Promoting Vertical Gardening in Maitland Garden Village

An Interactive Qualifying Project submitted to the Faculty of WORCESTER POLYTECHNIC INSTITUTE in partial fulfillment of the requirements for the Degree of Bachelor of Science

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The Green Light Project

Abstract

Maitland Garden Village (MGV) suffers from unemployment, widespread substance abuse, and few youth development opportunities. With the Green Light Project, a non-profit organization within MGV, we introduced vertical gardening to rebuild community and address the consequences of these challenges. We investigated local needs, restored the community garden, fabricated vertical gardens, and introduced sustainable teaching methods to the GLP and our volunteers. Literature reviews, personal conversations, and an iterative design process guided garden fabrication. Training documentation was formulated to help sustain the vertical gardening initiative. Recommendations include succession planning, ongoing workshops, and the increased sharing of ideas through community advocates.

Executive Summary

Maitland Garden Village and Their Deep-Rooted History

Maitland Garden Village (MGV) is a small, traditionally-Coloured community in the Pinelands region of Cape Town. Underneath struggles caused by drug abuse, low-incomes, food insecurity, and an aging population, lies a closely knit community with a rich gardening history, trying to heal and return to what it once was. Nestled on the bank of the Swartrivier, the MGV's geographical location and backyard centric design lends itself to supporting a green thumbed community. When it was founded, residents enjoyed cultivating home gardens and participating in friendly competitions to see who could grow the best plants and produce. Many of the residents fondly remember these gardens as a crucial component of their upbringing and community identity, and wish to return, quite literally, to their roots. However, due to recently paved over backyards, the construction of secondary structures, isolation from the pandemic, and water shortages, the practice of gardening in the village has decreased dramatically in recent decades. Despite these challenges, the love for gardening within the community is still as strong as it was at the village's origin.

The Green Light Project

The Green Light Project (GLP) is a non-profit that functions within MGV whose mission focuses around improving the quality of life within the MGV community through different initiatives. Drawing from the successes of their past gardening programs, the GLP endeavors to rejuvenate urban gardening initiatives within the community through the introduction of vertical gardening, a form of gardening that utilizes external, upright structures and above ground planters as opposed to traditional garden beds.

Our Goal

This project aims to create a vertical gardening initiative to make gardening more accessible for the small spaces available in the homes of MGV residents. Our initiative goes beyond just vertical gardening; it's about uniting the entire community and rekindling the history

of passion towards gardening. Past initiatives faltered as community excitement dwindled and many of the participants became distracted by their daily commitments. By fostering a sense of togetherness through participating in community gatherings run by the GLP, we aimed to strengthen the bonds that hold the MGV together. Showing the community what can be accomplished using only recycled materials has shown that gardening does not require extensive resources. With this sense of togetherness, we hope that the gardening initiative will grow enough to combat food insecurity as well as provide outlets for the unemployed to channel their energy into a fulfilling activity.

Our Approach

To successfully implement a sustainable, accessible vertical gardening initiative, we developed a set of objectives to guide our research and approach:

1. Objective 1: Investigate Gardening Within the Community and Determine Suitable Garden Designs of Volunteers' Vertical Gardens
2. Objective 2: Restore the Community Garden as a Nursery
3. Objective 3: Build Vertical Gardens with our Initial Participants
4. Objective 4: Grow Interest, Sustainability and Community Ownership

Our initial objective involved a comprehensive investigation into the existing gardening practices within Maitland Garden Village. Through interviews, personal conversations, and attendance at community events, we gathered valuable insights into the challenges faced by the community, such as limited space and economic constraints. This research informed the selection of suitable vertical garden designs tailored to the unique needs and limitations of MGV.

To restore the community garden as a nursery, we developed a multi-faceted approach. This included clearing and preparing plant beds and creating a nurturing environment for seedlings. Despite challenges such as resource availability, we successfully revitalized the community garden, laying the foundation for future gardening initiatives.

Allowing the community members to play a large role in the creation of their gardens was an important step in ensuring the community ownership of this initiative. To achieve this,

we prototyped 4 designs and attended discussions with volunteers to decide what the community was looking to gain from their gardens. The differences in these designs emphasized variability, accessibility, cost-effectiveness, and space efficiency.

Ensuring the sustainability and community ownership of the vertical gardening initiative required multiple strategies. We developed an instructional pamphlet, organized a community presentation, and established a platform for volunteers to showcase their gardens. By fostering a sense of pride and community, we aimed to instill a lasting commitment to the project, promoting its long-term success.

What We Learned

In talking with the community, we were able to truly see their love for gardening. We heard many childhood stories from interviewees where they recalled working in their gardens with their families and those who still lived in their childhood homes gave us detailed descriptions of how their homes once looked. However, in recent years these beautiful gardens were removed in order for families to build additional structures on their properties. Additionally, the reality of the paved over yards came to life as we walked through the village and visited homes.

We originally planned to utilize recycled materials that each participant had on hand, but discovered through interviews that extra materials in the village are repurposed and there are not many readily available. Additionally, many participants mentioned concerns of theft of plants and materials. From these interactions we learned that to create a successful gardening initiative, our garden designs had to fit in the limited space available, be made from accessible materials, and be mobile but secure.

Throughout our revitalization of the community garden, we were able to successfully transform the overgrown space into a nursery for vegetable and flower seedlings. We also identified a number of materials, such as tires, wire fencing, pallets, and 5-liter water bottles, that we could use in the construction of our vertical gardens. Our main worry is its preservation since we learned that the gardens only had one caretaker who unfortunately passed. While we could recommend something like an automatic irrigation system, it is not sustainable to solve a social

problem with a technological approach. Instead, we encouraged the community to collaborate to preserve the garden and become dedicated to the future of the gardening initiatives.

With the community garden restored and prepped for growing the seedlings, we were then able to move into our third goal of building the gardens through our design process. We broke up this process into 4 steps: gathering materials, designing and prototyping, collecting community feedback, and planting and delivering gardens. As aforementioned, almost all available materials in the village are reused or recycled for other uses. This forced us into finding materials elsewhere, but we wanted to use a process that could be replicated by the MGV community. Instead of purchasing new materials, we gathered materials for free which included scrap wood from a local roofing business, recycled bottles from other IQP members, and old car tires from around the community garden. With our materials, we then started brainstorming and prototyping designs based on information and criteria gained in our initial interviews. We took pictures of these prototypes and showed them to our volunteers to get their feedback and ideas for their gardens. We finalized new designs and with each build complete, we transferred seedlings from the community garden to each vertical garden and delivered them to their homes (see Figure 1).

