SCHOOL OF ENVIRONMENT AND SUSTAINABILITY
UNIVERSITY OF SASKATCHEWAN

ENVS 899.6 International Field Lab in Climate Resilient Urban Shorelines and Coastal Ecosystems

Assessment of Accessibility to Urban Coastal Mangrove Walking Trails in Auckland: Implications for Equity Deserving Groups

School of Environment and Sustainability
School of Community Health and Epidemiology
School of Architecture

University of Saskatchewan
University of Auckland

Timi Adelugba
Faculty Advisors: Dr. Varuni Jayasooriya, Dr. Oscar Zapata
Partner Faculty Advisor: Dr. Iresh Jayawardena

May 27 – August 17, 2026

© Copyright Timi Adelugba
2026 All rights
reserved.

Disclaimer: The purpose of this report is educational and does not substitute for professional services in any areas, including for example architectural, civil, legal, mechanical or health related design. The work served the experiential learning component of a course entitled ENVS 898.6 offered in the School of Environment and Sustainability's EcoShores Project. No obligations or liabilities are implied.

Copyright for the report remains with the author. The author may grant permissions for use upon written request. Conditions for use must be outlined in advance in a written agreement between the author and the organization for which the project was conducted. When a third-party requests permission for use, the author, the organization and the School of Environment and Sustainability at the University of Saskatchewan and University of Auckland must approve this request in writing.

Permission to Use: Permission to use this report is hereby given to the School of Environment and Sustainability (SENS) at the University of Saskatchewan and University of Auckland.

Executive Summary:

Mangroves are vital to Auckland's coast and they offer ecological benefits to the environment, specifically, coastlines. They can also serve as blue-green spaces that provide a plethora of other benefits, including physical activity and nature interaction. However, these benefits only matter if people can access and use these spaces in actuality. This project explores how mangrove walking trails in selected Auckland sites ensure equitable access amongst older adults, people with disabilities, and children. The goal was to identify many factors that influence fair access to the mangrove trails and develop a practical tool to assess this. A literature review highlighted the overarching concepts regarding equity, blue-green spaces, mangroves and accessibility. This background information informed the criteria selection for the tool. The tool was tested on three Auckland trails: Tuff Crater Reserve, Norana Esplanade Walkway, and Hobson Bay Walkway. GIS, online maps, and field observations were used to evaluate the sites according to the tool. The main outcome of this project is a practical assessment tool that identifies which groups face barriers and highlights areas needing improvement. Further testing and engaging with trail users would help to refine the tool.

Table of Contents

Executive Summary: 4
Introduction 6
Literature Review 7
Methods 14
Tool Development 15
Criteria Justifications 15
Assessment Tool 23
Site Profiles Visitation Observations 24
Tuff Crater Site Visit 25
Norana Esplanade Walkway Site Visit 33
Hobson Bay Walkway (East) Site Visit 41
Results 49
Discussion 50
Positionality 52
Future Directions 52
Conclusion 53
References 55
Appendix A: Tuff Crater Additional Information 66
Appendix B: Norana Esplanade Walkway Additional Information 68
Appendix C: Hobson Bay Additional Information 69

Introduction

There is a substantial body of research that highlights both the ecological importance and the climate-resilient characteristics of mangrove ecosystems. Mangroves are increasingly recognized for the benefits they provide which include flood mitigation, carbon storage, and protection against coastal hazards (Nahdatunnisa et al., 2025). These benefits make them an essential component of climate change adaptation and coastal resilience for cities such Auckland. Coastal environments support ecological functions such as habitat provision and shoreline stabilization while also offering spaces for walking, recreation and interaction with nature (Song et al., 2022). The benefits of walking access to blue-green spaces also have been evidenced (Song et al., 2022). It is also important to note that although walkability within mangrove environments is important, unmanaged visitation can exceed ecosystem carrying capacity and lead to environmental degradation (Zallesa et al., 2026).

Despite these benefits, mangroves remain very contested in many urban areas. In New Zealand, for example, mangroves are sometimes perceived as limiting recreational access or obstructing coastal views which has led to ongoing management debates. At the same time, there is growing recognition that human interaction with nature can foster environmental awareness, appreciation and stronger support for conservation (Barragan-Jason et al., 2023).

A glaring gap in existing research is that even though ecological and physiological benefits of mangroves are known, much less attention has been given to whether they are equitably accessible.

In order to reap the multitude of benefits related to mangroves, communities must be able to have safe and easy access to the trails surrounding them. Within this context, accessibility refers to the ease with which residents can reach and use mangrove walking trails. Walking trails

are considered accessible and equitable when people of different ages, abilities, incomes, and backgrounds can easily reach and use them (Lukoseviciute & Nelson, 2024). This can include having adequate connections to roads and nearby public transportation to get to the trails or the trails themselves. In order to be equitable, a trail ideally should be able to sustain the use of individuals without the influence of disparities.

Urban blue-green spaces are recognized as essential components of healthy cities, with documented impacts on physical health, mental health, stress, anxiety, and depression (Wang et al., 2022). Trail accessibility can also contribute to community engagement and inclusion when trails are designed for people of different ages and mobility levels. As part of this question, the student researcher will also address whom the site is accessible to and who might be excluded.

Not every trail in Aotearoa New Zealand has been built or maintained to consider the accessibility needs of people with different impairment types, or the design differences of adaptive trail equipment (Outdoors Accessibility Design Guidelines, 2025). When we accommodate for those with physical disabilities it often benefits the whole community. It allows to trail access for the most to least able bodied as well as minorities.

Literature Review

Nature-based solutions (NbS) are increasingly recognized as important strategies for addressing climate change and environmental sustainability challenges. Unlike traditional engineered solutions, nature-based solutions utilize already present ecological features to address climate-related problems. Mangrove ecosystems represent one of the most effective coastal nature-based solutions and have consistently demonstrated their ability to provide flood mitigation and shoreline stabilization as well as protection from coastal hazards (Nahdatunnisa et

al., 2025). Indisputably, these benefits are quite important for coastal cities such as Auckland, a place where sea-level rise and coastal erosion take place and extreme weather events present issues to urban populations. Cheek et al. (2025) argue that coastal ecosystems should not be viewed solely as protective infrastructure but also as conduits through which communities receive benefits. Similarly, Skiba et al. (2026) note that the planning of urban green spaces requires a consideration of accessibility. Gradinaru et al. (2023) found that green infrastructure planning frequently lacks meaningful consideration of how environmental benefits are distributed across different population groups.

Mangroves As Blue-Green Spaces

Blue-green spaces are environments, sometimes within urban areas, that can include parks, gardens, trails and water. As urbanisation continues and is projected to reach 70% of the global population by 2050, these spaces are becoming increasingly important components of an urban city (Wang et al., 2022). A growing body of evidence has linked access to these spaces with improved physical and mental health outcomes, including lower levels of stress, anxiety, depression, and obesity (Wang et al., 2022). They also provide environmental benefits such as air purification and urban cooling (Dorji et al., 2023). Bilkovic et al. (2017) further note that blue-green spaces support both personal wellbeing and broader community resilience. Given the importance of blue-green spaces, specifically in urban environments, it is imperative that all people have access.

Mangrove ecosystems are unique blue-green space and offer a plethora of benefits. In a physiological sense, mangroves act as biofilters that detoxify metals from the environment which provides a direct health benefit to coastal populations. They also function as living shorelines that store blue carbon while protecting inland areas from flooding. As long as visitation is

managed through pedestrian infrastructure then mangroves can become spaces for education, birdwatching, recreation and physical activity but we must consider the carrying capacity of these environments to ensure that excessive visitation does not lead to degradation (Zallesa et al., 2026).

Accessibility and Access to Blue-Green Spaces

The potential benefits of mangroves can only be realized if the public is able to reach and use them. Accessibility is generally defined by both spatial and physical dimensions. Spatial accessibility refers to the geographic location of a site relative to a population whereas physical accessibility concerns whether individuals can safely navigate those spaces once they arrive. Various factors influence this access, including transportation networks and physical barriers, if present (Cheek et al., 2025). Access to blue-green spaces is not evenly distributed across populations. Factors such as socioeconomic status, age, and disability can influence individual's ability to benefit from them (Wolch et al., 2014). Access therefore involves more than simply having a blue-green space nearby. The route to the space matters as much as the space itself because barriers encountered along the journey can limit who is able to enjoy its benefits.

