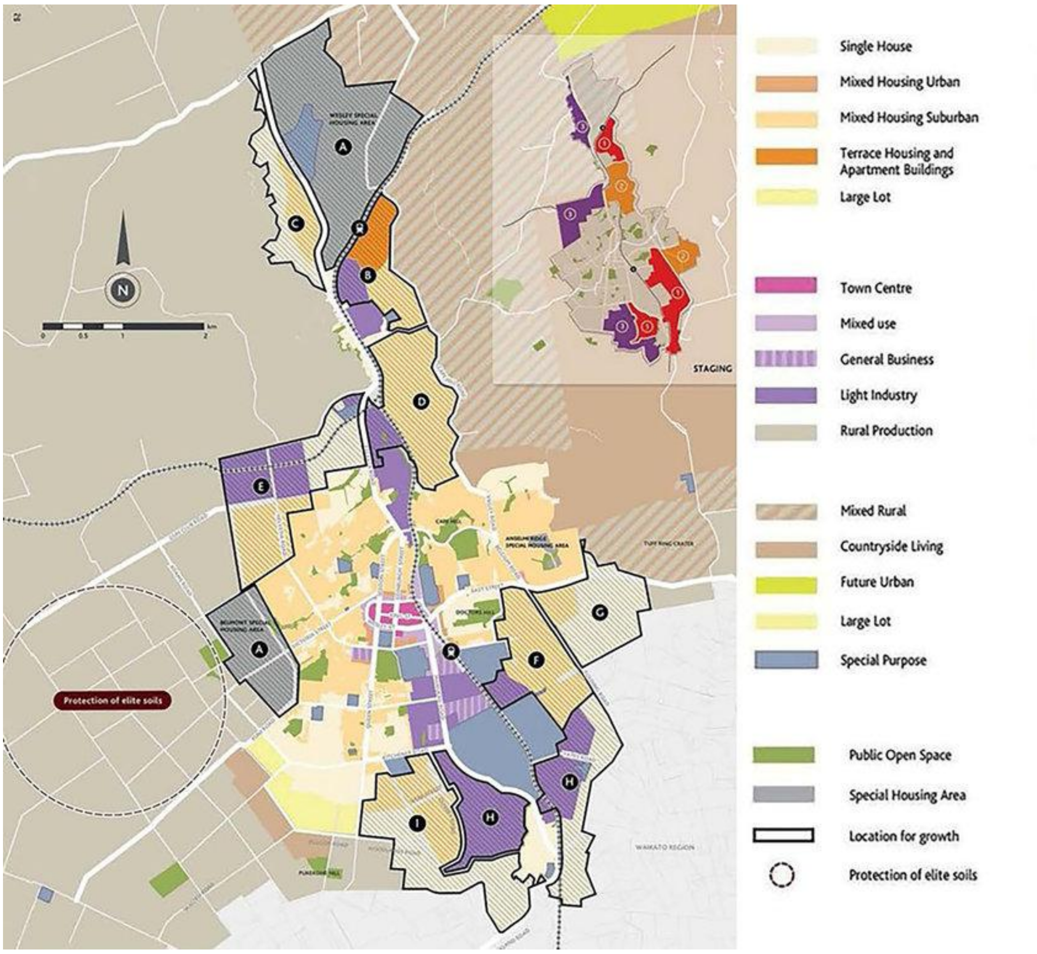



Figure 5.1: Map of Pukekohe and different land use zoning (Auckland Council, 2017, cited in Silva, 2018, p. 8)

One of the key challenges within Pukekohe suburb is providing sufficient and safe local public transport, which can increase convenience in the community and accordingly increase the incentive to let the local members attend public events and spaces, whether they are within vehicle distance. According to Auckland Council-Eke Panuku Development Auckland (2023, pp. 18–43), there are not enough transport options, and as some areas within Pukekohe do not have access to public transport, as do other parts of Franklin District, it is not safe and convenient to travel to the central areas of Pukekohe, whether by public transportation or by foot or bike. Therefore, such an unreliable public transport network is a challenge for those who cannot drive.

### 5.2.1 Overview of the characteristics of the Pukekohe public library's site

#### 5.2.1.1. Physical qualities

The site is located on Massey Avenue. In the meantime, there is parking at the back of the site, which is accessible from Edinburgh Street. The indicative area is 4639 square meters, according to the land record search via the online interactive map (Land Information New Zealand, 2024). According to the online interactive map (Auckland Council's Flood Viewer, 2024) (Figure 5.2), this site is located above the flood plain; however, there are a few "overland flow paths."

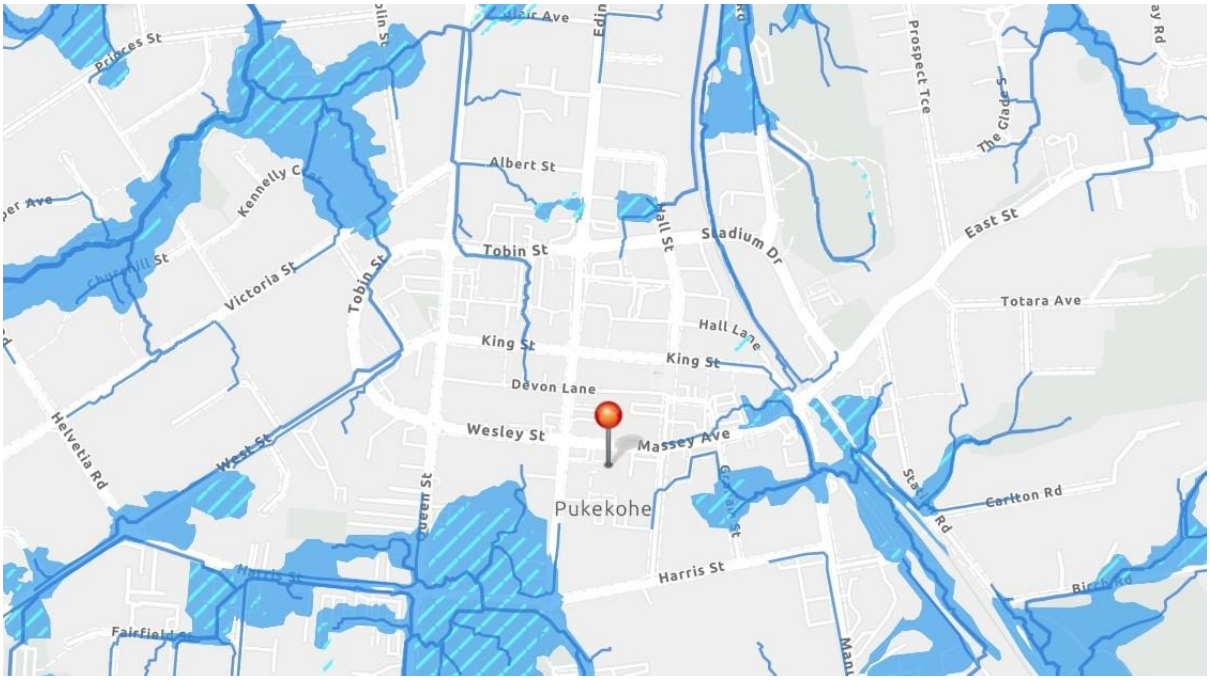



Figure 5.2: Flood viewer of the central zone within Pukekohe (Auckland Council's Flood Viewer, 2024)

#### 5.2.1.2. Zoning considerations

The selected site is located within the Pukekohe central zone. According to Section Business-Town Centre Zone of Chapter H of the recently updated Unitary Plan of Auckland Council (2024, p. 1), the Business-Town Centre Zone applies to the central zones of Pukekohe, as well as suburban centres all over Auckland, the central zones of Warkworth, and the rural areas of Helensville and Wellsford. Accordingly, Massey Avenue, as part of the central zone within Pukekohe, is included in the above circumstances. Hence, the central zone of Pukekohe encompasses some different considerations, which, according to Auckland Council-Eke Panuku Development Auckland (2023, p. 39) and Auckland Council-Panuku Development Auckland (Panuku) (2019, 66), include:

- Buildings within town centres such as Pukekohe are limited to a height variation control of 18m, which is around 5 to 6 levels.
- The building frontages are faced with controls all over the central areas. Accordingly, the aim of the controls is to increase activity within the streets and make sure of buildings' continuity throughout the street front, which has a direct link with Constitutedness which, according to Hillier and Hanson (1984, p. 92), illustrates the degree of adjacency and permeability from buildings to public areas. Thus, the degree of Constitutedness is very dependent on the adjacency of buildings' entrances and windows, which determine their connectivity and visibility to the street. In the meantime, the controls are making sure to boost pedestrian amenity and safety.
- The Unitary Plan encompasses some special provisions to protect the traditional character of the main streets in Pukekohe.
- The Unitary Plan has various approaches regarding parking in Pukekohe compared to the most central area in Auckland. As Pukekohe is recognized as a satellite centre, a minimum number of places are required for activities.

## 5.2.2. SWOT Analysis

### 5.2.2.1. Strengths

- The site of the library is located in Pukekohe Business - Town Centre Zone. Adjacency of the selected site to the central zone means higher access to the social zone compared with other areas within the Pukekohe, which boosts the occasion for the potential of redeveloping the library in the form of social infrastructure, which is the main objective of this study.
- The site is adjacent to the AT bus lines, with nearby stops (Figure 5.3). The locations of bus stations let the public have easier access to the library location, which is a supportive feature for the redevelopment of the library, specifically when socialization is an objective.

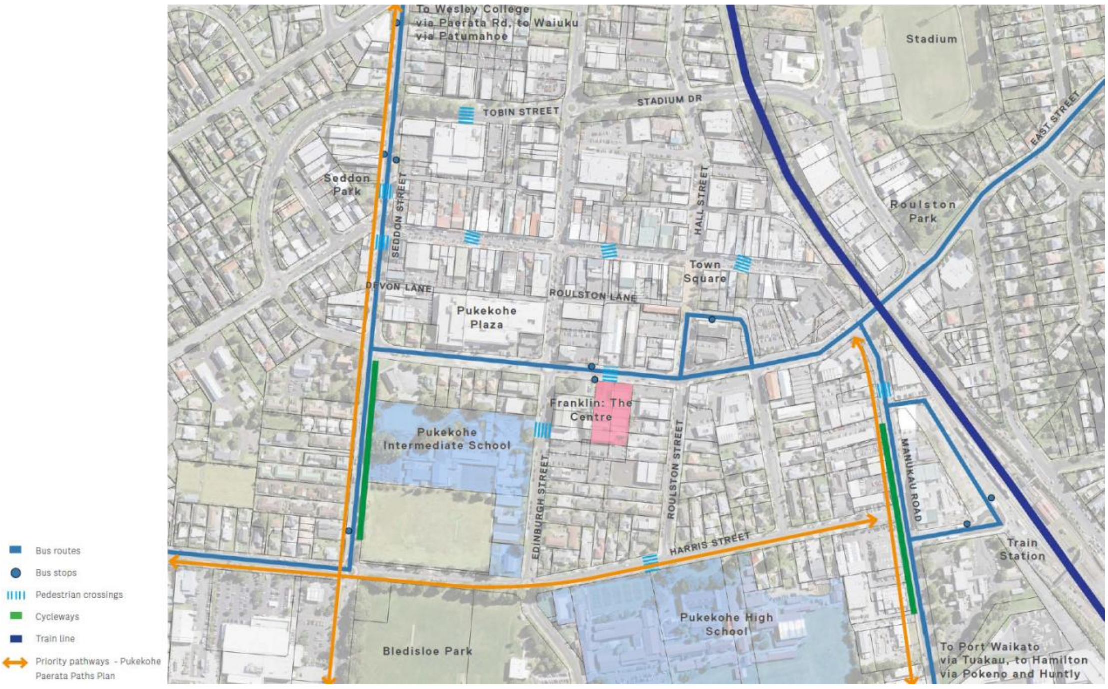



Figure 5.3: Pukekohe central area, public transportation network map Auckland Council, Eke Panuku Development Auckland (2023, p.40)

- The site is near a crosswalk for pedestrians (Figure 5.3). Instead of walking distance to reach the traffic light at the intersection of Massey Avenue and Edinburgh Street, the crosswalk in front of the Pukekohe library is a convenient shortcut for the public, specifically for kids, the elderly, and people with disabilities.
- The site is adjacent to residential neighbourhoods that are located within a walkable distance in the 800-meter radius of the centrality of the library's location.

- The site is close to both the intermediate school on Edinburgh Street and Pukekohe High School on Harris Street (highlighted blue blocks) (Figure 5.3).
- The site has frontage on Massey Street and also an entrance from Edinburgh Street via the parking at the library's rear side (Figure 5.4). These two accesses into different streets are occasions for the future redevelopment of the library in the form of gateways for social infrastructure.


Figure 5.4: Auckland Council, Geomaps, Pukekohe Public Library
(https://geomapspublic.aucklandcouncil.govt.nz)

- According to Auckland Council-Eke Panuku Development Auckland (2023, p. 35), the central business area of Pukekohe is located outside the flood plain and flood risk, which confirms the fact that the Pukekohe public library's location is located above the floodplain as well. This is an important feature in Auckland for a new development because it does not impact unexpected expenses due to flood risk.
- The library is near amenities such as restaurants, the nearby shopping mall, retailers, and public amenities such as the local city hall, the centre of Franklin, and the Franklin local board office. Adjacency to such amenities promotes the potential for sociability in the area, which is a key for a library as a social infrastructure to be conveniently accessible to the locals.

#### 5.2.2.2. Weaknesses

- The existing frontage at the location of the library has an unattractive façade, which is uninviting to the public, and accordingly, it is not very successful in boosting social welcome.
    - As the library site is located in the "Business - Local Centre Zone" of Pukekohe, it is adjacent to key retail streets within the zone, where they are the focal point of pedestrian activity. Hence, this is a distinguished occasion for the library's location. With that being said, the solution for the above weakness needs a new approach, which will be discussed and analysed in the next chapter by applying agent-based modelling through the new approach within the site and considering the space syntax analyses of connectivity, integration, and choice that have been done through the last chapter. The result of this study will show how to solve or mitigate the above weakness and, accordingly, will lead to the objective of breaking the boundary between the library's location and street activity.
- The existing site and its library's building have a large amount of impervious surface.
    - Such a weakness point can be improved by minimizing impervious surfaces, according to the Auckland Council Pukekohe-Paerata Structure Plan (2019, p. 131), which raises the infiltration capacity of the natural pervious surfaces or soil. In the meantime, disruption of such surfaces from natural pervious surfaces or soil lets more infiltration.
- However, there is vehicle access on the library's rear side via Edinburgh Street, but there is no vehicle access from the site front.
    - The above weakness can be mitigated in the future redevelopment of the library with regard to Section Business-Town Centre Zone of Chapter H of the recently updated Unitary Plan of Auckland Council (2024, pp. 3–16). Accordingly, the parking location can be designed in a way to mitigate damaging effects on both pedestrian paths and the streetscape. In this way, the landscape is the solution as a buffer and screening between parking and the street boundary. The buffer needs to be 2 meters in depth alongside the site frontage, which is visible from the street.

#### 5.2.2.3. Opportunities

- Due to the site's size and its potential, there is the opportunity to reach a new model approach in the form of a **public library as a social infrastructure**, which can boost **socialization**. As the above approach is the objective of this research study, it will be analysed and developed for each selected site location in the next chapter.
- A well-approached model for the Pukekohe public library could transform Massey Avenue into a beautiful, inviting area for Pukekohe, further enhance the connection to the surrounding areas, and enhance outsiders' views of Pukekohe.
- There is about a 600-meter distance from the library's site to the Pukekohe rail station.
- The presence of the intermediate school on Edinburgh Street and Pukekohe High School on Harris Street in short distances to the library's site is an opportunity for the library's location.
- Such a site as the Pukekohe public library, with its noted size, is able to knit together the surrounding community.
- By selling the Edinburgh Street super-lot site, which includes an excess of on-grade parking and some commercial services' premises, a great opportunity has been provided to redevelop the noted lot within the heart of Pukekohe Town Centre. This project has been controversial for a while as it will change the future of the town centre. With that being said, this project is an extraordinary opportunity for the Pukekohe Library's location, as it faces the library on the opposite side, from the northern side of Massey Avenue.

  According to CBRE (2024), a developer to partner with Eke Panuku, the Edinburgh Street superblock site is about 8,700 sq m and is connected to King Street, "the key retail frontage street," via the town square. The site is bounded by Edinburgh Street from the west, Devon Lane from the northern side, Roulston Street from the eastern side, and Massey Avenue from the southern side. Having said that, according to Auckland Council, Eke Panuku Development Auckland (2023, p. 16), the new proposal creates a new connection between the Franklin Centre, which includes the Pukekohe Library, and King Street through the Town Square. Accordingly, such a feature strengthens the potential for sociability adjacent to the Pukekohe library, which is the focus of this study's research.

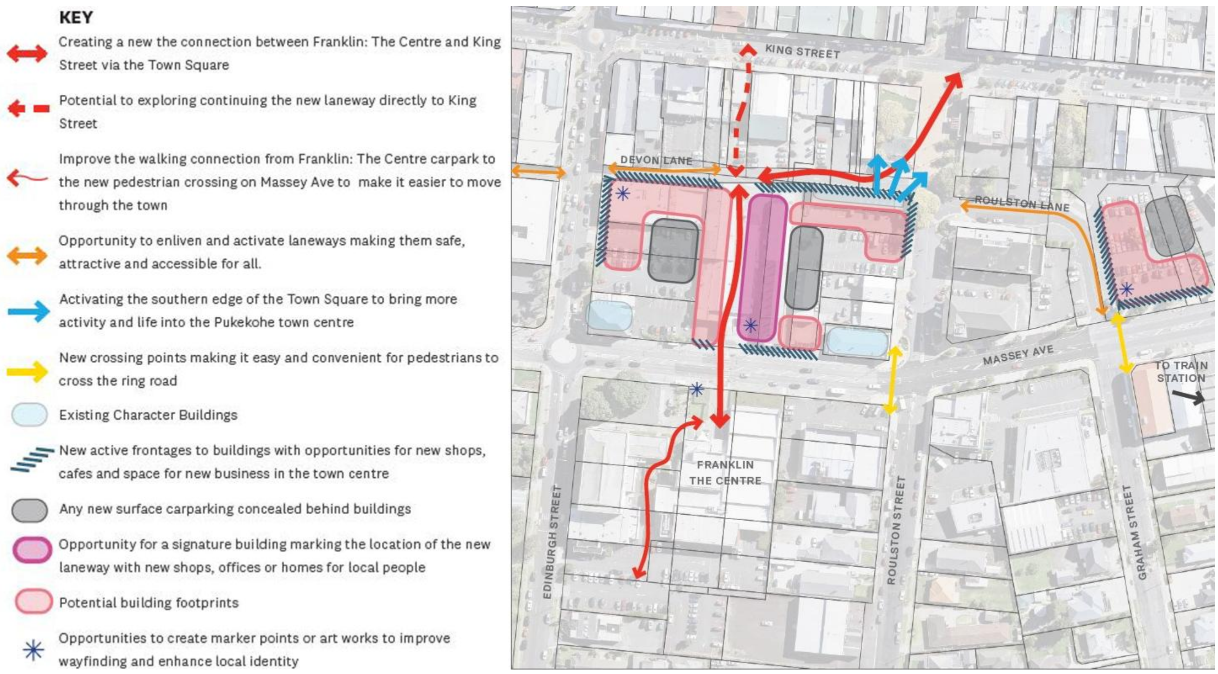



Figure 5.5: Pukekohe masterplan development opportunities, Auckland Council, Eke Panuku Development Auckland (2023, p. 17)

In a nutshell, with regard to Figure 5.5, there are outstanding potentials through the proposed development of the Edinburgh Street superblock, including:

- The new development brings more jobs within the local community as well as more commercial, retail, dwellings, and entertainment within the Pukekohe town centre, which means more population in the area. This is not only an opportunity for the Pukekohe library, but it is also the reason for redeveloping the library in the form of a social infrastructure in the zone to boost sociability.
- Edinburgh Street's superblock development presents the opportunity to improve accessibility to the Pukekohe town centre via the new pedestrian and cycling paths between King Street and the Pukekohe library.
- The superblock development causes improvements and activation on street frontages within the area, including Edinburgh, Devon Lane, Roulston Street, and Massey Avenue.
- To a large extent, the permeability will increase within the town centre, which is beneficial for pedestrians and cyclists.

#### 5.2.2.4. Threats

- With regard to the visibility step analysis and mean depth calculation in the last chapter, it was found that the Pukekohe library's location has a less continuous view than the second selected location, which is close to the junction of Harris Street and Edinburgh Street. Hence, the above result is a crucial factor in the expected new approach, which will be analysed and developed in the next chapter.
- As the off-street parking at the rear side of the library is shared parking with the nearby properties, it is crucial to address this to maximize any future potential development, which is an important case with regard to the Auckland Plan 2050.
- Lacking well-designed parking to support frontage entry, like the existing parking at the rear side, can impact public access on Massey Street. In the meantime, poorly designed vehicular access from Massey Street can impact the streetscape negatively.
- As the size of the site is not small, if a new model approach is proposed, it is possible to face a controversial project to finance, which can increase the financial risk for the local council.
- Almost most effects of climate change cause the severity of weather events, which in Auckland has led to natural hazards such as flooding, coastal erosion, including the effects of sea-level rise, cyclones, freshwater erosion, and land instability, according to Auckland Council 'no date'.
    - However, because Pukekohe library's location is not within the flood plain and flood risk, it is possible that severe climate change will impact the Pukekohe area, like the precedent low-pressure system that caused intense thunderstorms and vast flooding in Auckland in summer 2022. Accordingly, such natural hazards cause different impacts on people, buildings, and infrastructure. For instance, the consequences of severe flooding on the library's building could lead to:
        - Damp and unhealthy space, which can cause mold development, for instance.
        - The building structure could be wrecked, which would make it unsafe or uneconomical to repair or revitalize. For example, the consequences might lead to intense deterioration of the structure, which causes degradation of structural materials.

## 5.3. A general overview on different zoning within Parnell

As shown in Figure 5.6, the Parnell zone embraces diverse zoning with a wide range of opportunity sites, which illustrates a timeline of the suburb's growth in the past history and purposes toward the future growth within this suburb of Auckland. Parnell, with its diverse activities in the business and residential sectors and having open public areas, recreation facilities, infrastructure, and transport linkages, plays a key role as a zone with its dynamic nature within the city centre.

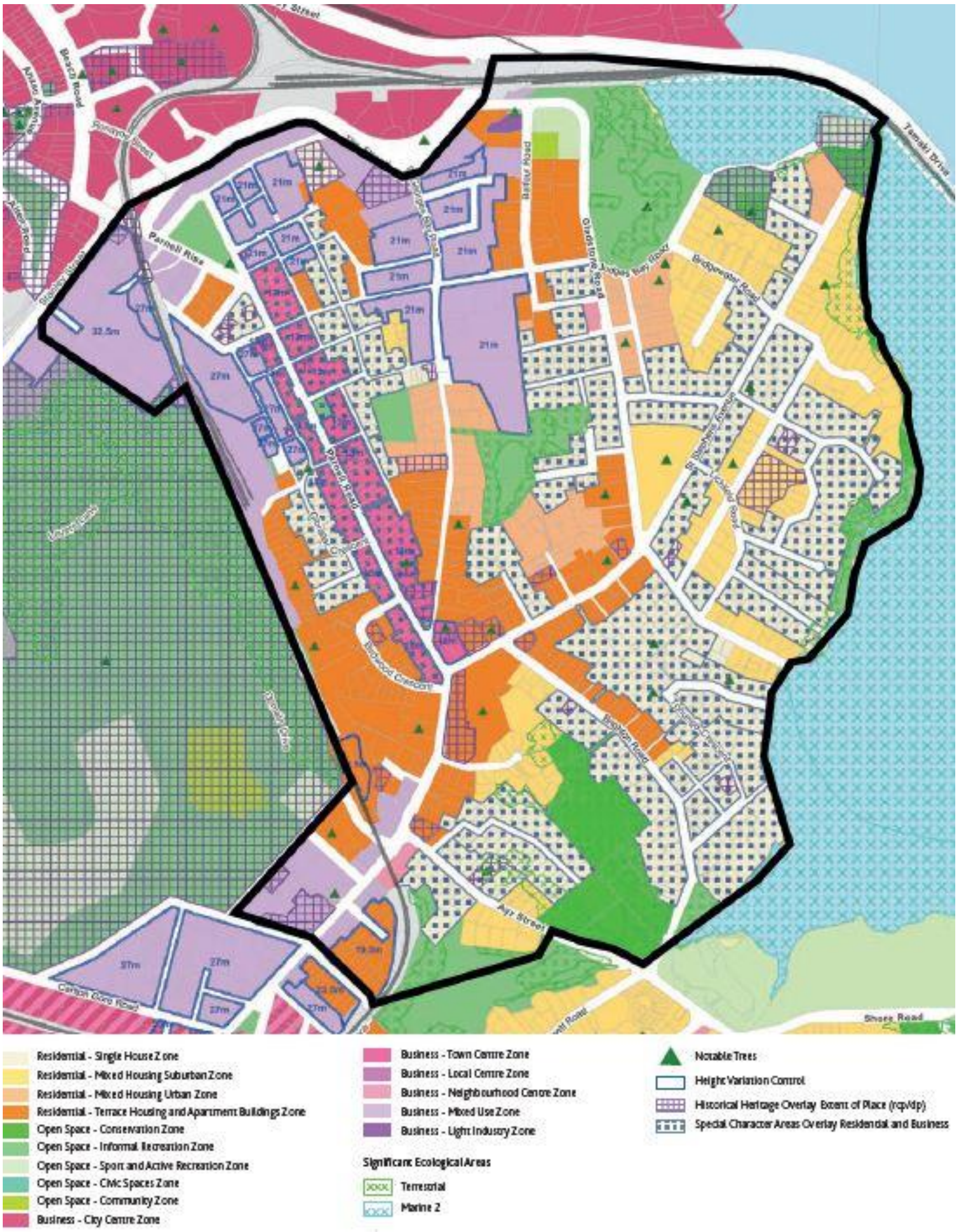



Figure 5.6: Map of Parnell and different land use zoning (Auckland Council, 2019, p. 46)

The Parnell suburb, according to Auckland Council (2022, pp. 112-117), was the first area beyond the central area within Auckland that was founded in the 1840s. They noted that the suburb became a flagship pattern during the last two centuries, with a wide range of different building types from its original settlement and later development. Also, this suburb is remarkable because of its physical and visual qualities, which are almost all about its built fabric, including buildings and urban context.

The commercial development appearance within Parnell was formed via the traditional main street of Parnell Road, which, from its southern end, is connected to Stanley Street via Parnell Rise. The main street became an arterial route, which is located between residential and commercial areas. In the meantime, the relationship between the urban network and building permeability in such a particular area can be visualized according to Hillier and Hanson (1984, p. 104), where they use an "interface map" that represents the relationship between streets directly linked to adjacent buildings. With that being said, the relationship shows that the majority of buildings' entrances with their adjacent windows are both directly linked to the street network, which is very obvious in the main street as the arterial route. Hence, an affirmative relationship is explicit between the public and private realms that encourages interaction with the main street.

### 5.3.1 Overview of the characteristics of the National library of New Zealand's site

#### 5.3.1.1. Physical qualities

The National Library of New Zealand is located on Stanley Street, which is a key road connecting the ports of Auckland via "The Strand" to the northern part of the central area via the "Northwestern Motorway." Also, it is connected to the main street of Parnell Road via the intersection at Stanley Street and Parnell Rise.

The indicative area of the selected site is 1952 $m^2$, as indicated on the land record search via the online interactive map (Land Information New Zealand, 2024). The library's site has a shared parking area on its rear side on Carlaw Park Avenue. In the meantime, as Stanley Street and The Strand are located within the flood plain, they are seriously vulnerable to coastal inundation, which occurred in January 2023. Hence, the selected site of the library on

Stanley Street is included within the noted area that, according to the online interactive map (Auckland Council's Flood Viewer, 2024) (Figure 5.7), the flood plain overlays over 50% of the library's site.

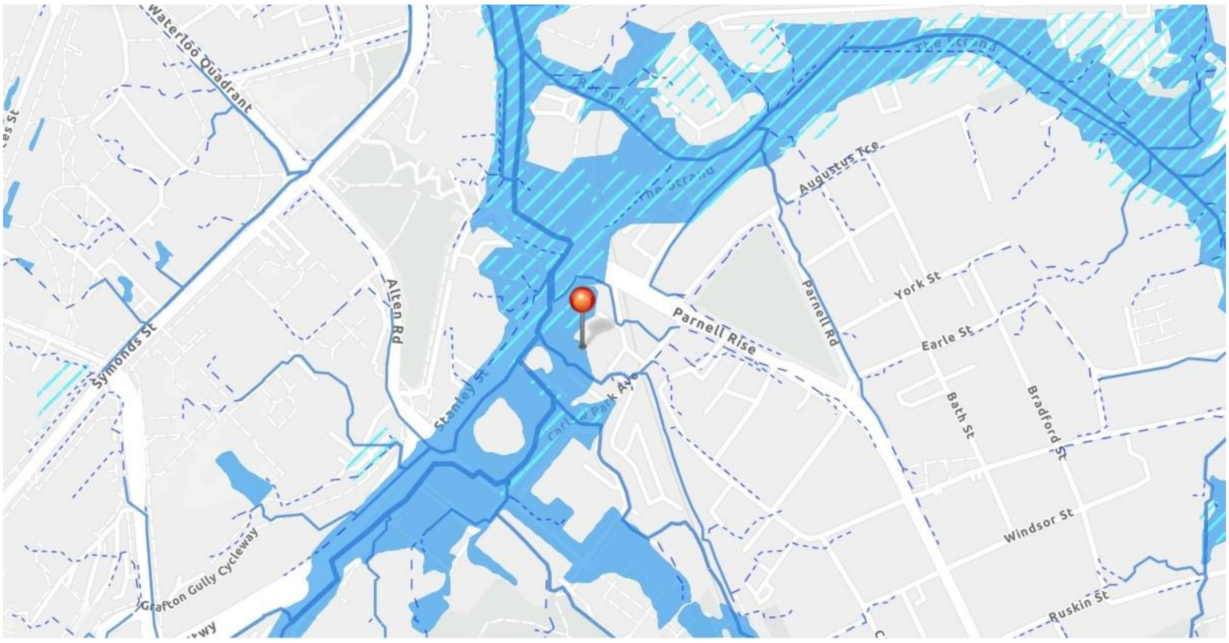


Figure 5.7: Flood viewer of the central zone within Pukekohe (Auckland Council's Flood Viewer, 2024)

### 5.3.1.2. Zoning considerations

As previously noted, the selected library's site is located in the Parnell area within the city centre zone. The city centre has distinct properties as they are obvious in different areas and places, which can be seen in areas such as Ports of Auckland that are established for ongoing usage where port and marine activities are provided. According to Section Business-City Centre Zone of Chapter H of the recently updated Unitary Plan of Auckland Council (2024, p. 1), development potential reduces in heights from different zones in the city centre toward ridgelines and transitions reaching wharf and landward, which lets diversity in different built forms. In the meantime, according to Section Business-City Centre Zone of Chapter H of the recently updated Unitary Plan of Auckland Council (2024, p. 1), it is important that the zone manages the quality of building design to make sure that the new buildings integrate with the current built form and public area in the city centre, which lets the skyline be recognizable. Accordingly, Stanley Street, as part of the Parnell area within the City Centre zone, is included in the above circumstances.

With regard to the above, there are some considerations that should be noted in the following:

- As Stanley Street is located in a business mixed use zone within the city centre area, according to the section Business-Mixed Use Zone of Chapter H of the recently updated Unitary Plan of Auckland Council (2024, p. 8), the zone imposes constraints of a maximum. Accordingly, a height of 16m on the "occupiable building height" and an additional height of 2m for the roof form, equaling the total building height of 18 m, are determined.
- With regard to the Business-City Centre Zone policies of Chapter H of the recently updated Unitary Plan of Auckland Council (2024, p. 6), conservation and keeping the historic heritage within the city centre should be retained, specifically those areas that are identified by Auckland Council. Accordingly, any changes and new attachments or additions to existing or new buildings should be in accordance with the character of the zone, which exposes their sympathetic perception of the current circumstances.
- Regarding the city form, there are some general considerations that are noted by the Business-City Centre Zone policies of Chapter H of the recently updated Unitary Plan of Auckland Council (2024, p. 6); however, every single of the considerations is not subjected to this study research. With that being said, unfavour able effects related to the form and height of buildings should be controlled and managed by: (a) lowering development density and building heights to the neighbourhoods that border the city centre and the harbour edge. (b) Protecting sunlight to the view shafts and designated open places in public. (c) The new construction's form and height should respect the valley and ridgeline form within the city centre; in addition, building designs should be supplementary to the planned or current character of areas. (d) Regarding the form and design of the buildings, it is necessary to prevent unfavour able dominance and/or amenity impacts on public spaces and roadways.
- Regarding the public realm in the city centre, it is expected that the design of building frontages to offer a sense of enclosure, intimacy, character, interest, and diversity at street level along designated public open areas and streets. Also, it is necessary to protect recognized sightlines to landmarks and natural elements that are situated beside public highways and open spaces in the city centre, like Constitution Hill,

which is visible directly from the location of the National Library of New Zealand on Stanley Street.

### 5.3.2. SWOT Analysis

#### 5.3.2.1. Strengths

- The site of the library is located in Business - City Centre Zone.
- Having a direct sightline to Constitution Hill, which is a natural zone within the area.
- The library's site has two entries with frontage on both Stanley Street and Carlaw Park Avenue.
- The library’s location is adjacent to AT bus lines by two bus stations that are located on Parnell Rise in both directions, just after the intersection at Stanley Street and Parnell Rise.
- There are pedestrian amenities on Stanley Street.
- The site is located nearby the Northwestern Motorway, which is a connector road in the area.
- The building façade is highly visible.

#### 5.3.2.2. Weaknesses

- There are not many amenities nearby the site, such as restaurants and retailers.
- The property is not owned by a single owner, as there are multiple storeys with different functions.
- As previously noted, the library's site on Stanley Street is overlaid by the flood plain by over 50%, which indicates to what extent the site is seriously vulnerable.
- However, there is parking on the library's rear side on Carlaw Park Avenue, but it is not easily visible to new visitors from Stanley Street unless they are familiar with the narrow access between the selected site and the next neighbouring building on the right-hand side. The solution for parking accessibility as a part of the solution for the

whole site, which includes the building and parking, will be discussed and explored in the next chapter.

- The existing building on the site has potential to be used for commercial and governmental departments, but this is not an ideal space for the public library with regard to the objectives of this research study.
- However, the existing building has an attractive façade for commercial and governmental departments, but it is not attractive for a public library to promote public participation and break the boundary between libraries' locations and public spaces.

#### 5.3.2.3. Opportunities

- The size of the library's site and the site position between Stanley Street and Carlaw Park Avenue bring the opportunity to create a model approach to planning the public library as a social infrastructure, which is aligned with this study's objective toward socialization. Accordingly, the new model approach will be created and analysed in the next chapter.
- The Parnell rail station is located less than 800-meters walkable from the library's site.
- The University of Auckland is located on Northwestern Motorway, following Stanley Street, which indicates that the university is located within a short distance of 250 meters from the library's site. With that being said, there is potential for the university and educational institutions to have partnerships with the library to run a wide range of workshops and meetings not just for experts but also for common visitors. Hence, the above potential can be promoted if an encouraging and inviting model that can boost **socialization** is created via an architectural approach.
- The dormitories of the University of Auckland on Stanley Street and Nicholls Lane are respectively located within 100 meters and 150 meters from the library's location.
- There is an opportunity to let the library's site drag the surrounding community and the university's students to gather together at the library's location via a well-approached model.