Figure 1: Three examples of the completed gardens.

One of the most rewarding parts of this project was our interactions with the community. Throughout the project, we had the opportunity to spend time in a multitude of settings in which we could get to know individuals and build trust and familiarity within the community. We attended a food distribution day where we were able to interact with community members that we were unfamiliar with, and we also attended other GLP events such as a craft day. Our hope was to inspire those we spoke with to get involved in the initiative while also giving us the chance to make observations about the culture and community of the MGV.

In addition, we created training handouts to pass out at our garden showcase that took place at the end of our project. Here, we demonstrated how to plant seeds and encouraged our volunteers to hand out the training materials to inspire more community members to participate in the initiative. By allowing community members to be the leaders in the handing out of materials, we hope that excitement about gardening will grow in the village and continue past our time in MGV.

Conclusions

Based on feedback we received from personal conversations, information collected in our literature, and interviews, we believe that the completion and continuation of this initiative in the MGV has the ability to provide multiple socioeconomic benefits. Many members of the community feel that the introduction of an outlet in the form of gardening will help give the population a productive path away from unhealthy habits such as drug use or theft. Additionally, the resurgence of gardening in the village can help reduce food insecurity and provide a path toward reengaging the community to restore it to what it once was. We have three main themes of recommendations for the GLP to ensure the success of this initiative as well as their platform:

1. Sustainability
2. Implementation
3. Succession

Sustainability was a recurring theme that came to the surface throughout the course of our project. We believe that a community-owned program can inspire advocates for the continuation

of the initiative. The importance of community ownership brings into question a few key points and recommendations about the succession and sustainability of the vertical gardening initiative and the GLP as a program. The future success of vertical gardens, as well as other potential initiatives within the village, relies on the participation of the community and their willingness to ensure the continuation of these programs.

In order for the vertical gardening initiative to continue, the GLP must identify and nurture community advocates. The question of continuity beyond our involvement is crucial, highlighting the need for a structured organizational plan within the Green Light Project. Recognizing the necessity for community advocates and the challenges of continuity, we stress the importance of a robust succession plan. This involves appointing multiple community members who will act as leaders and carry on the program. We also suggest the exploration of avenues for securing funding to allow future programs of the GLP to succeed.

Acknowledgements

We would like to thank everyone whose support made the success of this project possible. Firstly, Mrs. Ronell Trout for opening her home and lending her time and resources to help in the process of this project. We thank the members of the Maitland Garden Village who kindly welcomed us into their community. To our advisors, Professor Steve, and Adjunct Teaching Professor Rosemary Taylor, we extend our gratitude for the support, assistance, and feedback that guided us throughout the entirety of this experience. Finally, we thank the other members of our cohort who aided in the collection of recycled materials for the creation of our gardens.

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1.0 Introduction

Underneath the drug abuse, low-incomes, food insecurity, and aging population of the Maitland Garden Village lies a closely knit community with a green heart and rich gardening history, trying to heal and return to what it once was. The Maitland Garden Village, or MGV, was named after its once abundant and vibrant gardens. When it was founded, residents enjoyed cultivating home gardens and participating in friendly competitions to see who could grow the best plants and produce. Nestled on the bank of the Swartrivier, the MGV's geographical location and backyard centric design lends itself to supporting a green thumbed community. Many of the residents fondly remember these gardens as a crucial component of their upbringing and community identity, and wish to return, quite literally, to their roots.

Over the last decade, there has been growing populations and many tenants have constructed secondary structures to house family members or close friends, taking up much of the available outdoor space on each homestead. Many backyards were also paved over and covered for ease of upkeep. As a result, the number of gardens decreased due to the reduction of space. A downturn in community engagement and healthy diets followed the decrease in gardening practices. The isolation caused by the COVID-19 pandemic exacerbated the downward trend of the community's interest in gardening as they were unable to leave their homes to get the needed supplies. Although there have been efforts to reintroduce gardening to the village in the past decade, a lack of widespread community adoption of these practices led to the failure of these initiatives.

The Green Light Project (GLP) was founded on the principle of improving quality of life within the MGV through various projects. The organization bolstered community engagement through sports, music, and gardening initiatives. According to our sponsor at the GLP, Ronell Trout, the previous gardening initiative included a community garden which garnered the most community participation in comparison to the other activities. However, through the barriers of isolation of the pandemic and restricted key access, the support for the community garden fell away and the space went unused.

This project aims to create a vertical gardening initiative to make gardening more accessible for the small spaces available in the homes of MGV residents. But our initiative goes

beyond just vertical gardening; it's about uniting the entire community and rekindling the history of passion towards gardening. Past initiatives faltered as community excitement dwindled and many of the participants became distracted by their daily commitments. By showing the community what can be accomplished using only recycled materials we demonstrated that gardening does not require extensive resources. By fostering a sense of togetherness through participating in community gatherings run by the GLP, we aimed to strengthen the bonds that hold the MGV together. With this sense of togetherness, we hope that the gardening initiative will grow enough to combat food insecurity as well as provide outlets for the unemployed to channel their energy into a fulfilling activity.

Our goal was to reintroduce gardening in a more space efficient and sustainable way to the MGV community through the implementation of a vertical gardening initiative. The lack of outdoor space in the village has led to the need for traditional gardening to be replaced with vertical gardening, as vertical gardens can be constructed to fit in small urban settings, such as the homes in the MGV. Past research provides evidence to suggest that while urban, and specifically vertical gardening, has been introduced to low-income communities like MGV, there are many hesitations among community members stemming from a lack of knowledge and economic resources (Agova et al., 2023; Kanosvamhira, 2023). Our research and interviews allowed us to understand and address these hesitations in the development of methods to inspire enthusiasm for vertical gardening.