Equitable Access

Equity is an important consideration when assessing access to public spaces because providing the same level of access to everyone does not necessarily result in fair outcomes. The topic of distributional equity is particularly relevant when considering equitable access. This term refers to the distribution of infrastructure, amenities and opportunities across a community (Meerow et al., 2019). When opportunities are not distributed to all who occupy the built environment, participation is reduced. When referring to the built mangrove walkways, this

could be the result of physical inaccessibility, lack of connectivity, and lack of walkability, to name a few. Importantly, these barriers are not experienced equally.

While equality focuses on giving all people the same access to the same resources, equity recognises that different groups may require different levels of support to achieve comparable opportunities and benefits. Braveman and Gruskin (2003) and Betley et al. (2023) define equity as the absence of systematic differences in outcomes between groups with differing levels of social and economic advantage. In the context of assessing the outdoor built environment, this means considering how factors such as income, age, and disability influence people's ability to access and benefit from public spaces (Byrne & Wolch, 2009). As a result, equity in access to blue-green spaces has increasingly been framed as an environmental justice issue (Wolch et al., 2014; Shen et al., 2017). Understanding and addressing these inequities is therefore essential to ensuring that the benefits of public spaces are available to all members of the community.

This literature review examines equity in blue-green environments through the lenses of age and mobility disadvantage since these factors are commonly associated with disparities in access to and use of outdoor spaces and yet remain under-researched (Byrne & Wolch, 2009). Socioeconomic status will also be considered as an underlying driver of disparity.

Equity Deserving Groups

There are certain populations that have been historically and systemically overlooked in urban planning, specifically older adults, children, those with low socioeconomic status, racial/ethic minorities, those without adequate transportation opportunities and those with physical disabilities (Wen et al., 2013). To keep the scope of this project narrow, it is primarily focused on older adults, children, and those with physical disabilities, with attention to how lack

of transportation access and low socioeconomic status could influence blue-green space accessibility.

Older Adults and Equity in the Built Environment

The definition of older adults can be contested, but for the purpose of this study, older adults refers to those over the age of 65. Older adults face unique challenges such as changes in mobility, balance, vision, and physical endurance. Features at a trail such as steep slopes, uneven surfaces, stairs, inadequate seating, and limited access to public transport can reduce their ability to reach and comfortably use these environments. The World Health Organization's Age-friendly Cities and Communities framework identifies the built environment and transport connectivity as key factors that support healthy ageing (WHO). Access to green spaces (Finlay et al., 2015) and recreational services (Lui et al., 2022) can contribute to ones ability to age well in places. Being able to access blue-green spaces from home is particularly important, as older adults are more likely to use parks when they are located within a 15-minute walk (Iraegui et al. 2020). These findings suggest that simply providing blue-green spaces is not sufficient; their location, connectivity, and physical design must also support the needs of ageing populations if the benefits of these environments are to be experienced equitably. In a similar manner, children also experience unequal access to urban blue-green spaces.

Children and Equity

For the purposes of this project, children are defined as individuals aged 5–15 years. The ability of children to access these walking trails is often influenced by the characteristics of the trail and the location of the space relative to their homes. Iraegui et al. (2020) found that children

are more likely to utilize outdoor spaces when they are located within a 15-minute walking distance of their home, which points out the importance of having recreational spaces, such as walking trails near residential areas. Children often depend on walking, biking, or being pushed in a stroller by a caregiver to reach trails and so there is also a need for connected, usable pathways from residential areas and easy to locate trail entrances. However, it is imperative to recognize that when walking trails are not distributed equally across all communities, some children may have fewer opportunities to experience the wellbeing benefits that these environments provide (Iraegui et al., 2020).

The way the trail is constructed and the features it possesses can directly impact the way a child interacts with the space. Children, especially children who are very young, would require smooth surfaces to prevent tripping and falling incidents. Barriers and edges also help to prevent accidentally entering, or falling into, mangrove ecosystems. If these features are not present, a child should not be expected to be able to utilise the walking trail to its full potential.

Transportation, Low SES and Equity

Transportation plays quite an important role in the equitable access of blue-green spaces because it influences whether individuals are able to reach and use these environments in the first place. Equity is a multidimensional concept that has been applied across many disciplines but within transportation it is often concerned with how accessible the public transit is. Access to high-quality public transport is particularly important for people with low socioeconomic status (SES), as these individuals may be less likely to own or have regular access to a private vehicle (Chen & Chang, 2015). As a result, the accessibility of a mangrove walking trail is shaped not only by its physical characteristics, but also by the transportation options available to reach it. When these trails are within or near low income neighbourhoods, limited transport connections

can reduce their usability (Wolch et al., 2014). While it is common to measure transit access using factors such as the frequency of services at a stop, transportation equity goes beyond this. It also involves the nearness and connectivity. Therefore, assessing the availability and quality of public transport connections to blue-green spaces is important because the journey to the trail is an essential component of equitable accessibility.

Objectives

In order to reap the multitude of benefits related to mangroves, communities must be able to have safe and easy access to the trails surrounding them. In this context, accessibility refers to how easily residents can reach and use mangrove walking trails. Walking trails are considered accessible and equitable when people of different ages, abilities, incomes, and backgrounds can easily reach and use them (Lukoseviciute & Nelson, 2024). This can include having adequate connections to roads and nearby public transportation to get to the trails or the trails themselves. In order to be equitable, a trail ideally should be able to sustain the use of individuals without the influence of disparities.

Given the aforementioned importance to consider underserved communities in the built environment, this study aims to explore the following research question: To what extent do selected mangrove walking trails in urban Auckland reflect equitable access across socioeconomic and demographic groups? This project provides a new assessment tool for urban environmental equity planning. The objectives of this study are as follows: (i) to determine key trail qualities that influence equitable access, (ii) to identify which equity-deserving groups may have been potentially overlooked in the planning of the trail. In the final sections of this paper, some of the limitations of this study are discussed and directions for future studies are suggested.

Methods

Firstly, the student researcher conducted a literature review to gain a general understanding of nature-based solutions and their benefits to New Zealand populations. The review had an emphasis on the social and communal benefits of mangrove walking trails as well as public perceptions. The review also focused on mangrove walking tails and their relationship to recreation and public use. Through this review process, the student researcher familiarized themselves with widely used equity indicators presently being used in environmental, community health and urban planning fields to guide the criteria selection. Although not methodologically systematic, this literature review was thorough and transdisciplinary and only used peer-reviewed journal articles published after 2000.

Using the information gathered from the literature review, an accessibility assessment tool was created. The tool possessed items that determined whether a site was equitably accessible with regard to proximity to mangroves, connectivity to roadways/pathways, and trail characteristics, to name a few. Primarily, this tool is based on criteria and specifications outlined in the Outdoor Accessibility Design Guidelines (2025).

Following this, in collaboration with Dr. Iresh Jayawardena and Auckland Council, relevant mangrove ecosystem sites were selected. Then, site visits occurred. These visits were conducted to observe and document mangrove trail characteristics, putting the tool into action. Photos and field notes were also collected to complement the GIS analysis and provide rich detail about each site. Accessibility assessments, using the tool, were then compared across sites to identify strengths and limitations.

Tool Development

Based upon existing literature, the following criteria were chosen to make up this equity-focused assessment tool. The four categories are (1) Access and Arrival, (2) Trail Characteristic, (3) Safety and Comfort and (4) Wayfinding and Experience. Primarily, the Aotearoa Outdoor Recreation Guide was consulted when comprising this list to keep the tool grounded in a local context.

Criteria Justifications

Access and Arrival

Public Transport Access

Public transport access was included as a criterion because transportation is a major determinant of access to blue-green spaces. Individuals who do not own or have regular access to a private vehicle may depend on buses or trains in order to reach walking trails. Assessing the proximity of public transport stops helps to determine whether a trail can be accessed broadly by members of the community. Public transportation within ten minutes of walking has been used as an indicator of accessibility. This is approximately 400m which is based on the walking catchment distance used by the NZTA (New Zealand Transportation Agency, n.d.) For the sake of this project, I will assess if there are public bus stops within this radius to an entrance of the trail and how many.

Active Transport Access

This criterion evaluates the quality and safety of walking and/or cycling connections to the trail. Safe active transport infrastructure can remove barriers to participation by allowing individuals to reach the trail without a vehicle. This criterion was included because disconnected footpaths or unsafe connections could impact the trail. Connected active trails are extremely valuable as they enable a community to take trips to locations they otherwise would not be able to frequent (NZTA (New Zealand Transportation Agency, n.d.) This criterion will assess whether there is at least one connection to a separate cycling or walking infrastructure.