- With regard to the existing building at the site, there is the potential for multi-storey uses in the area.

#### 5.3.2.4. Threats

- As the library's site is located on Stanley Street, there is potential noise on the street, which connects "The Strand" path to the Northwestern Motorway.
- The existing multi-story building has more than one owner, which makes it difficult to reach a decision about a change by a new model approach.
- The off-street parking at the back entry of the library on Carlaw Park Avenue is shared parking with the upper level of the building. Thus, it is important to provide enough parking spaces for any potential new approach.
- Poorly designed parking access from the Stanley Street entrance toward the parking space on the rear side impacts public access on Stanley Street.
- As there is a multi-story building on the site, it will be a challenge to reach an agreement between the two owners to finance a new proposal, which raises the financial risk for both parties.
- Parnell is a key precinct in Auckland's history, and its urban development growth has always been under local authority focus. In the meantime, the Strand and Stanley Street have opportunities to be the gateways from the Domain and the Auckland city centre to Parnell. However, the position of Stanley Street, which follows the Northwestern Motorway, makes it uncomfortable and undesirable for local pedestrians to walk along the highway to reach the library's location at Stanley Street. Accordingly, it is likely that people travel to other neighbourhoods to reach a public library, regardless of the type of services that the National Library delivers to the public. Accordingly, the number of people who have access to a public library is low within the area, which is a disappointing signal against socialization when there has always been continuous attention to urban development growth within the area.

## 5.4. A general overview on different zoning within Albany

Albany, as an urban node, plays a key role in the Auckland 2050 strategy. According to Auckland Council (2023, p. 79), it is expected that the Albany node will be evolved and developed by an ongoing strategy for the north of Tāmaki Makaurau, as it is a key node that creates opportunities for new business and residential growth. In the meantime, this node is an opportunity to localize key facilities and services such as education and cultural centres like universities, schools, and public libraries, as well as medical centres or hospitals.

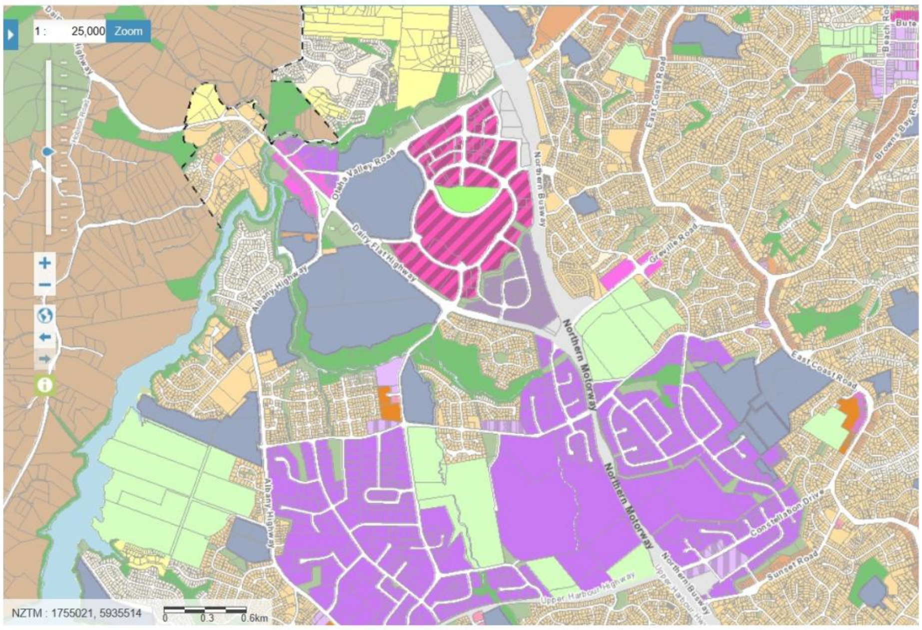




Figure 5.8: Map of Albany and different land use zoning
(Auckland Council Geomaps, 2024)

The Albany Centre Precinct is the key area within Albany node that includes the metropolitan centre, which, according to Section I502. Albany Centre Precinct of Chapter I of the Unitary Plan of Auckland Council (2024, p. 1) is located on the western side of State Highway 1, and it is also surrounded by Oteha Valley Road and Albany Expressway on its northern side (Figure 5.8). Accordingly, the position of this area impacts its adjacent areas' development and paths, such as Dairy Flat Highway, Oteha Valley Road Extension, Oteha

Valley Road, Library Lane, and Kell Drive, where Albany Village Library is located (Figure 5.8).

According to the above and Section I502. Albany Centre Precinct of Chapter I of the Unitary Plan of Auckland Council (2024, p. 1), the Albany Centre Precinct includes four sub-precincts, which are Sub-precincts A, B, C, and D with diverse significances on each. Respectively, the first area is considered for high-density residential development, specifically apartments and limited opportunities for retail stores on the ground floor; the second area is considered for high-density office buildings and also limited retail stores; the third area is considered for entertainment spaces and commercial units, which are car-oriented; and the fourth area is considered for the southern side of Albany Centre, focusing on small commercial units and limited retail stores.

### 5.4.1 Overview of the characteristics of the Albany Village Library's site

#### 5.4.1.1. Physical qualities

The location of Albany Village Library is on Kell Drive, which is a local street connecting to Dairy Flat Highway. Therefore, there are very few direction changes, including the syntactic steps from Kell Drive to Albany Centre Zone, as the precinct is located within a short walkable distance alongside Dairy Flat Highway.


Figure 5.9: Flood viewer of Albany Village and Albany Centre within Albany (Auckland Council's Flood Viewer, 2024)

The library was constructed within 895 $m^2$, according to the land record search via the online interactive map (Land Information New Zealand, 2024). There is a shared parking space on the rear side, which is shared between the library, the school of Massey University, and the adjacent cafes. Moreover, however, according to the online interactive map (Auckland Council's Flood Viewer, 2024) (Figure 5.9), Lucas Creek River and Oteha Stream are close to the backside of the library; the library's site is not covered by any flood plains, flood-prone areas, or coastal inundation. On the other hand, there is still a need to consider the site's adjacency to the noted areas. Having said that, there are also a few overland flow paths on the front neighbours' sites; however, it is not a critical situation for the library's site.

### 5.4.1.2. Zoning considerations

The Albany Zone in a wider zoning template includes the Albany Metropolitan Centre zone toward the north-east, Albany Village as a local centre, and a Business - Mixed Use zone (Massey University campus). As previously noted, the selected library's site is located in Albany Village, which, according to Munro (2013, p. 104), is explored as a historical development that reflects the primary usage of the Lucas Creek for business (Figure 5.10).


Figure 5.10: Viewing north along Dairy Flat Highway within the Albany Village (Google map library)

Munro (2013, p. 105) mentions that the development of Albany Village and Albany sub-regional centres has appeared under separate but integrated planning frameworks. He adds that Albany's combination of state highways, downhill land, geologic features, rivers and water streams, and dense shrubs has developed a more distinct "pod" pattern of discrete development areas, some of which are highly dense and scattered throughout the larger landscape, while large areas of south Auckland are flat and have been urbanized for a long time. Munro (2013, p. 105) notes that development in the north of Albany Village, where the selected library's site is located, has been focused along two axes over time. The Avenue lies to the east (Figure 5.11). Gills Road lies to the west (Figure 5.12). Each of them has been constructed otherwise, mostly drawing from the zones defined by the Albany Structure Plan that were made possible by the Operative Plan and allowed for much higher densities from Gills Road. Meanwhile, Kell Drive, which is located near Gills Road and on the other side of the Dairy Flat Highway, has also been constructed differently.

Figure 5.11: The Avenue, residential developed both sides (Google map library) Figure 5.12: Gills Road, commercial units have risen and winded into residential development a little ahead. (Google map library)

Albany Village as a local centre Within the Albany zone, includes appointed areas that, according to North Shore City District Plan (2007, p. 1) (Figure 5.10), are believed to be appropriate for high-quality mixed-use development. The Albany Village Library is located within the gray area with a highlighted black boundary, which is part of the mixed-use zones (Figure 5.13).


Figure 5.13: Proposed new mixed use zones within Albany Village (2007, p.21) – The highlighted black boundary area

In the following, as it has been learned that the Albany Village Library's site is located within the specified area in Albany Village, which is designated as a "mixed use zone" (Figure 5.10), some considerations according to the North Shore City District Plan (2007, pp. 1–21) need to be addressed:

- The building frontage should be incorporated with a considerable amount of glazing, windows, and entrances to create a clear visual relationship with the street. With that being said, a direct connection could be eased via windows and doors that are comprised of a large portion of the ground-floor facade. In the meantime, it is necessary to avoid applying large-scale and large-size blank walls to facades. However, a combination of reasonable design with some artworks, murals, materials, and colours can compensate for the reduced glazing. Accordingly, meeting the above considerations would lead to maximum visual contact via a continuous street frontage.
- There is a designated maximum height of 14 meters within Business 12—Mixed Use area A (Albany Village). Accordingly, there is an expectation regarding the building height effect on the access to daylight and sunlight in the amenities of the neighbouring residential units and recreational areas, which shouldn't have an adverse effect or should have a minimal effect. With that being said, the addressed building height should be coordinated with the surrounding lands and landscape to maintain their visual values and their natural features. Also, the regarded height should not cause adverse effects on neighbouring sites, which would result in them being overlooked and losing their privacy.
- The needed parking within the mixed-use zone is one place for every 35 m2 gross floor area. The requirements for parking within the mixed-use zone are reduced when there is sufficient public transport. The considered car parking within the noted area in a mixed-use construction should be located in the in the basement or to the rear of the selected site, which would lead to a beneficial urban and street environment where car parking or parking constructions won't dominate the areas.

### 5.4.2. SWOT Analysis

#### 5.4.2.1. Strengths

- The library's site is located in the local centre of Albany Village.
- The site is near amenities such as a hotel, restaurants, cafes, retailers, a medical centre, a pharmacy, and Albany Village Hall.
- The library's site on Kell Drive is close to two bus stations in both directions on Dairy Flat Highway, which is parallel to Kell Drive, and it only needs a few direction changes, including the syntactic steps from the library's location on Kell Drive to the bus stations.
- The library's site is out of flood plain, but it is close to the Lucas Creek River and Oteha Stream from its backside.
- The library and the School of Psychology at Massey University are located on the same site in a multi-story building.
- It is close to the Kell park
- The site is located within less than a 70-meter radius of Dairy Flat Highway.
- The library is adjacent to dwelling neighbourhoods

#### 5.4.2.2. Weaknesses

- The proximity of the library's site to the flood plain exists as the Lucas Creek River and Oteha Stream are close to the backside of the library. The more detailed situation is illustrated on pages 254–255.
- It is not centrally located as the site is located within a secondary street, and therefore, its permeability is weak.
  - With that being said, according to Bentley et al. (1985, p. 12), physical permeability indicates the environment with various directions from one location to another to specify a location's permeability, which lets people pick out how to access the place via one of the alternatives. In the meantime, alternatives need to be visible to people who are already familiar with the urban space. In this way, if an existing route is not visually visible, then visual permeability is weak. According to Bentley et al. (1985, p. 12), smaller blocks boost physical permeability because they make it easier for people to observe

another nearby junction or node along the path; accordingly, visual permeability would be increased, which would let people select one of the alternatives with awareness. With regard to the above, the Albany Village Library's location faces low physical and visual permeability because there are not many alternatives, and as the environment has not been divided into smaller blocks, the visual permeability is weak.

- The current library's building has an unattractive frontage to promote public participation.
    - As previously explained, the incorporation of the library's building frontage with glazing, windows, and doors is vital as it provides a direct visual relationship with the street. However, the Albany Village Library has no direct visual relationship with the street, as a single-story building is located between Kell Drive and the library. Hence, maximizing visual connection via a continuous street frontage is vital.
- The property is not owned by a single owner, as there are multiple storeys with different functions.
- There are shared parking spaces at the rear side of the library, its attached building, and the hotel; however, the parking spaces are not enough as many of the spaces are specified to the premises staff.

#### 5.4.2.3. Opportunities

- The proximity of both the School of Food and Advanced Technology and the School of Psychology at Massey University to the library's site.
- Potential for multi-storey uses in the area with regard to the current building at the site.

#### 5.4.2.4. Threats

- The current multi-story building has more than one owner, which makes it difficult to reach an agreement about a redevelopment using a new model approach. Hence, there is uncertainty regarding the ability to redevelop the site.
- The off-street parking at the library's rear is shared with other premises on the site, which doesn't make enough parking space at busy times of the day.

- Poorly designed parking access from Kell Drive toward the parking space on the rear side impacts public access to the parking area.
- There is a financial risk for any new proposal as there are more than one owner on this site, which makes it challenging to reach an agreement.

### 5.5. A general overview on different zoning within Warkworth

Warkworth with different zoning according to Figure 5.14 illustrates that according to Auckland Council (2019, p. 40), the Warkworth town centre is the focal point besides the Mahurangi River, which comprises retail stores, offices, community centres, civic spaces, and also has the potential to develop future local zones. According to Auckland Council (2019, p. 40), there is 9ha of mixed-use area around the town centre, which has the capacity to develop in the future.

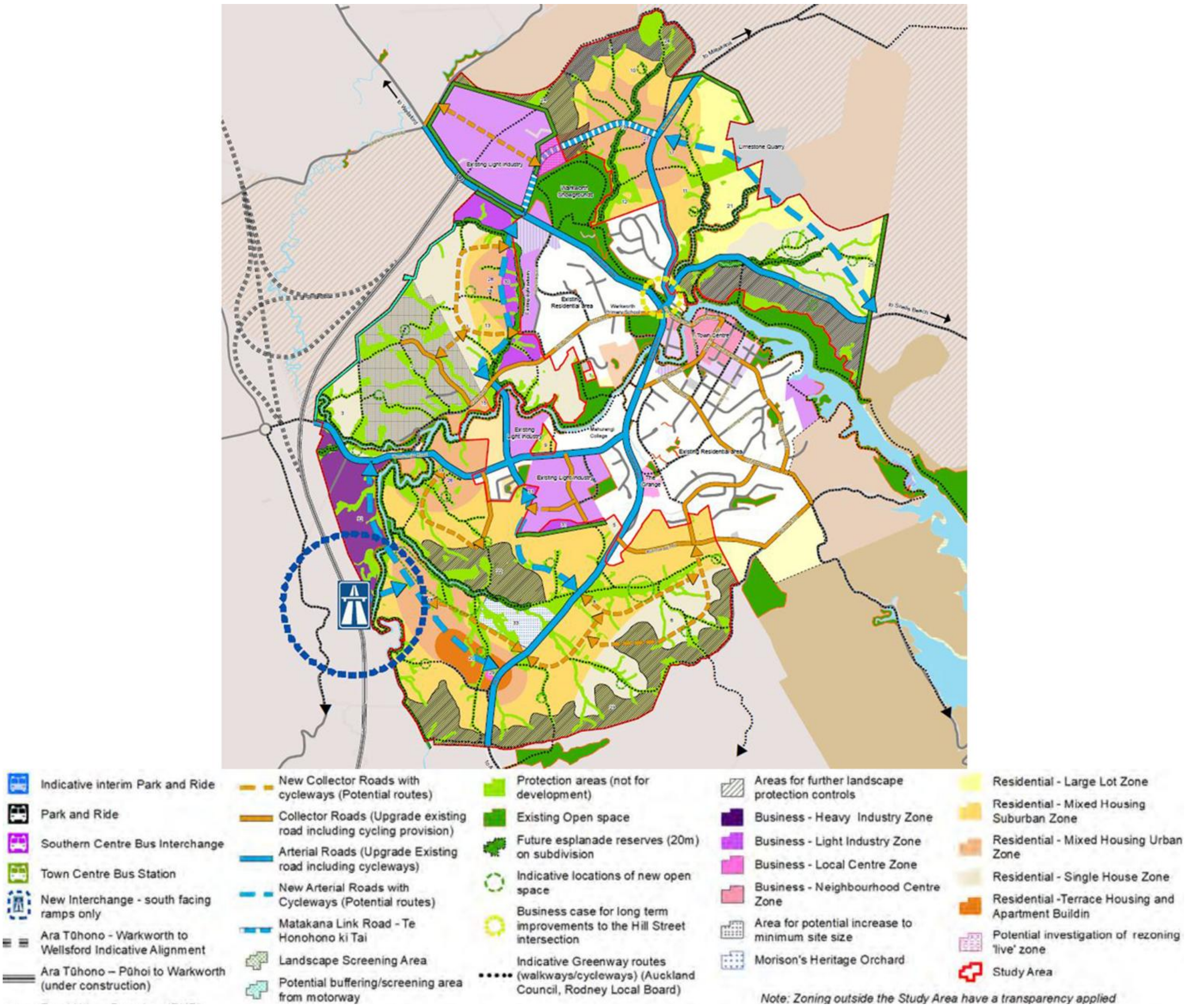



Figure 5.14: Map of Warkworth and different land use zoning (Auckland Council, 2019, p.5)

Local centres are the next areas that are provided for the local convenience demands within the surrounding residential zones, which comprise retail stores, commercial units, restaurants, and supermarkets. Such buildings are allowed to rise up to four storeys high, which allows for residential and office use on the upper floors, according to Auckland Council (2019, p. 41). The third zone includes Neighbourhood centres, which are the smallest centres within the north, west, and north-west of Warkworth, according to Auckland Council (2019, p. 41). These areas provide retail and commercial services for frequent needs and include places such as dairy, chemist stores, bakeries, takeaway stores, small offices, etc.

### 5.5.1 Overview of the characteristics of the Warkworth public library's site

#### 5.5.1.1. Physical qualities

The site of the Warkworth public library is located on Baxter Street within the Warkworth town centre. There is only one direction change to reach the adjacent collector road of Neville Street, which has access to the arterial road of Brown Road via Twin Coast Discovery Highway. The library hasn't any specified parking, and visitors need to find on-street public parking.

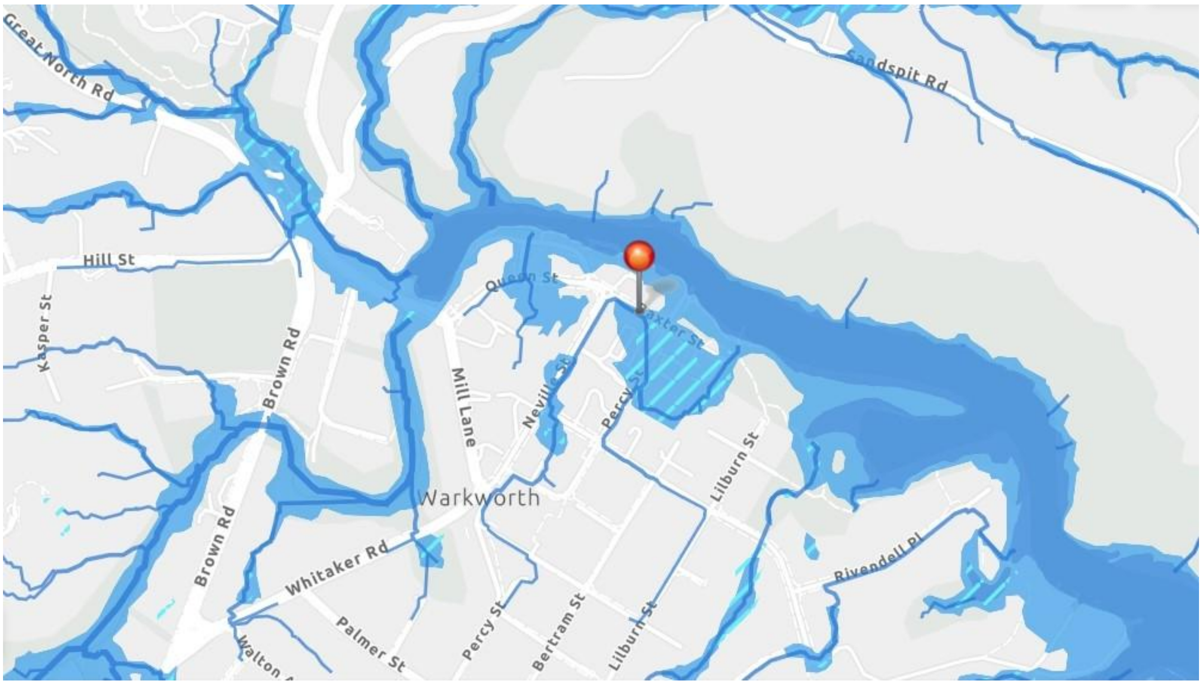



Figure 5.15: Flood viewer of Warkworth town Centre and surrounding areas within Warkworth (Auckland Council's Flood Viewer, 2024)

The indicative area is 1684 square meters, which is shared between the "Warkworth Public Library" and "Warkworth Information Centre" according to the land record search via the online interactive map (Land Information New Zealand, 2024). According to the online interactive map (Auckland Council's Flood Viewer, 2024) (Figure 5.15), there is a loop of flood plains around the Warkworth public library and also an overland flow path on Baxter Street on the opposite side of the library.

#### 5.5.1.2. Zoning considerations

As noted, the library's site is located within the Warkworth town centre, which is considered a Business – Town Centre Zone according to Section Business-Town Centre Zone of Chapter H of the Unitary Plan of Auckland Council (2024, p. 1). As a result, the above circumstances include Baxter Street, which is the location of the selected library. It is noteworthy that Warkworth town centre embraces some different considerations. Meanwhile, according to Auckland Council (2024, p. 1), Warkworth town centre has been split into four sub-precincts: Sub-precinct A (Core Area) that Situated in the older parts close to the Mahurangi River, it houses the main retail and related economic activity of the town centre. Sub-precinct B (Fringe Area), the remaining retail space on the margin of the Warkworth town centre, where premises like accommodation, offices, and small-scale retail stores are considered suitable, is included in the area. Sub-precinct C (Core Expansion) has been determined to offer the chance to build larger-format, highly pedestrian-generating stores. These stores could improve the surrounding core area's (Sub-precinct A) economic vitality and support the fine-grained retail operations that greatly add to the town centre's character. Sub-precinct D is included in the Fringe Area; however, because it is home to an existing supermarket, it is subject to less stringent rules applying to this site than the remainder of the Fringe Area.

With regard to the above and considering Sub-Precinct B, where Warkworth Public Library is located, some considerations are highlighted:

- As the gross floor area of the Warkworth public library is 286 $m^2$ according to a "community facilities assessment report" by Auckland Council (2019, p. 7), it is indicated as activity type 2 according to Auckland Council (2024, p. 2), which is about any activities other than residential that embrace a gross floor area of 200 $m^2$ and no more than 350 $m^2$. This type of activity in "Sub-Precinct B" meets the restricted discretionary activity.

- There are three frontage lengths according to Auckland Council (2024, p. 2), which include activities that have a frontage no greater than 6m, activities that have a frontage greater than 6m and no more than 12m, and activities that have a frontage greater than 12m. Accordingly, there are three frontage types, which indicate the activity status. According to Figure 5.16, "Sub-Precinct B," where the Warkworth library is located, embraces frontage types 1 and 2. In the meantime, the Warkworth library's frontage meets frontage type 1, which has a finer grain character than the other two frontage types. With that being said, the library's frontage exposes unbroken frontages along with a continuous pedestrian shelter alongside Baxter Street.

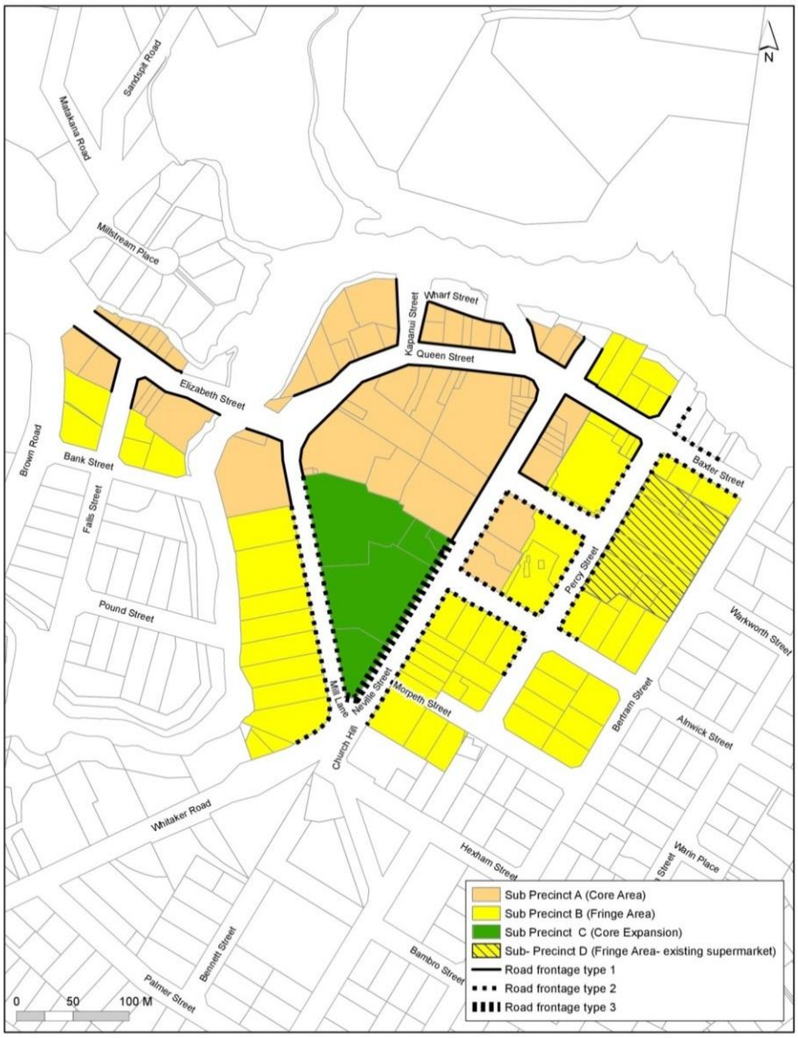



Figure 5.16: The three sub-Precinct plan within Warkworth town centre (Auckland Council, 2024, p.6)

- As previously noted, Warkworth town centre includes different sub-precincts. According to the proposed Auckland Unitary Plan, Part 5.55 Warkworth 1, Auckland Council (2013, p. 4), the maximum building height is different in sub-precincts. Accordingly, sub-precinct A is 13.5m, sub-precinct B is 8m, sub-precinct C is 8m, and sub-precinct D is 13.5 m.
- The Warkworth town centre applies different car parking requirements according to the proposed Auckland Unitary Plan, Part 5.55 Warkworth 1, Auckland Council (2013, p. 6). Accordingly, the car parking requirement for activities such as public libraries is one space per $35m^2$ GLA.

**5.5.2. SWOT Analysis**

**5.5.2.1. Strengths**

- The Warkworth Public Library's site is located within the Warkworth town centre.
- The library's site is adjacent to bus stations on both Baxter Street and Neville Street.
- The site is close to different amenities such as cafes, restaurants, retailers, a medical centre, a pharmacy, banks, etc.
- Riverfront views from the library's northern side.

**5.5.2.2. Weaknesses**

- Arguably, as previously described regarding figure 5.15, a considerable portion of the site is influenced by a loop of flood plain around the Warkworth public library, as the library is located alongside the Mahurangi River.
- The library does not have specific off-street parking.
- The library needs to have a logistical space to load and unload the books via courier vehicles, which needs to be easily accessible from Baxter Street.
- Warkworth Library does not have an attractive facade, which is a key to how the building frontage can persuade the public to make a contribution. The solution approach will be discussed and proposed in the next chapter.

- The library is small in size as two businesses are located on the same site. Having said that, according to Colliers International (2018, pp. 12–13), the population of Warkworth is anticipated to grow by 79% by 2038, which indicates that 7320 will be added by then. Hence, a refurbishment or redevelopment of the Warkworth library is needed to meet population growth.

#### 5.5.2.3. Opportunities

- According to the proposed Auckland Unitary Plan, Part 5.55 Warkworth 1, Auckland Council (2013, p. 4), there is a maximum of 8 m of building height for the potential of any redevelopment proposal for the same businesses.
- According to the chair of Rodney Local Board, "Brent Bailey" (no date, cited in OurAuckland, 2023), the Mahurangi river is pleached with the Warkworth area, which also brings accessibility, pedestrian safety, cycling, and vehicle parking into attention. He also added that the local community expects a sufficient relationship to the river, like what they have experienced with Elizabeth Street Bridge and with parts of Lucy Moore Park. With regard to the above, it is noteworthy that according to the Warkworth structure plan by the Rodney Local

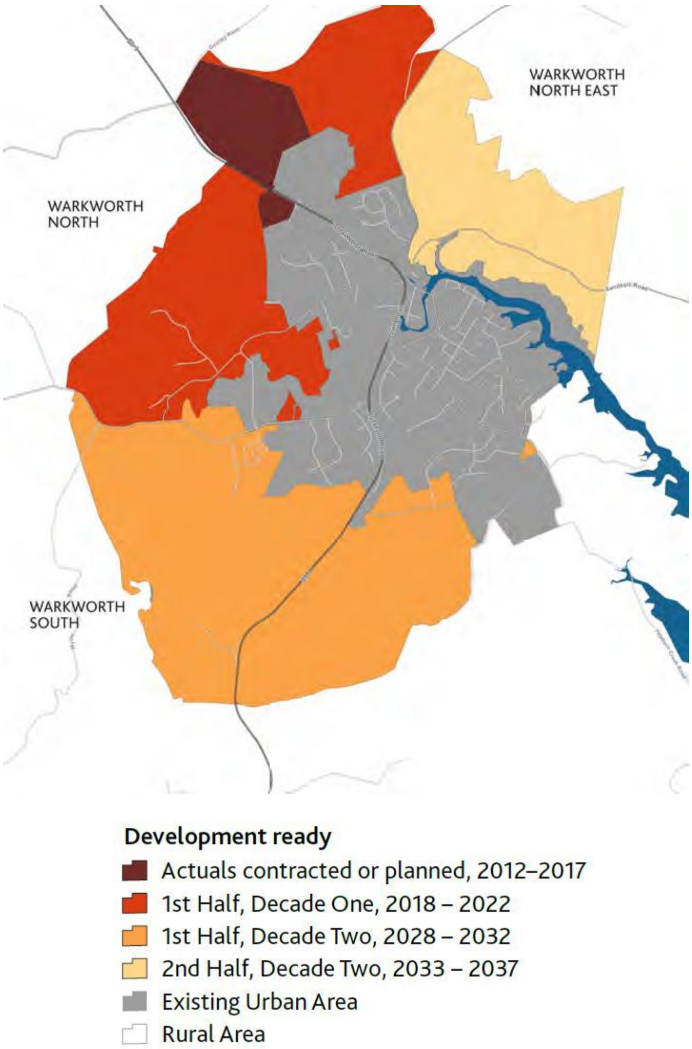



Figure 5.17: Warkworth Structure Plan – Future Urban areas sequencing (Rodney Local Board, Auckland Council, 2019, pp. 28-30)

Board (2019, pp. 28–30), the provided Future Urban Land Supply Strategy illustrates that Warkworth Northeast on the other side of the Mahurangi River is on the schedule for their plan of development (Figure 5.17).

According to the above priority of the local board and the potential for development between the Masonic Hall and Lucy Moore Park, there is an outstanding opportunity for the Warkworth public library redevelopment in the location with a great potential of connecting the Warkworth town centre by a bridge over the Mahurangi River between Lucy Moore Park and the opposite side at the other side of the river, which makes a smart shortcut to ease the accessibility of Warkworth northeast to the town centre. Accordingly, the redevelopment of the library alongside the area can take advantage of such a concept to boost socialization, which is aligned with the objective of this research study.

#### 5.5.2.4. Threats

- The current building's site has more than one owner, which makes it difficult to reach an agreement regarding a change by a new model approach.
- The lack of off-street parking for the library makes it unattractive to visitors.
- As previously noted, this site has more than one owner, which also poses a financial risk for any new proposal.
- According to the general note that mentioned previously regarding the climate change impacts within Auckland, which has led to natural hazards, there are some serious threats in some areas and locations such as the Warkworth Library that faces a loop of flood plains around its site.
    - The climate change that causes a low-pressure system can cause coastal inundation, vast flooding, and thunderstorms. Accordingly, the above natural hazard can be severe in the area as the library's location is adjacent to the Mahurangi River. Overall, the environmental threats against the selected location in Warkworth are similar to those noted regarding the Pukekohe area, although such threats are more severe to some degree because of the adjacency of the library site to the Mahurangi River.

From the architectural side, to achieve a mitigation approach to such environmental threats, it is needed to plan three policies about: coastal hazards and defences against coastal hazards; floodplains in rural areas; and overland flow paths. Accordingly, according to Section Environmental Risk, Part E36 of Chapter E of the recently updated Unitary Plan of Auckland Council (2024, pp. 4–7):

- Coastal hazards and defences against coastal hazards:

  A. The buildings that are within the areas that are subjected to coastal hazards should be located and designed in the ways that are needed, with a minimum of hard protection structures.

  B. Whether new residential development or alterations and extensions to existing buildings that are subjected to coastal storm inundation areas, they should be above the 1 percent annual exceedance probability (AEP) of a coastal storm inundation event, including an additional sea level rise of 1 m.

  C. There shouldn't be the removal or modification of sand dunes and vegetation on the dunes that are natural defences against the adverse effects of coastal hazards.

  D. It is needed to implement hard protection works where natural protection does not exist to protect the development against natural hazards.

- Floodplains in rural areas:

  Warkworth is considered a rural area, and locating the Mahurangi River makes the area's situation different compared to many other areas. With regard to the 1 percent annual exceedance probability (AEP) floodplain of the Mahurangi River, which is shown in Figure 5.17, it should be avoided to locate buildings that are vulnerable in such areas.

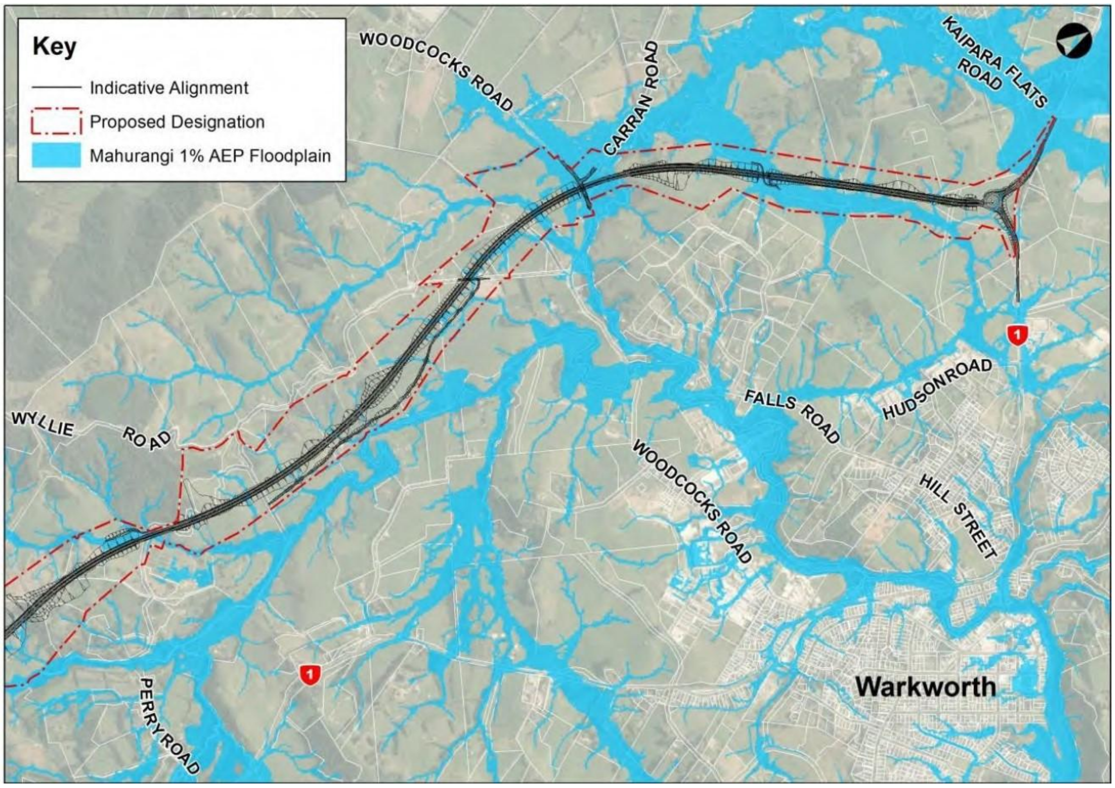



Figure 5.17: Mahurangi River 1% AEP Floodplain (Priestley et al., 2014)

- Overland flow paths:

  A. It is important to provide the transition of overland flow paths to stormwater runoff from a site to the pervious surface.