2.0 Background

Before we could effectively develop a solution to creating a sustainable gardening initiative within the MGV, we had to understand the specifics involving the project center and our assignment. This section will introduce the Green Light Project and their mission and delve into the demographics of Maitland Garden Village. We then explore methods of urban gardening and its place in modern society to determine the best approach. This is followed by an explanation of the practice of vertical gardening and its application to the urban landscape. We apply these benefits to the Maitland Garden Village of Cape Town, South Africa to further identify vertical gardening as a proper solution to the challenges we identify in our research. We have identified barriers, such as lack of participation and their solutions to acknowledge the challenges that arise in a project of this nature.

2.1 The Green Light Project

The Green Light Project (GLP) was founded in 2011 by our project sponsor Ronell Trout and partners in collaboration with the Maitland Garden Village community and a team of WPI students. Its mission is to promote a healthier lifestyle and engagement for the community which struggles with high unemployment and drug use (Green Light Project, 2013).

The GLP was initially divided into nine branches, with the most successful being the gardening branch. This branch was dedicated to improving the community landscape and supporting self-sufficiency of households through home gardening (Green Light Project 2013). A community garden was constructed at the local creche for the village to grow its own food and flowers. Unfortunately, this garden is on private land and due to fear of theft, a key is required to unlock the gate to enter the garden. Additionally, the 2016 water ban caused the community garden, along with many personal gardens, to dry out. The COVID-19 virus placed many of the GLP's programs on pause due to the community shifting its concerns towards the pandemic. Community members were not permitted to leave their properties. Social spaces, including the community garden, were closed (Ronell Trout, personal

communication, October 2023). The community garden has since become overgrown due to neglect from the pandemic and the recent passing of its caretaker. Despite these challenges, Ronell and the GLP are committed to reimplementing the gardening initiative as one of its first movements toward resuming their mission.

Although the GLP has been promoting gardening since its creation, many of its initiatives have died out due to lack of engagement or social challenges. In previous years, their efforts focused on the introduction of the community garden to the village but, due to the problems outlined above, upkeep of the community garden initiative died out. By redesigning their original gardening concept, the GLP has set a goal to reinspire community passion for home gardening. This program is committed to opening a doorway to food security and home aesthetics through the addition of greenery to private spaces in the village. It also aims to remain convenient and low cost to the MGV community. The GLP hopes to restore the beautiful, lush gardens to the MGV once again. However, a standard garden may not be the best solution as many homes no longer have the space or means to implement them.

2.2 Introduction to Maitland Garden Village

Maitland Garden Village (MGV) is a small community of approximately 2000 residents located in the Pinelands region of Cape Town, South Africa (see Figure 2). Established in 1922, it is one of the oldest villages in the Cape Flats. Initially, the garden village was celebrated for its flourishing green spaces, a source of pride for residents who engaged in friendly competitions to grow the best gardens. Despite the efforts of the GLP, the village has since lost much of its gardens in part due to limitations such as low income and crowded homes with added structures on the original properties. (Baker et al., 2011). Further research from our project shows why this happened and a potential solution for the MGV to restore its gardens.

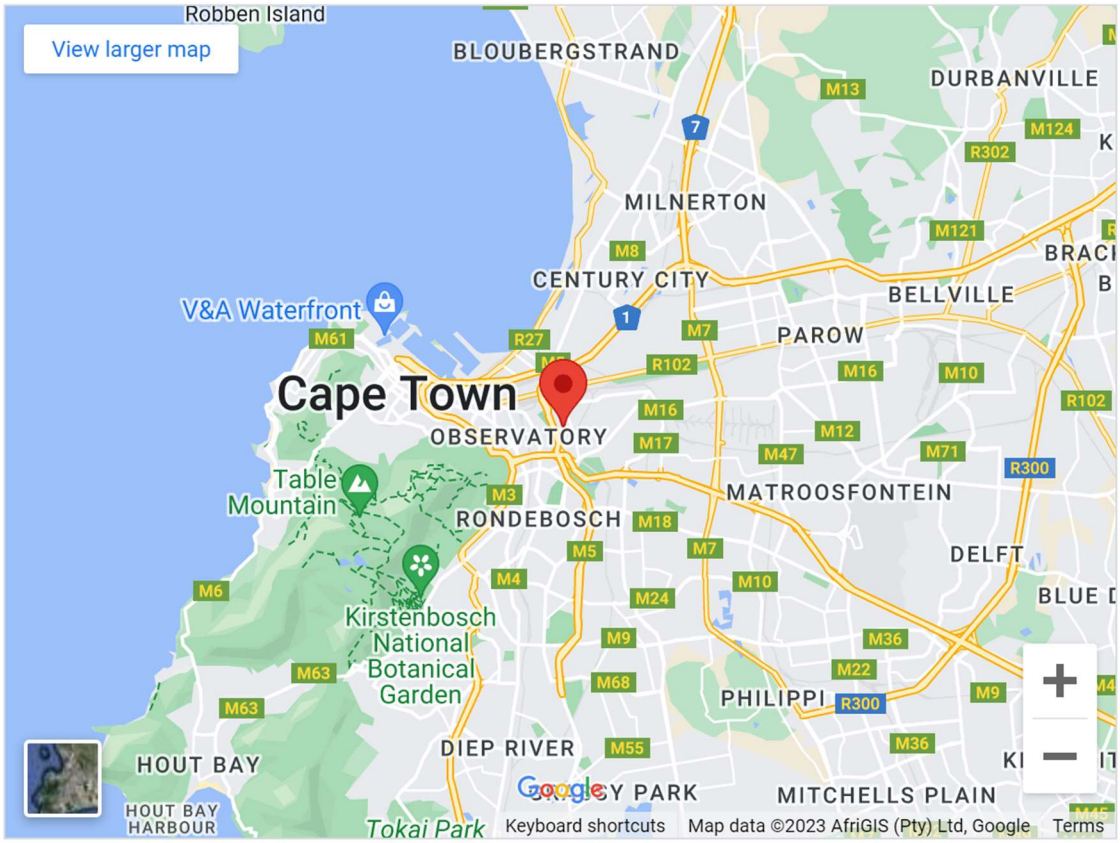

Figure 2: A view of the Maitland Garden Village's location in comparison to other areas of Cape Town.