Access From Residential Areas

Access from residential areas was included as one of the criteria because proximity is one of the strongest predictors of park and trail use (Xu et al., 2022). Trails located within walking distance of residential neighbourhoods are more likely to support regular visitation and use. This criterion helps determine whether the benefits of the trail are available to nearby communities rather than only those willing or able to travel longer distances. This project will take note of neighborhoods the trail is directly connected to and how many connections.

Entrance Visibility

How visible an entrance is will undoubtedly impact one's experience with the trail. Entrance visibility evaluates how easily trail access points can be identified from surrounding streets, car parks and pathways. This criterion was included because visible and identifiable entrances aid in accessibility and encourage visitation (Outdoors Accessibility Design Guidelines, 2025). This project will assess whether an entrance is clearly marked and experientially easy to access.

Car Parking

Each site will be assessed on how many parking stalls are available near the entrances and of which kind. Car parks are essential gateways to enjoying blue-green spaces when they are accessed by private vehicle. Their accessibility is important for facilitating participation in recreation as finding an appropriate place to get dropped off or to park your vehicle is a crucial step in the journey of 'arriving to'. This project will assess whether there is at least one wheelchair accessible spot for every 20 spots (Ministry of Business, Innovation and Employment, n.d.).

Trail Conditions

Slope Gradient

As for the slope, each trail will be assessed for how steep the gradient of the slope is. This refers to the steepness that may be encountered along the trail. If there are excessive slopes, this may restrict access for individuals with mobility limitations, older adults, and users of assistive devices. This criterion was included because slope gradient is a fundamental component of physical accessibility and can significantly influence whether a trail can be used comfortably and safely.

A trail gradient refers to the change in elevation over the course of the trail. There are conflicting figures used to determine how much of a slope is accessible. Some articles state that built slopes should not exceed 4.76° on built ramps (Flemmer, 2022). Kim et al. (2012) and Gagnon et al. noted that slopes should ideally not be steeper than 7.13°. The latter study also stated that a slope of less than 2.7° was able to be accessed by all of the participants (Gagnon et

al., 2014). In this study by Gagnon and associates, it was found that inclines of 2.7° to 3.6° required similar amounts of effort to climb which implies that it causes minimal harm to infer that 3.6° is a reasonable incline for most individuals. A study conducted in Japan found that slopes of no more than 2.86° should be constructed in an ideal scenario, while the absolute maximum slope could be up to 4.57° in places where a milder slope is not possible (Hashizume et al., 2013). Additionally, if there is a change in level where a ramp is necessary, then typically a ramp should be constructed with a gradient between 2.86° and 3.81°, but it would be best if there is no drastic change of level at all (BRANZ, n.d.). As evidenced here, there is not an agreed upon value and even less data available about trails in blue-green spaces (Lepoglavec et al., 2023). Considering all of this, for the purposes of this study, I will assess whether the trails have a gradient angle of less than 5.71°. Where the specific gradient is not measurable or available online, it will be calculated by dividing the elevation gain by the path length.

Path Surface Condition

This criterion was included because it examines the evenness and usability of the trail with regard to its surface and material. Uneven, damaged, or unstable surfaces can create safety risks and accessibility challenges for many users. Materials used in outdoor recreational spaces play a large role in overall accessibility. Boardwalk surfaces, present at all case study sites in this project, are a common choice for mangrove trails. They are known to provide access to environments that would otherwise be inaccessible. However, transitions between boards can be turbulent. Individual boards that are not in good condition can create a tripping hazard for children and those with mobility difficulties. Also, slippery surfaces can be hazardous and cause injuries which is a major risk for people with mobility related disabilities or problems with balance. One way to address this is to have anti-slip tread on at least one side (Outdoors

Accessibility Design Guidelines, 2025). Additionally, it's important to have kick-rails on the edges of boardwalks to avoid wheels rolling over the edge into the mangrove habitat or off the boardwalk. Sections with loose material on top can be a slip hazard and can cause wheeled mobility devices to lose traction, so, well compacted hard trail surfaces are ideal. In this project, I will be assessing whether the trails have anti slip material, have kick rails, the compactness and the overall evenness.

Path Continuity

Related to path surface, path continuity is an important criterion for this project. This assesses whether the route remains connected and uninterrupted throughout the trail. Gaps in infrastructure or abrupt changes in surface type can disrupt accessibility and reduce usability (Outdoors Accessibility Design Guidelines, 2025). This criterion was included because continuous routes are essential for maintaining independent movement and creating a predictable user experience. This project will assess whether the 3 sites' trails have smooth transitions between materials and surfaces.

Path Width

Path width evaluates the amount of space available for movement along the trail. Adequate width is necessary for two people to pass each other and also for accommodating strollers, wheelchairs or other mobility devices. This criterion will assess whether the trail supports this shared use. For any bridges specifically, 1 metre wide is typically accepted as not wide enough to allow people to pass through adequately (Outdoors Accessibility Design Guidelines, 2025) thus, the ideal width is at least 1.2m (BRANZ, n.d.). 3m wide would be the

best case scenario. This project will assess whether the three sites are wider than 1.2 along the majority of the trail.

Stairs

Staircases, or even a few steps at the entry or exit point, can be a complete access barrier for anyone who is unable to walk up steps. Steps on or up to trail structures can pose a significant safety hazard if they are unexpected, particularly if the rest of the trail is step-free (Outdoors Accessibility Design Guidelines, 2025). This project will assess whether the sites possess stairs or steps that would hinder entrance or access to the trail.

Safety and Comfort

Hazard Management

This criterion evaluates how effectively present risks are identified and mitigated. Hazards such as slippery surfaces or damaged boardwalks and even uneven terrain may discourage use or increase injury risk. This criterion was included because a safe environment is a prerequisite for equitable access and sustained trail use (Outdoors Accessibility Design Guidelines, 2025). To assess this criterion, any temporary signs or indicators of active hazards were noted.

Safety Infrastructure

This criterion assesses the presence of physical features that are permanently in place and designed to improve user safety. This includes railings, barriers and edge protection. This also includes measures such as handrails, which provide extra safety and support. If present, handrails should be about 1m high to aid in walking (BRANZ, n.d.). These features may reduce the

likelihood of injury and increase user confidence. This criterion was included because safety infrastructure can be particularly important for children, older adults, and individuals with physical disabilities. The sites will be assessed on whether they include these useful safety features throughout the trail.

Seating and Rest Areas

This criterion will assess the availability and distribution of opportunities to stop and recover while using the trail. Rest opportunities are particularly important for older adults, children, and individuals with reduced mobility (Outdoors Accessibility Design Guidelines, 2025). This criterion was included because the ability to pause and recover can determine whether some users are able to move through a trail comfortably. It also significantly improves the outdoor recreational experience for those with increased levels of impairments (Outdoors Accessibility Design Guidelines, 2025). Where space allows, resting places 1.8m wide and 2 m long allow enough space for two wheelchair users to pass each other. Notably, it doesn't always have to be formal bench seating, but rather well-placed natural features such as large rocks, logs, or empty spaces along the side that can be useful for users to rest (Outdoors Accessibility Design Guidelines, 2025). This project will note the presence and number of resting opportunities.

Shade and Shelter

This criterion evaluates the protection from environmental conditions like direct sunlight and rain. Exposure to weather can affect both comfort and safety, particularly during periods of extreme heat or poor weather. This criterion was included because environmental protection can influence how frequently and for how long people are able to use a trail (Outdoors Accessibility Design Guidelines, 2025). Shelters can include built structures along the trail that provide

covering or extensive overhanging trees. The three sites will be assessed for the extent to which they possess shelter opportunities (how many and what kind).

Toilets

Lack of accessible toilets can be a hinderance to engaging with trail sites. This can contribute to feelings of fear and unease and can be the reason people with mobility issues or chronic illnesses avoid going entirely (Perry et al., 2021). The amount of bathrooms at the trail will be noted.

Wayfinding and Experience

Wayfinding and Signage

This criterion will assess the availability and clarity of information that helps users navigate that trail. Effective signage reduces confusion and supports independent use of the trail. This assesses how easily users can understand and follow the trail once they have entered it. If a trail is very complex in layout and has unclear junctions then the routes may create navigation challenges. This criterion was included because unclear or absent wayfinding may discourage use for first-time visitors who unfamiliar with the area and children (Soh & Smith-Jackson, 2003).