  B. It is needed to provide modifications to overland flow pathways in order for them to continue being able to safely transport stormwater flows without endangering a property.

## 5.6. Conclusion

The SWOT analysis in this chapter projected the same socio-economic challenges. Accordingly, socio-economic challenges and their effects on public libraries have always been in debate, specifically during the COVID pandemic. According to the strategic framework of the platform "public libraries of New Zealand" (2020, p. 24), the pandemic in New Zealand, like many other countries, caused many people to face limited internet connections because of the lack of devices such as computers and laptops. This is the time when libraries face a growth in demand for such services for different reasons, as that part of the community finds itself in economic hardship. Hence, libraries, in such situations, are the place where people can find support against their barriers. The government of New Zealand placed a fund to support libraries, which illustrates the importance of the position of public libraries in the community. As the former minister of internal affairs of New Zealand, Minister Martin, said, “Libraries play a vital role as a community hub and they can be the places where people can get real practical help during the tough economic times” (Martin, 2020). Accordingly, the minister Martin's argument can also be inspired by the architectural aspect of how an architectural approach can deliver an initiative through a new model for the future development of public libraries, not just to prevent the fading out of the presence of visitors in public libraries but to boost the socialization in public libraries, whether in a tough time such as a pandemic or usual time.

With regard to the SWOT analysis via the four locations of the selected public libraries, a framework of the existing circumstances was provided, which addresses the understanding of strengths, weaknesses, opportunities, and threats for each study area. In the meantime, general characteristics and zoning considerations are provided for each selected library's site in this research study. Overall, the analysis assists this study in highlighting its strengths, such as identifying the physical qualities and their potential in future developments, historical significance and architectural value, highlighting modern infrastructure, and community engagement. Weaknesses reflected the zoning limitations and their impacts, accessibility issues, frontage issues, the extent of flood risk, and logistical challenges. Opportunities explored include ongoing or upcoming projects that could align with the identified opportunities in Pukekohe, public transportation adjacency to the selected locations, adjacency of public spaces to the locations, potential partnerships with educational institutions, and the potential of new initiatives that could be introduced in the areas. Finally, threats highlighted how climate change and natural disasters could impact the library’s functionality, urban sprawl and its implications on the library’s usage, vehicle parking issues, and financial risk from the large size of sites for redevelopment.

With regard to highlighting key insights from each location, proposing mitigation ways for different weaknesses and threats, and also proposing ways of identifying the potentials and initiatives for improving Auckland’s public libraries in line with the Auckland Plan 2050, the Swot analysis assists the objectives of this study to reach the concept of a model to strengthen the sociability of future libraries in the urban context of Auckland. Therefore, the next chapter will start to form a model by considering the outcome of this chapter and also chapter three, which lets this study reach a fine-tuned final model.

# Chapter 6

# Development of an initial model leading to the final model

# Chapter 6

## 6.1. Proposed parameters of the initial model to meet the adaptable social infrastructure

To reach the objectives of this study, it is expected that the proposed model output of this study for the public libraries in each of the four selected locations promotes socialization. Accordingly, the proposed model should cause social change in its surroundings via the new initiative-based arrangement of spaces that can create a new sense of community and socialization through informal interaction. Arguably, the focal importance would be given to the sort of use of the public library's location as a pathway or a spot for acquiring knowledge or meeting, whether by a planned intention or by accidentally crossing the location. Accordingly, in both circumstances, the rising social pattern is unavoidable, which leads to boosting socialization in the area considerably.

This chapter, by exploring the parameters of the initial model and forming the final model, will expose a new approach to public libraries that meets the characteristics of an adaptable social infrastructure. Accordingly, this chapter, by exploiting the above outputs, will respond to the **research objectives**: 1. evolve the concept of "public library" within the context of Auckland, which is expected to promote public participation; 2. break the boundary between the public (street) and internal location, including the public library and its site, to improve the urban integration of public libraries in Auckland.

To reach all the above, this chapter looks at the data collected and different analyses for each of the four selected public libraries in Auckland during chapters 5 and 6. With that being said, the last two chapters illustrated how each of the four public libraries' locations is different from each other in terms of their space syntax indicators and SWOT analysis. Therefore, once the expected model is ready, this chapter is expected to be built via the exploitation of the last two chapters to implement the achieved model for each of the four selected locations in the further sections to achieve the aforementioned targets of this study. In the meantime, the importance of the achievement in this chapter is aligned with Auckland 2050 (2018, p. 54) priorities, as it is emphasized that libraries help visitors learn, socialize, and experience social interaction. According to Auckland 2050 (2018, p. 54), it is expected to plan and develop social and cultural infrastructure such as libraries, art galleries, theatres, community centres, etc. to create communities that are liveable and viable, which is vital as the existing services are under pressure because of population growth and demographic change.

### 6.1.1. The approach of the model structure

With regard to the above, this study suggests an approach of modelling to maximize accessibility, visual connection, and transparency. According to the suggestion, it is considered each department of a library as a shelf of books referring to a science or subject. In this way, we have different shelves that are separated from each other, and accordingly, they are accessible via corridors among them within the library spatial (Figure 6.1). This concept is considered to be inspired in the way of extending the pedestrian from the public (street) into the public library's location among different departments of the library.

Figure 6.1: The initial inspiration of public libraries for the expected research model (By author).

The above inspiration can strengthen the context of the idea, which raises three important directions:

- Development of a quality network of public library departments and facilities reflecting local communities
- Contributing to socializing a city node centre
- Locating future public libraries at the heart of multipurpose urban community spaces.

With raising the above directions, three main key players share spaces to coexist (Figure 6.02). With that being said, the public (street), the library's site, and the library's departments are given the approach of sharing spaces, which provides the opportunity for this study to form a model to meet the three directions that were mentioned earlier.

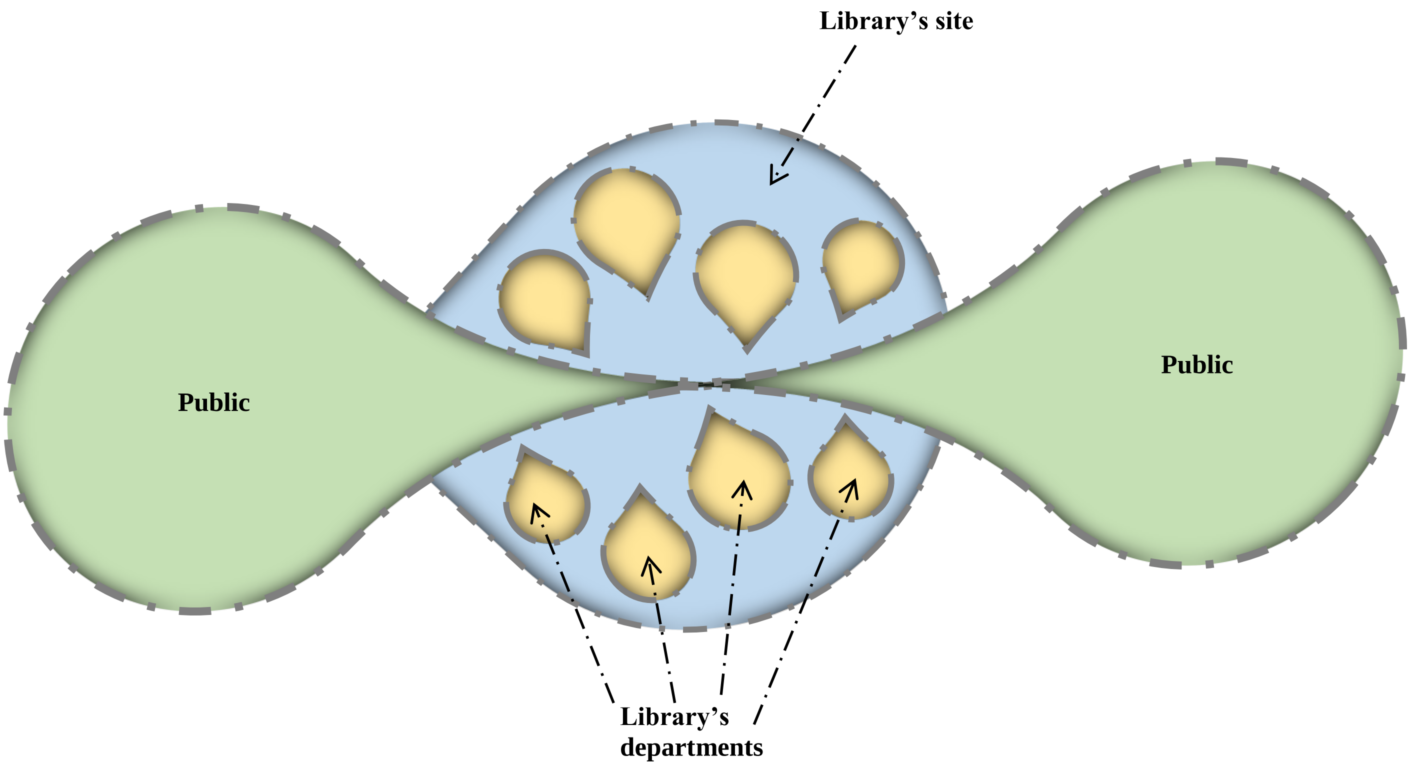



Figure 6.2: The concept of the expected initial research model (By author).

According to the considered approach, the pedestrian from the public (street) enters the library's site, which is distributed into different paths to reach out to each of the library's departments, like the way the corridors within the libraries are connected among different book shelves. In the meantime, the pathway lets visitors exit from the other side of the library's site to continue their tracks (Figure 6.2).

Concerning the above, the suggested model by this research study applies indicators of space syntax such as connectivity, integration, choice, and visibility (VGA and agent-based modelling). The aim of exploiting these indicators is to reach out to an extent of permeability about each of the selected libraries' locations within their local region (Figure 6.3). Accordingly, the above indicators illustrate to what extent a selected location is accessible to people by applying the suggested model. In this way, such a scenario is entailed by the number of connections between all separated sections of the library and also their connections to the public on the one hand and the connection of the library's location to its surrounding spaces on the other hand. In the meantime, the suggested approach gives substantial notions for the layout that should be considered at the early stage of the possible future design process of a public library and its site location.

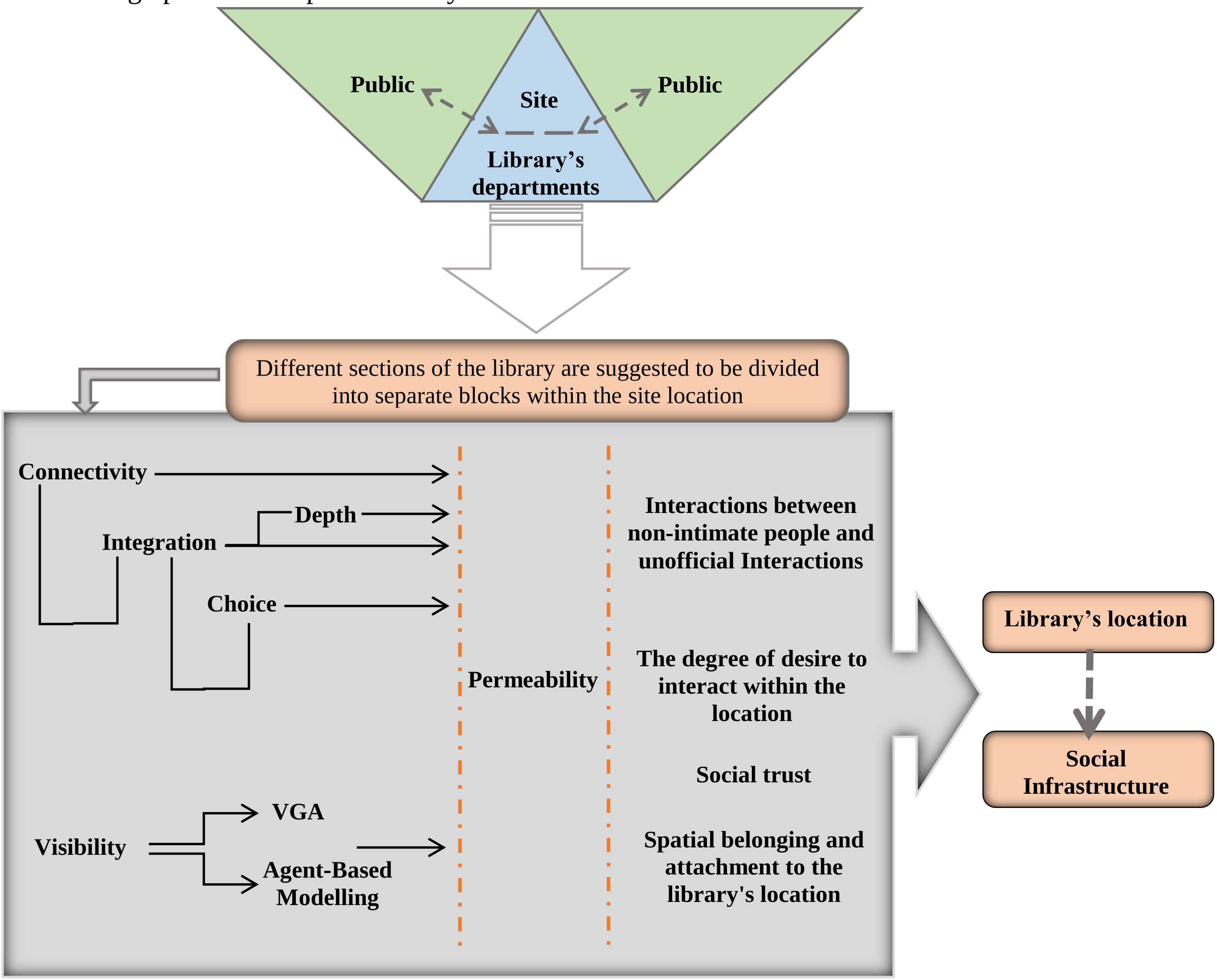



Figure 6.3: The suggested research model content (By author).

The approach of the suggested model lets each department of the library have directly connected lines to all other nearby departments without any need to enter a section to reach another department of the library and also have different connections to reach the public via minimum depth steps. Therefore, the efficiency of the above approach will be evaluated for each selected location of four public libraries in Auckland via the aforementioned indicators. With that being said, the number of new connections will be considered by the connectivity indicator, which includes through-site pedestrian access that also affects the rising of connectivity, and hence, the higher connectivity affects "permeability," which relates to the capacity of connections to and through the locations that carry people or cars specifically regarding the locations that are located close to the local community's amenities and services. In other words, connectivity lets us explore the degree to which the redeveloped location is permeable or well-connected. In the meantime, according to Hillier et al. (1987, p. 383), the permeability in this circumstance indicates how the relation between the site location and its nearby neighbour is built via the possible routes, which leads to where you can go and how to get there (Hillier et al. 1987, p. 383). With regard to the above, it is realised that permeability generally depends on the number of alternative paths from one point to another within an urban public space that will be evaluated for each of the four selected public libraries' locations and their selected surrounding areas. In this way, as visual permeability matters, more visible alternative paths for people who know the region cause stronger visual permeability. Besides, increasing the visual permeability means that people have multiple choices to choose a convenient route.

According to Van Nes & Yamu (2017, p. 10), there is a relationship between integration and people's accessibility and presence, the space of socioeconomic activities, vitality, and urbanism. With regard to the suggested model of this research, by extending the connection from the public through the location of each of the four selected public libraries, the approach will illustrate that each selected site location, to what extent, is integrated with its surrounding public spaces. In the meantime, as it was previously mentioned, busy central areas within many urban nodes have low global integration values; however, the same areas have high local integration. Hence, walkable radii of 400 m to 500 m with the centring of the selected public libraries' locations in each selected node are considered to be analysed via topological distance to see how the suggested model affects integration values. Besides, integration analysis allows for illustrating the average depth of a street or space, which relates to all other streets or spaces in the selected area. Accordingly, it shows how deep or shallow each space or street is from all other spaces by representing the number of syntactic steps in the selected area. According to the above description and according to Hillier et al. (1993, pp. 29–66), permeability is essentially the fundamental idea behind the to- and through-movement (obtained by the measures of integration and choice), which are metrics that capture how people perceive the urban grid. For instance, a daily travel from point (a) to point (b) via a chosen path. In addition, according to Hillier et al. (1987, p. 383), the way spaces relate to their immediate neighbours creates a system of potential paths that makes up the permeability structure of a complex. It outlines the locations we can go to and the ways that we choose to reach them.

With regards to the relationship between the aforementioned indicators of space syntax and permeability, it shows that there is direct impact from each of the space syntax indicators to permeability to make a low permeability or great permeability that will be examined via the suggested model on each of four selected areas in Auckland. In the meantime, the correlation between the values of integration and choice on the one hand and the correlation between the values of connectivity and integration on the other hand—both correlations are directly impacted by the status of the aforementioned indicators of space syntax.

By concentrating on the last part of the analyses of the suggested model, the extent of the relationship between permeability and visibility via VGA and agent-based modelling will be examined since there is an interrelating relation between "what you can see," which is visibility, and "where you can go," which is permeability. Accordingly, when people have the opportunity to have an open and/or wider field of views, the space they are looking for is easier accessible, which has a direct impact on the permeability of the destination in the area.

In a nutshell, the proposed model by this study is a spatial strategy model derived from layered analyses—visibility, integration, SWOT, and agent-based model simulations—to reposition suburban libraries as socially engaging infrastructure. Its novelty lies in integrating these tools for suburban Auckland, a context underexplored in global literature.

## 6.2. Analysis of the initial model and provision of the fine-tuned final model

### 6.2.1. Pukekohe

The region of Pukekohe, as a vibrant and dynamic satellite town, has a various range of crowds. According to Auckland Council-Eke Panuku Development Auckland (2023, p. 41), the Pukekohe population is expected to rise to 50000 within the next 20 years. It adds that the census by 2018 dedicates the majority of the population to the age categories of 15 to 39 and 40 to 64, which are respectively 32% and 29% of the total in the area (Chart 6.1).


Figure 6.4: Pukekohe central area (Google map library)

Accordingly, the age categories of 0 to 14 and over 65 are respectively 23% and 16%. However, the proportion among the same categories will be changed gradually so that it is expected to face a downward trend through the three categories of 15 to 39, 40 to 64, and 0 to 14 by 30%, 28%, and 20%, while the age category over 65 will be increased gradually to 22% by 2043 (Chart 6.2).

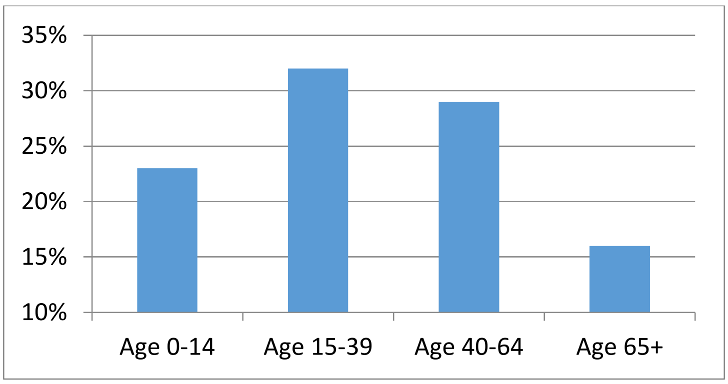



Chart 6.1: Age categories for Pukekohe region, 2018 (By author)

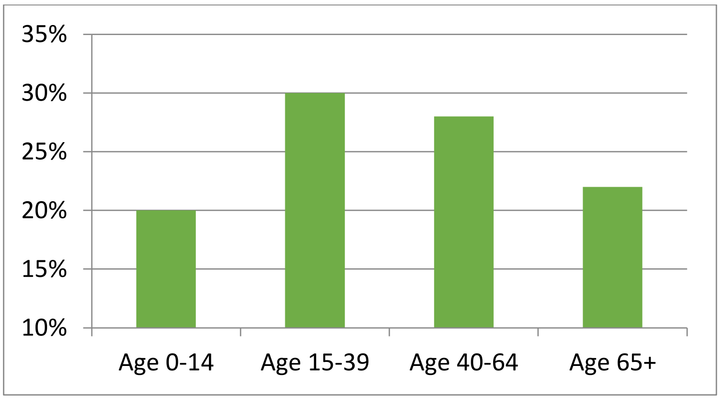



Chart 6.2: Age categories for Pukekohe region, 2043 (By author)

In the meantime, according to Auckland Council-Eke Panuku Development Auckland (2023, pp. 43–48), feedback from participants via written submissions and face-to-face interviews illustrates that they expect a vibrant public place in Pukekohe centre area (Figure 6.4) that offers fun and safety, where people can share stories and celebrate them, and where people can feel an enjoyable welcome that increases sociability. With regard to both local expectations and population growth, it is comprehensible the importance of this study's targets via the suggested approach model for the selected public libraries' locations within regions such as Pukekohe in Auckland.

### 6.2.1.1. Connectivity analysis

As it is mentioned, a walkable radius with the centring of the selected location of the current Pukekohe's library at Massey Street is considered to contrast the variations between connectivity analysis of the existing selected location with its surrounding urban context and after applying the new approach model at the same location. The new approach compared to the existing circumstances provides the opportunity not just to break the boundary between the public

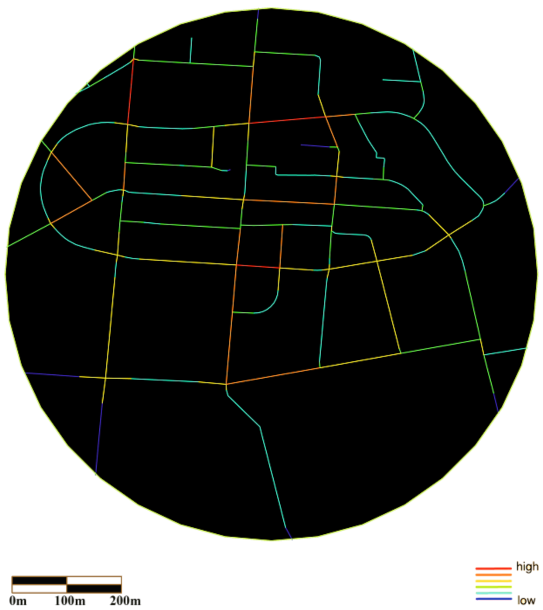



Figure 6.5: Connectivity analysis via the suggested approach model for the selected location within the selected area of Pukekohe region (By author).

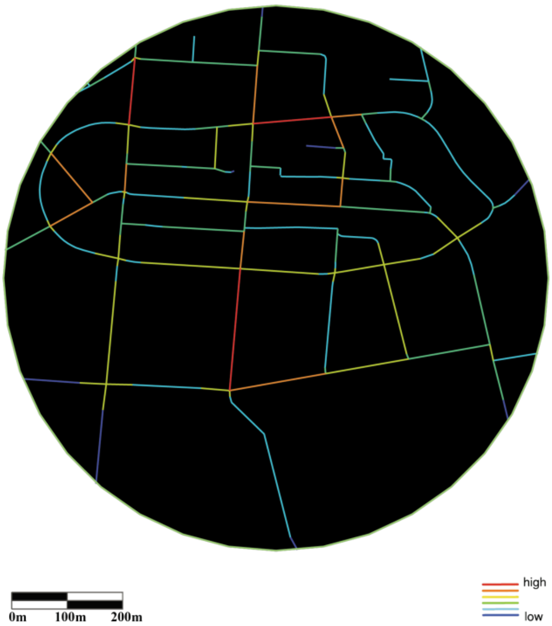


Figure 6.6: Connectivity analysis for the existing circumstances within Pukekohe region (By author).

and the library's site plan, but it also increases the chance of having a shortcut between the area close to Roulston Street at Massey Avenue and the southern side of Edinburgh Street (Figures 6.5 & 6.6). In the meantime, the new shortcut path via the library's location is not just the easiest direct footpath between both sides of Massey Avenue through the crosswalk, but it would be an adaptable shortcut to the new potential that has been planned by the local council for a development opportunity on a Superblock, which is surrounded by Edinburgh Street, Devon Lane, Roulston Street, and Massey Avenue.

As it is explained in Chapter 4, the relation between connectivity and line length can affect the extent of permeability value. The aforementioned new route via the suggested approach model through the library's site lets the line be aligned with the main potential path that it is part of the new development (Figure 6.7) at the superblock that is located on the opposite side of the library's site on the Massey Street. Hence, the line length, including the path from Devon Lane and the following route through the library's site via the crosswalk on the Massey Street,

Figure 6.7: Edinburgh Street development opportunity (Auckland Council-Eke Panuku Development Auckland, 2023, p. 52).

causes greater connection to reach the southern part of Edinburgh Street. Accordingly, permeability will be strengthened to some extent. Besides, by adopting the new approach model, Massey Street experiences stronger connectivity as well.

### 6.2.1.2. Integration analysis

**Note:** As previously noted in Chapter 4, a local area or a local axial line has a high local integration but low global integration. In the meantime, as this study concentrates on the impact of applying the new approach model on the selected location of each library and each location's surrounding urban context within the considered four nodes in this study, the analysis will be taken for local integration.

- **Local Integration Analysis**

The same walkable radius scale is applied to compare the differences between integration

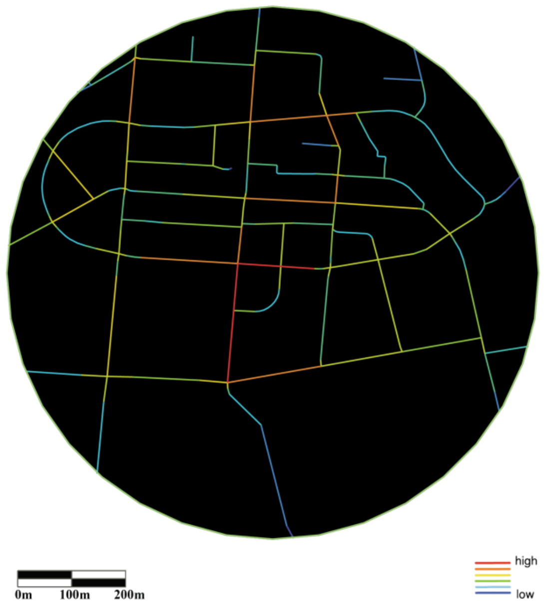



Figure 6.8: Local Integration analysis via the suggested approach model for the selected location within the selected area of Pukekohe (By author).

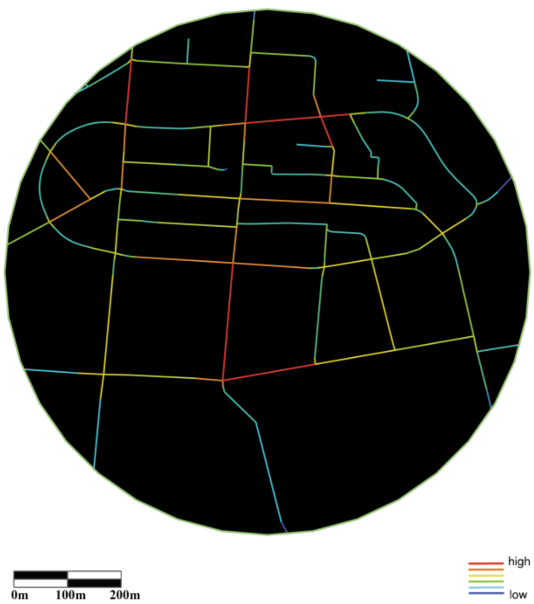



Figure 6.9: Local Integration analysis for the existing circumstances within Pukekohe region (By author).

analysis of the current selected location with its surrounding urban context and after adopting the new approach model at the same location. The comparison is considered via the local integration. The local integration analysis by applying the new approach model within the selected location causes Massey Street to meet a higher level of integration value than the existing circumstances of the selected library's site (Figures 6.8 & 6.9). With that being said, the new approach lets Massey Street be more integrated in the local system by making three-direction changes to the accessible lines.

As it is previously explained in Chapter 4, four indicators should be assessed through the integration analysis, including mean depth (MD), real asymmetry (RA), real relative asymmetry (RRA), and finally the integration value (INT) (Tables 6.1 and 6.2).

| Ref. number Massey Street | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA)-R3 | Real Relative Asymmetry (RRA)-R3 | (TD)-R3 |
|---|---|---|---|---|---|
| **217** | **2.050229** | **2.214286** | **0.089947** | **0.487750** | **62** |

Table 6.1: Local integration analysis's result for the Massey Street within the central area of Pukekohe in Auckland via adopting the new approach model (by author)

The comparison of both tables 6.01 and 6.02 illustrates that applying the new approach lets Massey Street meet the higher local integration value of 2.050229 than the existing condition with the value of 1.673451. Accordingly, both RA and RRA meet the lower values via the new approach than the current condition. Hence, the above comparison acknowledges that the new approach lets Massey Street meet a shallower system than its current circumstances, which means that it is more integrated via the new approach.

| Ref. number Massey Street | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA)-R3 | Real Relative Asymmetry (RRA)-R3 | (TD)-R3 |
|---|---|---|---|---|---|
| **205** | **1.673451** | **2.210526** | **0.134503** | **0.597567** | **42** |

Table 6.2: Local integration analysis's result for the Massey Street within the central area of Pukekohe in Auckland for existing circumstances (by author)

### 6.2.1.3. Choice analysis

By following the choice analysis, it is examined the degree to which the new routes and/or Massey Street are likely to be used as part of a route by comparison between the new suggested approach and the existing circumstances (Figures 6.10 & 6.11). Hence, it brings the opportunity to learn to what extent the suggested new approach assists the tendency of choosing the longest path with the least angle to the direction, which lets of having the straightest route.

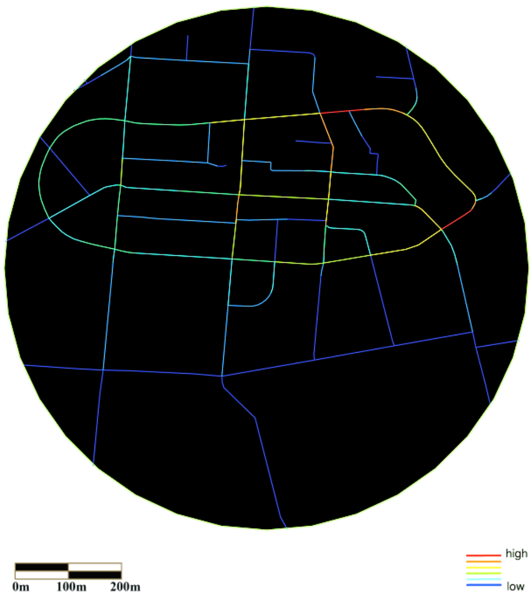



Figure 6.10: Angular Choice analysis via the adopting the new approach model for the selected area within the central area in Pukekohe in Auckland with the 500m distance from the library's location (by author).

According to the angular choice analysis that was illustrated and analysed in Chapter 4, calculating the angular mean depth is the first step. Accordingly, the total depth value and the number of segments or nodes in the system "k," which are provided by depthmapX analysis for the new approach model, are respectively 341.84375 and 300 within the selected 500 m radius. The angular mean depth value is 1.14329 via the below formula:

(MD) = total depth (TD) / k-1

The value for angular choice is 1800, which is provided by depthmapX.

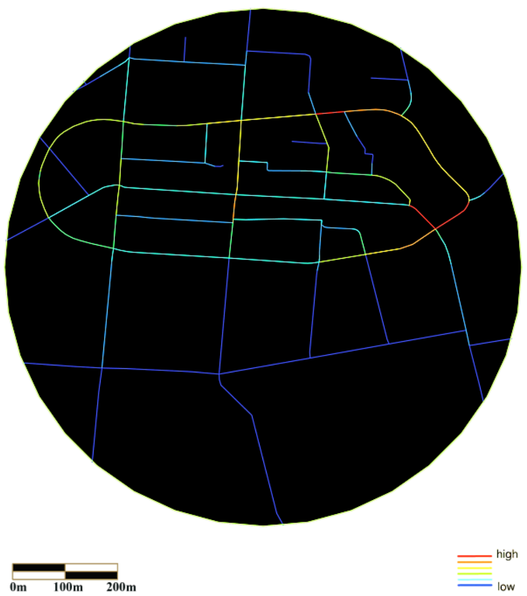



Figure 6.11: Angular Choice analysis via the existing condition for the selected area within the central area in Pukekohe in Auckland with the 500m distance from the library's location (by author).

In contrast, the total depth value and "k" for the existing circumstances are respectively 281.031250 and 284 within the selected 500 m radius. The angular mean depth value is 0.9930 via the below formula:

(MD) = total depth (TD) / k-1

The value for angular choice is 1441, which is provided by depthmapX.

The comparison of both circumstances illustrates that the new approach causes a higher value of angular choice than the current condition. Hence, Massey Street is more likely to be used than the existing condition as part of a route via the new approach model in the central area of Pukekohe.

#### 6.2.1.4. Visual Graph Analysis (VGA)

Similarly to the VGA procedure that has been done in Chapter 4, every cell would be evaluated in the way of its association with all other cells within the selected rectangle in the central area of Pukekohe. In the meantime, the comparison between the VGA via the new approach model and the existing condition illustrates that while both systems meet a similar depth level, the new approach model causes an opportunity for visual connection through the selected public library's site (Figures 6.12 & 6.13). The level of visual connection from the most well-connected cells to the weakest is shown from red to dark blue.

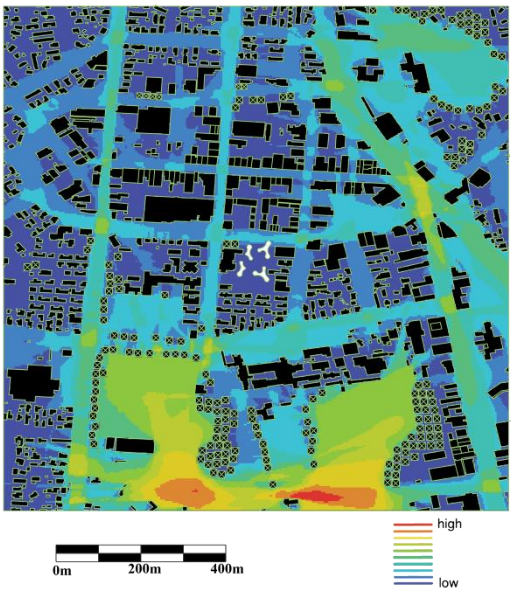



Figure 6.12: VGA study via applying the new approach model through the selected location of the library at Massey Street within the central area in Pukekohe (by author).