MGV is considered a Coloured community and struggles with poverty and high unemployment. According to a 2011 survey, over 75% of households in the Western Cape earn less than R153,800 or $8,083 per year (Neighborhood Profile, 2020). However, because of its small size (see Figure 3) and a majority of the land being paid off, the community faces barriers in getting funding from the government to improve their situation. (Green Light Project, 2013). Members of the community that we have spoken with claim that the lack of activities in the community have caused an increase in drug use and theft. In addition, residents of the MGV have reported that unemployed members of the community may feel unfulfilled in their daily lives with little to no hobbies to keep them occupied. The village population remains steady with only 15 properties sold between 2011 and 2020 (Neighborhood Profile, 2020). This steady population has shifted the demographic towards the older generations.

Figure 3: A demonstration of the size of the Maitland Garden Village. Note that there is a rectangular perimeter of about 1000 ft.

Homes in the MGV are small, close together, and divided into fenced plots (see Figure 4) These plots were originally designed with spaces intended for gardens in the front and back of the houses, but many residents have built structures to act as additional living space. Each area may contain up to 3 living units that include a main house, original to the space, and up to two temporary structures. These structures are occupied by tenants who are typically friends or family of the landowner and often live there illegally to avoid paying rent or facing relocation (Neighborhood Profile, 2020). Because of this, homeowners no longer have enough space for a typical garden setup, and many pave over their yards with concrete or brick for ease of care. (Neighborhood Profile, 2020) (see Figure 5). Extra materials are used in the construction of structures creating a lack of materials in the village, which emphasizes the need for utilizing recycled materials in creative ways.

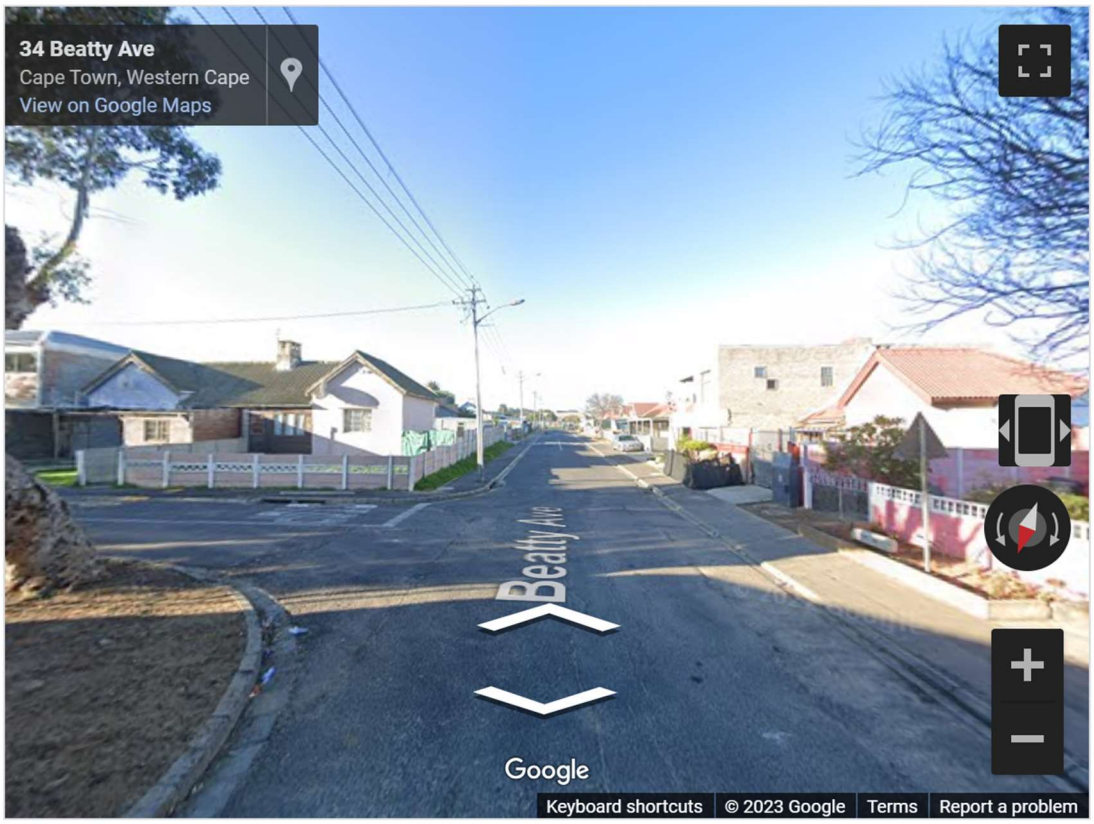

Figure 5: The view of a typical street in MGV.

Figure 4: The view of a typical MGV home. Yards are mostly paved over with little green spaces. Many community members park their cars in these spaces as well.

The community of Maitland Garden Village can be classified both as a geographic community and a community based on the shared characteristics of members' race, ethnicity, and shared experiences from the village's creation through apartheid to the present day. These classifications help to guide the direction of appropriate methods of building a broader sense of community within MGV. Community organizing refers to the way different community groups approach problems within themselves (Minkler, 2012). The empowerment of a community, and the placing of such initiatives in the community's control, allows for more success when it comes to the ultimate organization of community enhancements (Minkler, 2012). Our team strived to make the vertical gardening initiative community-owed to help sustain the program, but to educate the community on an initiative they would be excited about we had to first understand the technicalities of urban gardening, specifically, how it can be applied in the MGV.

2.3 Introduction to Urban Gardening

In urban settings, gardening can provide many benefits to users such as promoting sustainable, healthy lifestyles and helping alleviate food insecurity. According to Michael Elmes[1] (2018), home gardens give urban dwellers crucial access to fresh and low-cost produce, reduce food insecurity and encourage healthier diets. Urban gardens can also help reduce the urban heat island effect[2], enhance air quality, and create green spaces in crowded places, all of which have a positive impact on the environment (Eigenbrod & Gruda, 2014). Urban gardening helps build community, provides educational opportunities, and has been connected to better mental health and wellbeing for city dwellers (Eigenbrod & Gruda, 2014). In a study surrounding the physical and mental health of 28 African American citizens of Detroit Michigan, participants reported that the addition of gardens into their lives resulted in improved mood and decreased levels of stress (Beavers et al., 2022).