Educational Information

This criterion evaluates the availability of content available to read related to local ecology, history and culture. Educational features can improve visitor understanding and deeper engagement with the landscape. This criterion was included because trails can serve not only recreational functions but also educational and community learning purposes (Hughes & Morrison-Saunders, 2002).

Mangrove and Coastal Interaction

This assesses the extent to which visitors can experience and engage with the mangrove ecosystem. This criterion was included because meaningful interaction with the natural environment is a primary purpose of many mangrove trails and contributes to the value of the visitor experience (Ke et al., 2022)

Assessment Tool

The assessment tool, located in Microsoft Excel, begins with the completion of the site information at the top of the Site Assessment sheet. Each criterion is then evaluated using the scoring rules provided. Assessors assign a score of 1, 2, or 3 based on the conditions observed at the site. The Assessor Notes column can be used to record additional information that may provide context to the assessment. Once the scores have been entered, the Equity Impact column automatically converts each accessibility score into an impact value. A score of 3 receives an impact value of 0, a score of 2 receives an impact value of 1, and a score of 1 receives an impact value of 2. These values are then used to generate the Equity Summary, which calculates the potential exclusion impact for older adults, people with physical disabilities, and children across the assessed criteria.

The purpose of the Equity Summary is to indicate which groups may be most affected by the conditions present on the trail. The tool does not determine who can or cannot use a site, nor does it measure the experiences of trail users directly. Instead, it provides an estimate of where barriers may exist and identifies the groups that may be more likely to encounter them.

Site Profiles Visitation Observations

The following site profiles present the observations recorded during visits to each trail using the assessment criteria outlined in this framework. The profiles provide a description of what was observed during the field assessments. The site equity assessments, which were completed using the Microsoft Excel assessment tool, can be found as separate attachments to this document. Additional site information can be found in Appendix A, Appendix B, and Appendix C.

Tuff Crater Site Visit



Public Transport Access

Within approximately 400m of the entrances, there are 14 bus stops. Bussing is the main mode of public transportation in the area.

Active Transport Access

Before entry to the trail, there are footpaths that surround the trails and there are signs along nearby sidewalks directing people toward the pathway entrances. Runners and walkers have the means to enter the trail as there are connected sidewalks on Exmouth Road, St Peters Street and The Warehouse Way that lead directly to the entrances. Also, the multiple entrances that are distributed around the reserve further support access without the need of a private vehicle.

Access From Residential Areas

The trail appears well connected to the surrounding community as there is a path that leads directly onto St. Peter's Street and Exmouth Road which is located within the Northcote neighborhood. Heavily residential streets surround much of the reserve and all six of the entry points connect directly to Arahia St., St. Peters Street and Akoranga Drive. Sidewalks within the Northcote neighbourhood led directly to the trail entrances which makes it easier for residents to walk to the reserve.



Entrance Visibility

Upon arriving at the entrance at the end of Exmouth Road, there is a clear entrance to the reserve and it is clearly marked. There are six entrances total. This gives users multiple opportunities to



access the trail from surrounding neighbourhoods rather than relying on a single entrance. The entrance I arrived at was easy to locate and not ambiguous.

Car Parking

Upon arriving at the Exmouth Road entrance, there were four clearly marked parking spaces available. Of the four, there were none that were identifiably marked as accessible. In addition to these four, there were also spots available on the street.



Slope Gradient

The precise gradient is not available online. The calculated gradient (length of trail/ elevation change) is 1.78%. When rounded to 1.8%, it is equivalent to about 1.02°. Experientially, the pathway was generally smooth and did not contain steep slopes that could make movement in a mobility device difficult.

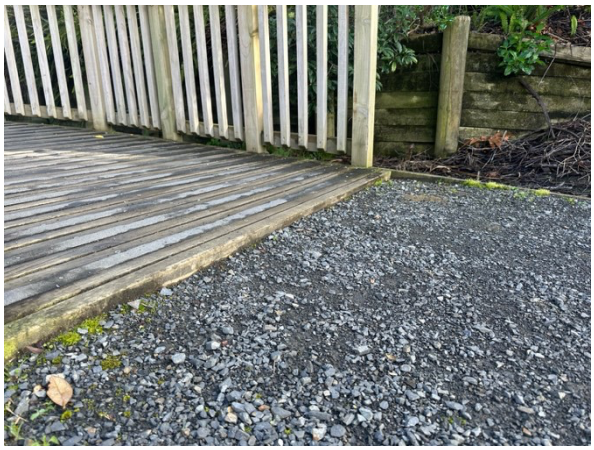
Path Surface Condition

The pathway alternated between gravel surfaces and boardwalk sections. The boardwalk infrastructure allowed users to travel through areas of mangrove habitat without disturbing it too much. In most locations, the pathway was well maintained and comfortable to walk on. A small drop between the boardwalk and the surrounding ground was noted where railings were absent, but the height difference was relatively minor at approximately four to five inches.



Path Continuity

Transitions between the gravel sections and boardwalks were relatively level and did not appear to create major barriers.



Path Width

The width, as calculated through Auckland Council Geomaps, is 2.0m around the crater. The trail was wide enough to comfortably accommodate passing users.

Stairs

There were just two steps noticed on this site visit. The steps led off the trail onto a grassy area and it did not seem like commonly used access point.



Hazard Management

Several safety measures were observed throughout. Whenever there were low-hanging branches extended over the pathway, red and white hazard tape had been wrapped around them to improve visibility. This would likely reduce the risk of people hitting their heads. One hazard noted during the case site visit was the potential slipperiness of some boardwalk sections when wet. Some sections of the trail had black grip material had been installed to improve traction yet this treatment was not present throughout the entire trail.





Safety Infrastructure

It is important to note that handrails were present in some areas which provided additional support for users who may require assistance with balance or stability. In areas where the boardwalk crossed briefly above water, railings were present.

Seating and Rest Areas

On this trip, there were 5 benches seen. Benches provided opportunities to rest and enjoy views of the environment.



Shade and Shelter

No specific observations regarding shade and shelter were recorded during the site visit.

Toilets

Bathrooms were not located during the site visit.

Wayfinding and Signage

Signage was one of the stronger features of the site. At the entrance, informational signs provided a map of the reserve. Along the route, wayfinding signs clearly indicated which streets users would exit onto and the signs on the sidewalks navigated users onto the trail.

Route Clarity

Once on the trail, users could easily navigate between different access points and surrounding streets. It is quite a straight forward path and there are no turns or curves that require much guidance.

Educational Information

At the entrance, information boards provided a map of the reserve and they outlined the wildlife restoration efforts occurring within Tuff Crater. There was also historical information about the area listed. There were more signs throughout the trail highlighted Māori perspectives and discussed the importance of freshwater within the local environment.

One limitation was that the main information board appeared to be written only in English, which may reduce accessibility for non-English speakers.





Mangrove and Coastal Interaction

One of the most noticeable aspects of the trail was the extent of mangrove exposure throughout. Mangroves were visible along much of the route and, in many places, were directly beside the pathway. The boardwalk sections allowed visitors to walk through the mangrove environment and experience it up close rather than simply viewing it from a distance. However, despite their prominence throughout, there was no information explaining what mangroves specifically are, why they are important, or the ecological functions they provide.

Situational Observations

The presence of older adults was particularly notable given the nearby residential neighbourhoods and suggests that the trail is accessible to at least some members of this population group. It should be acknowledged, however, that all observations regarding age groups were estimates and may be influenced by biases. In total, there were 12 users on the trail at the time of visitation (5 adults, 5 older adults, 2 kids).

Norana Esplanade Walkway Site Visit



Public Transport Access

Near the entrance of the trail (within an approximate 400m radius), there are 6 bus stops.

Active Transport Access

Footpaths connected surrounding residential streets to the entrances. The pathway itself was clearly designed to accommodate both walkers and cyclists. To the north, the trail links with the Waterfront Road Reserve Trail, which continues toward Coronation Road.

Access From Residential Areas

There were 3 sidewalks that connected surrounding residential streets to the entrances. These connections make it easier for residents to reach the site by walking or cycling perhaps from other communities as well.



Entrance Visibility

Four formal entrances were identified during the site visit but finding them initially was not straightforward. Despite using Google Maps, some of the suggested access locations did not provide direct access to the trail. One example was the end of Rymer Place, which is actually a gated industrial area rather than an actual entrance. This could easily create confusion for first-time visitors. Signage in the surrounding streets was limited and there were few visual cues indicating where access points were located.



Accessible Car Parking

At the entrance on Hastie Avenue, a small parking area was present but had been temporarily closed with a chain barrier. This lot included one accessible parking space.