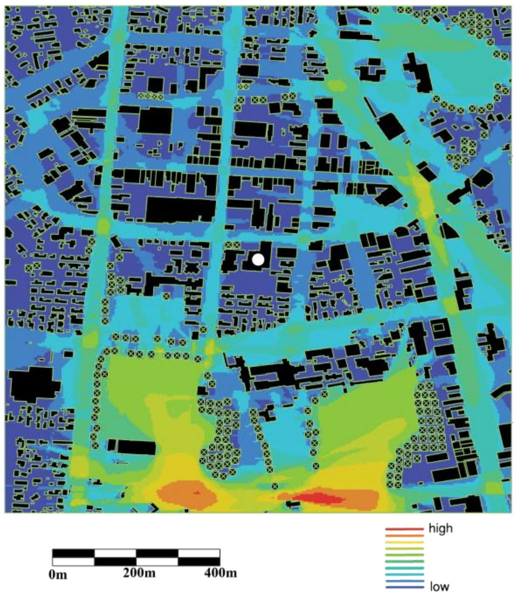



Figure 6.13: VGA study via the current condition within the central area in Pukekohe (by author).

By following further in this section, the “visibility step” from the same root cell is compared between the way of adopting the new approach and the current condition to clear to what

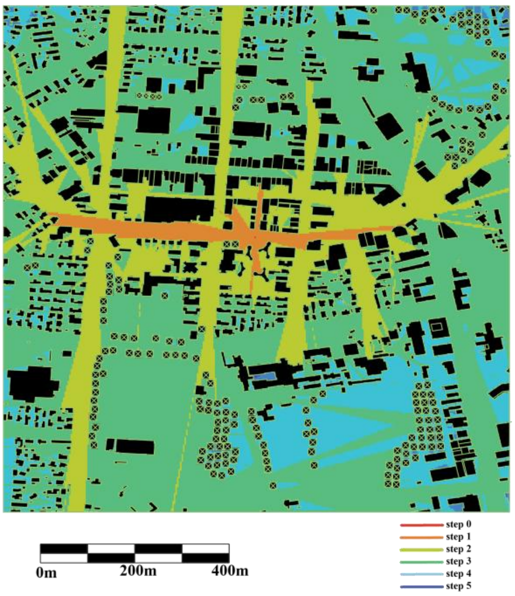



Figure 6.14: Root cell (A) in Massey Street, Visibility step analysis via applying the new approach model through the selected location of the library within the central area in Pukekohe (by author).

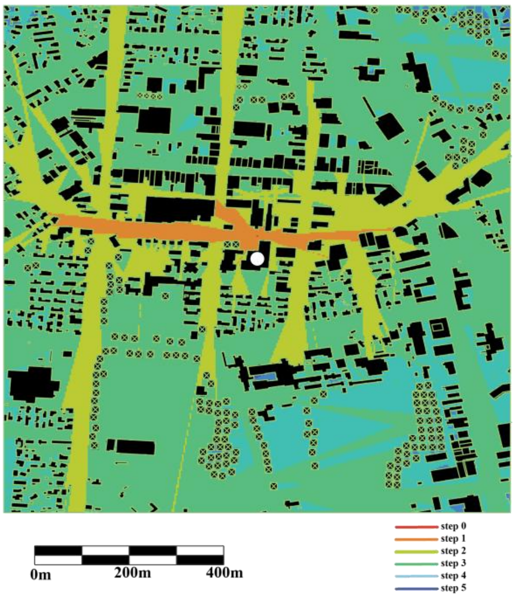



Figure 6.15: Root cell (B) in Massey Street, Visibility step analysis via the current condition within the central area in Pukekohe (by author).

extent all cells can be observed. The comparison between the two conditions illustrates that the number of possible steps from the root cell on Massey Street is different since the root cell in condition (A) meets lower steps than condition (B), as the number of visible cells that can be seen directly is higher from the root in condition (A) than (B) (Figures 6.14 & 6.15). As two conditions are compared from the same location, changing the obstacles’ positions between the two conditions is the main reason to vary the degree of visibility from the same root cell. With that being said, the mean depth value is influenced by the building blocks, which are the most obstacles in the selected area. Having said that, the mean depth, as previously explained, represents which raster system is deeper from its proposed root cell's location (Table 6.3).

| Mean depth for location (A)<br><br>Via the new approach model | Mean depth for location (B)<br><br>Via the existing condition |
|---|---|
| TD = 244148<br>K = 84009<br>MD = 244148 / 84009 – 1<br>MD = 2.90 | TD = 245655<br>K = 83948<br>MD = 245655 / 83948 – 1<br>MD = 2.92 |

Table 6.3: mean depth calculation for conditions (A) and (B) within Pukekohe (by author).

By comparison between the two circumstances, mean depth faces lower value via status (A) than status (B), which means that the raster-based system is deeper from the same location via existing status (B) than the status (A). The above results acknowledge that more cells are reachable easier via status (A) than (B) to the same location in Massey Street (Table 6.3). Besides, the location's status (A) has a longer continuous view than status (B), which means that there are more number of cells with the same value in the first step that can be seen from the location in condition (A) (Figures 6.14 & 6.15). With that being said, the new approach model lets the same location have more reachable and visible cells through the library's location from Massey Street, which helps to **break the boundary between the public and the library's site.**

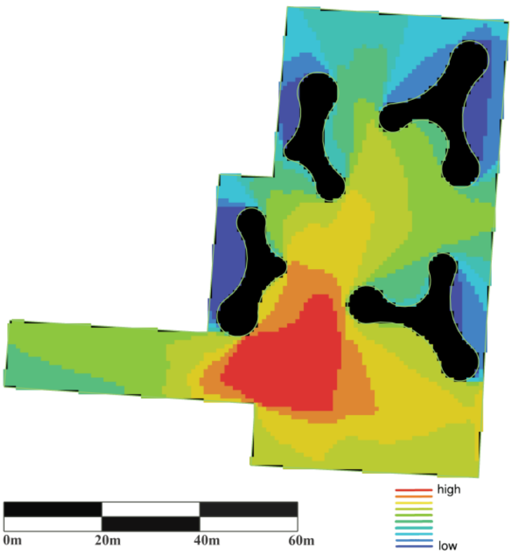



Figure 6.16: VGA study via applying the new approach model through the selected location of the library within the central area in Pukekohe (by author).

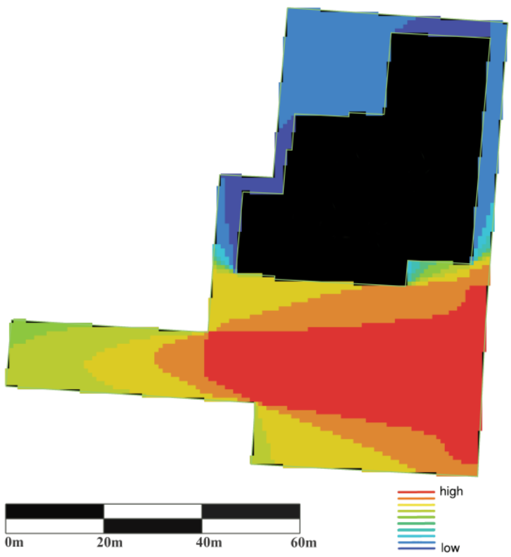



Figure 6.17: VGA study via existing status through the selected location of the library within the central area in Pukekohe (by author).

The VGA study via adopting the new approach within the selected public library's site illustrates the opportunity of how it becomes feasible for all of the isovist fields from every root in the selected site to be integrated. In the meantime, the relations among all cells represent that the majority of the cells within the library's site are well-connected to their adjacent cells, which strengthens permeability. Hence, it is easier to access from the public not just to explore the library's location but to choose the new route as a shortcut passage (Figures 6.16 & 6.17). Moreover, "through vision" analysis within the library's site represents

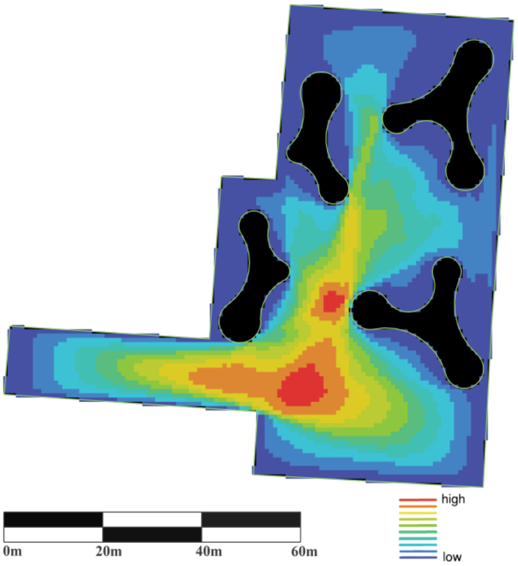



Figure 6.18: Through vision analysis via applying the new approach model through the selected location of the library within the central area in Pukekohe (by author).

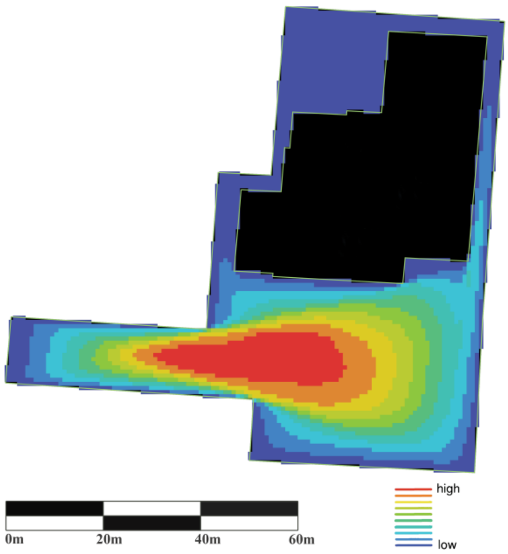



Figure 6.19: Through vision analysis via existing status through the selected location of the library within the central area in Pukekohe (by author).

the potential of having a lower number of longer lines of vision in the location by applying the new approach than the existing status (Figures 6.18 & 6.19). However, there is a highlighted difference between the two statuses. Hence, by adopting the new approach, there is the possibility of having longer lines of vision through the new spaces or cells, while the existing status of the library's form doesn't let us have such potential of vision within the site (Figures 6.18 & 6.19). Accordingly, the highest degree of longer lines of vision to the weakest degree are shown from red to dark blue. In the meantime, the status of line vision can be varied as the new approach model is flexible to different design layouts that adopt the approach. Hence, having the longer lines of vision can strengthen both physical and visual permeability, which can impact orientation, wayfinding, and people’s behaviour, as noted previously in Chapter 4 that it brings into account its strong relation with sociability regarding the location in the selected urban context.

### 6.2.1.5. Applying the Agent-Based Modelling

Similarly, in this part, one raster system for three analysis' types with a distance of 500 meters from the library's location and one set of three analyses over the library's location are applied. The three scenarios' analyses over the whole selected raster system, including the agent as an average person, the agent as a visitor or tourist, and the agent as a local, with adopting the new approach model on the selected location of the library, illustrate that there is not much difference between them (Figures 6.20, 6.21, and 6.22) and the existing condition that analysed in Chapter 4 (Figures 4.23 and 4.24). However, the new approach lets the library's site be explorable via dragging paths among the split library's building to multiple separated units.

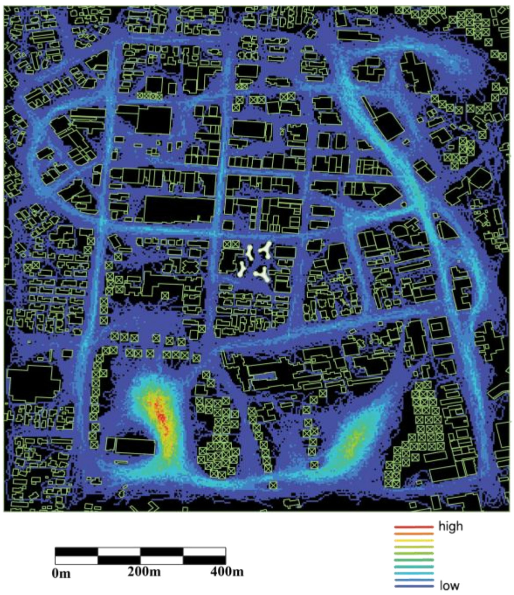



Figure 6.20: The agent as an average person via the new approach model through the selected location of the library and the selected surrounding area within the central area in Pukekohe (By author)


Figure 6.21: The agent as a tourist or visitor person via the new approach model through the selected location of the library and the selected surrounding area within the central area in Pukekohe (By author)

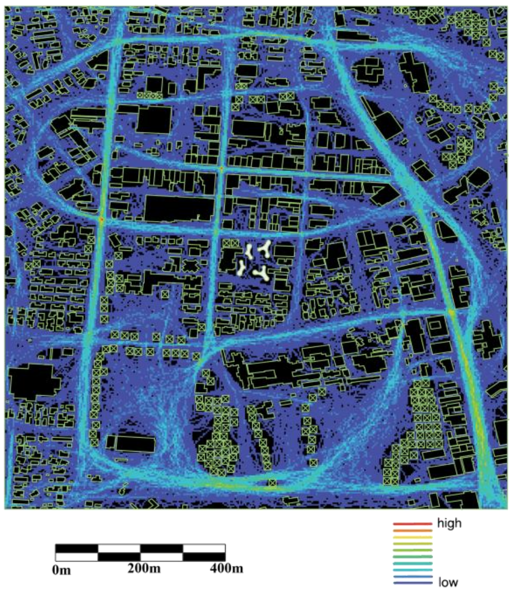



Figure 6.22: The agent as a local person via the new approach model through the selected location of the library and the selected surrounding area within the central area in Pukekohe (By author)

With regard to the prior explanation, the further scenarios are concentrated on the library's site by a comparison between the applying the new approach model and the existing status.

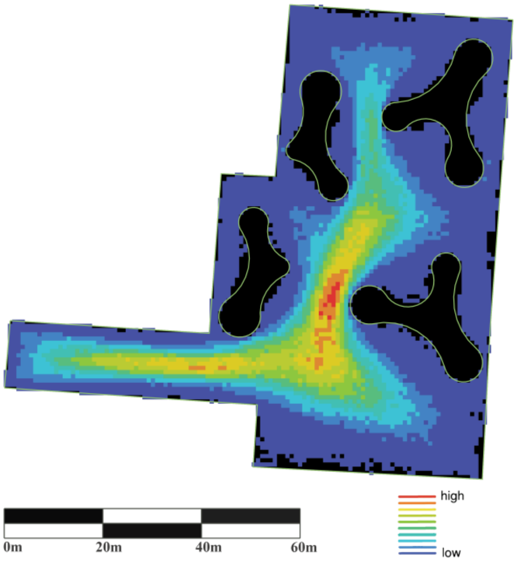



Figure 6.23: The agent as an average person via applying the new approach model through the selected location within the Pukekohe central area (by author)

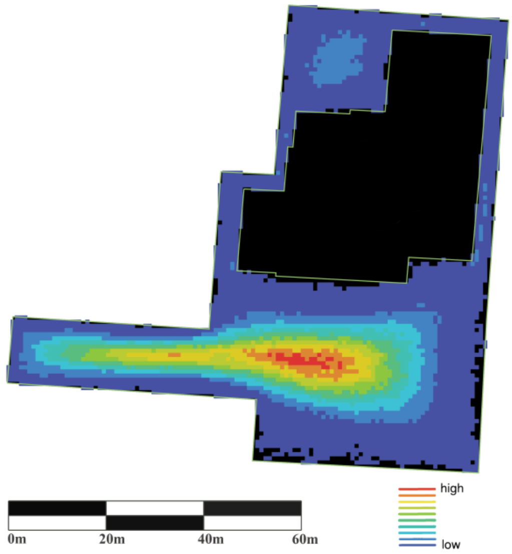



Figure 6.24: The agent as an average person for current status through the selected location within the Pukekohe central area (by author)

The first type of the three scenarios (Figures 6.23 & 6.24), which is the agent as an average person, describes both local and tourists' movement through the paths with the vision field at 15°, which is why the outcome looks blurry. In the meantime, the analysis acknowledges that the routes through the selected location between the conceptual units face a relatively high

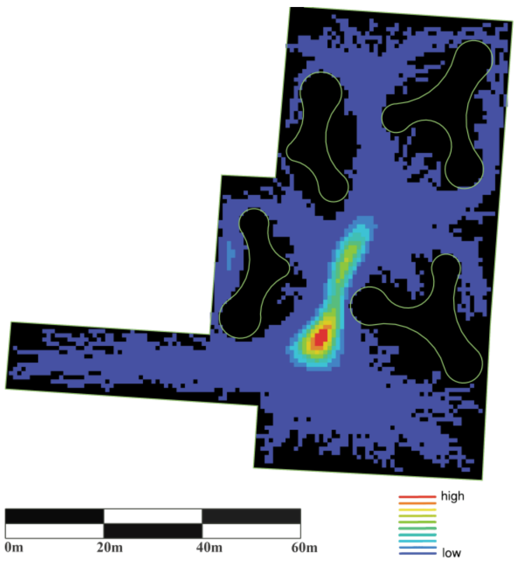



Figure 6.25: The agent as a tourist or visitor via applying the new approach model through the selected location within the Pukekohe central area (By author)

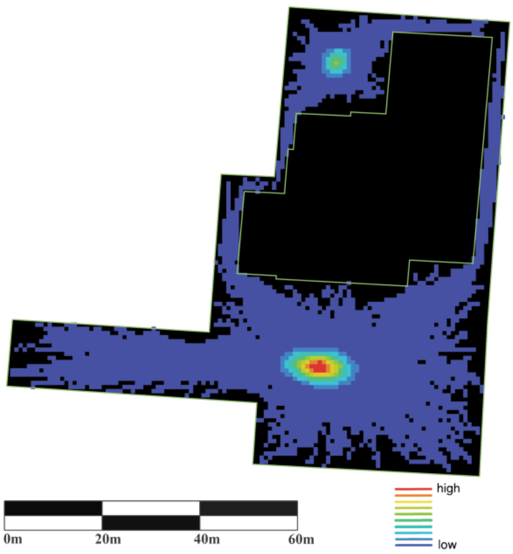



Figure 6.26: The agent as a tourist or visitor for current status through the selected location within the Pukekohe central area (By author)

movement activity in comparison to the existing status (Figures 6.23 & 6.24).

The second type is the agent as a tourist or visitor. The reason for the different movement pattern with other types is the one syntactic step, while the first type includes three syntactic steps. As the comparison analyses (Figures 6.25 & 6.26) illustrate, tourists or visitors chose the location within the site with the longest vision since they are not familiar with the area but they would explore it. Hence, the vision field at 30° is placed. Accordingly, the comparison indicates that visitors have the opportunity to attend in the central spots among new building units compared the existing status (Figures 6.25 & 6.26). The third type, which

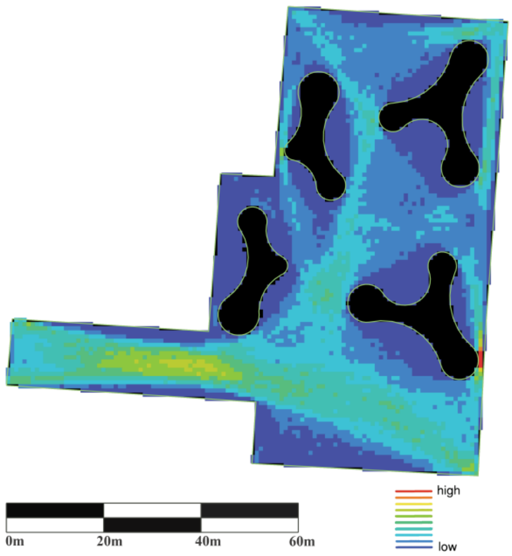



Figure 6.27: The agent as a local person via applying the new approach model through the selected location within the Pukekohe central area (By author)

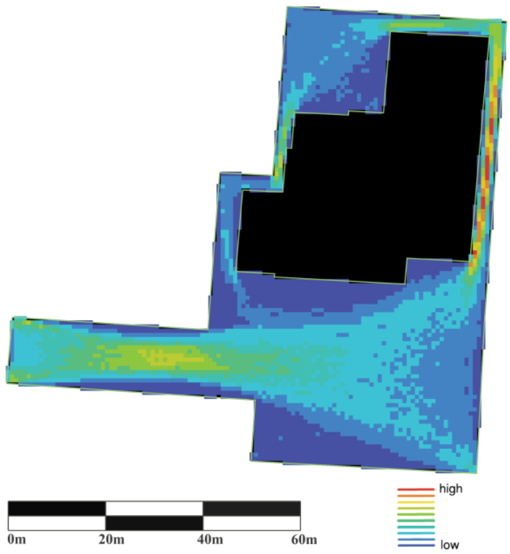



Figure 6.28: The agent as a local person for current status through the selected location within the Pukekohe central area (By author)

is the agent as a local, takes five steps that have been taken by the same five thousand agents to move with the vision field at 7°. As it is shown (Figures 6.27 & 6.28), the movement paths of locals are straightened out, and they wouldn't gather in the centre of the area. The reason is that they are familiar with the area, and accordingly, they know the route leading to their destination. The comparison between the new approach model and existing condition represents that locals have very smooth and easier wayfinding through the new building units than the current status (Figures 6.27 & 6.28).

The above analysis made clear that visitors are looking for the locations with the greatest integration of the through vision, while locals are following the movements, based on the angular choice analysis's results.

### 6.2.2. Parnell

Parnell, as a well-known central region, is a busy and running region that includes diversity of population (Figure 6.29). According to 2018 Census data about Parnell West and East, Stats NZ (n.d.), the population of both parts is 7563 with a median age of 36.6 years. It also is noted that the majority of the population of both parts is dedicated to the age category of 30 to 64, which is 47.62% of the total in the area (Chart 6.3). Accordingly, the age categories of 15 to 29, over 65, and under 15 are respectively 27.72%, 14.45%, and 10.22%. In the meantime, according to the 2023 Census data Stats NZ (n.d.), the median age has slightly declined by the age of 36.2 years, while the population has met a growth to reach 7788 (Chart 6.4). It is also noteworthy that the same indicator has had a gradual slope since 2013, which was the age of 37.9 years when the population was 7095 (Chart 6.4).


Figure 6.29: Parnell region (Google map library)

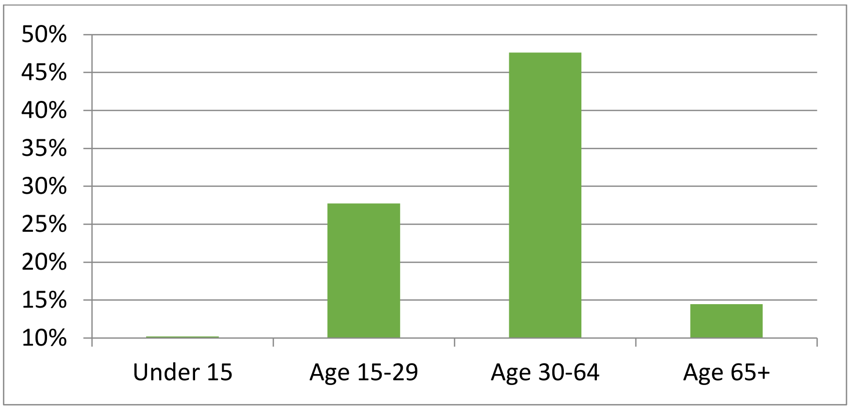



Chart 6.3: Age categories, Parnell census 2018 (By author)

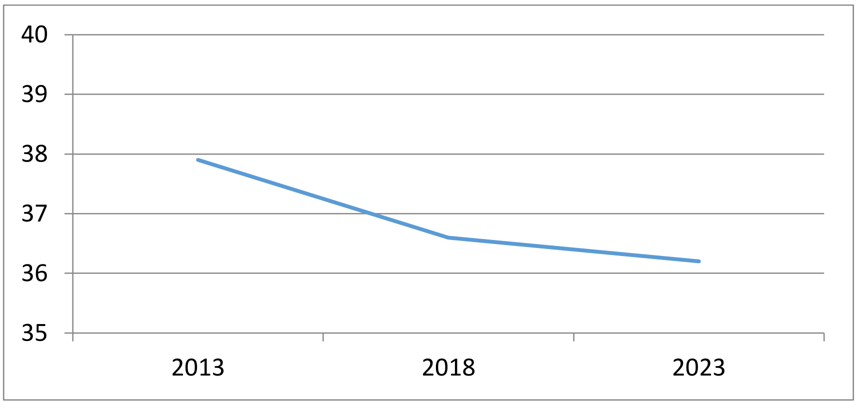



Chart 6.4: Median Age comparison, Parnell census (By author)

### 6.2.2.1. Connectivity analysis

The analyses through the specified space syntax indicators within Chapter 4 brought to the attention that there is a better location with three sides access to the public, including main roads and highways, compared with the existing location of the National Library of New Zealand on Stanley Street. Besides, there is a long boundary on each side between the public and the suggested location.

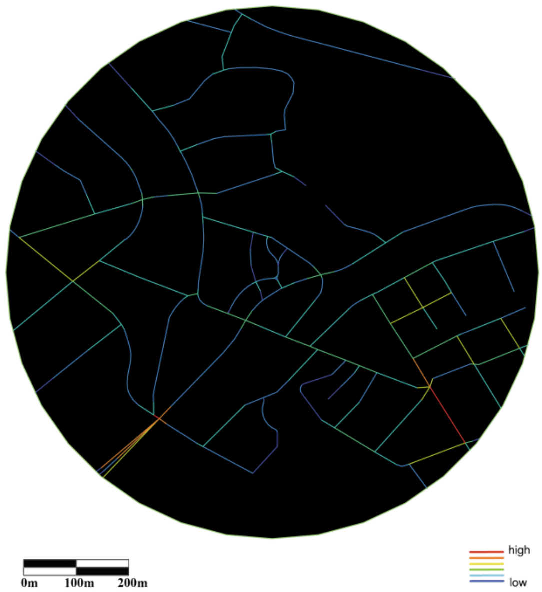



Figure 6.30: Connectivity analysis via the suggested approach model for the selected location within the selected area of Parnell region (By author).

Connectivity analysis for this area of Parnell is considered similarly to the Pukekohe with the same walkable radius size. As the analysis is considered for the comparison of the connectivity between the existing location of the National Library of New Zealand with its surrounding urban context and the suggested new location with its surrounding urban context, then each analysis is applied to the same radius size but with the centring of the two different selected locations at The Strand and Stanley Street (Figures 6.30 & 6.31).

By adopting the new approach model to the new suggested location (Figure 6.30) at Strand Street, a shortcut gives an opportunity to residents from residential unites along Ronayne Street to reach The Strand via the new suggested library's site location. Also, the new location lets locals and visitors have direct walkable access to The Strand and Ronayne Street from Parnell Rise without entering the highway, which is safer and encouraging to the people to explore the route within the suggested location as part of their daily travel. In the meantime, the new approach causes the entry from The Strand to the location to come with a slightly higher connectivity than the entry from Stanley Street to the existing location (Figures 6.30 & 6.31).

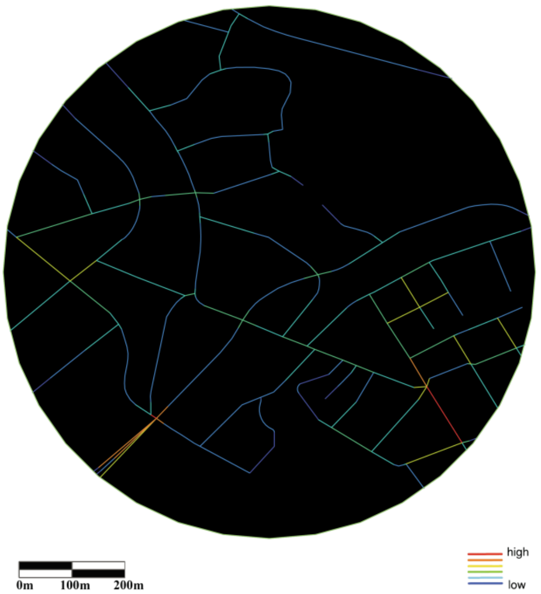


Figure 6.31: Connectivity analysis for the existing circumstances within Parnell region (By author).

### 6.2.2.2. Integration analysis

- **Local Integration Analysis**

Similar to the last section, this part applies local integration analysis through the same walkable radius scale to compare the integration status locally between the new suggested location with its surrounding urban context and the existing circumstances. The local integration analysis displays that the level of integration for The Strand is boosted compared to the Stanley Street that the existing library is located in (Figures 6.32 & 6.33). In other words, The Strand is more integrated via three-direction changes to the available axial lines.

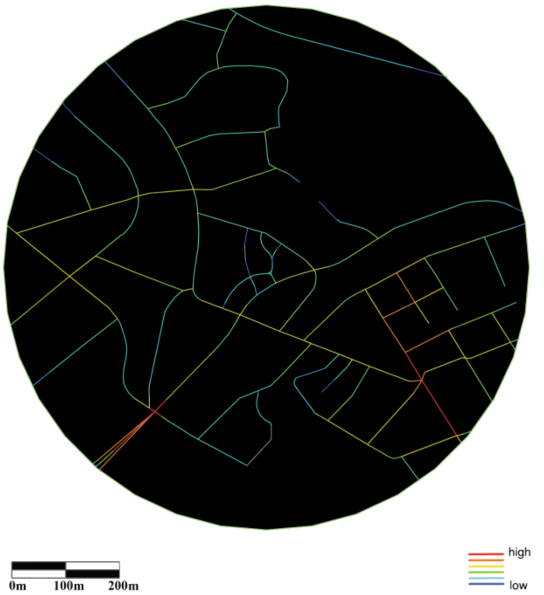


Figure 6.32: Local Integration analysis via the suggested approach model for the selected location within the selected area of Parnell (By author).

In continuance, four indicators, including mean depth (MD), real asymmetry (RA), real relative asymmetry (RRA), and finally the integration value (INT), should be assessed to make a clear perception of the above (Tables 6.4 and 6.5).

| Ref. number<br>The Strand | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA)-R3 | Real Relative Asymmetry (RRA)-R3 | (TD)-R3 |
|---|---|---|---|---|---|
| **240** | **1.21234** | **2.25** | **0.227272** | **0.824852** | **27** |

Table 6.4: Local integration analysis's result for The Strand within Parnell in Auckland via adopting the new approach model (by author)

With regard to Tables 6.4 and 6.5, The Strand meets a higher local integration value of 1.21234 compared to Stanley Street with the value of 1.01028. Accordingly, RA and RRA for The Strand, where it is adjacent to the new suggested location for the potential library, received lower values than values for Stanley Street adjacent to the current library's location. Thus, applying the new approach model causes a shallower system for The Strand than Stanley Street adjacent to the current

Figure 6.33: Local Integration analysis for the existing circumstances within Parnell region (By author).

circumstances, which acknowledges how The Strand is more integrated via the new approach.

| Ref. number<br>Stanley Street | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA)-R3 | Real Relative Asymmetry (RRA)-R3 | (TD)-R3 |
|---|---|---|---|---|---|
| **273** | **1.01028** | **2.5** | **0.27272** | **0.989823** | **30** |

Table 6.5: Local integration analysis's result for Stanley Street within Parnell in Auckland for existing circumstances (by author)

### 6.2.2.3. Choice analysis

Same as the previous section, it is examined to what extent the new routes and/or The Strand are likely to be chosen as part of daily travel. Accordingly, a comparison would be taken

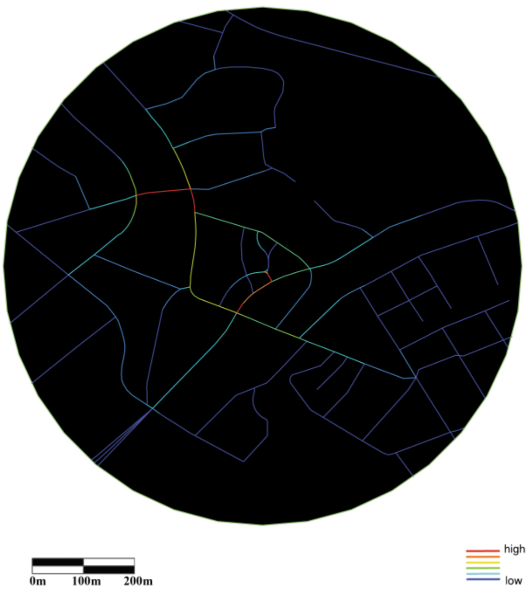



Figure 6.34: Angular Choice analysis via the adopting the new approach model for the selected area within Parnell in Auckland with the 500m distance from the library's location (by author).

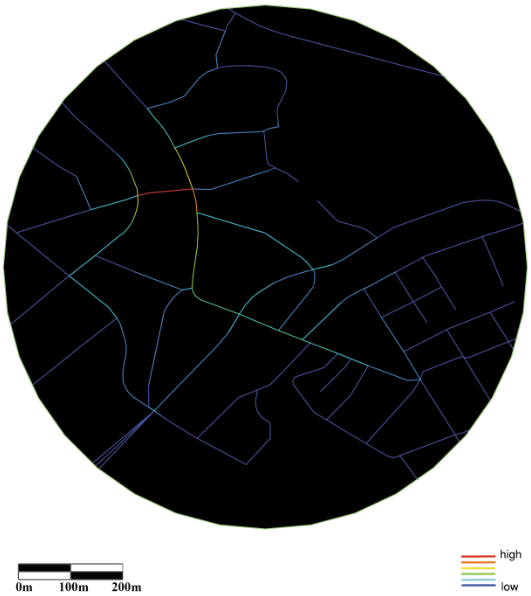



Figure 6.35: Angular Choice analysis via the existing condition for the selected area within Parnell in Auckland with the 500m distance from the library's location (by author).

between the new suggested approach and the existing status (Figures 6.34 & 6.35). The above makes clear how the new approach model causes people to choose the longest route with the least angle to the direction to have the straightest route.

According to the regular procedure of the angular choice analysis as explained previously, the angular mean depth is the priority to be calculated. Hence, the total depth value and the number of segments or nodes "k" are provided by the depthmapX platform through the analysis. With that being said, the total depth value is 591.9375 and "k" is 255. Accordingly, the angular mean depth value is achievable via the below formula:

(MD) = total depth (TD) / k-1

(MD) = 2.33

In the meantime, according to the analysis through depthmapX, the angular choice is 8983.

In comparison to the new approach model, the total depth value is 423.2187 and "k" is 196 for the existing circumstances. Accordingly, the angular mean depth value is achievable via the below formula:

(MD) = total depth (TD) / k-1

(MD) = 2.17

Also, the angular choice is 1629, which is concluded by depthmapX similar to the above.

The consequences of the above illustrate that the new approach causes a considerably higher angular choice value than the existing status. Thus, The Strand adjacent to the new suggested library's location is more likely to be chosen after adopting the new approach model than Stanley Street adjacent to the existing library's location as part of daily travel.