Despite the increase in interest for urban gardens, urban gardeners experience hurdles related to land availability, soil quality, access to resources for building or planting, and community engagement. Many urban areas face limited space for gardening, particularly in low-

[1] A professor at WPI whose recent research focuses on food insecurity and inequalities in the industrial food system.
[2] The significant warming of urban areas in comparison to rural regions due to human activity and the retainment of heat in condensed spaces (Chen et al., 2020).

income neighborhoods where concrete and infrastructure dominate the landscape (McLoughlin et al., 2020). In the past, the GLP has struggled to sustain long term community engagement surrounding their initiatives. It is a common trend that a new activity, such as gardening or sports, will draw participants for a brief period before work or other preoccupations distract community members. Due to this trend, the sense of strong community that many older members grew up with has decreased in recent years (Ronell Trout, personal communication, October 2023). Gardening has been found to increase the sense of community within condensed urban areas through fostering safe social spaces. Such gardening initiatives are dependent on the level at which the community is willing to commit to the long-term success of its gardens. The success of building a sense of community relies on the support of community members around a central idea or cause (Minkler, 2012). Giving a community a central focus fosters better results toward the reaching of a common goal. We want to understand the difficulties that come with engaging a community and the benefits that can stem from a community working towards a cause. For example, in the community of Loisaida, a neighborhood in New York City, residents lobbied for the ability to participate in the community garden in their neighborhood. This push resulted in widespread accessibility of gardening and demonstrates that community engagement leads to the success of gardening initiatives in urban areas (Schmelzkopf, 1995). However, in some regions, residents may lack the knowledge or resources needed to initiate and maintain urban gardens. Inequities in access to green spaces and an increase in food insecurity persist, especially in low-income settings (McLoughlin et al., 2020). Within MGV, the lasting effects of the isolation caused by the 2020 pandemic, as well as an increase in drug use and theft in recent years, has provided barriers between community members coming together, thus decreasing that sense of familial community that many older members of MGV remember.

Another limitation that is more abundant in low-income urban areas, and can be observed in the MGV, is a lack of building resources. With the inflation of material costs, such as those of wood and PVC, many households cannot afford to buy new materials for the construction of garden beds. Due to this, urban gardening practices, including composting and utilizing recycled materials for gardens, have gained momentum worldwide. Repurposed pallets, tires, and discarded containers are being transformed into garden structures, promoting resource efficiency (Thomas, 2022). In MGV, the lack of accessible new materials points the initiative in the direction of building these vertical gardens out of the materials on hand in the village. This

practice demonstrates the ability to create vertical gardens in a low-income urban area despite limited resources. By challenging these barriers, the vertical gardening initiative that we implemented provides the educational resources for community members to implement vertical gardening in their yard in an inexpensive way. This also addresses the food insecurity issue within the MGV by providing access to homegrown food. Urban gardening is different depending on region, resources, and allotted space, meaning the specifics required to make a successful garden in the MGV can be explored through research of urban gardening in South Africa.

2.3.1 Urban Gardening in South Africa

It is estimated that almost half the population of South Africa spend 70% of their monthly income on food purchases. With inflation rising steadily over the last few years, food prices have become overwhelming for many residents. Because of this, the South African government is urging residents to grow their own food at home (Schönfeldt et al., 2010).

In South Africa, while there is a lack of widespread adoption, there have been many efforts to promote gardening in low-income areas. In a survey conducted throughout the country, 22% of households indicated that they practice urban gardening to some degree (Frayne, McCordic, and Shilomboleni 2014). Many of these gardening efforts are sponsored by non-governmental organizations and non-profit organizations, such as the Green Light Project, who aid in the facilitation of such efforts. Some of these programs include community gardens where gardening spaces are used for the benefit of a wider area or village population. Conversely, other gardening efforts are much more individualistic, with smaller, household gardens being cultivated for the use of single residents or families. This style of individual gardening is what we implemented in the Maitland Garden Village and will be discussed further in this section.

In low-income areas of Cape Town, South Africa, public perception of gardening remains largely negative despite efforts made to promote it. A study conducted by Kanosvamhira (2023) surveyed 20 community members in Mitchells Plains, Cape Town about their perceptions of urban gardening, following an initial demographic survey. It was found that 55% of respondents held negative opinions while less than 13% held a favorable view. Many of these respondents indicated that they felt gardening practices were costly to undertake and required an undesirable

amount of labor. Additionally, others perceived the probable success of such projects to be low, and thus not worthy of the necessary effort. Finally, many of those surveyed cited a lack of community trust. Specifically, one participant stated, “neighbors will come to pick your stuff before you come and get it, my tires here in front here had plants but they took that also” (Kanosvamhira, 2023). Overall, the study results demonstrated the lack of widespread support for gardening within Cape Town. There are still a majority of residents who hold apprehensions, which the study found stemmed from a lack of understanding about what urban gardening fully entailed (Kanosvamhira, 2023).

The introduction of gardening in low-income urban settings can prove beneficial for both environmental and socio-economic reasons (Eigenbrod et al., 2014; Elmes, 2018). The addition of vertical gardening into the urban landscape allows for the more efficient use of already limited space. Food grown in the added vertical space allows for a decrease in food insecurity due to the introduction of home-cultivated produce. (Agova et al., 2023). As demonstrated in Agova et al. (2023), using a study of smallholder farming families in Kenya, the addition of vertical structures into the limited spaces in farms allowed for increased cultivation of produce, thus also increasing economic gain. Therefore, the additional cultivation space from vertical gardens made a noticeable impact in the amount of produce able to be grown and sold on these farms. This practice can be simulated on a smaller scale through the increase in “ground” space vertical gardens add to home gardens, which is what we emulated in our initiative. Similar studies pertaining to the effectiveness of vertical gardening initiatives in low-income communities have been conducted in other parts of Africa, as well. In Mitchell’s Plains, Cape Town, it was found that not only did the promotion of vertical gardening within the community increase economic opportunities due to the available produce that could be sold, but it also increased healthy diet due to the availability of freshly grown vegetables (Kanosvamhira, 2023).

Despite efforts to promote home gardening by the South African government and other organizations, the public remains largely reluctant to adopt the practice. These hesitations are a result of misinformation and lack of education about the cost, effort, skills, and other factor that can affect gardening initiatives. Within MGV, hesitations toward gardening stem mainly from lack of resources, fear of theft, and physical accessibility challenges (Community member interviews, personal communication, October 2023). Hesitations call for the need to provide education and guidance about vertical gardening in the village. Through our research we

determined the source of hesitations towards gardening to determine the best way to introduce vertical gardening to the village. As we approached this issue, we looked to address the barriers that affect the sustainability of gardening in the MGV and how the engagement and collaboration of the community can make an impact.