Slope Gradient

When walking on the path, the route had no drastic changes. This 3.6 km trail had a 25 m elevation gain which means there was an average slope gradient of approximately 0.7% (0.4°).



Path Surface Condition

The pathway consisted of a combination of paved surfaces and wooden boardwalks. Along the way it was noticed that the anti-slip surface on the boardwalk was beginning to lift but otherwise, the surface remained relatively smooth.



Path Continuity

The route remained connected throughout the site visit. There were no breaks in the path that made following along confusing or difficult.

Path Width

At approximately 3.2 metres wide, the pathway provided ample space for people to pass each other comfortably. This trail had the widest path out of all three chosen sites.

Stairs

No stairs or steps were observed during the site visit.

Hazard Management

It was very helpful that the map located at the entrance identified hazard areas along the route which may help users assess whether the trail is suitable for their needs before beginning. There was anti-slip material present to mitigate the slipperiness of the wood but the anti-slip material was beginning to peel in some places and could become a tripping hazard if left unrepaired.



Safety Infrastructure

When there, we saw high railings also present along many of the boardwalk sections that passed through dense mangrove areas. These railings provided a sense of security and helped reduce the risk of falls. However, railings were not present throughout the entire boardwalk. In some locations the edge of the boardwalk was exposed which may pose a greater risk for young children or individuals with balance difficulties.

Seating and Rest Areas

Four benches and picnic tables were observed along the route. They provided places to rest and made the trail more accessible for people who may require regular breaks.



Shade and Shelter

No specific observations regarding shade or shelter opportunities were recorded during the site visit.

Toilets

Public toilets were located near the sports field at the entrance but they were closed during the site visit and no explanation was provided. This may create challenges for visitors planning longer strolls.



Wayfinding and Signage

Wayfinding infrastructure was present but could be improved. At the Hastie Avenue entrance, there is a big blue sign that shows a map with the trail route and potential hazard areas. Also, there were relatively few signs on surrounding streets directing people toward the trail. When trying to arrive, despite using Google Maps, it was initially hard to find the entrance to the trail.



Educational Information

On the signs present, there was no information that talked about the ecology or provided historical information about the area.

Mangrove and Coastal Interaction

The trail also offers extensive interaction with the mangrove environment and allows visitors to enjoy many benefits of blue-green spaces. However, the nearby industrial surroundings might limit the regular experience one might typically have in natural settings. One section of the trail ran beside noisy industrial buildings and commercial lots. Industrial noise was very noticeable and could cause issues for visitors sensitive to sound.



Situational Observations

During the observation period at approximately 10:30 a.m. on a weekday, 11 walkers, 5 cyclists, and 2 runners were observed using the trail. This suggests that the trail attracts a variety of users and appears to be well used even outside of peak recreational hours. No individuals using mobility devices were observed during the visit.

‘

Hobson Bay Walkway (East) Site Visit



Additional Information

Hobson Bay Walkway is located within the Ōrākei Local Board area of Auckland. The east path specifically is approximately 2.4 km long which is between Victoria Avenue and the Ōrākei Bay Village area. The following site visit was only to the East path. Therefore, the observations and assessment results presented in this site profile should not be considered representative of the entire Hobson Bay Walkway.

Public Transport Access

In regards to public transit, the main forms nearby are train and bus. There are 21 bus stops within 400m of the entrances. There is also a public train service that arrives at the Orakei Station which is 200 meters away from the walkway entrance on Orakei Road.

Active Transport Access

There are sidewalks through Parnell that accommodate those walking from other sides of Hobson Bay. It is feasible to believe that runners and walkers could access the path from various connections.

Access From Residential Areas

Sidewalks connected residential streets in the neighborhoods of Rumera and Parnell to the entrances. These connections increase the accessibility of the trail and make it easier for residents to reach the site by walking or cycling from these communities. The photo below shows the entrance from the end of Victoria Avenue, in Rumera.



Entrance Visibility

Four formal entrances were identified during the site visit but finding them initially was not straightforward. Despite using Google Maps, some of the suggested access locations did not provide direct access to the trail. One example was the end of Rymer Place, which directs visitors toward a gated industrial area rather than an actual entrance. This could easily create

confusion for first-time visitors. Signage in the surrounding streets was limited and there were few visual cues indicating where access points were located.

Accessible Car Parking

There is a very large parking lot attached to the Shore Road reserve, which is a short walk from one of the Hobson Bay East entrances. In this lot, there are 76 spots, including 3 accessible spots.



Slope Gradient

The entire Hobson Bay walkway loop is an 8.5 km trail with an average elevation gain of 300 m. When calculated (8500/300), this yields an average slope gradient of approximately 3.5% (2.0°). When walking on it, the route was generally flat as it has no significant hills or steep areas.

Path Surface Condition

Most of the path was gravel which then transitions into a wooden boardwalk. It was in relatively good condition and had no notable disruptions in the surface.

Path Continuity

This walkway is not fully continuous because the trail is divided into the Hobson Bay East Path and Hobson Bay West Path. Any users wanting to continue along around the entire Hobson Bay would have to transition between paths. This interruption means that users may have to use sidewalks and busier streets as opposed to solely the path when at this site.

Path Width

At approximately 3.2 metres wide, the pathway provided ample space for people to pass each other comfortably. This trail had the widest path out of all three chosen sites.

Stairs

No stairs or steps were observed during the site visit.

Hazard Management

Not unlike the other sites, there was anti-slip material; however, it was beginning to lift in some areas. There were no signs to warn users of this hazard. However, there were signs warning users to watch their footing as the boardwalks can be slippery.





Safety Infrastructure

The only prominent safety features present were handrails that extended around the sections of the path that were amongst mangroves.



Seating and Rest Areas

There were 3 benches observed along the route.



Shade and Shelter

During the visit, there was one built, overhanging structure that provided shade (and also seating).



Toilets

There were no bathrooms observed on the site visit.

Wayfinding and Signage

Directional signs were present on Shore Road and they clearly pointed pedestriens on the sidewalk to the walkway. The signs were easy to locate and were positioned where users could read them without leaving the path. There were no signs on the path itself and more so on just at the entrances/exits.





Educational Information

On the site visit, there were a few signs that were noticed. These signs gave information about the environment and history of the area, such as this sign beside Tinana Wilson's Beach.





Mangrove and Coastal Interaction

Mangroves are one of the defining features of the Hobson Bay Walkway. Large sections of the eastern and western paths run directly alongside the mangroves. The boardwalk offers close views across the mangroves and allows visitors to experience the ecosystem without being harmful to it.



Situational Observations

The site was visited at around 1 pm on July 16, 2026. During the site visit, nine people were observed using the walkway, including one adult runner, three adults, one older adult, and four older adults riding bikes.

Results

When looking at the data from the Excel tool, it is clear that the scores do not always match the actual conditions experienced during site visits but they still provide useful insights. The overall accessibility scores for Tuff Crater were 48/54, Norana Esplanade Walkway was 46/54 and Hobson Bay was 48/54. There seemed to be only slight differences in the features of each site, which certainly contributes to the very similar overall scores for overall accessibility. The differences lie in the equity scores for each group.

The scores, once translated to the equity scores for the individual equity-deserving groups, the results were as follows:

Tuff Crater – 48/54

Older Adults	6	Moderate exclusion risk
People with Physical Disabilities	4	Low exclusion risk
Children	3	Low exclusion risk

Hobson Bay – 48/54

Older Adults	6	Moderate exclusion risk
People with Physical Disabilities	5	Moderate exclusion risk
Children	4	Low exclusion risk

Norana Esplanade – 46/54

Older Adults	6	Moderate exclusion risk
People with Physical Disabilities	4	Low exclusion risk
Children	7	Moderate exclusion risk

The tool uses a scoring system from 0 to 4 for low risk of exclusion, 5 to 9 for moderate risk and 10 or above for high risk. Interestingly, the locations that scored the highest overall accessibility, Hobson Bay and Tuff Crater, still have moderate exclusion risks for older adults and people with physical disabilities. Older adults also had the same exclusion risk across all three sites.

All felt quite similar in terms of ease of use. This shows the importance of looking at both the numbers and personal experiences to fully understand accessibility and equity. Considering the experiences of those who are members of these equity-deserving groups is particularly crucial to seeing the full picture.