#### 6.2.2.4. Visual Graph Analysis (VGA)

The selected range within Parnell is considered to be analysed by VGA to evaluate the visual association of every cell with all other cells in the selected area. As a new suggested location is considered, a comparison of VGA between the new location via the new approach model and the existing model within the selected location is implemented. The comparison reveals that more cells with the highest level of visibility appeared at The Strand adjacent to the new suggested location, which is impacted by the new approach model, while Stanley Street adjacent to the existing library's location has a considerably lower visibility level (Figures

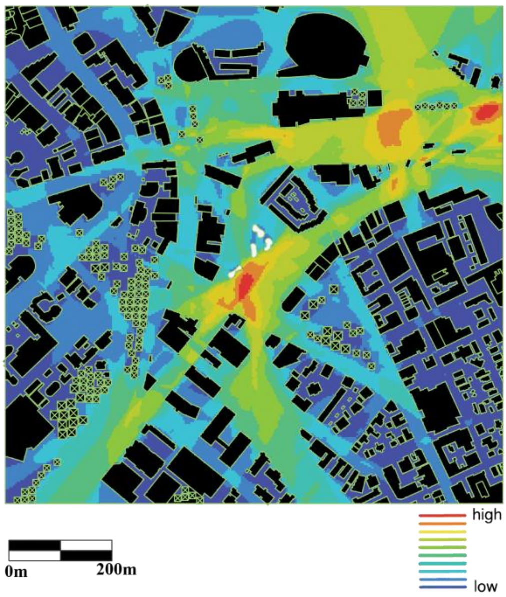



Figure 6.36: VGA study via applying the new approach model through the selected location of the library at The Strand within the Parnell in Auckland (by author).

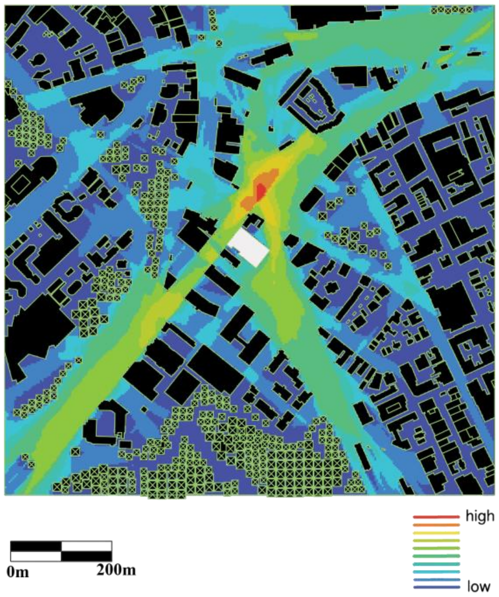



Figure 6.37: VGA study via the current condition at Stanley Street within the Parnell in Auckland (by author).

6.36 & 6.37). As usual, the level of the visibility graphic analysis is represented by the most well-connected cells in red to the weakest in dark blue.

The next phase of comparison via the "visibility step" between the two root cells displays to what extent all cells can be observed in selected areas. The comparison shows that while

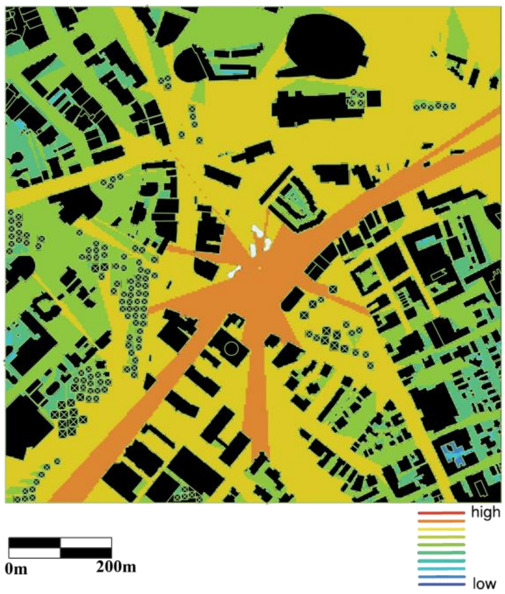



Figure 6.38: Root cell (A) in The Strand, Visibility step analysis via applying the new approach model through the selected location of the library within Parnell (by author).

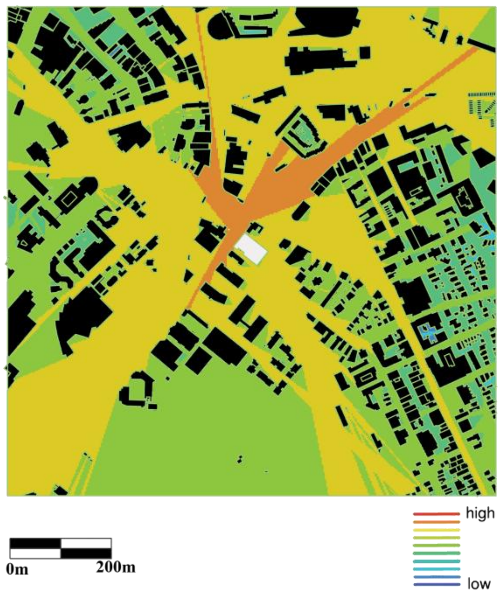



Figure 6.39: Root cell (B) in Stanley Street, Visibility step analysis via the current condition within Parnell (by author).

there are the same steps from each root cell to observe other cells, there are considerably more cells that can be observed directly from location (A) than location (B) (Figures 6.38 & 6.39). Hence, the new suggested library's location is preferable to the existing library's location, as the new location is considerably more observable directly than the existing location.

| **Mean depth for location (A)**<br>**Via the new approach model** | **Mean depth for location (B)**<br>**Via the existing condition** |
|---|---|
| TD = 110014<br>K = 48057<br>MD = 110014 / 48057 – 1<br>MD = 2.29 | TD = 111126<br>K = 46424<br>MD = 111126 / 46424 – 1<br>MD = 2.39 |

Table 6.6: mean depth calculation for conditions (A) and (B) within Parnell (by author).

With regard to the above comparison of mean depth results between the two selected root cells (Table 6.6), it is concluded that the mean depth value is higher for status (B) than status (A) within selected raster-based systems, which means that the raster-based system is shallower from the root cell (A), which is also adjacent to the new suggested library's location that is impacted by the new approach model, than the root cell (B) adjacent to the existing library's location (Figures 6.38 & 6.39). It goes without saying that changing the obstacles' positions causes the degree of visibility from a root cell, which is obvious in the comparison between spots (A) and (B) (Figures 6.38 & 6.39). Accordingly, it is obvious how the mean depth value is influenced by obstacles, specifically the building blocks. The overall of the above consequences acknowledges that more cells are visible easier from root cell (A) via the first step in The Strand than (B) in Stanley Street. Thus, the root cell (A) has a longer continuous vision than the root cell (B) (Figures 6.38 & 6.39). In a nutshell, the comparison displays how the new approach model is successful in breaking the boundary between the public and the new suggested library's location.

The comparison of VGA analysis shows that to what extent, within the new suggested library's location, it is more feasible to let every root and its isovist field be integrated with

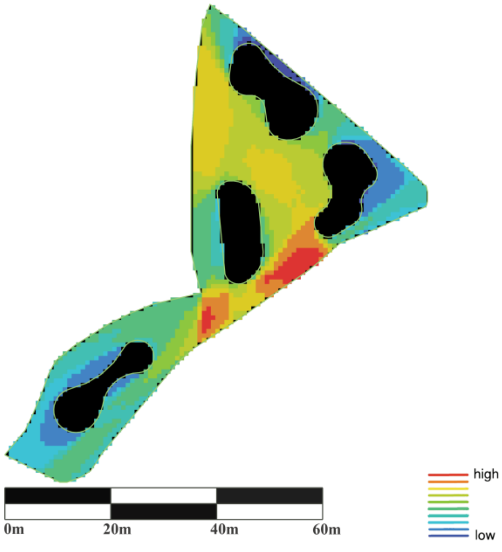



Figure 6.40: VGA study via applying the new approach model through the selected location of the library within Parnell (by author).

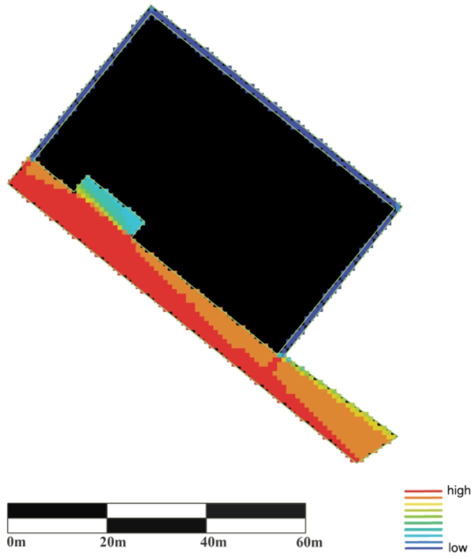



Figure 6.41: VGA study via existing status through the selected location of the library within the Parnell (by author).

all other roots than the same comparable status within the existing library's location (Figures 6.40 & 6.41). Accordingly, the comparison acknowledges a higher number of cells that are well-connected to their adjacent cells within the new library's location than the existing location, which also means the better the connection between the cells, the stronger the permeability. With that being said, it is easier for the public not only to explore the new library's location but also to choose a new route within the location as a shortcut pathway.

The comparison of "through vision" analysis between the two selected locations shows that existing status has a higher number of spots with a high level of through vision than the new suggested location on the one hand (Figures 6.42 & 6.43). On the other hand, adopting the new approach model within the new library's location provides the opportunity to let the spots with the longest continuous view have the vision through the new separated library's sections, which raises the possibility of visual exploration through the location, while the spots with the longest continuous view within the existing library's location are limited to a narrow linear pathway between the existing bulky library building and the neighbour's building (Figures 6.42 & 6.43). Thus, having the new approach model lets us have the longer lines of vision in the way of strengthening both physical and visual **permeability** that, as previously noted in Chapter 4, it promotes the level of orientation, wayfinding, and people’s behaviour, and therefore, the potential of **sociability**.

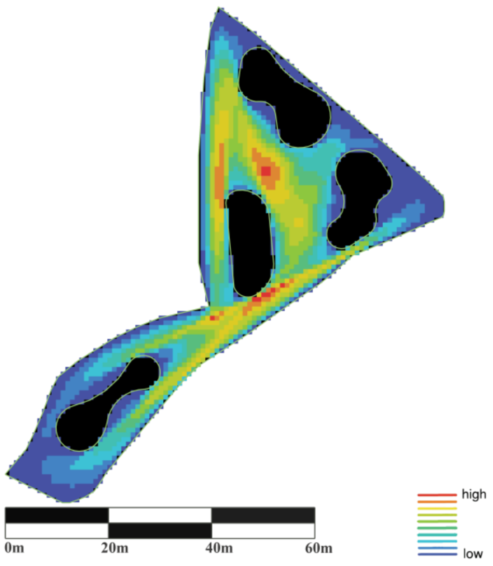



Figure 6.42: Through vision analysis via applying the new approach model through the selected location of the library at The Strand within Parnell (by author).

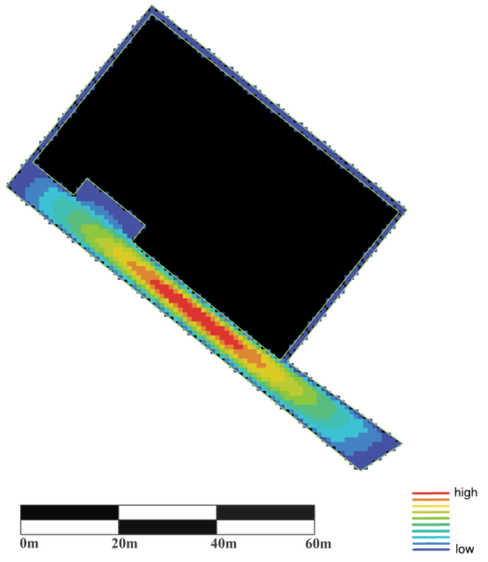



Figure 6.43: Through vision analysis via existing status through the selected location of the library at Stanley Street within Parnell (by author).

### 6.2.2.5. Applying the Agent-Based Modelling

Having the comparison via the raster-based system for the agent-based modelling between the two noted statuses shows that while adopting the new approach model in the new suggested library's location lets the agent as an average person and the agent as a local have

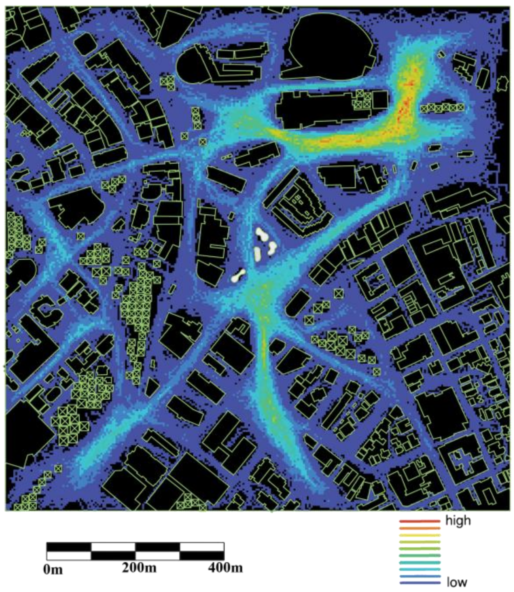



Figure 6.44: The agent as an average person via the new approach model through the selected location of the library and the selected surrounding area within Parnell region (By author)

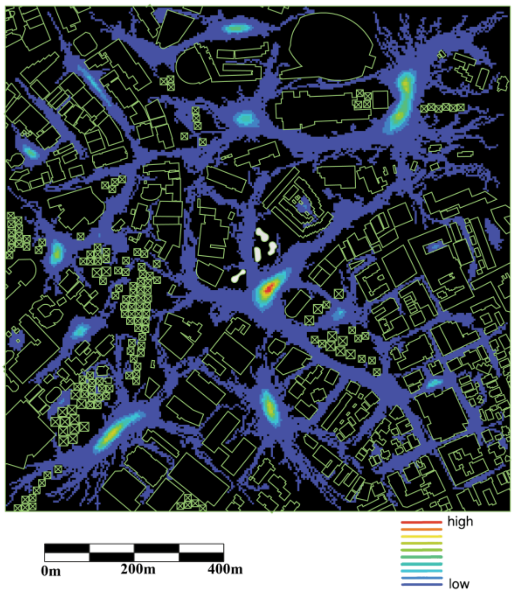



Figure 6.45: The agent as a tourist or visitor person via the new approach model through the selected location of the library and the selected surrounding area within Parnell region (By author)

the opportunity to choose a new route through the new location as part of their daily travel (Figures 6.44 & 6.46), the existing library's location deprives both agent types of having the same opportunity as shown in Chapter 4 (Figures 4.51 & 4.53). In the meantime, the comparison of the agent as a visitor or tourist between the two statuses displays a slight strengthening of presence adjacent to the new location (Figure 6.45) compared to the existing status (Figure 4.52).

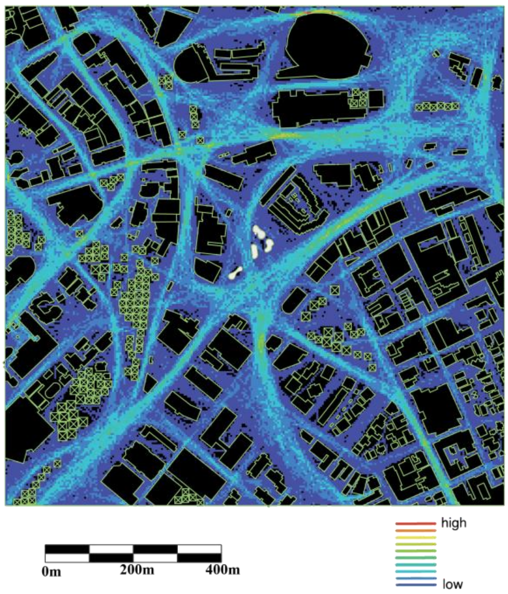


Figure 6.46: The agent as a local person via the new approach model through the selected location of the library and the selected surrounding area within Parnell region (By author)

The next step is concentrated on applying the same three scenarios within the new library's location and, therefore, comparing it with the existing library's location. The comparison for the agent as an average person between the two statuses shows a high level of movement across the new suggested location via adopting the new approach model (Figure 6.47), while the existing status is faced with the movement activity, which is limited to the noted narrow pathway from the main entrance to the parking at the property's rear space (Figure 6.48). Hence, increasing the potential of **permeability** and, accordingly, **sociability** is obvious via adopting the new approach model.

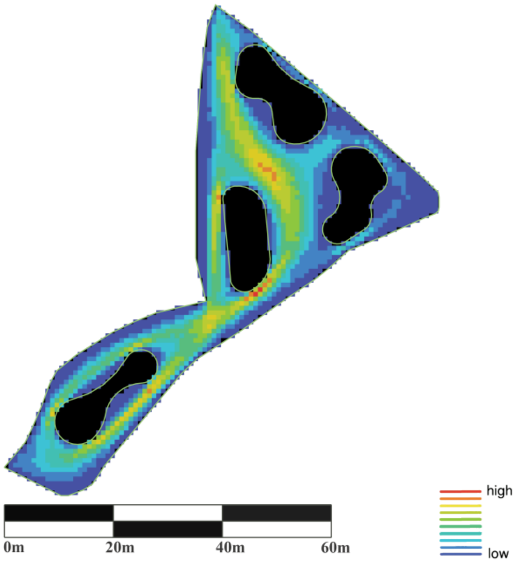


Figure 6.47: The agent as an average person via applying the new approach model through the selected location within Parnell region (By author)

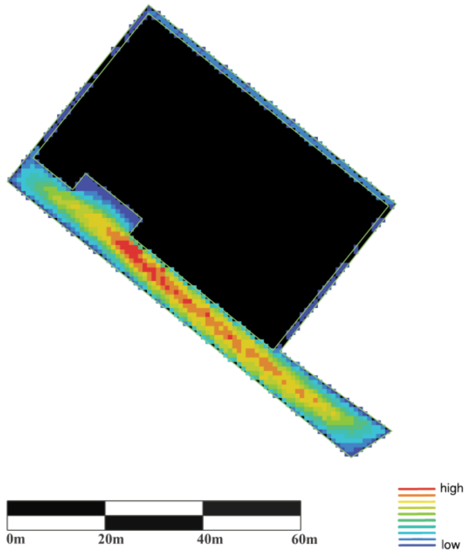


Figure 6.48: The agent as an average person for current status through the selected location within Parnell region (By author)

The comparison of the agent as a tourist or visitor between the two statuses indicates that the visitors have the opportunity to gather in the middle of the new library's separated departments within the new suggested location since the new approach model is adopted (Figure 6.49). Hence, visitors have the highest vision on the spot to almost the majority of

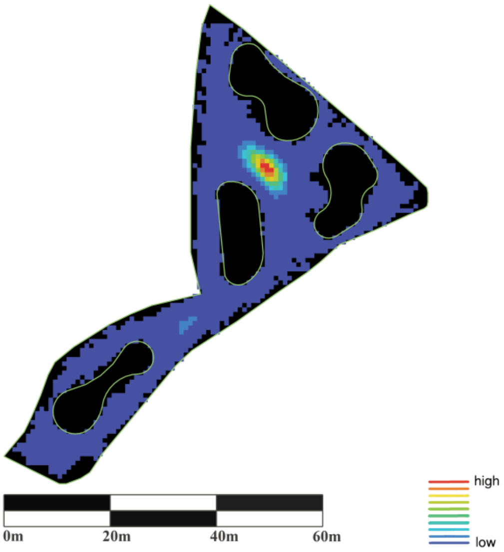



Figure 6.49: The agent as a tourist or visitor via applying the new approach model through the selected location within Parnell region (By author)

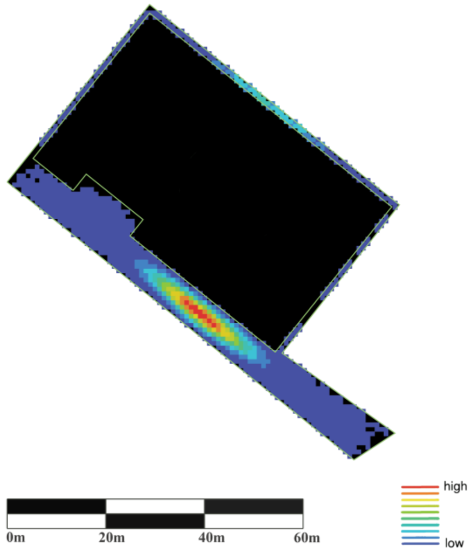



Figure 6.50: The agent as a tourist or visitor via current status through the selected location within Parnell region (By author)

departments in the location. In contrast, the spot, where it faces the visitors' presence, the vision is limited to the same noted narrow pathway (Figure 6.50). Thus, the chance of

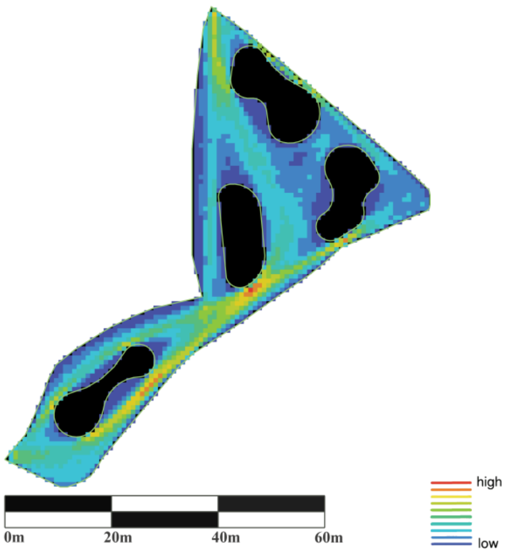



Figure 6.51: The agent as a local person via applying the new approach model through the selected location within Parnell region (By author)

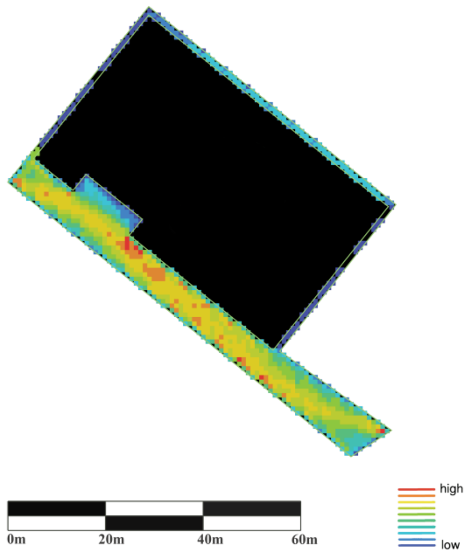



Figure 6.52: The agent as a local person via the current status through the selected location within Parnell region (By author)

sociability within the existing status is considerably lower than the new location's status.

The last comparison of this section for the agent as a local between the two statuses displays that locals, as they are familiar with the area, regularly choose routes along the edge between the new suggested location and the public as part of their daily travel (Figure 6.51). In the meantime, as they have a chance to view the library's departments directly, then they choose the routes in the middle of the location but not regularly (Figure 6.51) since their movement is usually based on the angular choice analysis’s results. However, locals have only one option to choose to cross the noted narrow pathway within the existing library's location, which declines the level of **permeability** and **sociability** compared to the new location status (Figure 6.52).

### 6.2.3. Albany

The area of Albany is known as the fastest-developing area within the Upper Harbour in Auckland (Figure 6.53). Besides, the area plays a role as the bridge between north Auckland and south Auckland, which makes this node distinguished. With that being said, the growing development and the position of the region caused the region of Albany to be faced with a diverse population over time. Having said that, according to the 2018 census data from Stats NZ (n.d.), it illustrates that the population is 9,984, which includes a median age of 35.6 years. The average shows that the age category of 30 to 64 between all four regions of Albany dedicates the longer proportion of the population to itself, which is 53.44%. Besides, the age categories of 15 to 29, under 15, and over 65 are respectively 29.32%, 29.25%, and 25.17% (Chart 6.5).

Figure 6.53: Albany region (Google map library)

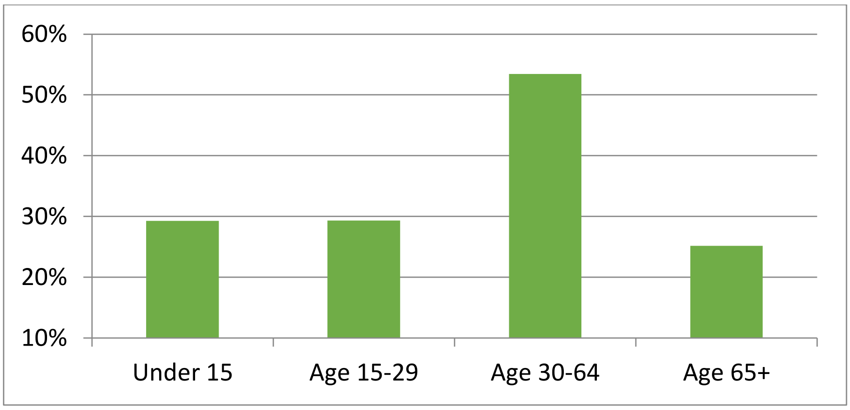


Chart 6.5: Age categories, Albany census 2018 (By author)

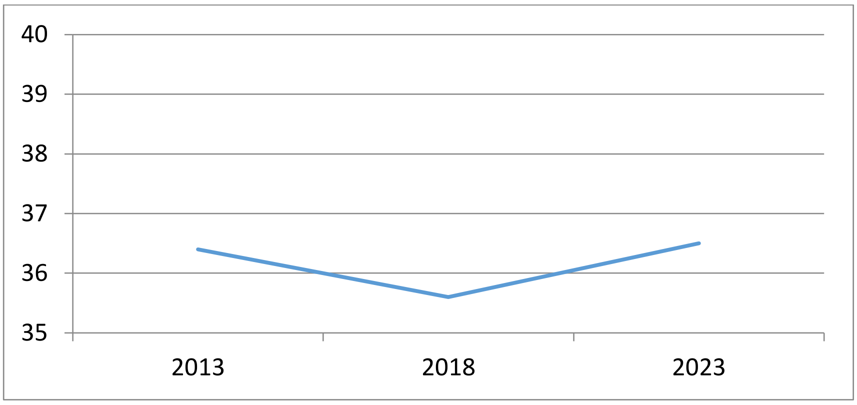


Chart 6.6: Median Age comparison, Albany census (By author)

According to the 2023 Census data Stats NZ (n.d.), the median age has slightly increased by the age of 36.5 years than results of both 2018 and 2013 Census data (Chart 6.6). Accordingly, Stats NZ (n.d.) illustrates that the population has gradually increased since 2013 from 8,349 to 11,964 in 2023.

Like the way that a new location was suggested for the library in Parnell, this study suggests a new location instead of the current location of the public Albany Village Library. The reason is laid on outcomes from space syntax indicators within Chapter 4. The analysis indicated that since the current library's location is located in a secondary street, the levels of the three space syntax indicators are weak, while the new suggested location stands in a better status from this point of view.

In the meantime, according to Upper Harbour Local Board (2020), the library's staff commented there is a need for investment in a new library facility, which is the best strategic and economic option for the change. Also, the local board recommends that there is a need to extend the current size of the library since the Albany region has been facing a fast-growing population. They have also come to the conclusion that the area close to the metropolitan centre of Albany is the appropriate location, as the area is close to retail, amenities, and key routes or highways. With regard to the above and according to Upper Harbour Local Board (2020), the staff assessment over local provision based on Community Facilities Network Plan (CFNP) guidelines illustrates that local libraries need 41 m2 per 1000 people. In other words, currently, there is around 840 m2 under-provision of service in the study area.

#### 6.2.3.1. Connectivity analysis

With regard to the above description, the connectivity analysis in this section compares the connectivity circumstances between two locations. With that being said, the new location, by siding next to the Albany Community Hub and Albany Community Preschool on the one hand and adjacency to two key highways, Dairy Flat Highway and Albany Highway on the other hand, has the upper hand compared to the existing location. Hence, the new location meets the maximum contact with the public.

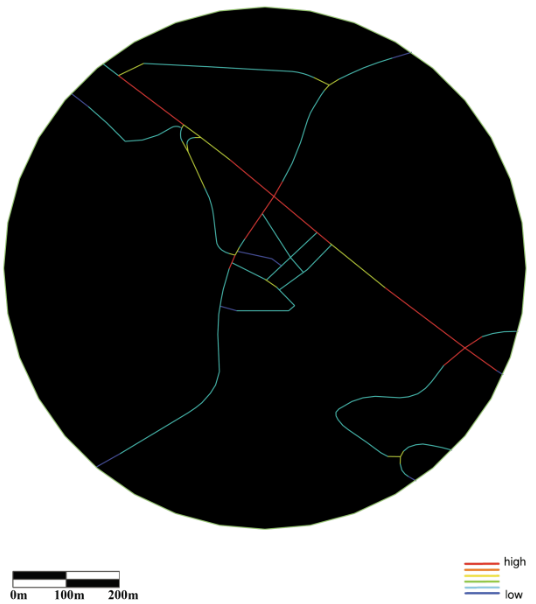


Figure 6.54: Connectivity analysis via the suggested approach model for the selected location within the selected area of Albany region (By author).

The comparison connectivity analysis is applied between two different locations of the current library's location at Kell Drive and the suggested new location at Dairy Flat Highway and Albany Highway, but same radius size with the centring of the same noted locations (Figures 6.54 & 6.55).

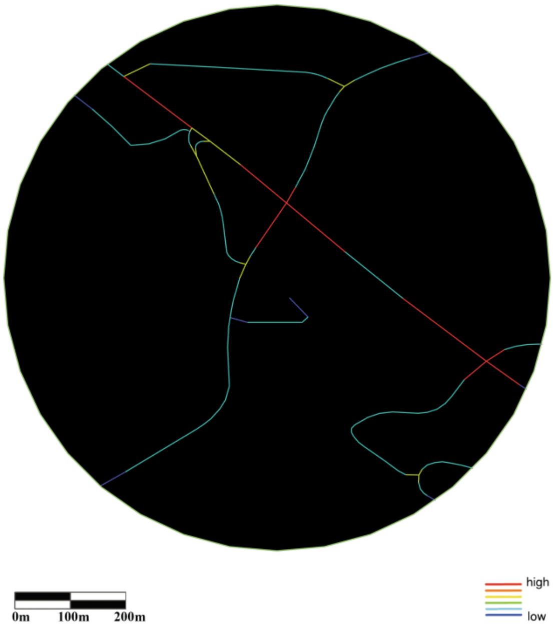


Figure 6.55: Connectivity analysis for existing circumstances within Albany region (By author).

The new suggested location via new approach model (Figure 6.54) at Dairy Flat Highway and Albany Highway, provides a distinguished axial connection between four different areas of Albany metropolitan commercial area, cultural, educational, and residential areas. Hence, the new location becomes an encouraging spot to let people explore and choose routes within the new suggested location as part of their walking daily travel.

The comparison of both scenario analyses shows that the new location exploits both Dairy Flat Highway and Albany Highway with the highest level of connectivity in contrast to the existing library's location, which is located on a secondary street that is neither familiar to tourists or visitors nor a suitable passway to locals (Figures 6.54 & 6.55).

#### 6.2.3.2. Integration analysis

- **Local Integration Analysis**

This analysis, similar to the procedure of the last two nodes, represents that the local integration status increased by applying the new approach model within the new suggested library's location compared to the current status of the existing library's location (Figures 6.56 & 6.57). Having the new approach model causes raising the

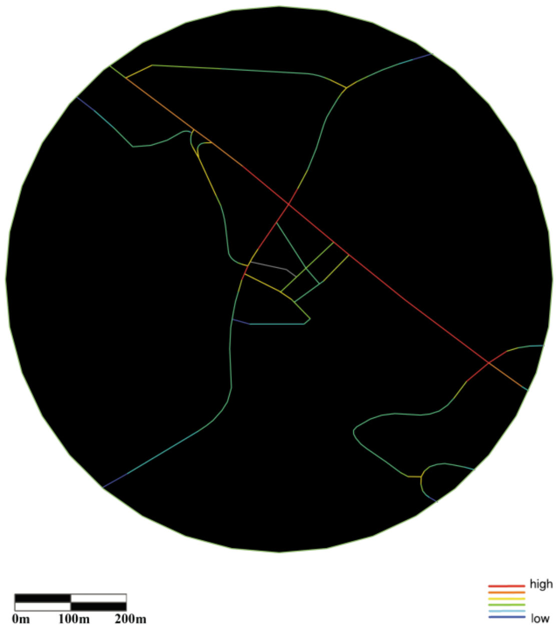


Figure 6.56: Local Integration analysis via the suggested approach model for the selected location within the selected area of Albany region (By author).

integration value of Dairy Flat Highway, which is the same key axis between the new suggested library's location and the metropolitan centre of Albany. The highway is highlighted in red (Figure 6.56). In the meantime, the new approach model causes the entry of the new suggested location for the noted library to boost the value of the local integration of Albany Highway as it is shown in red (Figure 6.56).

By following the above, mean depth (MD), real asymmetry (RA), real relative asymmetry (RRA), and the integration value (INT) are assessed (Table 6.7) to acknowledge the superiority of applying the new approach in comparison with the existing status (Tables 6.7 and 6.8).

| **Ref. number Dairy Flat Highway** | **Integration value – R3** | **(MD) – R3** | **Real Asymmetry (RA)-R3** | **Real Relative Asymmetry (RRA)-R3** | **(TD)-R3** |
|---|---|---|---|---|---|
| **45** | **1.53645** | **2.23** | **0.154412** | **0.650852** | **38** |

Table 6.7: Local integration analysis's result for Dairy Flat Highway within Albany in Auckland via adopting the new approach model (by author)

The comparison of results between tables 6.7 and 6.8 illustrates that Dairy Flat Highway is preferable to Kell Drive according to the integration analysis in Chapter 4, but adopting the new approach model to the new suggested location for Albany Village Library indicates a considerable boost in local integration value for Dairy Flat Highway, which is 1.53645, compared to Kell Drive, which is 0.849123. In other words, the comparison shows a mutation of value around two times higher between two noted routes. Accordingly, the results of both RA and RRA represent lower values for Dairy Flat Highway compared to Kell Drive (Tables 6.7 and 6.8). Hence, the new approach model on the new suggested location not only boosts its

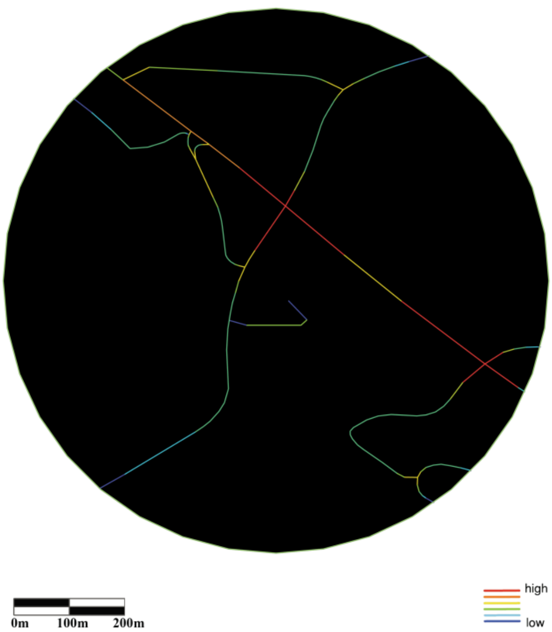


Figure 6.57: Local Integration analysis via the existing status within the selected area of Albany region (By author).

integration status in the area, but it also boosts the integration status of Dairy Flat Highway. With that being said, when stronger integration is achieved, the **presence of locals** is expectable, which increases the level of **socialization** in an area.

| Ref. number Kell Drive | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA)-R3 | Real Relative Asymmetry (RRA)-R3 | (TD)-R3 |
|---|---|---|---|---|---|
| **70** | **0.849123** | **2** | **0.4** | **1.177686** | **12** |

Table 6.8: Local integration analysis's result for Kell Drive within Albany in Auckland for existing circumstances (by author)

### 6.2.3.3. Choice analysis

As choice analysis has been experienced previously, in this section, impacts of both adopting the new approach model within the new suggested library's location and the existing situation of the current library's location to their surrounding urban context should be assessed to explore how impacts cause locals to choose a route as part of daily travels.