2.3.2 Vertical Gardening: Designs and Implementations

Vertical gardening is utilized in the urban landscape to adorn buildings, aid in food insecurity, and create healthier environments in congested urban areas (Basdogan & Cig, 2016; Felix et al., 2018). Vertical gardening presented itself as a possible solution to the lack of outdoor space and reduction in community gardening within the Maitland Garden Village.

Vertical gardening designs can be split into two main subcategories: green facades and living walls. Green facades consist of vine-like plants that are rooted in the ground and adhere directly to the side of a building or other supporting structure (Kohler, 2008). Ivy-covered buildings serve as an example of a green facade. Unlike green facades, living walls are vertical gardens grown inside secondary structures such as plastic containers or metal frames potentially with added irrigation systems or geotextiles[3] (Basdogan & Cig 2016; Yu-Peng, 2010). Their lightweight and modular designs allow for them to be utilized in many different spaces, including the small outdoor spaces such as those in the MGV. Due to the living wall's adaptability of soil depth and light received on each level, they allow for the cultivation of many different varieties of plants to pertain to the user's needs (Yu-Peng, 2010). These modular characteristics allow the gardens to be built using a variety of different materials and techniques to fit the needs of the limited spaces available in community homes. Additionally, the vertical design of the gardens allows for older populations in the village to access their gardens easily even with physical limitations. This addresses accessibility for the aging population.

Living walls include a variety of different designs that increase adaptability of the addition of a vertical garden to a space. A subcategory of living walls utilize the side of a building as support or function with the help of a secondary wall. One design for this style of

[3] Flexible materials used to aid in drainage, protect landscapes from erosion, and protection of crops (Prambauer, 2019).

vertical garden is a modular peg board structure. As described by Vach & Masin (2009), this pegboard makes use of containers that can be moved around on the wall to form different configurations. The extra support added by the building allows for fewer materials to be needed in the creation of the structure of the garden. Similar designs include modular fabric planters (see Figure 6), tiered flower boxes, stacked planters, and general frames built to hang planting boxes on (Fisher, 2014). Like the pegboard design, these additional designs utilize the support of the building wall. However, this design is limited by the need for specific materials and open outdoor wall space. Additionally, different wall materials, such as stucco or brick, make it difficult to attach these gardens.

Figure 6: An example of a modular fabric living wall. "mobbs' vertical garden" by nicolas.boullosa is licensed under CC BY 2.0.

Another common type of living wall is a tower, which is usually presented in two forms. The first form consists of plants connected around a tube or column that provides nutrients to the roots of the plants and the water needed for survival (Vach & Masin, 2009). In this form of garden, plants may be contained in small modular containers surrounding the tube or in stackable pots. The nutrients are fed to the edibles and flowers through the central tube mechanism of the structure which allows for an even distribution of nutrients to each plant

(Nwosisi et al., 2017). However, these structures require on average twice as much water compared to alternate designs, such as the previously mentioned building wall designs (Manzella, 2020).

The second form of garden tower is built by stacking a series of flower beds. Unlike the previous method, the nutrients are not delivered through the center of the structure but through overhead watering and adding fertilizer. This option does allow for more space for growing plants, but it was reported that soil erosion can cause "significant plant death" (Manzella, 2020).

Vertical gardens can also be modeled after a shelving system. In this design, multiple layers of planting beds are fixed above one another. The shelves allow for water to drip down from the top layer to be recycled into the lower levels of the shelving unit (Manzella, 2020). A subset of the shelf-style garden is the pallet vertical garden (see Figure 7). Landscape fabric can be used to line each level and create pockets for the soil and plants to sit in. When compared to other designs, pallet-style vertical gardens are the most affordable option due to the use of recycled materials. This design also reduced soil erosion and water usage (Manzella, 2020). However, extra materials are needed to aid in the assistance of keeping the pallet in an upright position.

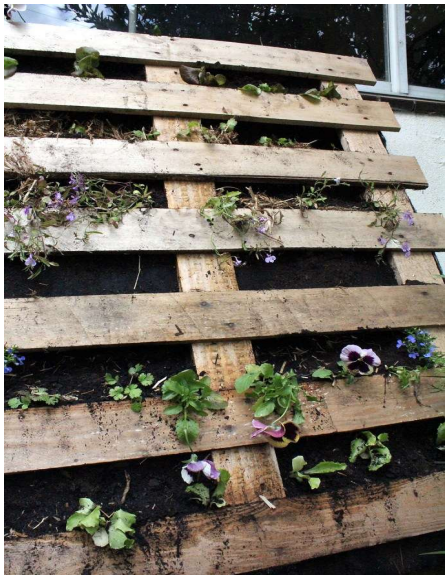

Figure 7: Another example of a pallet vertical garden which puts the soil directly in the pallet. "pallet garden" by various brennemans is licensed under CC BY-SA 2.0.

Regardless of the style of vertical garden, a main consideration in the selection of plants to be grown is the required soil depths for each desired produce. Common soil depths for vertical gardens range from around 10 cm to around 60 cm, which is suitable for leafy and smaller root vegetables, such as lettuce or radishes. (Fisher, 2014). The catalog of commonly grown vegetables in South Africa includes many of the suggested vegetables that are suitable for growth in vertical gardens. Cabbage, garlic, zucchini, and lettuce can be cultivated at soil depths that fit the criteria of a vertical garden (South Africa Online, n.d.). Herbs such as cilantro, parsley, rosemary, and oregano are all herbs that are widely grown around South Africa (South Africa Online, n.d.). In addition to growing edible produce, vertical gardens can also be used to increase the aesthetic look of a space through the planting of different flowers.

Our sponsor reports that within the Maitland Garden Village, past gardening initiatives failed to bolster widespread support because community garden spaces were located on private property and required key access. Based on the failures of these previous projects, as well as the literature surrounding failures of community gardens in urban settings, we implemented private vertical gardens in MGV. By constructing home vertical gardens on each separate homestead, the problem of private access to the community garden was rectified. The individualistic aspect and adaptability of vertical garden designs makes vertical gardening an effective alternative method of introducing gardening into urban settings such as MGV. Factors such as cost, required maintenance, and security concerns were considered during the design process of this initiative. Due to our address of these previous failures of gardening initiatives, we believe our project will show more success. Even with the understanding of the infrastructure and of the MGV, as well as the techniques used to implement vertical gardening, there were still questions surrounding the effectiveness of vertical gardening within the social structure of the village. Understanding this knowledge gap, we determined a more detailed method of introducing vertical gardens to the homes of the community.