Discussion

The tool was developed with the understanding that the way a site is experienced can differ greatly between individuals. People often assess environments through the lens of their own abilities and experiences. As a result, features that create challenges for some users may go unnoticed by others. The Equity Summary encourages assessors to consider how trail conditions may affect different groups. In doing so, the tool can help identify where certain populations may have been overlooked during planning. It can also encourage assessors to reflect on whether their own positionality has influenced how they understand accessibility and whose needs they prioritize when evaluating a site. While the tool cannot replace consultation with community members or people with lived experience, it provides an objective way to consider whose needs may not be fully reflected in the current condition of a trail.

Although I did not mention low socioeconomic status as one of the main equity-deserving groups, it has significant implications for how one may access a trail. Transportation options, access to private vehicles, and the availability of nearby recreational spaces are all related to one's financial means, and this factor cannot be separated from this conversation. While this project's assessment tool did not include minority groups or low socioeconomic status among the main equity-deserving groups considered, improving equitable access for the three groups mentioned could enhance equity for members of other equity-deserving groups. Despite only prioritizing these three groups, it should be known that true equity goes far beyond just the groups that have been mentioned. Equity is a complex concept that requires consideration of the diverse experiences across populations.

Consultation with Community

The phrase "Nothing about us without us" is a well-known phrase that is used in the disability community and is pertinent to mention in relation to this research. Due to the constrained time frame of this project, I couldn't sufficiently consult with people with disabilities and members of minority groups to receive their input. Such consultation would have offered valuable insight to the evaluation of accessibility and the concerns. Community members often have lived experiences that extend beyond what site assessments can reveal. Their perspectives could have provided crucial context on obstacles and ways to enhance access to mangrove walking trails.

Time Constraints and Limitations

This project was conducted within a 12-week time frame, which contributed to several limitations and constraints. During the 12-week period, the first few weeks were spent situating

myself within the New Zealand context and finalizing project plans. Initially, the project had a broader scope that included an assessment of the potential impacts on community wellbeing; however, this component was removed as the project became more focussed on equity alone. This pivot happened weeks into the fellowship and caused a slight delay while I reframed. The project quickly became constrained by time. As a result, decisions had to be made regarding the scope of the project, the number of sites assessed, and the depth of analysis that could reasonably be completed within the available period.

Positionality

Not unlike all research projects of this nature, my role as a researcher in this is not neutral. Due to a component of the research that involved me, the researcher, physically going to the site, the lenses through which I view my environment played a role. The tallies I recorded of the demographics of those who used the trail were based on my interpretations and the meanings I attached to the users appearance. Also, as an able-bodied, uninjured, young person with no impairing disabilities that hinder my movement through the world, I acknowledge how my position shapes my research angle and the questions investigated.

Future Directions

Going forward, future iterations of this tool could further explore the relationships between assessment criteria and different equity-deserving groups. The framework is intended to identify factors that may influence equitable access to mangrove walking trails; however, it is now evident to me that there is deep complexity in measuring accessibility through a single assessment tool.

There is considerable opportunity to expand the tool in the future. Additional criteria and community perspectives could be incorporated to provide a more comprehensive understanding of accessibility. In the future, this project could be expanded by adding more criteria which would even more accurately capture the elements of accessibility that impact equity. In the future, more sites could be assessed to see the consistency and validity of the tool.

Conclusion

Mangrove ecosystems provide very important environmental benefits for coastal cities like Auckland. They help to reduce flooding while stabilizing the shoreline. There are also health and social benefits, as well. However, these advantages depend on safe and accessible trails for all users. Ensuring equitable access means considering not just where mangrove trails are, but also the conditions people face when reaching them. So, mangroves should be regarded both as coast-protecting ecosystems and useful blue-green spaces.

This project developed an equity-centered tool to assess the accessibility of three mangrove walking trails in Auckland: Tuff Crater, Hobson Bay, and Norana Esplanade Walkway. While their overall accessibility scores were close, from 46/54 to 48/54, the Equity Summary indicated that a high total score doesn't mean all groups experience equal accessibility. Older adults were moderately at risk of exclusion across all sites. In addition, people with physical disabilities faced a moderate risk at Hobson Bay as well as children at Norana Esplanade.

These results highlight the need to look beyond an overall accessibility score to assess the trail’s equitable nature. The calculated equitable scores indicate that some features could pose barriers for older adults, children, or people with disabilities. The tool brought attention to these differences and prompted a more critical look at whose needs might be overlooked, which was the initial goal of the tool.

This project also showed that equitable access can't be fully measured with a single assessment tool limited to three groups. Other factors such as income and location can also influence whether they can access and enjoy green-blue spaces. Future versions of the framework should involve consultations with people who have lived experience, especially those with disabilities and those with low socioeconomic status.

Overall, the tool is a helpful first step for understanding how accessibility features impact different populations. While it doesn't replace community input, it can identify potential gaps and support more meaningful discussions about equitable access. Making sure mangrove walking trails are accessible involves so much more than just creating a path that most people can use. It can require recognizing that people's experiences of these spaces differ and some are more likely to encounter barriers than others.

References

AllTrails. (n.d.). *Hobson Bay East Path*. https://www.alltrails.com/trail/new-zealand/auckland/hobson-bay-east-path

AllTrails. (n.d.). Hobson Bay West Path. https://www.alltrails.com/trail/new-zealand/auckland/hobson-bay-west-path

Auckland Council. (n.d.). Auckland GeoMaps. https://geomapspublic.aucklandcouncil.govt.nz/viewer/

Auckland Council. (n.d.). Norana Esplanade Walkway. https://ourauckland.aucklandcouncil.govt.nz/news/2020/03/norana-reserve-walkway-opens-to-public/

Auckland Council. (n.d.). Ōrākei Local Board area. https://www.aucklandcouncil.govt.nz/about-auckland-council/how-auckland-council-works/local-boards-all/Pages/orakei-local-board.aspx

Auckland Council. (n.d.). Tuff Crater Reserve. https://www.aucklandcouncil.govt.nz/parks-recreation/Pages/park-details.aspx?Location=2496

Auckland Transport. (n.d.). Journey planner and public transport network information. https://at.govt.nz/

Barragan-Jason, G., Loreau, M., & de Mazancourt, C. (2023). Psychological and physical connections with nature improve both human well-being and nature conservation: A systematic review of meta-analyses. Biological Conservation, 277, 109842. https://doi.org/10.1016/j.biocon.2022.109842

Beery, T., Berge, O. K., & Gentin, S. (2026). Governing access to outdoor recreation: Nordic coastal trails under pressure. Journal of Environmental Planning and Management, 0(0), 1–23. https://doi.org/10.1080/09640568.2026.2621993

Betley, E. C., Sigouin, A., Pascua, P., Cheng, S. H., MacDonald, K. I., Arengo, F., Aumeeruddy-Thomas, Y., Caillon, S., Isaac, M. E., Jupiter, S. D., Mawyer, A., Mejia, M., Moore, A. C., Renard, D., Sébastien, L., Gazit, N., & Sterling, E. J. (2023). Assessing human well-being constructs with environmental and equity aspects: A review of the landscape. People and Nature, 5(6), 1756–1773. https://doi.org/10.1002/pan3.10293

Bilkovic, D. M., Mitchell, M. M., La Peyre, M. K., & Toft, J. D. (Eds.). (2017). Living shorelines: The science and management of nature-based coastal protection. CRC Press. https://doi.org/10.1201/9781315151465

BRANZ. (2015, December 1). Accessible building access. https://www.branz.co.nz/design-build/articles/accessible-building-access

Braveman, P., & Gruskin, S. (2003). Defining equity in health. Journal of Epidemiology and Community Health, 57(4), 254–258. https://doi.org/10.1136/jech.57.4.254

Byrne, J., & Wolch, J. (2009). Nature, race, and parks: Past research and future directions for geographic research. Progress in Human Geography, 33(6), 743–765. https://doi.org/10.1177/0309132509103156

Cheek, L., Dixon, B., & Trotz, M. (2025). If you build it, who will come? Rethinking living shoreline site selection through integration of equity index and human well-being benefits using geospatially integrated method. Applied Geography, 183, 103746. https://doi.org/10.1016/j.apgeog.2025.103746

Chen, J., & Chang, Z. (2015). Rethinking urban green space accessibility: Evaluating and optimizing public transportation system through social network analysis in megacities. Landscape and Urban Planning, 143, 150–159. https://doi.org/10.1016/j.landurbplan.2015.07.007

Dencer-Brown, A. M., Alfaro, A. C., & Milne, S. (2019). Muddied waters: Perceptions and attitudes towards mangroves and their removal in New Zealand. Sustainability, 11(9), 2631. https://doi.org/10.3390/su11092631