With regard to the analyses through the depthmapX platform (Figures 6.58 & 6.59), while the new routes within the new suggested location don't be chosen frequently, the new

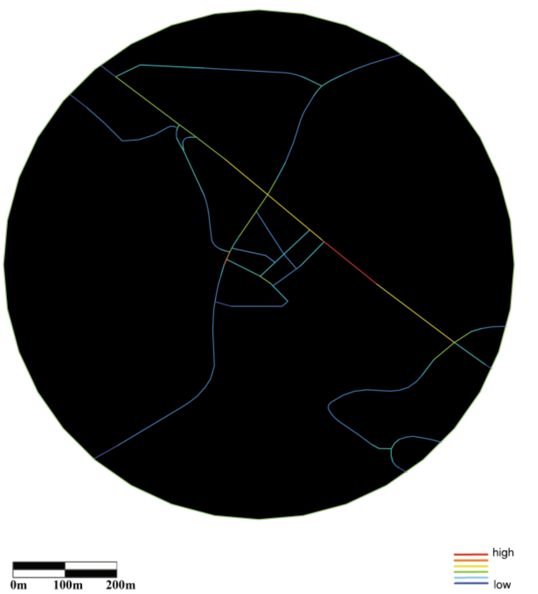



Figure 6.58:Angular Choice analysis via the adopting the new approach model for the selected area at Dairy Flat Highway within Albany in Auckland with the 500m distance from the library's location (by author).

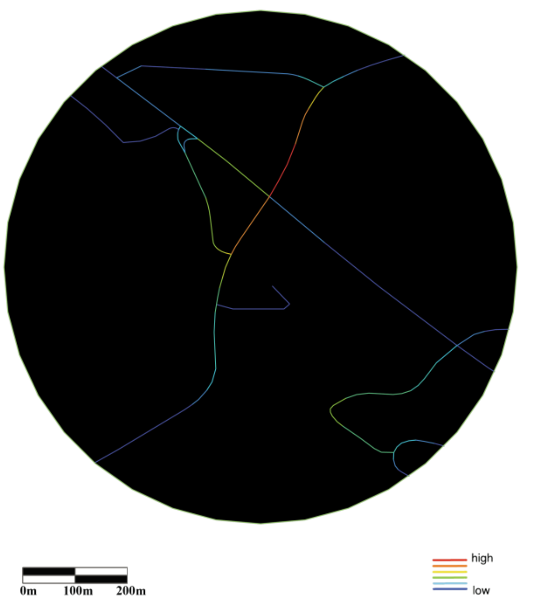



Figure 6.59: Angular Choice analysis via the existing condition for the selected area at Kell Drive within Albany in Auckland with the 500m distance from the library's location (by author).

approach causes the highest level of choice for the key part of Dairy Flat Highway, which is the key axis between the metropolitan centre of Albany, the new suggested library's location, Albany Community Hub, and Albany Community School.

The comparison of mean depth value between the new status within the new suggested library's location and the existing condition of Albany Village Library's location as part angular choice analysis is as follows (Table 6.9):

| **Mean depth for new location**<br>**Via the new approach model** | **Mean depth for current location**<br>**Via the existing condition** |
|---|---|
| TD = 133.4375<br>K = 147<br>MD = 133.4375/ 147 – 1<br>MD = 0.914 | TD = 9.375<br>K = 132<br>MD = 9.375 / 132 – 1<br>MD = 0.07 |

Table 6.9: mean depth calculation for new library’s location and existing location (by author).

As it is concluded, the new approach model causes a higher mean depth value than the existing situation. In the meantime, the analysis through the depthmapX platform shows that the angular choice appears by a higher value of 668 for Dairy Flat Highway via adopting the new approach model compared to the value of zero for Kell Drive via the existing status.

#### 6.2.3.4. Visual Graph Analysis (VGA)

The VGA analysis for the selected area in Albany follows the same procedure as it is applied to the last two nodes. The comparison analysis shows that the new suggested location for Albany Village Library has the opportunity to have a considerable number of cells with the highest level of visibility at the Dairy Flat Highway adjacent to the location, while the existing library's location is deprived of such opportunity since it is located on a secondary street (Figures 6.60 & 6.61). In the meantime, a building is placed between the secondary street edge and the existing library, which blocks a direct vision from the street to the library's frontage (Figure 6.61).

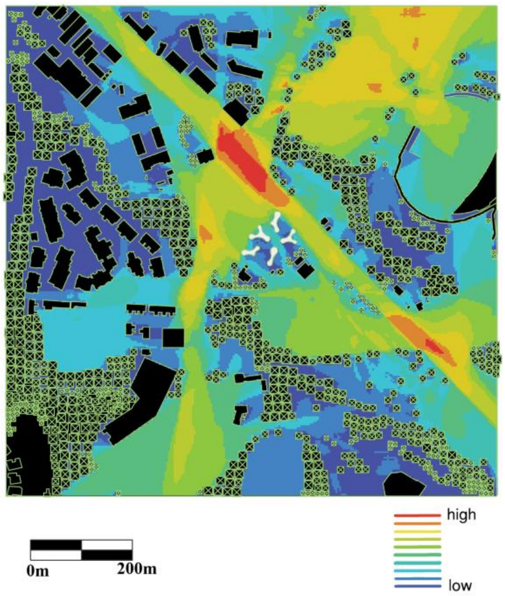



Figure 6.60: VGA study via applying the new approach model through the selected location of the library at Dairy Flat Highway within Albany in Auckland (by author).

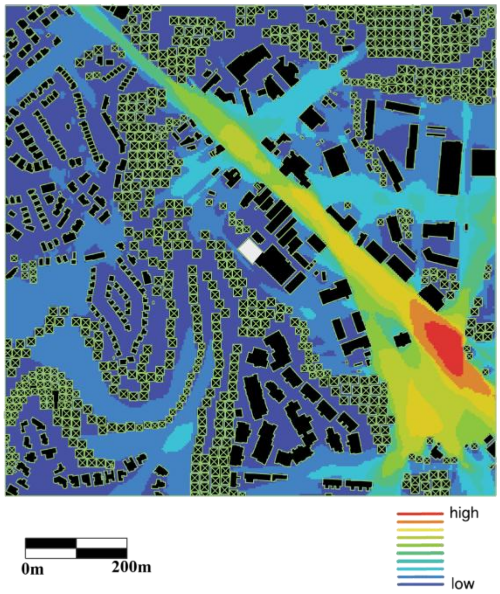



Figure 6.61: VGA study via the current condition through the selected location of the library at Kell Drive within Albany in Auckland (by author).

The “visibility step” analysis is carried out via a comparison between the specified two root cells. The analysis addresses the root cells to explore to what extent all cells can be seen in selected areas. The comparison concludes that there are more cells that can be seen from the spot (A) than the spot (B) (figures 6.62 & 6.63). Thus, it is learnt that the new suggested

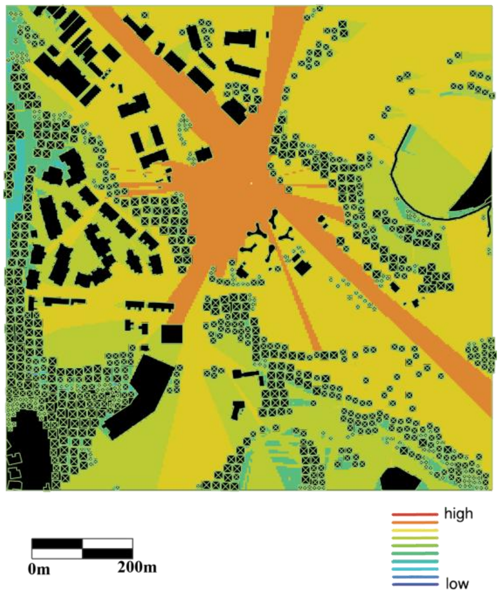



Figure 6.62: Root cell (A) in The Strand, Visibility step analysis via applying the new approach model through the selected location of the library within Albany (by author).

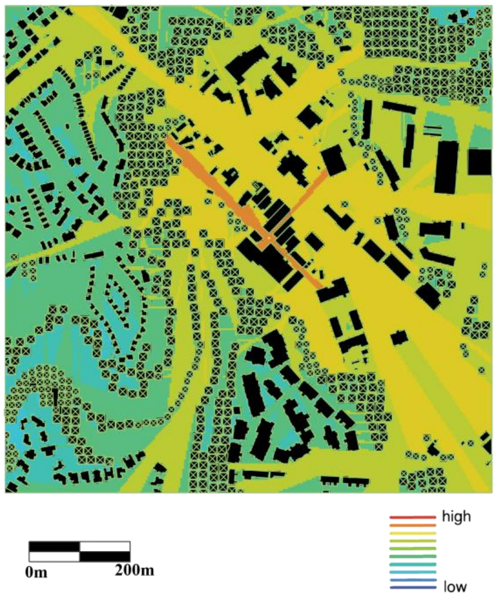



Figure 6.63: Root cell (B) in Stanley Street, Visibility step analysis via the current condition within Albany (by author).

library's location at Dairy Flat Highway is preferred considerably more than the existing library's location at Kell Drive.

| **Mean depth for location (A)**<br><br>**Via the new approach model** | **Mean depth for location (B)**<br><br>**Via the existing condition** |
|---|---|
| TD = 113387<br>K = 51240<br>MD = 113387 / 51240 – 1<br>MD = 2.21 | TD = 153157<br>K = 48335<br>MD = 153157 / 48335 – 1<br>MD = 3.16 |

Table 6.10: mean depth calculation for conditions (A) and (B) within Albany (by author).

The comparison of mean depth between the two selected root cells (Table 6.10) shows that status (B) meets a higher mean depth value than status (A) within selected raster-based systems. With that being said, the raster-based system is deeper from the root cell (B), which is located adjacent to the existing library's location at Kell Drive, than the root cell (A), which is located adjacent to the new suggested library's location at Dairy Flat Highway (Figures 6.62 & 6.63). Thus, the mean depth value is impacted by obstacles, specifically the building blocks. In the meantime, there is an opportunity that more cells can be visible easier from root cell (A) than cell (B) (Figures 6.62 & 6.63). Therefore, adopting the new approach model is prosperous to break the boundary between the public and the new suggested library's location.

With concentrating on the comparison between the new suggested library's location on Dairy Flat Highway and the existing library's location on Kell Drive via VGA, it is concluded that adopting the new approach model within the new location provides the opportunity to let every cell and also its isovist field be considerably more integrated with all other cells than the status within the existing library's location (Figures 6.64 & 6.65). The above consequences result in a stronger permeability within the new library's location than the existing location since more cells are connected well with their adjacent cells by adopting the new approach model in the new location than what status is in the existing library's location. Accordingly, the above result is a privilege for the new location since it encourages the public to explore the location and also use a route within the location as part of their daily travel.

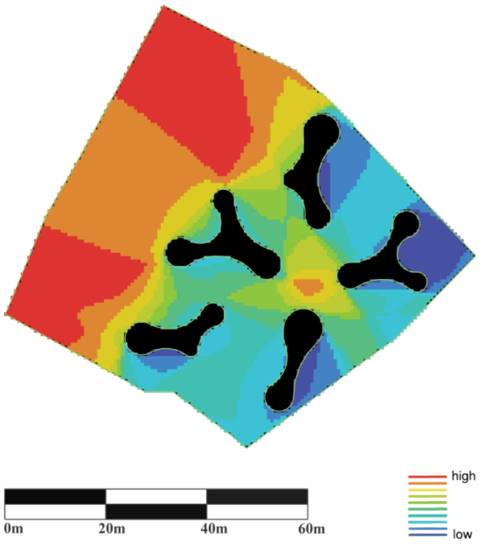



Figure 6.64: VGA study via applying the new approach model through the selected location of the library within Albany (by author).

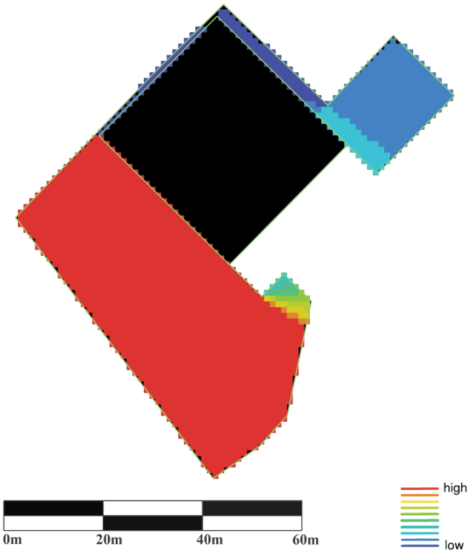



Figure 6.65: VGA study via existing status through the selected location of the library within the Albany (by author).

Following the above, "through vision" analysis displays that the new suggested library's location, by adopting the new approach model, meets a slightly higher number of cells with a high level of through vision than the new suggested location (Figures 6.66 & 6.67). In the meantime, cells with the longest continuous view within the new location have visibility through the new library's sections, which raises the eventuality of visual exploration through the new location, while the cells with the longest continuous view inside the existing library's location are limited to the car parking at the rear of the library. (Figures 6.66 & 6.67). Therefore, adopting the new approach gives the opportunity to boost both physical and visual **permeability**, which raises the level of orientation and wayfinding. Accordingly, the higher the presence of people, the higher the potential of **sociability**.

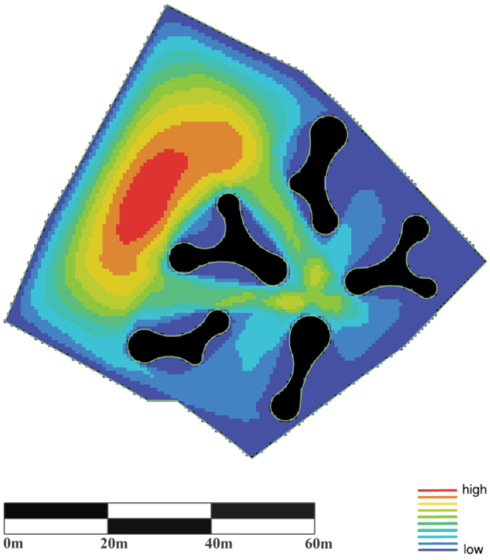



Figure 6.66: Through vision analysis via applying the new approach model through the selected location of the library at Dairy Flat Highway within Albany (by author).

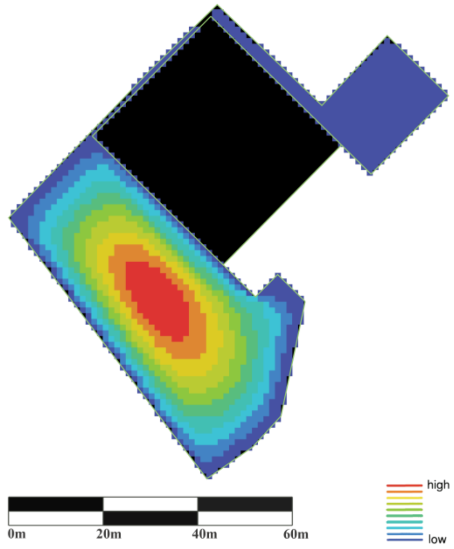



Figure 6.67: Through vision analysis via existing status through the selected location of the library at Kell Drive within Albany (by author).

### 6.2.3.5. Applying the Agent-Based Modelling

The following analysis illustrates the status of the new suggested location for the Albany Village library in three scenarios as they were applied similarly for the last two regions in

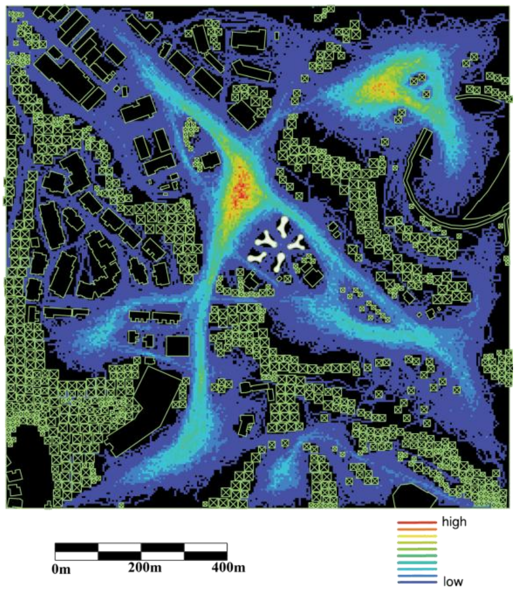



Figure 6.68: The agent as an average person via the new approach model through the selected location of the library and the selected surrounding area within Albany region (By author)

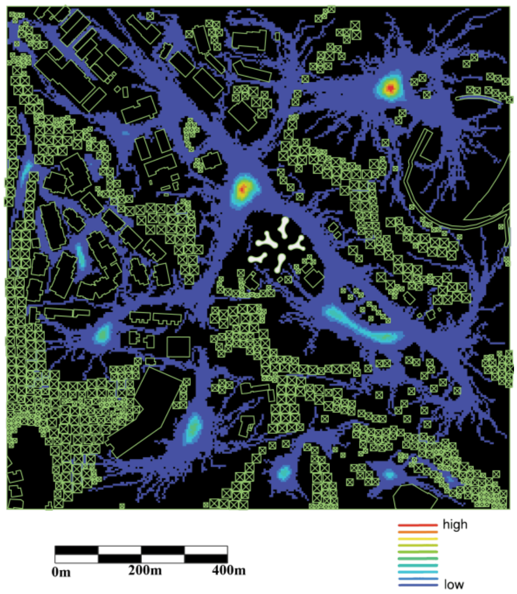



Figure 6.69: The agent as a tourist or visitor via the new approach model through the selected location of the library and the selected surrounding area within Albany region (By author)

this chapter. The new approach model, as it is shown (Figures 6.68 & 6.70), causes the agent, as an average person and the agent as a local, to choose a route via the new location as part of their daily travel. Accordingly, the activity on both Dairy Flat Highway and Albany Highway is boosted slightly adjacent to the new location's entries, specifically from the Albany Highway (Figures 6.68 & 6.70). In contrast to the above result, the existing library's location deprives the same opportunities as shown in Chapter 4 (Figures 4.79 & 4.81). The reason is that the library is located on a secondary street; firstly, and secondly, its location is located within an enclosed curved space, which is deprived of connecting directly to the western side of the library's site. Finally, regarding the agent as a visitor or tourist, there is not much difference between the surrounding areas of the new library's location and the existing location (Figures 6.69 & 4.80).

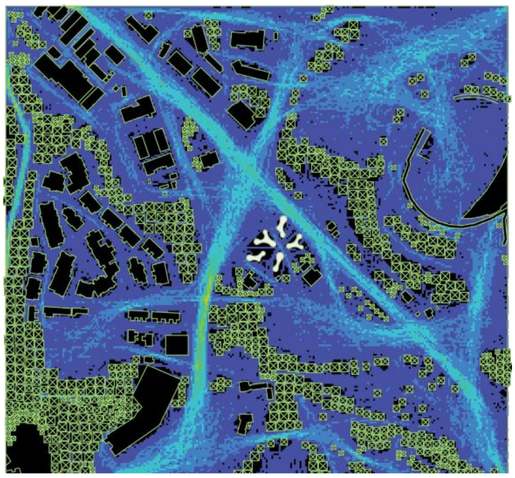


Figure 6.70: The agent as a local person via the new approach model through the selected location of the library and the selected surrounding area within Albany region (By author)

Similarly, the three scenarios are applied with a concentration on the new suggested library's location compared to the existing library's location. The first comparable scenario with a focus on the agent as an average person shows multiple opportunities of exploring the new

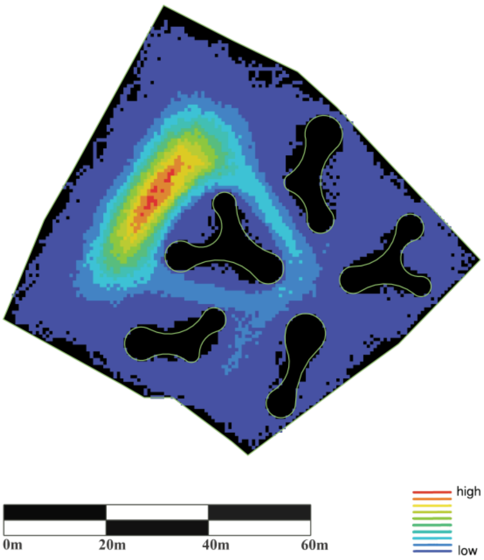



Figure 6.71: The agent as an average person via applying the new approach model through the selected location within Albany region (By author)

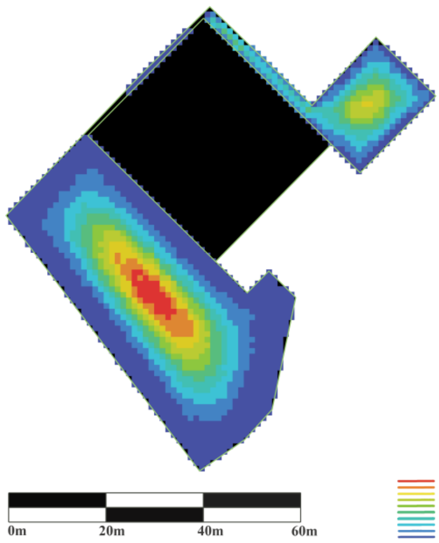



Figure 6.72: The agent as an average person for current status through the selected location within Albany region (By author)

library's section by new routes between the sections because of adopting the new approach model (Figure 6.71), while the existing library's location lacks such opportunities, and the highest level of movement is in the parking at the rear of the library (Figure 6.72).

The second scenario the agent as a tourist or visitor represents that the highest level of presence of visitors in the new suggested location is located at the site's half front, where they have the maximum available vision to the depth of the site location through the library's sections (Figure 6.73). The status for the existing location is limited to the spot in the parking at the library's rear space (Figure 6.74). Hence, the new location has a higher potential of sociability than the existing location.

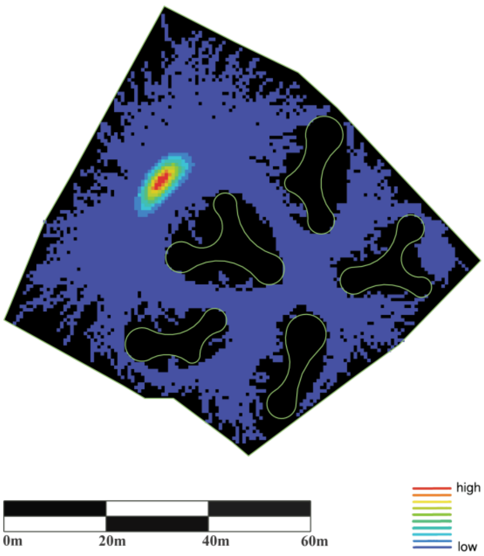



Figure 6.73: The agent as a tourist or visitor via applying the new approach model through the selected location within Albany region (By author)

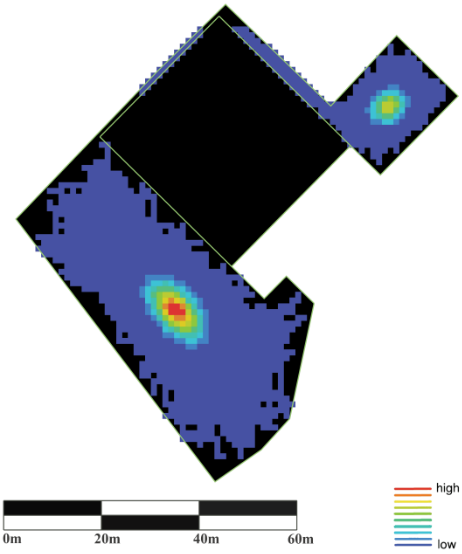



Figure 6.74: The agent as a tourist or visitor via current status through the selected location within Albany region (By author)

The third scenario, the agent as a local, concludes to an overall busy area relatively within the new location since locals are familiar with the area. Thus, locals regularly choose most of the routes as part of their travel (Figure 6.75). However, the status of the existing library's location is considerably weaker since most of the movement activities are limited to the parking at the rear side of the library (Figure 6.76). Therefore, the level of permeability for the existing library's location is lower than the new location as it applied the new approach model. Accordingly, the potential sociability within the new location is higher than the existing library's location.

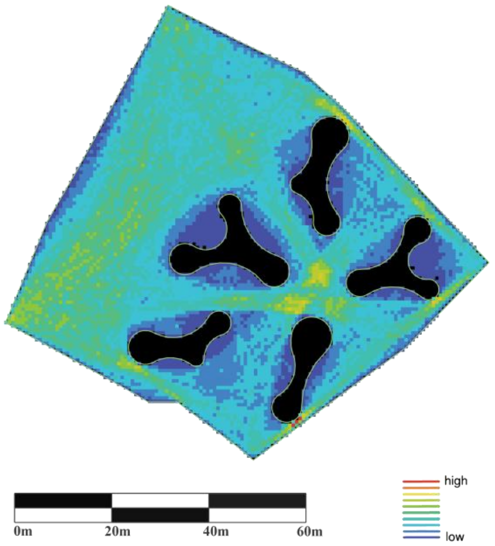



Figure 6.75: The agent as a local person via applying the new approach model through the selected location within Albany region (By author)

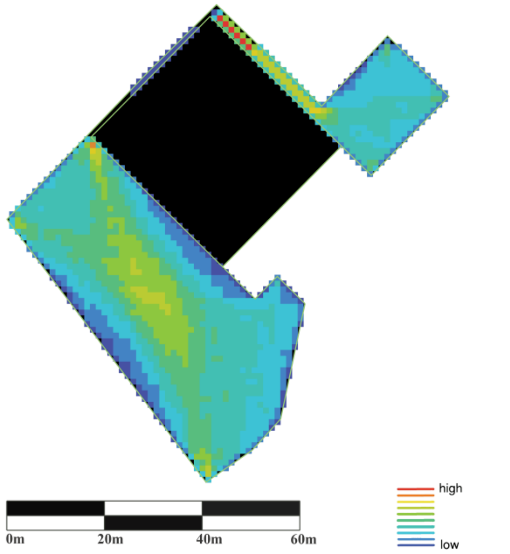



Figure 6.76: The agent as a local person for current status through the selected location within Albany region (By author)

### 6.2.4. Warkworth

Warkworth, with its rural node character in the northern part of Auckland, plays a key role, as according to Auckland 2050 (2018, p. 260), the region will be expected to dedicate around 1100 hectares to urban land for the next 30 years (Figures 1.5 & 6.77). Hence, the expected climbing in dwelling lets the region face a considerable range of population over the next 30 years.


Figure 6.77: Warkworth region (Google map library)

According to Stats NZ (n.d.), the 2018 census data illustrates that the population of Warkworth, including East and West, is 5586 with a median age of 45.4 years. The Census average illustrates that the longer proportion of the population is dedicated to the age category of 30 to 64, which is 28.15%. In the meantime, the age categories of over 65, under 15, and 15 to 29 are respectively 27.97%, 17.92%, and 15.82% (Chart 6.7).

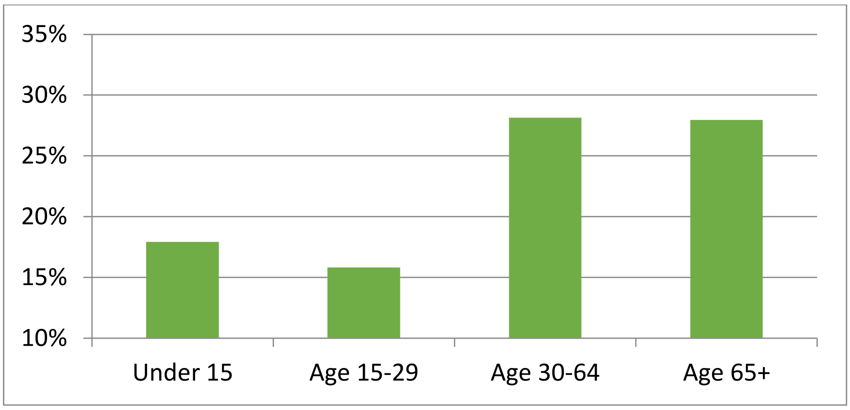



Chart 6.7: Age categories, Warkworth census 2018 (By author)

The 2023 Census data Stats NZ (n.d.) presents that the median age has slightly declined by the age of 44.2 years than 2018 census data, which is promising. This is while the census had an upward trend from 2013 to 2018 (Chart 6.8). In the meantime, the census data illustrates via Stats NZ (n.d.) that the population has gradually increased since 2013 to 2023 by 4269 to 6675.

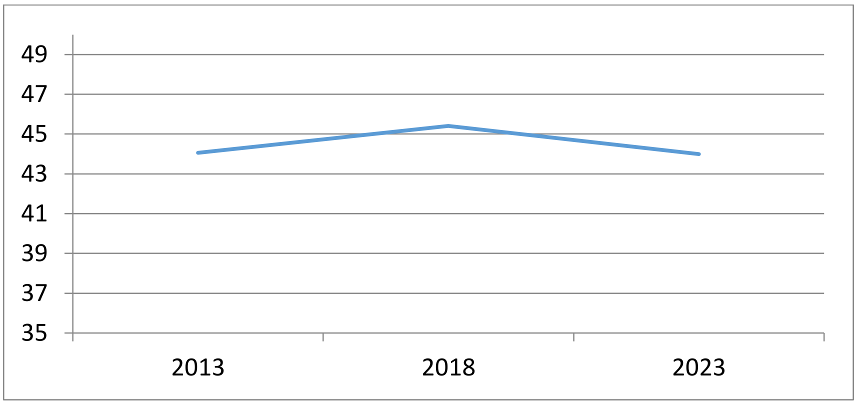



Chart 6.8: Median Age comparison, Warkworth census (By author)

This study suggests a new location instead of the current location of the public library of Warkworth with regard to two views:

1. The outcomes via space syntax analysis and review over VGA, visibility step, and agent model-based analysis through chapter 4 indicate that levels of noted indicators are weak,

while the library's site is located in the existing built-up business area of Warkworth. Hence, the current situation cannot help with sociability, which is the priority for the development of Warkworth in the next 30 years and the target of this study.

2. According to the Warkworth structure plan by the Auckland council (2019, p. 62), the council’s Community Facilities Network Action Plan recognizes any priorities to meet solutions regarding issues across the community facilities network, such as needs for development and refurbishment of the public library within Warkworth since there are unmet needs such as new facilities and spaces. In the meantime, as previously mentioned in Chapter 5, both significances, the local community's expectations regarding a sufficient relationship to the Mahurangi River and the development plan through Warkworth Northeast, boost the needs of the recreation new library's spaces in a new location in the area.

#### 6.2.4.1. Connectivity analysis

With regard to reasons about the suggestion of a new location for Warkworth Library, the connectivity analysis shows that separating the existing library building into different sections physically in the new location and offering new walkable routes between the different sections on the one hand, and locating the new location in the corner at the new intersection by suggesting a new route on the opposite side of Percy Street at Baxter Street, lets the location be explorable to the

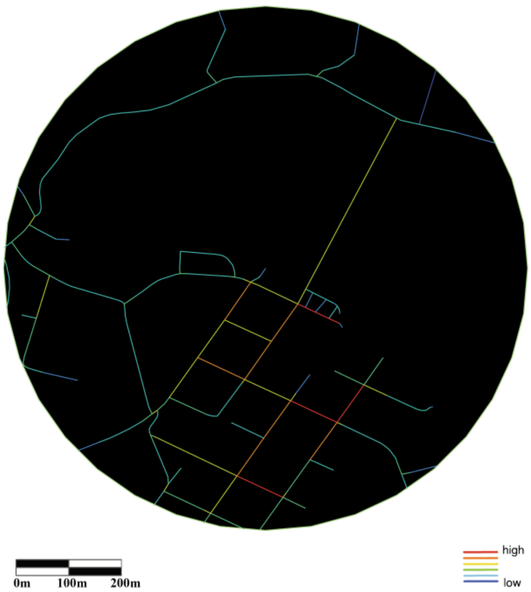



Figure 6.78: Connectivity analysis via the suggested approach model for the selected location within the selected area of Warkworth region (By author).

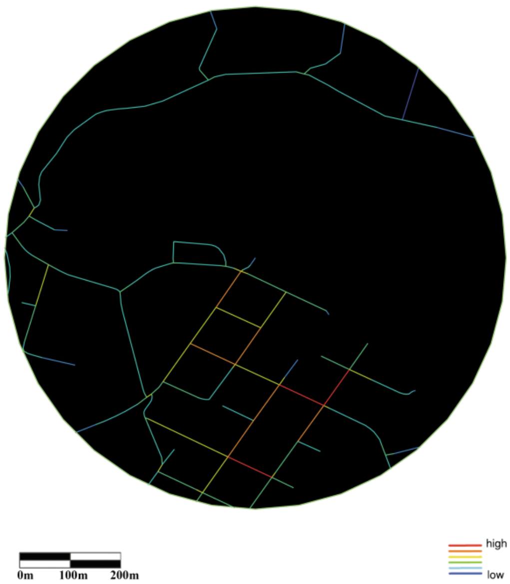



Figure 6.79: Connectivity analysis for existing circumstances within Warkworth region (By author).

public as the boundary between the public and the new location is removed by new routes within the new location on the other hand (Figure 6.78). It is noteworthy, as it is suggested in the last chapter that the new route on the opposite side, Percy Street at Baxter Street, crosses over the Mahurangi River to reach Sandspit Street to deliver a smart shortcut to ease the accessibility of Warkworth northeast to the town centre. Hence, while the connectivity level is raised at Baxter Street by applying the new model approach within the new location (Figure 6.78), the current circumstance of Baxter Street (Figure 6.79) shows the street has a considerably lower level of connectivity than the new suggested model. Besides, the adjacency to the public parking next to the new suggested location for the library's sections lets people choose the library's location as part of their pathway, which causes the location to be more explorable, and accordingly, Baxter Street benefits under the new circumstances since its connectivity level increases.

### 6.2.4.2. Integration analysis

- **Local Integration Analysis**

The expected local integration analysis with the purpose of a comparison between two different statuses of adopting the new approach model within the new suggested library's location at Dairy Flat Highway and the existing status of Kell Drive, where the current Albany Village Library is located (Figures 6.80 & 6.81).

Adopting the new approach model as it is shown (Figure 6.80), causes a higher integration level for Baxter Street due to the breaking the boundary between the street and the new suggested library's location by the new walkable routes within the location, which link the separated library's sections together, and also the new suggested route

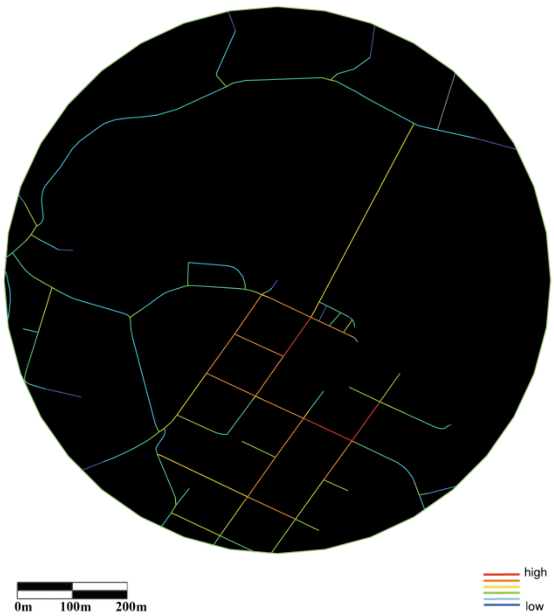



Figure 6.80: Local Integration analysis via the suggested approach model for the selected location within the selected area of Warkworth region (By author).

on the opposite side of Percy Street at Baxter Street as previously described how it can make Warkworth northeast to the Warkworth town centre. Baxter Street, shown in orange, is not the only route that has met a higher local integration value since the new approach model was adopted; also, Percy Street, shown in orange, has met a higher local integration value (Figure 6.46).