3.0 Methods

In collaboration with the Green Light Project, we reintroduced gardening to the Maitland Garden Village through the implementation of vertical gardens and related training materials. We accomplished this through the following main objectives:

1. Investigate gardening interests and needs within the community and determine suitable vertical garden materials and designs
2. Restore the community garden as a nursery
3. Build volunteer's vertical gardens
4. Grow program interest, sustainability and community-run aspects of the initiative

We wanted to approach the project by working alongside the community members to design and build gardens. By allowing community members to take the lead in many aspects of the project, we strived to create a system that could be continued once we left. This community-based approach allowed for more ownership of the project by the community and led to a stronger sense of connection with the results, thus resulting in more ongoing community support for the initiative (DeCoito, 2021).

The first objective was getting to know the community members to better understand their motivations and needs through various interactions while building community engagement. Through informal, semi-structured interviews, we collected data about which materials are readily available around the village. This allowed us to identify and assess the variety of recycled materials available between households as we moved towards our second objective of recovering the community garden. We compared the materials that the community had with the materials at the garden to begin our initial designs for the home gardens. We worked with our initial six participants to use their ideas to prototype initial garden designs. Due to the expected variation of materials in this catalog, each garden was constructed in a unique way. In our third objective, we worked to refurbish the community garden space and establish it as a center for vertical garden training. Throughout that time, we attended community events to become familiar with the community and used it as an opportunity to inspire community advocates for the GLP and the gardening initiative. Through our final objective, we ran community training sessions and provided training materials for the entire community. By providing these materials, additional community

members will be able to construct their own gardens, thus aiding in the sustainability of this initiative.

3.1 Objective 1: Investigate Gardening Within the Community and Determine Suitable Garden Designs

We immersed ourselves within the community to learn their interests, assets, and limitations related to vertical gardening. Here we wanted to learn the strengths and limitations of the community as a whole and answer the questions "how has gardening been a part of the MGV community culture?" and "what, if anything, has caused people to stop in recent years?" To find the answer, we used two strategies to communicate with members of the community. The first strategy used informal, semi-structured interviews with predetermined guiding questions that led us towards a better understanding of our project by allowing members to give input towards what they felt would make it most successful. Secondly, we held meetings with each participant to design and construct vertical gardens for our initial participants.

3.1.1 Semi-Structured Interviews

Our sponsor, Ronell Trout, had gathered six volunteers, who wished to begin vertical gardening prior to our arrival. We felt six people would be a reasonable number as it would allow us to meet with a variety of people to collect data and construct a training guide, while still giving us time to make sure each garden is personalized. The volunteers were read the script shown in Appendix A before they verbally consented to participate in the project.

We began our investigation process through informal, semi-structured interviews administered during the first two weeks of the project (see Figure 8). During these interviews we walked around the Maitland Garden Village with Ronell and visited the homes of the volunteers. At each household we were able to see the spaces that the volunteers had available, and we held 10-to-30-minute conversations with them about their interest in our initiative and the specifics of the vertical gardens they were envisioning. Some participants required Ronell to translate to Afrikaans while other volunteers were able to communicate their answers directly to us. The questions shown in Appendix A guided our interviews which allowed us to stay on topic while still exploring relevant tangents. Informal, semi-structured interviews allows for topics to arise in

conversation that researchers may not previously consider (Drew et al., 2007). This method allowed us to gain more information than we expected as interviewees were able to discuss topics in more detail. Because we were in the private homes of the people we were interviewing, volunteers could be assured they were in a safe space to share their ideas with us. This added comfort, as well as our ability to visualize the available space at each home, made in-person interviews at each household the best option. From the pictures, notes, and recordings we took during these interviews we were able to determine the space availability, materials at hand, and the plants that volunteers wished to grow.

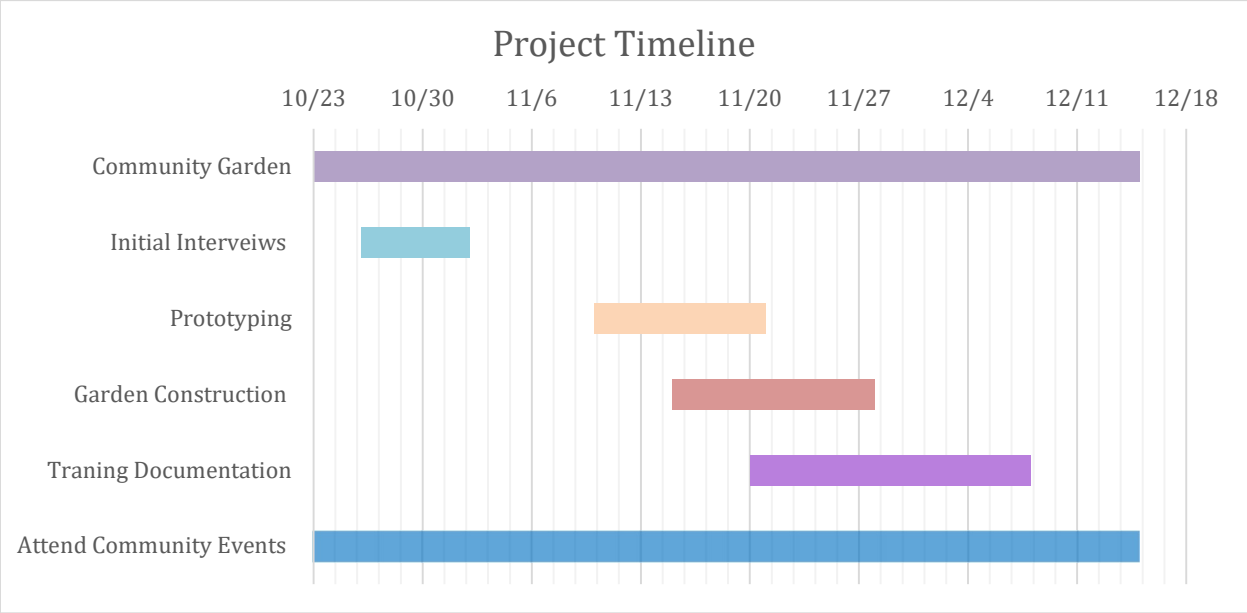

Figure 8: Expected Project Timeline in the form of a Gantt Chart.