Dorji, T., Morrison-Saunders, A., & Blake, D. (2023). Understanding how community wellbeing is affected by climate change: Evidence from a systematic literature review. Environmental Management, 72, 568–586. https://doi.org/10.1007/s00267-023-01833-w

Finlay, J., Franke, T., McKay, H., & Sims-Gould, J. (2015). Therapeutic landscapes and wellbeing in later life: Impacts of blue and green spaces for older adults. Health & Place, 34, 97–106. https://doi.org/10.1016/j.healthplace.2015.05.001

Flemmer, C. L. (2022). Improving the built environment for manual wheelchair users: A review. IOP Conference Series: Earth and Environmental Science, 1101(3), 032031. https://doi.org/10.1088/1755-1315/1101/3/032031

Gagnon, D. H., Babineau, A.-C., Champagne, A., Desroches, G., & Aissaoui, R. (2014). Pushrim biomechanical changes with progressive increases in slope during motorized treadmill manual wheelchair propulsion in individuals with spinal cord injury. Journal of Rehabilitation Research and Development, 51(5), 789–802. https://doi.org/10.1682/JRRD.2013.07.0168

Gariépy, G., Thombs, B. D., Kestens, Y., Kaufman, J. S., Blair, A., & Schmitz, N. (2015). The neighbourhood built environment and trajectories of depression symptom episodes in adults: A latent class growth analysis. PLOS ONE, 10(7), e0133603. https://doi.org/10.1371/journal.pone.0133603

Gollan, N., & Barclay, K. (2020). "It's not just about fish": Assessing the social impacts of marine protected areas on the wellbeing of coastal communities in New South Wales. PLOS ONE, 15(12), e0244605. https://doi.org/10.1371/journal.pone.0244605

Gradinaru, S. R., Onose, D. A., Oliveira, E., Slave, A. R., Popa, A. M., & Gavrilidis, A. A. (2023). Equity in urban greening: Evidence from strategic planning in Romania. Landscape and Urban Planning, 230, 104614. https://doi.org/10.1016/j.landurbplan.2022.104614

Gu, Z., Luo, X., Chen, Y., Liu, X., Xiao, C., & Liang, Y. (2022). Density, diversity, and design: Evaluating the equity of elderly communities using three measures of the built environment. Land, 11(11), 1976. https://doi.org/10.3390/land11111976

Guek-Nee Ke, Utama, I. K. A. P., Wagner, T., Sweetman, A. K., Arshad, A., Nath, T. K., Neoh, J. Y., Muchamad, L. S., & Suroso, D. S. A. (2022). Influence of mangrove forests on subjective and psychological wellbeing of coastal communities: Case studies in Malaysia and Indonesia. Frontiers in Public Health, 10, 898276. https://doi.org/10.3389/fpubh.2022.898276

Hashizume, T., Kitagawa, H., Lee, H., Ueda, H., Miyamoto, T., Yoneda, I., & Fujisawa, S. (2013). Evaluation of physical load while propelling manual wheelchair on cross slope road and wave road. Assistive Technology Research Series, 33, 183–188. https://doi.org/10.3233/978-1-61499-304-9-183

He, S. Y., Thøgersen, J., Cheung, Y. H., & Alesia, H. Y. (2020). Ageing in a transit-oriented city: Satisfaction with transport, social inclusion and well-being. Transport Policy, 97, 85–94. https://doi.org/10.1016/j.tranpol.2020.06.016

Heckert, M., & Rosan, C. D. (2016). Developing a green infrastructure equity index to promote equity planning. Urban Forestry & Urban Greening, 19, 263–270. https://doi.org/10.1016/j.ufug.2015.12.011

Hughes, M., & Morrison-Saunders, A. (2002). Impact of trail-side interpretive signs on visitor knowledge. Journal of Ecotourism, 1(2–3), 122–132. https://doi.org/10.1080/14724040208668119

Infometrics. (2025). Māngere-Ōtāhuhu Local Board: Regional economic profile. https://regions.infometrics.co.nz/mangere-otahuhu-local-board

Iraegui, E., Augusto, G., & Cabral, P. (2020). Assessing equity in the accessibility to urban green spaces according to different functional levels. ISPRS International Journal of Geo-Information, 9(5), 308. https://doi.org/10.3390/ijgi9050308

Kim, C., Lee, D., & Chung, M. (2012). Effects of ramp slope on usability when a wheelchair is propelled by attendant. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 56(1), 629–633. https://doi.org/10.1177/1071181312561131

Lang, I. A., Llewellyn, D. J., Langa, K. M., Wallace, R. B., & Melzer, D. (2008). Neighbourhood deprivation and incident mobility disability in older adults. Age and Ageing, 37(4), 403–410. https://doi.org/10.1093/ageing/afn092

Lepoglavec, K., Papeš, O., Lovrić, V., Raspudić, A., & Nevečerel, H. (2023). Accessibility of urban forests and parks for people with disabilities in wheelchairs, considering the surface and longitudinal slope of the trails. Sustainability, 15(10), 7741. https://doi.org/10.3390/su15107741

Liu, J., Wei, W., Peng, Q., Xue, C., & Yang, S. (2022). The roles of life satisfaction and community recreational facilities in the relationship between loneliness and depression in older adults. Clinical Gerontologist, 45(2), 376–389. https://doi.org/10.1080/07317115.2021.1901166

Lukoseviciute, G., & Nelson, M. (2024). Accessible trail tourism: Trail accessibility and difficulty rating approach designed for individuals, including those with mobility impairments. International Journal of Tourism Research, 26, e2787. https://doi.org/10.1002/jtr.2787

Meerow, S., Pajouhesh, P., & Miller, T. R. (2019). Social equity in urban resilience planning. Local Environment, 24(9), 793–808. https://doi.org/10.1080/13549839.2019.1645103

Ministry of Business, Innovation and Employment. (n.d.). Accessible car parking spaces. New Zealand Government. https://www.building.govt.nz/building-code-compliance/d-access/d1-access-routes/accessible-car-parking-spaces/what-does-the-d1-acceptable-solution-say-2

Ministry of Education. (n.d.). Education Counts: New Zealand Schools Directory. https://www.educationcounts.govt.nz/directories/list-of-nz-schools

Nahdatunnisa, Tahir, M., Biantoro, A., Soewarno, A., & Lanontji, M. (2025). Development of sustainable pedestrian path concept in mangrove area to support ecotourism. IOP Conference Series: Earth and Environmental Science, 1543, 012009. https://doi.org/10.1088/1755-1315/1543/1/012009

New Zealand Transport Agency. (n.d.). Bus stop spacing. https://www.nzta.govt.nz/partners/design-guidance/public-transport-design-guidance/bus-stop/bus-stop-location-planning/location-fundamentals/bus-stop-spacing

New Zealand Transport Agency. (n.d.). Network planning considerations. https://www.nzta.govt.nz/partners/design-guidance/cycling-network-guidance/cycle-network-and-route-planning-guide/principles/network-planning-considerations#hierarchy

Perry, M., Cotes, L., Horton, B., Kunac, R., Snell, I., Taylor, B., Wright, A., & Devan, H. (2021). "Enticing" but not necessarily a "space designed for me": Experiences of urban park use by older adults with disability. International Journal of Environmental Research and Public Health, 18(2), 552. https://doi.org/10.3390/ijerph18020552

Recreation Aotearoa, & Outdoors Accessibility Working Group. (2025). Outdoors accessibility design guidelines. https://www.nzrecreation.org.nz/outdoors-accessibility-design-guidelines

Shen, Y., Sun, F., & Che, Y. (2017). Public green spaces and human wellbeing: Mapping the spatial inequity and mismatching status of public green space in the Central City of Shanghai. Urban Forestry & Urban Greening, 27, 59–68. https://doi.org/10.1016/j.ufug.2017.06.018

Skiba, M., Mrówczyńska, M., Sztubecka, M., Bonenberg, W., Qi, L., & Zhou, M. (2026). Reasoning maps for solving complex location problems: Blue-green infrastructure strategies toward sustainable urban development. Journal of Housing and the Built Environment, 41(2), 953–977. https://doi.org/10.1007/s10901-025-10254-6

Soh, B. K., & Smith-Jackson, T. L. (2003). Designing cues for recreational parks to support wayfinding behaviors [Data set]. PsycEXTRA. https://doi.org/10.1037/e577012012-016