Figures 6.11 and 6.12 represent the assessment of mean depth (MD), real asymmetry (RA), real relative asymmetry (RRA), and the integration value (INT) for both the new status at Baxter Street, which is impacted by the new approach model, and the existing status at the same street before applying the new approach model.

| Ref. number Baxter Street | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA)-R3 | Real Relative Asymmetry (RRA)-R3 | (TD)-R3 |
|---|---|---|---|---|---|
| **14** | **1.8** | **2.19048** | **0.119048** | **0.55555** | **46** |

Table 6.11: Local integration analysis's result for Baxter Street within Warkworth in Auckland via adopting the new approach model (by author)

The results of table 6.9 compared to table 6.10 represent that Baxter Street achieves a higher local integration value of 1.8, where it is adjacent to the new suggested library's location, than the current status of Baxter Street with the value of 1.46441, where it is adjacent to the existing library. Accordingly, the results for RA and RRA acknowledge the above local integration values since both indicators' values are lower for the new status than the existing status (Tables 6.9 and 6.10). With regard to the above argument, the **presence of locals** is expected to be increased that means a higher level of **socialization** via applying the new approach since it causes raising the local integration regarding the new location and its adjacent Baxter Street than the existing status.

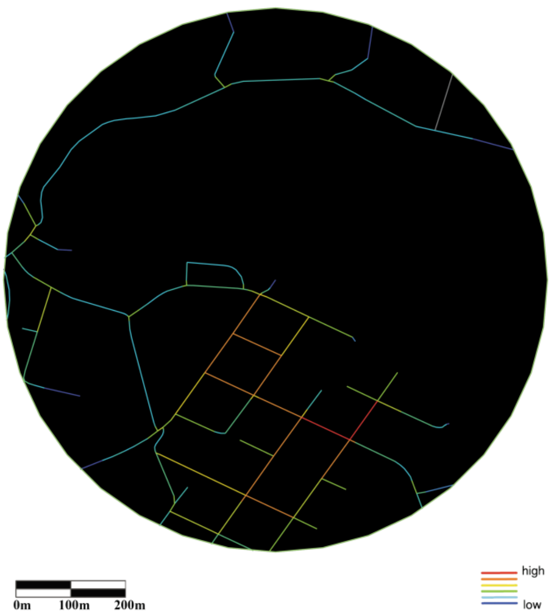


Figure 6.81: Local Integration analysis via the existing status within the selected area of Warkworth region (By author).

| Ref. number<br><br>Baxter Street | Integration value – R3 | (MD) – R3 | Real Asymmetry (RA)-R3 | Real Relative Asymmetry (RRA)-R3 | (TD)-R3 |
|---|---|---|---|---|---|
| **7** | **1.46441** | **2.2** | **0.17143** | **0.682868** | **33** |

Table 6.12: Local integration analysis's result for Baxter Street within Warkworth in Auckland for existing circumstances (by author)

### 6.2.4.3. Choice analysis

With regard to having two different locations, it should be explored that either adopting the new approach model to the new suggested library's location or existing circumstances to the current library's location is more successful because it lets people choose the longest route with the least angle to the direction to have the straightest route as part of daily travel.

Comparison of both circumstances via the depthmapX platform (Figures 6.82 & 6.83) illustrates that the new approach model via the new routes within the new suggested library's

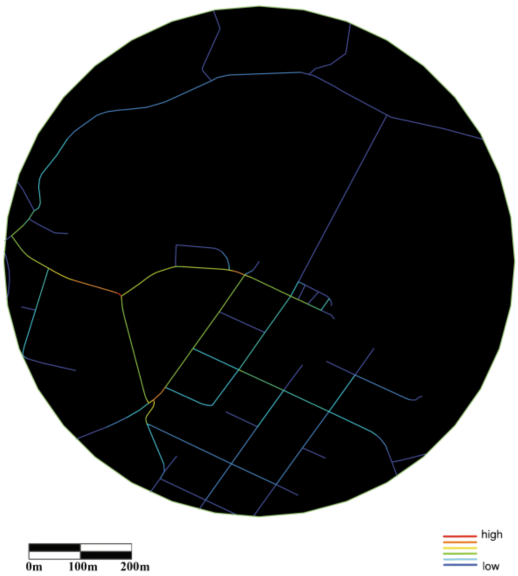



Figure 6.82: Angular Choice analysis via the adopting the new approach model for the selected area at Baxter Street within Warkworth in Auckland (by author).

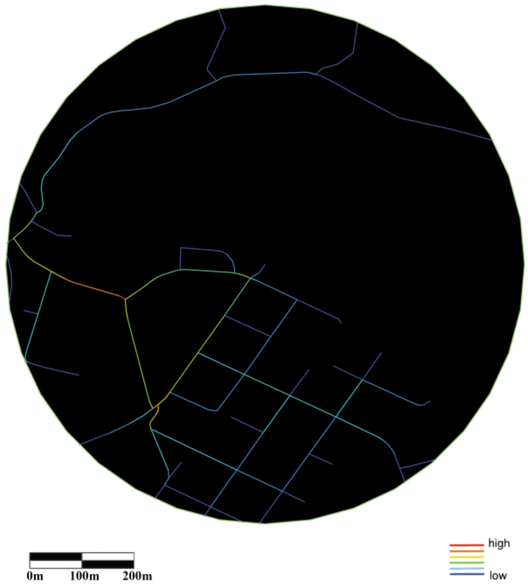



Figure 6.83: Angular Choice analysis via the existing condition for the selected area at Baxter Street within Warkworth in Auckland (by author).

location (Figure 6.82) makes a considerable impact not only on the location but also within its surrounding urban context compared to the existing status of the library's location. The analysis through the new approach shows that a continuous line from Elizabeth Street from the other side of the bridge over the Mahurangi River, followed by Queen Street, and then Baxter Street drives deep to routes within the new suggested library's location, which displays how locals chose the longest route with the possible least angle to the direction to reach the suggested library's location from town centre to the noted location (Figure 6.82). Therefore, locals find the route easier to explore, which means more presence of people and thus more chance of **socialization**.

The next part of the analysis is dedicated to the comparison of mean depth value between the two circumstances as part angular choice analysis (Table 6.12):

| **Mean depth for new location**<br><br>**Via the new approach model** | **Mean depth for current location**<br><br>**Via the existing condition** |
|---|---|
| TD = 165.6562<br>K = 219<br>MD = 165.6562/ 219 – 1<br>MD = 0.76 | TD = 128.094<br>K = 202<br>MD = 128.094/ 202 – 1<br>MD = 0.63 |

Table 6.13: mean depth calculation for new library’s location and existing location (by author).

The conclusion about the above comparison illustrates that the mean depth via applying the new approach model comes with a higher value than the existing circumstances (Table 6.12). Besides, angular choice values also acknowledge the whole above analyses by the value for Baxter Street after adopting the new approach model raises, which is 1672 that concluded by the depthmapX platform, while the value for the existing status before applying the new approach is 492. Hence, there is a considerable difference between the two argued circumstances, which witnesses that the new approach can be a preferable potential for an improvement in the selected area.

### 6.2.4.4. Visual Graph Analysis (VGA)

The VGA analysis in this section shows that in contrast to the existing library's location and its surrounding urban context (Figure 6.85), adopting the new approach model within the new suggested library's location allows for more visibility between the divided library's section via new routes on the one hand (Figure 6.84). On the other hand, the new suggested

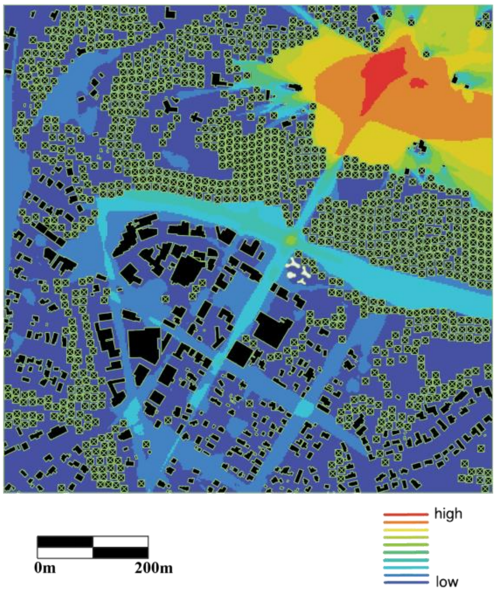



Figure 6.84: VGA study via applying the new approach model through the selected location of the library at Baxter Street within Warkworth in Auckland (by author).

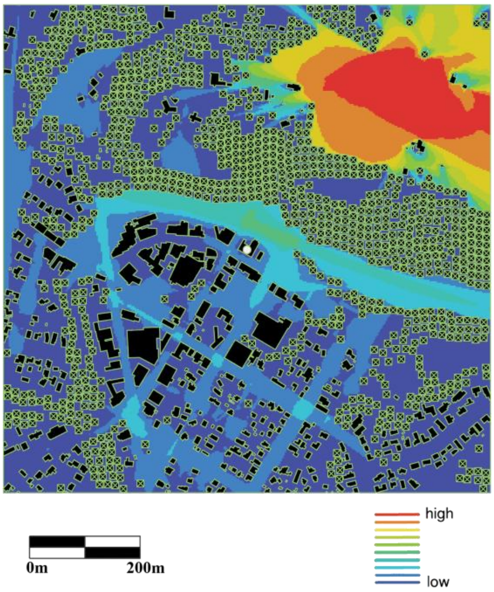



Figure 6.85: VGA study via the current condition at Baxter Street within Warkworth in Auckland (by author).

route in the last chapter, which is on the opposite side of Percy Street at Baxter Street that crosses over the Mahurangi River to reach Sandspit Street, raises the VGA level alongside the new library's location toward both Sandspit Street and Percy Street (Figure 6.84).

The comparison via "visibility step" analysis shows that more cells can be reached visually by root cell (A) adjacent to the new library's location on Baxter Street than root cell (B) adjacent to the existing library's location on the same street (Figures 6.86 & 6.87). Accordingly, the root cell (A) is able to see the depth of the new library's location at the same visual step since the library's location applied the new approach model in contrast to the root cell (B), which has a weaker visibility to the existing library's location.

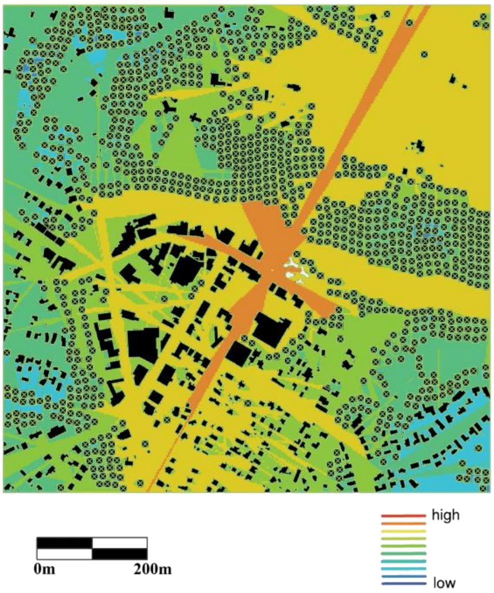



Figure 6.86: Root cell (A) in Baxter Street, Visibility step analysis via applying the new approach model through the selected location of the library within Warkworth (by author).

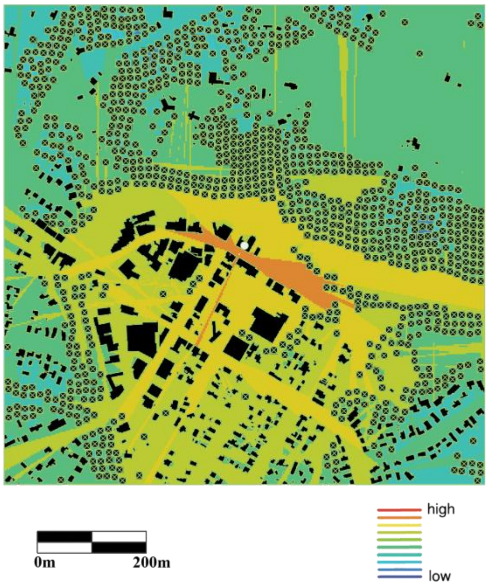



Figure 6.87: Root cell (B) in Baxter Street, Visibility step analysis via the current condition within Warkworth (by author).

The comparison as it is shown (Table 6.13), mean depth value is lower considerably from root cell (A) within the selected raster-based system than root cell (B). Hence, the raster-based system is shallower from the root cell (A), which is located adjacent to the new suggested library's location at Baxter Street, than the root cell (B), which is located adjacent to the existing library at the same street (Figures 6.86 & 6.87). The above conclusion acknowledges how obstacles, such as building blocks, affect the mean depth value. Thus, the new approach model not only boosts the visual step value, it also causes the breaking of the boundary between the public and the potential location.

| **Mean depth for location (A)** | **Mean depth for location (B)** |
|---|---|
| TD = 221642<br>K = 78819<br>MD = 221642 / 78819 - 1<br>MD = 2.81 | TD = 274910<br>K = 78588<br>MD = 274910 / 78588 - 1<br>MD = 3.5 |

Table 6.14: mean depth calculation for locations (A) and (B) within Warkworth (by author).

The comparable VGA analysis between the existing and the new potential location shows that the new approach model within the new suggested library's location at Baxter Street lets the majority of cells and also their isovist fields be much more integrated in connection to each other compared to the status of cells within the existing library's location (Figures 6.88 & 6.89). Thus, the more integrated the connection between every cell and their adjacent cells,

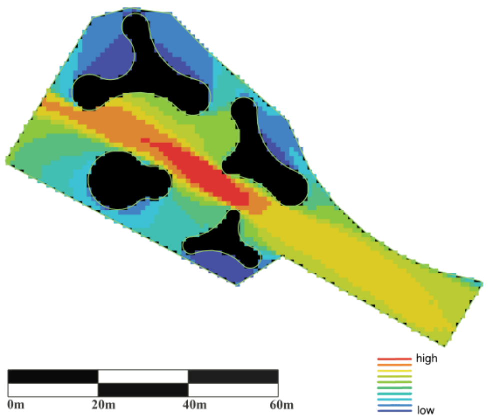



Figure 6.88: VGA study via applying the new approach model through the selected location of the library at Baxter Street within Warkworth (by author).

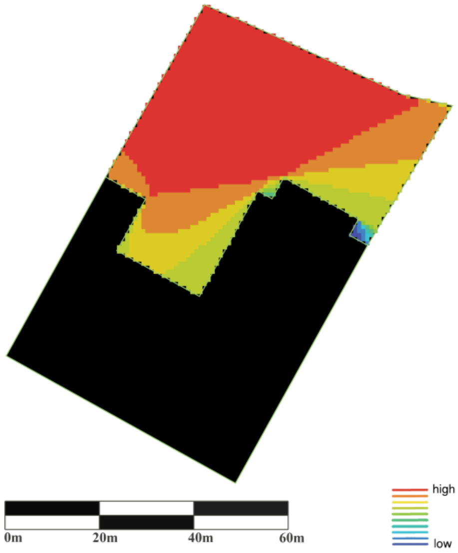



Figure 6.89: VGA study via existing status through the selected location of the library at Baxter Street within Warkworth (by author).

the stronger the **permeability**. Accordingly, the public tendency to explore the new suggested location is considerably higher than the existing library's location on the same street. Besides, people would tend a new route within the location as part of their daily travel following the above results.

Further step, which is "through vision" analysis, it is concluded that while there are a lower number of cells with a high level of through vision within the new suggested location than the existing library's location, the new approach within the new potential location provided the opportunity of visual exploration through the new location for cells with the longest continuous, the existing library's location is deprived of such opportunity since the location is limited to a rear enclosed open space that is attached to the single library's building (Figures 6.90 & 6.91). Therefore, boosting physical and visual permeability is expected to the new potential location, which accompany with the increasing level of orientation and wayfinding, and accordingly, the higher the presence of people, which causes much more sociability.

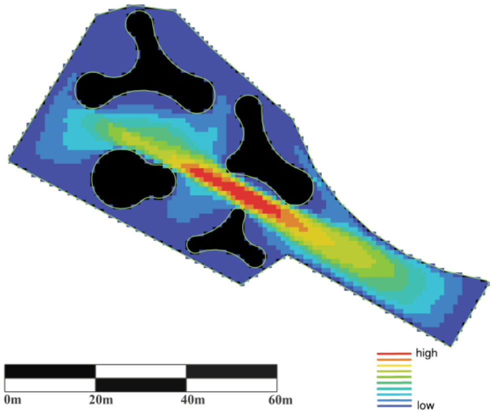



Figure 6.90: Through vision analysis via applying the new approach model through the selected location of the library at Baxter Street within Warkworth (by author).

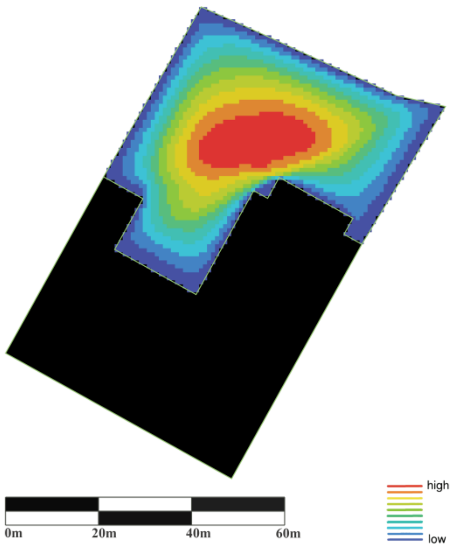



Figure 6.91: Through vision analysis via existing status through the selected location of the library at Baxter Street within Warkworth (by author).

### 6.2.4.5. Applying the Agent-Based Modelling

Same as the last three regions, three scenario analyses of agent-based modelling are considered for this selected area within Warkworth. The two scenario analyses of the agent as an average person and the agent as a local indicate that by applying the new approach

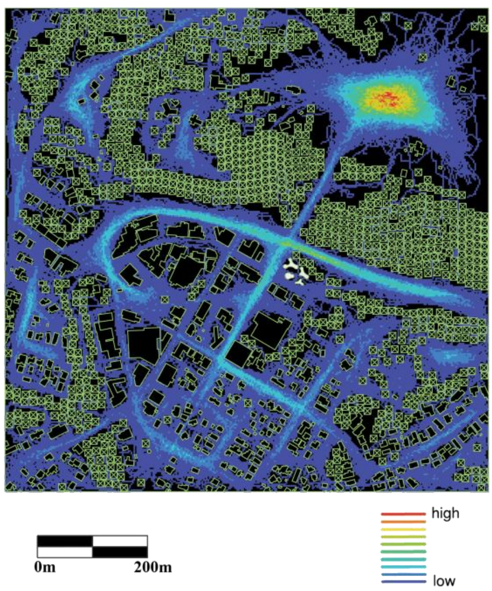



Figure 6.92: The agent as an average person via the new approach model through the selected location of the library and the selected surrounding area within Warkworth region (By author)

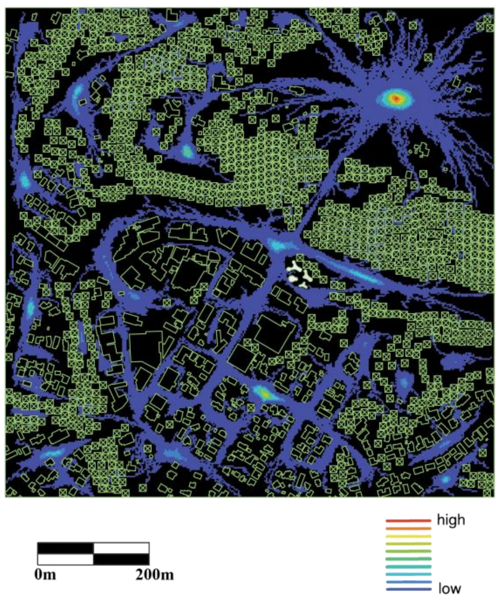



Figure 6.93: The agent as a tourist or visitor via the new approach model through the selected location of the library and the selected surrounding area within Warkworth region (By author)

model within the new suggested library's location at Baxter Street, the public has the opportunity to choose a route via the new location as part of their daily travel (Figures 6.92 & 6.94). Besides, the new suggested route on the opposite side of Percy Street at Baxter Street, as previously noted, brings more public movement alongside the new suggested library's location, which raises the potential of entry to the potential location by the public. In contrast, since the existing library's location lacks the above opportunities as shown in Chapter 4 (Figures 4.107 & 4.109), then it misses a rising of reaching out by the public. Therefore, while there is a potential of permeability for the new suggested library's location, the existing library's location is deprived of it. The last scenario analysis, the agent as a visitor or tourist, hasn't met much difference between the surrounding areas of the new library's location and the existing location (Figures 6.93 & 4.108).

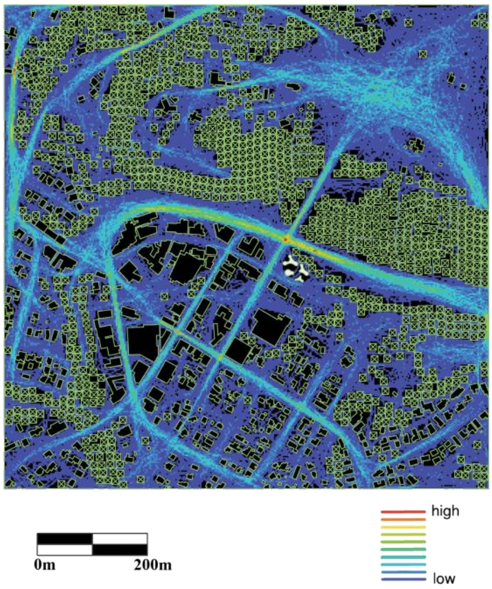



Figure 6.94: The agent as a local person via the new approach model through the selected location of the library and the selected surrounding area within Warkworth region (By author)

The first scenario analysis of agent-based modelling with a concentration on both argued locations shows that the agent as an average person meets multiple opportunities within the

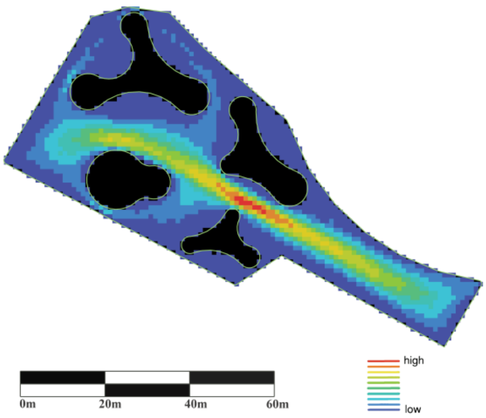



Figure 6.95: The agent as an average person via applying the new approach model through the selected location within Warkworth region (By author)

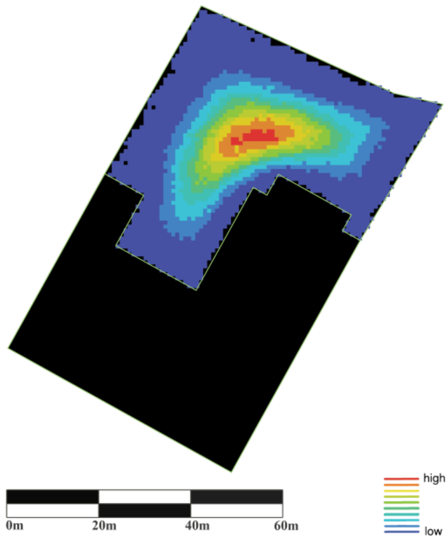



Figure 6.96: The agent as an average person for current status through the selected location within Warkworth region (By author)

new suggested library's location as it is shown in figure 6.95. Hence, adopting the new approach lets the location have multiple entries, which also causes multiple routes between the new libraries' departments. Accordingly, the public is not only interested in exploring the location, but they also find routes as part of their longer route, such as the main axis, which is also highlighted in red from the highest movement spots to the lower movement spots in the location that lets them reach the public parking and Lucy Moore Memorial Park at the rear side of the new potential location by entering the new potential location from its corner at the intersection at Percy Street and Baxter Street (Figure 6.95). In contrast, the existing library's location is deprived of the above movements within the location, as it is clear that the highest level of spots are shown in the location's rear, which is enclosed from the public at Baxter Street (Figure 6.96).

The second scenario analysis, which is the agent as a tourist or visitor, represents that they gather at the spot, where they have the highest vision to depth of the new potential location toward all the new library's sections, the public parking, and Lucy Moore Memorial Park at the rear side of the new potential location (Figure 6.97). However, the existing library's location is limited to the spots at the library's rear space (Figure 6.98), which doesn't let it be a place of promoting sociability in contrast to the new suggested location.

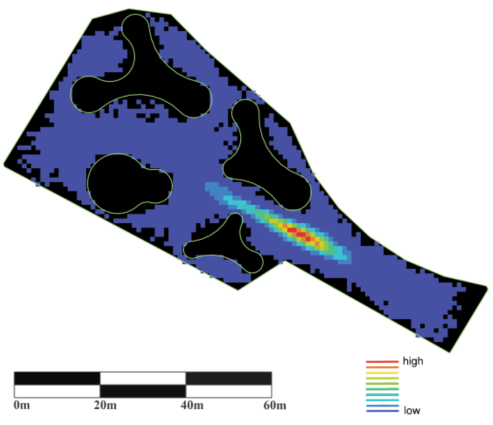



Figure 6.97: The agent as a tourist or visitor via applying the new approach model through the selected location within Warkworth region (By author)

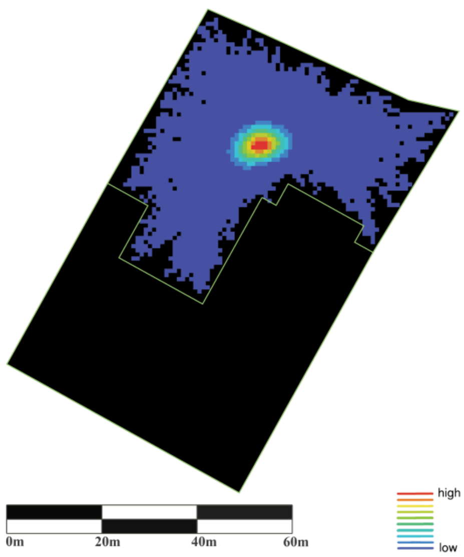



Figure 6.98: The agent as a tourist or visitor via current status through the selected location within Warkworth region (By author)

The agent as a local, which is the last scenario analysis, shows how every route and spot within the new potential are used from the highest level to the lower level (Figure 6.99). The reason is that the locals are familiar with the region and the location. Therefore, they regularly use most of the routes as part of their longer routes. In contrast, the status for the existing library's location is much weaker since most of the movement activities are limited to the enclosed rear side of the library, which is not accessible directly to the public at Baxter

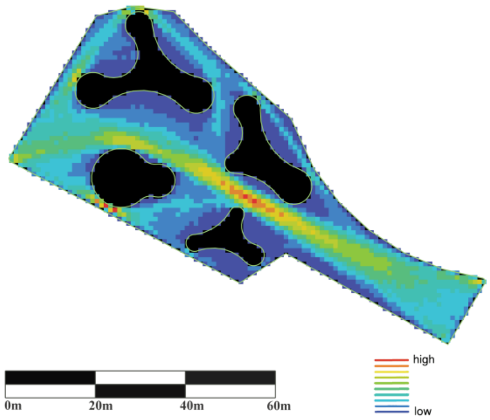



Figure 6.99: The agent as a local person via applying the new approach model through the selected location within Warkworth region (By author)

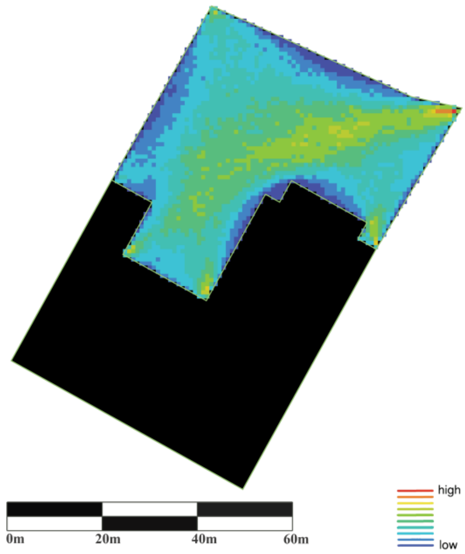



Figure 6.100: The agent as a local person via the current status through the selected location within Warkworth region (By author)

Street (Figure 6.100). Hence, the existing library's location is not an explorable place to the public immediately, which can decline the level of permeability and, accordingly, sociability in contrast to the new potential location for the library.

### 6.3. Comments on outcomes of analyses of this chapter

In this section, following the last section, which is focused on the concept and parameters of the initial model, a comparison approach including space syntax indicators, VGA, and agent-based modelling between the existing status of each library's location plus its surrounding urban context and the new status by adopting the new approach model, whether within the existing location or a new suggested location plus its surrounding urban context, was implemented.

However, the new approach model doesn't impact the entire urban context of the selected radius within every region, but it considerably impacts every specified library's location in the way of promoting the library's position in a local community, as it is argued in this chapter. Accordingly, the consequences show how the permeability is promoted via adopting the new approach model. Following the earlier description in this chapter, spatial metrics have a direct impact on strengthening permeability via space syntax indicators. Accordingly, adopting the new proposed model led this study to a common result over the four selected locations, which, according to Xu et al. (2021, pp. 118-119), shows a higher degree of connection of a given cell or space with other cells in each selected location than the existing circumstances. With that being said, the higher extent of connectivity caused a stronger influence on the surrounding cells, which led to better space permeability. In the meantime, the integration status among topological relationships for each selected location shows a higher value for each after adopting the new suggested model approach, which, according to Hillier et al. (1993, cited in Lyu et al., 2023, p. 1148), indicates a greater permeability of the spatial space that also causes a higher ability of each selected spatial space to attract crowds. Also, according to Alsabbagh (2024, pp. 2-7), permeability is remarkably influenced by its spatial features, like choice in an urban structure, which gives a choice of movement through the system and within it. Accordingly, raising choice leads to an increased potential for circulation, which means a permeable street causes people to navigate the space more easily than other alternatives.

As previously noted, the concept of permeability refers to the degree of how a space is open and how easy it is for crowds to get into or move through it, which relies on visibility. With that being said, according to Shafieiyoun et al. (2023, p. 118), VGA makes clear the relationship between visibility and permeability, and the analyses illustrated that adopting the new suggested model caused higher visibility through each selected space, which led to higher permeability. Also, agent-based modelling helped this study to show how people navigate throughout each selected environment, which showed the new suggested model successfully eased the crowd's movement throughout each selected environment.

With regard to the above description, this study examined how spatial analysis using space syntax and visibility analyses, including VGA and agent-based modelling, affected permeability status by adopting the new suggested model. In the meantime, the strengthening of sociability in a public space depends on the quality of permeability visually and physically. According to Heidari et al. (2023, pp. 17-32), people are more likely to enter a public space when more details are visible from inside the public space via its entrances, which, thus, causes higher attendance that raises informal interactions and sociability. In a nutshell, on the one hand, obvious and easy-to-navigate inputs and routes encourage people to move into and through a public space. On the other hand, the sense of openness to the surrounding environment makes it less scary, which causes people to feel comfortable attending the space, which increases informal interactions and sociability.

The **generalizability** is a priority to be more detailed and illustrated in the next chapter's content, as it has been learned in this chapter that the suggested approach model in this study has the ability to be applied within different regions, communities, and locations without any limitation regarding the site size or orientation.

### 6.4. Validation through Literature Review

In this section, a set of previously validated models or findings are considered to review to let this study approach prove how it aligns with or expands upon them. The overview illustrates considerable outcomes regarding the latest achievements, which assist in comprehending the potential of social activities in public spaces via applying different methodologies. For example, according to Safari & FakouriMoridani (2017, pp. 456–468), there is a direct relation between "cognitive mapping and the quality of visibility" and "wayfinding and social interaction." In the meantime, the analysis via space syntax indicators shows changes in accessibility in the region, and the suggested square plays a role in boosting accessibility and sociability. Accordingly, they concentrated on how spatial factors such as regular geometry like a square impact the sustainability and sociability of urban spaces. Askarizad & Safari (2020, pp. 253-264) reached out to how semi-open spaces play an efficient role in enhancing the sociability of public libraries. By comparative analyses between the existing and hypothetical models via the exploitation of the Space Syntax method and visibility graph analysis (VGA), they explored how the level of integration would be boosted by having semi-open spaces and how it would be descended in reverse circumstances. In the meantime, they found out how semi-open spaces can positively affect sociability in public libraries. Zerouati & Bellal (2020, pp. 34-53) clarified how in-between spaces can influence the social interactions of users that accompany different levels of permeability, which affect habitants' social interactions. They reached the point that significant indicators of social activities, including connectivity and clustering coefficients, showed how using in-between spaces was impacted by spatial configuration. Unlike the previous hypothesis, their studies reached out that the areas of less connected are the places that social interaction would be increased, where also, the level and quality of permeability impact the dependency of social activities. Hamdoon & Ahmed (2021, pp. 335-346) believe an urban waterfront has a significant role in forming the city image and boosting the life quality for the residents of the city and visitors. Accordingly, the study's framework consisted of the primary social sustainability elements of density, forming an environment that is lively, safe, accessible equally, and culturally integrated, and therefore causes boosting happiness, health, and social life. Sheng et al. (2021) reached out that social interaction behaviours are affected by space configurational attributes within urban parks, such attributes including route length, zone area, depth to the key road, and connectivity. In the meantime, they found out that indicators such as NACH (normalized angular choice) are affiliated positively with personal interactions in a radius of 10,000 m on the one hand. On the other hand, indicators such as space scale and depth to the main urban route, with their influence, whether positive or negative, affect the intensity of social interaction. Tedjari & Abbaoui (2023, pp. 9899–9905) clarified that the space syntax method unfolds the reasons for the attractiveness and the gap in the visit frequency between open public places. In the meantime, they found out how the space syntax method reveals the relationship between cause and effect between spatial configuration and human behaviour. Bayoumi et al. (2023, pp. 1-13) said the potential for social interaction and distribution of occupation could be improved by retrofitting. Besides, their research hybrid method proceeds by integrating space syntax methodology as both methods of computational and observational, which assists in recognizing areas for social improvement within the same selected area. Askarizad (2020, pp. 253-264) stated that the approach of designing open-configured plans in public libraries' spaces enhances spatial integrity and sociability. However, the approach causes descending through depth and the level of privacy. Accordingly, his study research via the descriptive-inferential analysis concluded that the point of having both open and closed spaces lets people have liberty to attend different spaces with regard to their activities' needs, which boosts the social interaction.

| Author(s) | Topic | Land Use | Location | Methodologies |
|---|---|---|---|---|
| Safari & FakouriMoridani | Syntactical Analysis of the Accessibility and Sociability of a Square | Urban square | Kuala Lumpur City Centre, Malaysia | Space syntax, observations of gate counts, snapshots, directional splits, people following |
| Askarizad & Safari | Investigating the role of semi-open spaces on the sociability of public libraries using space syntax | Public library | Arizona, USA | Space syntax, visibility graph analysis (VGA) |
| Zerouati & Bellal | Evaluating the Impact of Mass Housings' In-Between Spaces' Spatial Configuration on Users' Social Interaction. | housings' in-between spaces in neighbourhoods | Setif, Algeria | Space syntax, snapshot observations |
| Hamdoon & Ahmed | Towards socially sustainable waterfront urban regeneration | Urban waterfront | Abu Dhabi, UAE | Space syntax |
| Sheng et al. | Effect of Space Configurational Attributes on | Urban parks | Beijing, China | Space syntax, observations |

| | | | | |
|---|---|---|---|---|
| | Social Interactions in Urban Parks. | | | |
| Tedjari & Abbaoui | Space Syntax for Evaluating Attractivity and Visit Frequency | Urban square | Setif, Algeria | Space syntax |
| Bayoumi et al. | Effect of Space Configurational Attributes on Social Interactions in Urban Parks | Urban parks | Beijing, China | Space syntax, observations |
| Askarizad | Evaluation of the Effective Factors on Social Interactions in the Design of Public Libraries | Public library | Rasht, Iran | Space syntax, questionnaires |

Table 6.15: The specifications of the reviewed literatures.