Song, S., Wang, S., Mengxi, S., Hu, S., & Xu, D. (2022). Urban blue–green space landscape ecological health assessment based on the integration of pattern, process, function and sustainability. Scientific Reports, 12, Article 7705. https://doi.org/10.1038/s41598-022-11960-9

Stats NZ. (2023). 2023 Census data for Kaipātiki Local Board Area. https://www.stats.govt.nz/tools/2023-census-place-summaries/kaipatiki-local-board-area/

Stats NZ. (2023). 2023 Census data for Māngere-Ōtāhuhu Local Board Area. https://www.stats.govt.nz/tools/2018-census-place-summaries/mangere-otahuhu-local-board-area

Stats NZ. (2023). 2023 Census data for Ōrākei Local Board. https://www.stats.govt.nz/

Stats NZ. (2025). Kaipātiki Local Board Area: Place and ethnic group summaries. https://tools.summaries.stats.govt.nz/places/TA/kaipatiki-local-board-area

Stats NZ. (2025). Māngere-Ōtāhuhu Local Board Area: Place and ethnic group summaries. https://tools.summaries.stats.govt.nz/places/TA/mangere-otahuhu-local-board-area

Stats NZ. (2025). Ōrākei Local Board area place summary. https://tools.summaries.stats.govt.nz/places/TA/orakei-local-board-area

Wang, K., Sun, Z., Cai, M., Liu, L., Wu, H., & Peng, Z. (2022). Impacts of urban blue-green space on residents' health: A bibliometric review. International Journal of Environmental Research and Public Health, 19(23), 16192. https://doi.org/10.3390/ijerph192316192

Wang, R., Browning, M. H. E. M., Kee, F., & Hunter, R. F. (2023). Exploring mechanistic pathways linking urban green and blue space to mental wellbeing before and after urban regeneration of a greenway: Evidence from the Connswater Community Greenway, Belfast, UK. Landscape and Urban Planning, 235, 104739. https://doi.org/10.1016/j.landurbplan.2023.104739

Wen, M., Zhang, X., Harris, C. D., Holt, J. B., & Croft, J. B. (2013). Spatial disparities in the distribution of parks and green spaces in the USA. Annals of Behavioral Medicine, 45(Suppl. 1), S18–S27. https://doi.org/10.1007/s12160-012-9426-x

Wheaton, B., Waiti, J. T. A., Olive, R., & Kearns, R. (2021). Coastal communities, leisure and wellbeing: Advancing a trans-disciplinary agenda for understanding ocean–human relationships in Aotearoa New Zealand. International Journal of Environmental Research and PublicHealth, 18(2), 450. https://doi.org/10.3390/ijerph18020450

Wolch, J. R., Byrne, J., & Newell, J. P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities "just green enough." Landscape and Urban Planning, 125, 234–244. https://doi.org/10.1016/j.landurbplan.2014.01.017

World Health Organization. (2007). Global age-friendly cities: A guide. https://iris.who.int/handle/10665/43755

Xu, Y., Wheeler, S. A., & Zuo, A. (2022). The effectiveness of interventions to increase participation and physical activities in parks: A systematic review of the literature. International Journal of Environmental Research and Public Health, 19(19), 12590. https://doi.org/10.3390/ijerph191912590

Zallesa, S., Ihsan, Y. N., Pribadi, T. D. K., Qiang, Y. X., Syamsudin, M. L., & Irawan, B. (2026). Assessing the carrying capacity of mangrove ecosystems for sustainable ecotourism development in Pangandaran, Indonesia. International Journal of Agriculture and Biosciences, 15(1), 69–76. https://doi.org/10.47278/journal.ijab/2025.142

Appendix A: Tuff Crater Additional Information

Theme	Indicator	Value
Site Information	Site Name	Tuff Crater Reserve (Te Kōpua o Matakamokamo)
	Local Board	Kaipātiki Local Board
	Ward	North Shore Ward
	Site Type	Coastal volcanic reserve with mangrove boardwalk and walking track
	Trail Length	2.8 km loop track, 60 mins to complete
	Path Width	Varies
	Coastal Setting	Upper Waitematā Harbour estuarine environment
	Main Ecosystem	Mangrove wetland, volcanic crater and saltmarsh habitat
	Number of Formal Entrances	6 entrances
Population & Demographics	Total Population (Kaipātiki Local Board)	95,600 residents (2025 estimate)
	Number of Families	23,634 families
	Private Dwellings	32,508 private dwellings
Age Structure	Median Age	36.1 years
	Children (<15 years)	18.2%
	Older Adults (65+)	12.8%
Ethnicity	European	56.5%
	Asian	34.8%
	Māori	9.4%
	Pacific Peoples	6.6%
Education	Adults with Post-School Qualification	59.5%
Income & Socioeconomic Status	Median Household Income	118,000 annually
	Households Without Vehicle Access	8–10%

Potential Equity Groups	Population with Disability	17–18% of residents
Transportation	Closest Public Transport	Bus connections along Exmouth Road, Lake Road, Onewa Road and Akoranga Drive
	Nearby Bus Routes	923 , 94, 95B, 95C, 926, NX1, NX2
	Rail Access	No railway station within the local board

Appendix B: Norana Esplanade Walkway Additional Information

Theme	Indicator	Value
Site Information	Trail Name	Norana Esplanade Walkway
	Local Board	Māngere-Ōtāhuhu Local Board
	Ward	Manukau Ward
	Trail Length	3.9 km shared pathway
	Path Width	2.5 m
	Trail Type	Shared walking and cycling path
	Surface	Concrete pathway with elevated timber boardwalks
	Coastal Setting	Manukau Harbour coastline
Population	Total Population (Māngere-Ōtāhuhu Local Board)	85,900 residents (2025 estimate)
	Number of Families	17,271
	Private Dwellings	21,504
Age Structure	Median Age	30.9 years
	Children – less than 15	24%
	Population under 24 years	41%
	Older Adults 65 plus	10%
Ethnicity	Pacific Peoples	60%
	Māori	17%
	Asian	16%
	European and Other Ethnicities	18%
Education	Adults with Post-School Qualification	42%
Income	Median Personal Income	$34,700
Housing	Home Ownership Rate	40.8%
Transportation	Public Transport Access	Bus routes operate along Mahunga Drive, Coronation Road, Favona Road and Massey Road corridors Harania Creek, 8 min walk Favona Road, 14 min walk
	Nearby Bus Routes	Routes 309, 313, 314, 31

	Rail Access	No railway station within walking distance
	Nearest Rail Stations	Middlemore Station and Ōtāhuhu Station are the nearest heavy rail connections. Routes: STH, EAST.

Appendix C: Hobson Bay Additional Information

Theme	Indicator	Value
Site Information	Site Name	Hobson Bay Walkway (East and West Paths)
	Local Board	Ōrākei Local Board
	Ward	Ōrākei Ward
	Trail Length	Consists of two sections: Hobson Bay East Path (2.4 km, approximately 30 minutes) and Hobson Bay West Path (3.7 km, approximately 40 minutes)
	Walking Time	Approximately 70 minutes to complete both sections
	Surface Composition	Gravel: 47% (1.1 mi); Paved: 23% (0.5 mi); Wooden boardwalk: 18% (0.4 mi); remaining sections consist of bridges and mixed surfaces
	Coastal Setting	Hobson Bay estuarine environment connected to the Waitematā Harbour
	Main Ecosystem	Mangrove forest, tidal mudflats, coastal saltmarsh and estuarine habitat
Population & Demographics	Total Population (Ōrākei Local Board)	86,800 residents (2025 estimate)
	Number of Families	22,962 families
	Private Dwellings	33,951 private dwellings
	Population Density	Approximately 3,100 persons/km²
Age Structure	Median Age	40.9 years
	Children (<15 years)	17.5%
	Older Adults (65+)	17.5%
Ethnicity	European	68.4%
	Asian	26.7%
	Māori	6.4%
	Pacific Peoples	3.7%

Education	Adults with Post-School Qualification	67.3%
Income & Socioeconomic Status	Median Household Income	Approximately $157,000 annually
	Households Without Vehicle Access	Approximately 5–6%
Potential Equity Groups	Population with Disability	Approximately 15–17% of residents
Transportation	Closest Public Transport	Bus services along Remuera Road, Shore Road, Ngapipi Road and Ōrākei Road; Meadowbank Railway Station nearby
	Bus Network Access	Multiple Auckland Transport routes serve Meadowbank, Remuera and Ōrākei catchments
	Nearby Bus Routes	75, 76, 77, 781, 782