The above findings of the reviewed research studies illustrated a wide range of variety viewpoints, sights, and comprehension regarding the relationship between urban spaces, spatial configuration, and social interactions within the urban context. This study research, like each of the above-reviewed studies, has a particular view and approach. Accordingly, while there are different targets of these studies, there are some similarities about adopted methods between this study research and the above-reviewed studies' literatures. Hence, there are similar relationships across the different urban settings that were reviewed above between sociability and urban spatial specifications. For instance, intermediate spaces, whether in public areas or in buildings, have a significant role in enhancing community engagement within urban local areas. Accordingly, in-between spaces and connectivity of streets play important roles to boost social interactions. In the meantime, while space syntax is a key method of analysis in this study research, as well as in most of the above-reviewed studies, there are various interpretations of outcomes since each study has a different synthesis of methodology to reach their findings. Besides, there is a difference regarding the concentration of each study. For instance, the influence of visibility through spaces, connectivity, integration, and choice on enhancing social interaction and sociability was focused on in this study, as well as some of the above-reviewed studies, while other reviewed studies concentrated on the effect of local landscapes or conservation of historical urban settings on sociability within public spaces. With regard to the above, the multifaceted essence of sociability became obvious via different studies and approaches, which indicate the significance of considering different factors of culture, demographics, society, and the environment. Accordingly, while this study insists on extending new routes by breaking the public library's building into separate spatial structures to enhance social interaction and sociability via applying the same methods such as space syntax and visibility graph analysis, some of the above-reviewed studies' literatures focused on the conservation of historical urban settings and friendly design axioms and rules to promote social interaction and sociability within spaces.

# Chapter 7

# Discussions and Conclusion

# Chapter 7

## 7.1. Introduction

This chapter, with regard to the findings presented in the previous analytical chapter, returns to the concept of permeability and its relation to the found targets through the last chapter. Accordingly, as it is noted in the last chapter, the relation between the found targets and the main objectives will be detailed. Besides, a guideline for design/positioning public libraries in the Auckland urban context will be suggested, which in turn could be a road map for other cities in New Zealand. Finally, limitations of the research and a statement of future research directions will be stated, which could be probable to arise from the research forming this thesis.

As permeability plays a key role in this research model study, its relation with the found targets in the last chapter is vital to the suggested model in this research since the permeability lets the approach model derive the found targets. With that being said, the more a place's accessibility, the stronger permeability is achieved, which makes the possibility of offering choice to a community. Accordingly, permeability clears the quality of responsiveness of a place, to what extent it lets people have a choice of access from one spot to another through the same place. In the meantime, while stronger permeability for a location is a key target, it does not mean that there is accessibility everywhere in the place physically or visually; otherwise, there would be no privacy or security for some spaces, such as lavatory or staff rooms. However, it also matters to what degree people have a choice to attend in both public and private spaces.

With regard to the nature of the suggested model approach in any of the four selected libraries' locations and a common principle, it is learned that neither public places nor private places can work independently since they are complementary, whether there are different types of public and private places, which regards the level of need of access to any of those. Thus, such interaction between the two noted types of space gives people an opportunity of choice. In the meantime, each of the two spaces and the interfaces between them each have diverse notions about permeability.

The number of alternative routes that were created by the new approach model in a selected location is important since they connect one spot to another. In the meantime, the noted alternatives should be visible to people; otherwise, there is only one group benefiting from the location, who are familiar with the area. With that being said, visual **permeability** is important as it raises the social presence and **desire to interact within the location and, accordingly, social trust.**

As the quality of both physical and visual permeability relies on the way of dividing a selected area into blocks by the network of public space, the new approach model responded to the above concern, which was obvious during the different analyses in Chapter 6. In the meantime, the achievement will be illustrated in detail in this chapter. Accordingly, the size and shape of new blocks within the selected location are different, which depend on the development of public routes within the area.

With regard to the above, the further sections are going to illustrate how permeability raises the four noted targets, including interactions between non-intimate people and unofficial interactions, the degree of desire to interact within the location, social trust, and spatial belonging and attachment to the library's location via adopting the new approach model for each selected four locations. With that being said, this chapter synthesizes the findings to highlight how permeability functions as a key determinant in the spatial organization and social function of public libraries within the Auckland urban framework.

### 7.2. Influences of permeability on the four noted targets for the selected locations

With regard to Bentley et al. (1985, pp. 12-27), there are some clues that can clarify how the new approach model is successful in each of the four locations. Accordingly, the first matter shows that applying the new approach model lets a few unofficial small blocks be formed via the separate departments of each of the four selected libraries within the selected locations

(Figures 7.1, 7.2, 7.3, and 7.4). Hence, since physical permeability, according to Abdeldayem et al. (2023, p. 9), means the quality of the public route interface, which lets people enter a place from the public, then it connects two realms that encourage people to walk into the location, which causes social interaction. With that being said, the consequences within the four selected locations show the increasing physical permeability for letting people have attending and exploring within libraries' locations. In the meantime, the outcomes show increasing visual permeability as well, which promotes the available choice to people since the new approach provides easier vision from one connection spot to the next within a selected location. Accordingly, the strengthening of physical and visual permeability raises social trust since there is an easier way of attending and exploring in the location, which also


Figure 7.1: Applied the new approach model within the selected location in Pukekohe region (By author)


Figure 7.2: Applied the new approach model within the selected location in Parnell region (By author)

causes more unofficial interactions, and therefore, people tend to interact within the location, which encourages people to feel an attachment to the location. Accordingly, it was illustrated that adopting the new suggested approach model caused the increased visual permeability observed in all four argued and analysed selected locations that led to facilitated more spontaneous interactions, as evidenced by increased foot traffic through newly established pathways, which was examined in Chapter 6 via "Agent-Based Modelling" for each location.


Figure 7.3: Applied the new approach model within the selected location in Albany region (By author)


Figure 7.4: Applied the new approach model within the selected location in Warkworth region (By author)

The next matter is **hierarchical** layouts, which cause permeability reduction. Hence, it is the matter of how paths and the separated sections of a selected library are formed in a selected location since, according to Silavi et al. (2017, pp. 16-17), people who know the area usually also know the routes and their spatial structures.

There are two scenario analyses about each of the four selected locations and their surrounding areas. One scenario is about new hierarchical layouts within each of the four selected locations, and the other is about the available tracks, which use the new routes within each of the four selected locations as a pathway for people's daily travels.

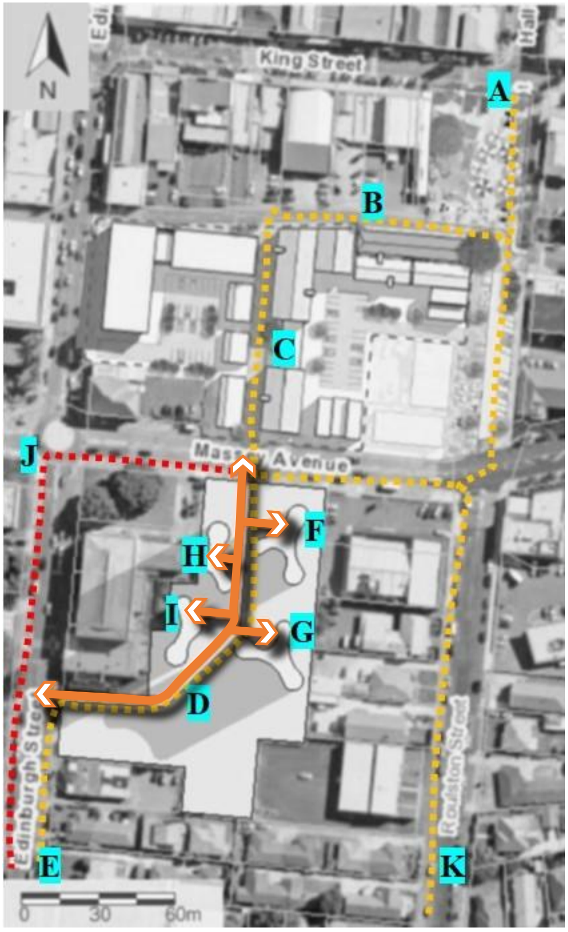


Figure 7.5: New hierarchical layouts via the new approach model within the selected location in Pukekohe region (By author)

The first scenario analysis within the Pukekohe region illustrates the way that the new suggested approach model causes multiple bilateral ways from A to E and from K to E, as they are shown in figure 7.5. Hence, as it is resulted, there are two opportunities from A to E and also from K to E, which, as it is obvious, the new approach model lets people have a shortcut when they are able to choose a pathway through the library's location (Figure 7.5). The second scenario analysis shows that there are only two syntactic steps that include one direction change from the main entrance on Massey Street to the library's separated departments within the selected location. Hence, people, by having visibility through the alternative routes, would be encouraged to enter the location to explore such public space whether they know the area or not, which increases the two found targets in the last chapter, including the degree of desire to interact within the location and social trust.

The analysis of the first scenario in the Parnell area shows that the new approach model creates multiple two-way paths from B to E, B to D, and from C to L, as shown in Figure 7.6. The user from the residential complex (spot B) on Ronayne Street can choose one of the routes J or K and then H and Parnell Rise and Churchill Street to reach E. In addition, there are two other options that can allow the user to get to E by crossing Beach Road or The Strand following Ronayne Street to reach E at Churchill Street. There are three alternatives between B and D; however, only two of those are the closest ways. Thus, the user can choose either J or K from the library's location and then The Strand to reach the D at Stanley Street. Besides, the distance between C and L has five alternatives. Accordingly, the user can travel via one of the new routes I, J, or K within the library's location to reach L. Alternatively, there are opportunities by crossing either Beach Road or Ronayne Street to reach L at The Strand.

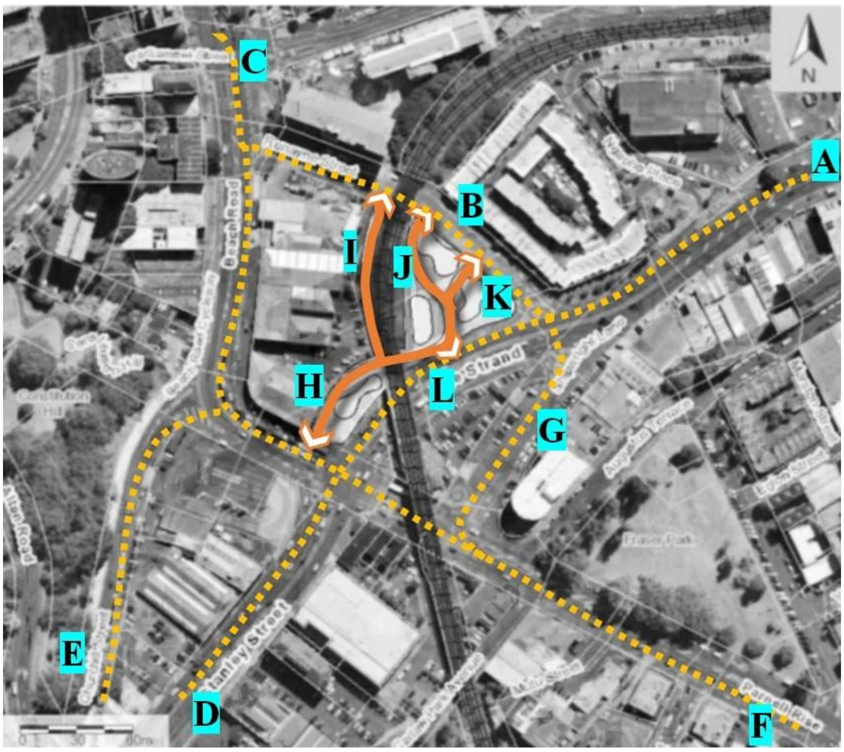



Figure 7.6: New hierarchical layouts via the new approach model within the selected location in Parnell region (By author)

The second scenario analysis shows that all library's separated departments are reachable from any of the three sides of the property directly. Also, a department on one side of the property is accessible from the other side by taking two syntactic steps from any of the surrounding public roads, including Ronayne Street, Beach Road, or The Strand. Accordingly, as the new suggested approach model provides the opportunity of maximum visibility from all sides of the property toward the depth of location, locals or visitors are encouraged to investigate the location apart from their familiarity with the area. With that being said, the potential of increasing both the extent of desire to interact within the location and social trust are very expected.

The next selected location within the Albany region is analysed, which adopts the new approach model. By having the approach model, users who are located within the big residential block (spot B) at Albany Highway have multiple alternatives to reach Coliseum Drive (spot A), which is near Albany shopping centre and North Harbour Stadium (Figure 7.7). Accordingly, they can have a shortcut instead of the current pathway from B to A (yellow dotted line) by entering into E following the Albany Highway, then H or I, and then

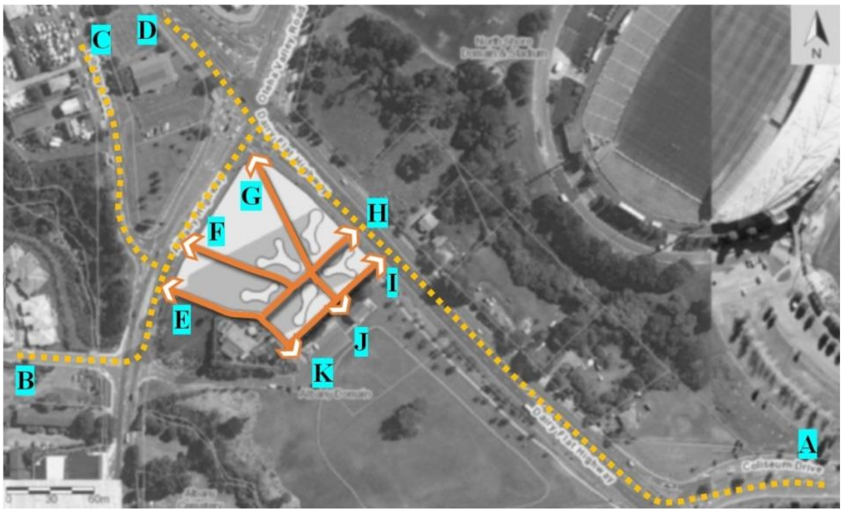


Figure 7.7: New hierarchical layouts via the new approach model within the selected location in Albany region (By author)

crossing Dairy Flat Highway toward the south, which lets them access Coliseum Drive (spot A). However, the current pathway will remain as an alternative as it is.

The second scenario is concentrated on how, physically and visually, each separated department of the library is permeable by having the new routes from each side of the property. With that being said, since the property is located at the corner edging the main two routes, Dairy Flat Highway and Albany Highway, there is a high permeability, visually and physically, via new routes from each property's boundary edge to the separated departments within the library's location (Figure 7.7). As it is obvious in the same figure, the farthest department from each side needs only two syntactic steps that include one direction to be reachable, which also acknowledges low hierarchical layouts that cause higher permeability. Therefore, all alternatives are visible from each side; accordingly, people, whether they know the area or not, can take advantage of the location. With regard to the above, adopting the new approach model causes a higher extent of desire to interact within the location and social trust compared to the current situation of the Albany Village Library's location.

Figure 7.8: New hierarchical layouts via the new approach model within the selected location in Warkworth region (By author)

Since the library's location is located adjacent to the Mhurangi River, and the urban network is located on the southern side of the selected location, the only advantage of the location as a pathway is its position between Baxter

Street and the Lucy Moore Memorial Park. Hence, the concentration is on the physical and visual permeability of the selected location and the layouts of new separated departments of the library as it is suggested by adopting the new approach model (Figure 7.8).

As the suggested location for the library has the outstanding feature of its position at the corner edging Baxter Street and the street adjacent to the property's western side, there is a high level of visibility not just from the aforementioned sides but also from the property's eastern side that is adjacent to the Lucy Moore Memorial Park and from the sidewalk adjacent to the northern side of the property. In the meantime, the number of alternative routes strengthens physical permeability within the location, which lets people move easier from one spot to another within the location that promotes people's tendency to explore the area. Accordingly, as alternative routes (Figure 7.8) are visible to people, who are familiar with the area or not, it causes an increase in the quality of the visual permeability, which also causes a better quality of desire to interact within the location and social trust compared to the existing location of the Warkworth library.

The **interface** is a key matter for the quality of permeability, and it is noteworthy according to Al Mushayt, Dal Cin, and Barreiros Proença (2021, pp. 2-3), as various types of architectural forms along the street are important since they present cultural values, mobility, and impression, where architecture is used as the street interface, which can refer to social places or other places that illustrate different ways of living activities of a community. Accordingly, according to Pafka & Dovey (2017, p. 154), while some of the aforementioned public spaces could be impressive and interesting to a community, most of them are entered via an interface, which, according to Al Mushayt, Dal Cin, and Barreiros Proença (2021, pp. 2-3), is formed between the architectural forms and public pathway on the ground floor. With that being said, according to Al Mushayt, Dal Cin, and Barreiros Proença (2021, pp. 2-3), street interface plays as a connector between two areas visually and physically, which impacts the quality of permeability, and accordingly, it eases the connection between the community from street to different places and social interaction between people.

With regard to the above, physical permeability refers to a space's street interface, which lets people enter the location on the ground floor from the street or the public pathway.

Accordingly, according to Bentley et al. (1985, pp. 12-27), the interface causes raising the level of activity around the edges of a public space, whether about a building or open spaces such as a garden, which causes enrichment to the public space. Accordingly, this study represents how adopting the new approach model increases the interfaces around the edges of each of the four selected locations and their spatial and architectural spaces.

Adopting the new approach through the existing library's location within Pukekohe shows how new interfaces reduce restrictions from the public, including Massey Street and Edinburgh Street entering the noted location (Figure 7.9). Accordingly, the new interfaces have the opportunity to let people have higher visibility toward the depth of the property to


Figure 7.9: New interfaces via the new approach model within the selected location in Pukekohe region (By author)


Figure 7.10: Existing interfaces between the public and the selected location in Pukekohe region (By author)

see different departments of the library. In contrast, the existing circumstances of the Pukekohe library's location show that the only interface (Figure 7.10) from Massey Street doesn't reflect a physical permeability to promote social activity, including the degree of **desire to interact** within the location and **unofficial interactions**, since nowadays, common people would not be interested in attending within the conventional format of the building type that is called a library, as they are involved with digital platforms for different purposes, whether for daily needs or reading resources if they needed. Accordingly, when the level of interacting within the location and unofficial interactions remains low, the **social trust** and **attachment to the library's location** become weaker.

As a new location is suggested for a potential library development in Parnell, the circumstances of the new location give an outstanding opportunity by its position at the

Figure 7.11: New interfaces via the new approach model within the selected location along The Strand in the Pukekohe region and the existing interfaces around the existing library's location (yellow dotted line) at Stanley Street (By author).

corner, which is siding the main road of The Strand from the southern side and Ronayne Street from the eastern side with a high level of visibility to the depth of the site along both lengths of the property (Figure 7.11). Accordingly, by adopting the new approach, two interfaces from Ronayne Street, one interface from The Strand, and one interface from

Parnell Rise are suggested, which minimize the restrictions by multiple interfaces on different boundaries around the location to cross from the public to the location's spaces (Figure 7.11). Thus, the opportunities of increasing the tendency to interact within the location and unofficial interactions would appear, which accordingly cause social trust and attachment to the library's location. Besides, the two interfaces at Ronayne Street give the optional choice of locating the parking between them (highlighted light red area), which causes people to have a wide vision toward the depth of the location that promotes the visual permeability further (Figure 7.11). Compared with the above, the position of the existing library at the location (yellow dotted line) and the two interfaces at Stanley Street and Carlaw Park Avenue don't promote permeability and social trust since the building occupies the bulk of the location, and its height at the edge of the location's boundary and the monolithic form of the building, similar to its many neighbours' commercial or governmental buildings, don't let people be encouraged to explore the area by entering the location from the public to get an intimate connection with the location (Figure 7.11).

The new suggested location instead of the existing location for the Albany Village Library provides a considerable situation since the site is embedded along the Dairy Flat Highway

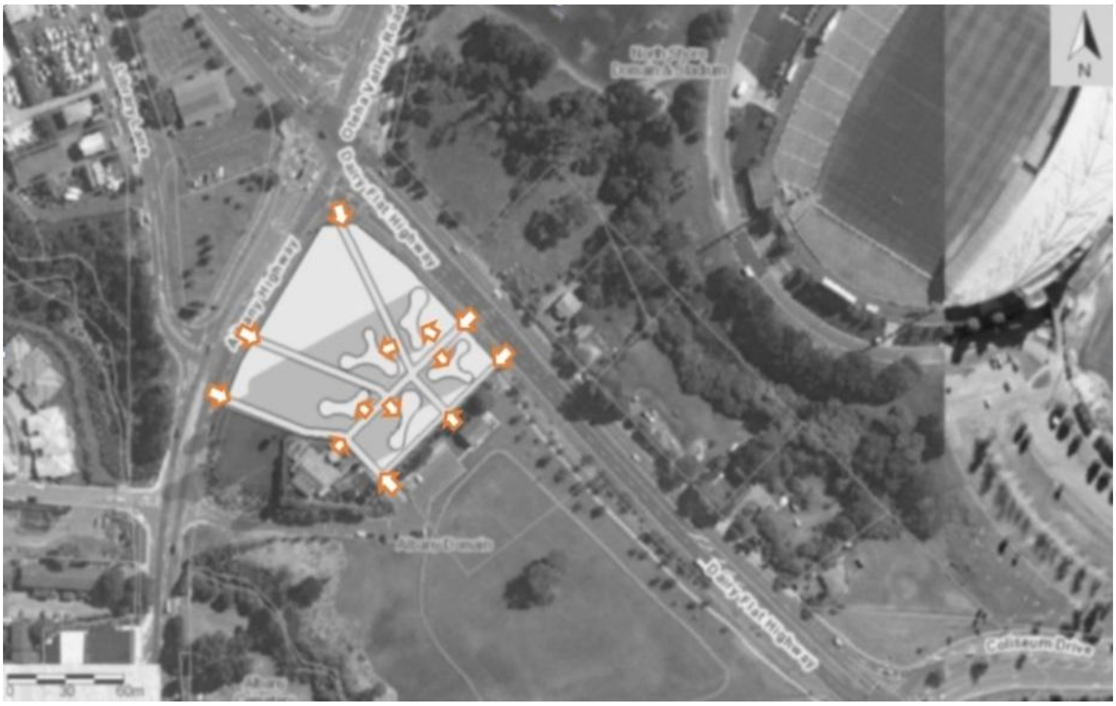


Figure 7.12: New interfaces via the new approach model within the selected location in Albany region (By author)

from the northern side and Albany Highway from the western side, which strengthens the visual permeability because of wide and deep vision toward the new suggested location (Figure 7.12). Applying the new approach model by exploiting the site's position features lets us have five interfaces from the two noted key public routes and three interfaces adjacent to its neighbours that are the community hub and a school. Besides, as it is noted in Chapter 5, the priority of the Auckland council for a replacement location for Albany Village Library is a location adjacent to the Albany metropolitan centre, which is considered in this study as the new suggested location is adjacent to the centre, and therefore, as the interfaces on Dairy Flat Highway strengthen physical permeability perfectly, people are encouraged to walk in to investigate the area specifically since the location is located next to the community hub. Also, its location between the big residential block on Albany Highway opposite the new suggested location and the metropolitan centreadjacent to the Dairy Flat Highway arouses people's expression not just to explore the location but also to encourage them to use the location as a pathway via the suggested **street interfaces** (Figure 7.12). Unlike the above, the existing library's location doesn't support a direct street interface to its location since a low-height building is located between the library's location and the secondary street of Kell Drive, which weakens visual permeability (Figure 7.13). Also, since the library's location is enclosed from behind by a curved bush of Kell Park and its access to the street interface from the secondary is not a direct access, then the location faces a weak physical permeability, so almost only people who are familiar with the area have a chance to walk into the space; otherwise, others either miss the location or have no tendency to


Figure 7.13: Existing interfaces for the existing Albany Village Library within the Albany region (By author)

seek the library's location to attend there (Figure 7.13).

Similar to what is suggested within the Parnell and Albany regions about the two selected libraries, it is also suggested a location replacement for the Warkworth library, which is argued and analysed through different analyses in chapters 5 and 6. Accordingly, the new


Figure 7.14: New interfaces via the new approach model within the selected location along Baxter Street in the Warkworth region and the existing interface in front of the existing library's location (yellow dotted line) at Baxter Street (By author).

interfaces are created for the new suggested library's location at Baxter Street once different library departments are formed into separate physical structural forms by adopting the new approach model (Figure 7.14). With that being said, the suggested location exploits six interfaces at its edges, including three interfaces that are located at the edge of the location on Baxter Street, one interface from the open public parking at the end of the same street that is enclosed by Lucy Moore Memorial Park, one interface at the other edge of the site on the street opposite to Percy Street, and the last interface at the northern side of the property from a sidewalk (Figure 7.14). Thus, the new approach model provides the highest level of visibility and transparency from all four sides to the depth of the new suggested library's location, which is an acknowledgment of how new suggested interfaces are applicable successfully, specifically regarding those that are located at the southern side of the site location, which have the most visibility to their adjacent key shopping centreand public parking on Percy Street just next to the intersection of Baxter Street and Percy Street (Figure 7.14). With that being said, the new interfaces strengthen the visual and physical permeability, which promotes the degree of desire to interact and the social trust that accordingly raises the potential of interactions between non-intimate people in the area. In contrast to the new suggested location, the existing library of Warkworth lacks the above initiatives, as the only street interface causes a monotonous mood and passivity in people instead of raising arousal and socializing, according to Ellard (2015, pp. 109-124), and accordingly, as there is not any meaningful difference between the interface at the edge of the library's location and other locations with their building types in the area, it transfers passionlessness instead of promoting a livelier environment to the public.

### 7.2.1. A comparative summary and comment on the approach model generalizability

While adopting the new approach model for each of the four selected locations causes a distinguished situation once they have undergone changes, there are some comparable differences among them. Accordingly, the new suggested routes and separate departments for Pukekohe Library's location were formed, which, apart from features for any potential of the library development in the future, are also very likely to be aligned with targets of the Auckland Council plan for the development opportunity of the superblock at Massey Street on the opposite side of the Pukekohe Library. With that being said, according to Auckland Council, Eke Panuku Development Auckland (2023, p. 16), the council has been looking for a new connection between the Franklin Centrecar park on Edinburgh Street to King Street via the Town Square, and the suggested approach for the library's location can make the above reasonably feasible. Thus, the same location for the Pukekohe Library is authentic for any potential of the library development since adopting the new approach model not only causes it to be a supplement to its superblock neighbour on its opposite side, but it also causes the location to be more integrated with its surrounding area as well as raising the connectivity value as analysed in Chapter 6. In contrast, the other three locations were suggested to be moved to new locations because of reasons that were explained and analysed in both Chapters 5 and 6. In comparison with the Pukekohe library location, it was suggested a new location for each of the three locations as their reasons argued and analysed in chapters 5 and 6. Accordingly, the new three suggested locations exploit at least two major streets at their different sides' boundaries with multiple street interfaces, which also not only help to minimize hierarchical layouts by the public access to the different library's departments from multiple interfaces between the public (street) and a library's site. Hence, all three locations meet considerable permeability compared with the three existing locations for the public libraries within Albany, Parnell, and Warkworth.

Analyses and explanations on the selected locations via adopted indicators in this chapter following the outcomes of analyses via space syntax indicators and visibility analyses through Chapter 6 illustrated how the found targets in Chapter 6, **including interactions between non-intimate people and unofficial interactions, the degree of desire to interact within the location, social trust, and attachment to the library's location**, are dependent on the quality of **permeability**. With that being said, the stronger the permeability, the better the quality over the noted above targets, which meets the major target of this study that is looking for the **public library** as a **social infrastructure** via the suggested new approach model in Chapter 6.

With regard to the above, adopting the new approach model within each of the four selected locations shows how separate departments of a public library can shape the way people interact within the location via new routes, which not only connect departments to each other but also let people enter from one side and exit from the other side of the location. Accordingly, the suggested approach model provides the opportunity for the public to have access to each separate department of a selected library only by one direction change or two syntactic steps from each created interface at the edge of a selected site location, which also acknowledges the minimizing hierarchical layouts that cause higher **permeability**. Thus, the new approach model causes a feasible approach aligned with the theoretical framework of this study to achieve the transformation from controlled places to informal social environments, which lets the separate departments of the public library in the form of a "**public-interior**" but in an open space that is not under the same roof to give the term of "**public access**" from different sides of the site location to all departments connecting by new routes within the location that is an initiative approach to **promote distribution of movement, co-presence, and informal interactions**. Therefore, it would be a kind of meaning of **social infrastructure** in the context of the library. With that being said, adopting the new approach model eases **breaking the boundary** between the public (street) and each of the selected four locations. Thus, it acknowledges the **generalizability** of adopting the approach model for all four locations, which could be a pattern for other public libraries' development. In the meantime, while the model presents a structured approach, factors such as differing zoning regulations and socio-cultural behaviours may influence its application beyond Auckland.

### 7.3. Suggestions for the design/positioning of public libraries' locations in the Auckland urban context.

Analyses and arguments in chapters 5 and 6 let this study suggest an initiative approach in the development of public libraries in Auckland that could be a pattern for whole regions across New Zealand and any similar community, such as Australia, with consideration of the previously noted keynote that factors such as differing zoning regulations and socio-cultural behaviours may influence the new suggested approach's application beyond Auckland. Thus, the approach could be a pattern of public libraries' development across the noted communities, as they have also been looking for developing public libraries and extending social influences of public libraries in the community, specifically in the era that communities have been involved with digitalization. However, this is not limited to public libraries, but it is also about different aspects such as businesses, education, scientific research, etc.

With regard to all results in this research study, this study proposes a set of suggestions for designing or positioning public libraries' places along the adopting the suggested approach model, including:

- The prior step to design or position is considering how locals or visitors can enter the location from its surrounding areas and waggle from one side to another.
- As strengthening permeability is a key target, it is significant that new paths be visible and recognizable to people, which should be planned by continuous routes from multiple access spots and/or street interfaces. Accordingly, specifying street interfaces and public access spots is a priority, as their destinations within the location are important.
  - That is why, according to Ellard (2015, pp. 109-124), the general design of interfaces between the public (street) and a site location can influence the psychological and emotional expression of people. Accordingly, according to Ellard (2015, pp. 109-124), people would be quiet and inactive in front of solid structures similar to any type of structures like banks, courthouses, and business towers, or cross fast from them, while they are lively and talky at a livelier location. Hence, adopting the new suggested approach model causes increasing people's arousal and their positive expression, which encourages them to cross boundaries between the streets and any of four selected locations via suggested interfaces in this study. With regard to the above, the new approach model, by strengthening the role of new suggested interfaces, animates people's tendency to interact within the location, which causes unofficial interactions and social trust, and accordingly, people find attachment to the library's location.
  - With regard to the above point from Ellard, this study also suggests that one practical implementation would be integrating mixed-use spaces within high-density urban locations to support multifunctional usage, ensuring that libraries remain adaptable to shifting community needs.
- Connecting to the library's location with the most direct connection from the main street is a priority, which can be examined and recognized via comparing the numbers of direction changes or syntactic steps that are vital on daily journeys along each path from the main street to a selected/suggested library location.
- It is essential to recognize streets linking to the selected library's location, which have the highest number of connections to the location's immediate surroundings. The reason is strengthening the connection between the library's location and its immediate surroundings via a direct street to the site. For instance, in the Pukekohe

region, Massey Street and Edinburgh Street have the most connections to the Pukekohe library's adjacent surroundings, as shown in figures 7.9 and 7.10.

- According to the SWOT analyses for each of the four selected locations in Chapter 5, all four public libraries are needed to be developed, whether by general public demand and/or ongoing Auckland regions' sprawl. Accordingly, it is noteworthy to consider the national benchmark regarding the required public libraries' sizes according to the Community Facilities Network Plan (2015, p. 24), which is equated to 41 $m^2$ per 1000 people.
- With regard to the above, this study suggests that three indicators of the required location size for a public library, parking standard regarding cars per gross square meter built space, and required building height as explained in Chapter 5 should be considered prior to developing the new routes within a selected location.

## 7.4. Limitations of the research and future research

With regard to the aims of this study, it has become possible to acknowledge that the suggested new approach model responded to the questions and targets of this research study, which were planned in Chapter 1. With that being said, the nature of the **generalizability** of adopting the suggested approach model lets the formation of an approach lead to promoting public participation in public libraries' locations within the context of Auckland, and also it caused breaking the boundary between the public (street) and libraries' locations to improve the urban integration of public libraries with their surrounding urban spaces.

With regard to the above, the nature of the **generalizability** of the approach model reflects the concept of "**urban acupuncture**" once it is adopted by different public libraries' locations within different regions in Auckland. Accordingly, according to Lerner (2014, pp. xv-3), "**urban acupuncture**" presents an urban project that is missed in a neighbourhood before design, which can also cause wider cultural changes in the area. Arguably, it can be led that the surrounding environment be affected by whether a small or bigger project, such as a public library, which accordingly, is the result of a fine-tuned, programmed, and disciplined approach. However, apart from the achievement of this study by successfully producing and adopting the new approach model for each of the four selected locations, it should be acknowledged that there are **limitations** in this study.

On the one hand, one notable constraint was the reliance on space syntax analysis, which, while effective in mapping spatial configurations, does not capture behavioural nuances that qualitative methods could elucidate. On the other hand, as the process of data collection and analysis, which led to the achieved approach model, was time-consuming for the period of this research program, it thus was not possible to go through any further potential gaps in the knowledge, such as forming internal interfaces, which represent the relationship between new routes within a selected location and the suggested library's separate departments that play as urban morphological elements. Hence, success in the above makes the internal new routes livelier. The above argument becomes highlighted when architecture is posited as the interface, which lets the ground floors of each separate department of the public library propose mobility and cultural values. Accordingly, while there is a limitation because of the time-consuming nature of reaching the noted phase, it is an opportunity for future research. With that being said, future research could be concentrated on the architectural aspects of the interfaces between separate departments of the public library and new routes within the same location. Besides, subsequent studies should incorporate demographic factors to better understand the intersection of spatial accessibility and community engagement. Accordingly, the above suggestions for future studies could be framed as logical extensions of the current research study.

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