3.1.2 Participant Meetings

Based on the data, constraints, and size requirements gained from our interviews, we began brainstorming build ideas based on the materials available to us. This conceptual prototyping took place in the form of meeting with each participant, suggesting ideas, and revising based on received feedback. Our prototyping meetings were guided by the script shown in Appendix B. Prior to this, we used the materials we had to create three different designs to show these individuals. These designs were prototyped by us to serve as a guide to talk with participants about and introduce them to vertical gardening. At each meeting, we

took measurements of space and discussed which design would work best for the space each participant had available.

Prototyping allowed us to translate our gathered data and ideas about what would make a successful vertical garden into tangible models. Because prototyping enables the user to test and refine designs practically, it ensures suitability for the context of the problem (Murphy et al., 2022). This meant that prototyping allowed us to visualize and measure the designs we were creating before finalizing a design. We utilized a modified form of parallel prototyping to come up with the final designs. As opposed to iterative prototyping, which involves starting with one prototype and making improvements through different iterations until a final design is reached, parallel prototyping includes building multiple prototypes simultaneously to reach a final design (Murphy et al, 2022). Parallel prototyping has been found to increase design performance when compared to iterative prototyping (Murphy et al, 2022), while also being a more beneficial option for projects with lower budgets and shorter time frames (Dahan & Mendelson, 2001). While the basic model of parallel prototyping ends in one final design, we chose to take this framework and modify it slightly. As we wanted to end up with multiple designs to have a better catalog to fit the needs of the community, we prototyped multiple designs in a parallel manner to end up with three final designs. We then took these designs to each participant to gather their input. Involving community members through meetings empowered them to have a voice in the design process (Drew et al. 2007), thus enhancing our project's community-centric nature. This objective underscored our commitment to community engagement and sustainability, ultimately contributing to our overarching goal of enhancing the Maitland Garden Village through vertical gardening solutions.

While prototyping is an important step in the creation of a final design, it took time to work out the best use for all the materials we had on hand. However, these initial ideas served as guidelines to determine what garden structures work best given the available materials, thus the required time was necessary and justified.

3.2 Objective 2: Restore the Community Garden as a Nursery

We dedicated Mondays towards recovering the community garden space located at the creche. After being somewhat abandoned for several years, the space was extremely overgrown

with weeds and littered with scrap materials and trash. We learned how to create a more sustainable initiative by first understanding why the community garden failed in this way. We did this through our time spent in the garden as well as communications with those who have worked in it. We first cleared out old plants and weeds from the preexisting flower beds. We took inventory of all the scrap materials and tools that were scattered around the community garden. Taking inventory of the scrap materials enabled us to begin brainstorming ideas for vertical garden structures as they were eventually used in the construction of the gardens. The rest of the work included weeding the entire yard space and clearing out overgrown branches obstructing the walkway to the garden.

We decided to use the community garden space to act as the MGV's nursery as it is a safe and local space already dedicated to gardening. Once the seeds we planted sprouted into seedlings, we transplanted them into the previously constructed vertical gardens. We took feedback we got from interviews about what certain plants the community would like to grow and used it alongside our research to dictate what seeds to plant. Our method of propagation and transplantation allows for future community members who wish to participate to have a head start in the cultivation of their gardens. Additionally, the presence of actively growing vegetables will continue to show the community that gardens are a possibility and inspire more people to join the initiative.

3.3 Objective 3: Fabrication of Volunteers' Vertical Gardens

After we completed our prototyping meetings, we began the construction of the volunteers' gardens. We worked with each of the first six participants to assemble their garden in the space they had designated. Using Ronell's home as our building space, we were able to build each individual's garden with their supervision or help, depending on their abilities. Many of the participants are part of the older demographic of the village and were unable to physically help as much as they were able to conceptually help. Additionally, members of the initiative who were younger and more physically able, including our sponsor's son, aided us in the construction of the gardens. We tailored the gardens to each homeowner's individual needs and visions and gained an understanding of any potential challenges other participants may encounter in the future. This process was especially important considering the variety of

materials and allowed space dedicated for each garden. Once the initial structures are constructed and the plants from the community garden have grown enough to be moved, we transplanted seedlings to their permanent homes within the home gardens of our volunteers. With this understanding and practical experience of assembling the gardens, we were able to adjust our training materials to account for any common issues we experienced during assembly, making the process more streamlined for future participants.

3.4 Objective 4: Grow Program Interest, Sustainability and Community-Run Aspects of the Initiative

Finally, we wanted to explore how our project can be expanded upon and sustained past our departure. To promote the sustainability of our project, we aimed to inspire community advocates throughout the village who will continue to foster the initiative and guide others on how to get involved with vertical gardening themselves. We asked our initial volunteers to share their new gardening experience with the community to encourage more members to become involved in gardening. The initial participants that Ronell selected were chosen due to their dedication toward helping the community and their affinity for wanting to start or continue their gardening habits. We hope that these combined traits will qualify them to spread the vertical gardening initiative through the community in our absence.

Additionally, Ronell planned community events for the Green Light Project that we attended to immerse ourselves in the community and further demonstrate our efforts to truly work with the community not for the community. We attended a craft session with the disability group where we aided in making Christmas decorations out of recycled materials. Further, we joined Ronell on her weekly trip to a local church to pick up food to distribute to the community. This inspired an idea to distribute seedlings and training pamphlets to the community in a similar manner. However, we wanted our volunteers to be more involved since they hold the potential to sustain the program. We made printed training pamphlets (see Appendix C) attendees of our showcase presentation. In addition, we provided a station at our presentation with toilet paper rolls, compost, and seeds where we showed attendees how to plant their own seeds. We then asked them if they are willing to share the seedlings and pamphlets with their neighbors to

encourage them to take ownership of the gardening initiative and spread the word to non-participating members of the MGV community. We updated the GLP website with a more in-depth version of the training manual for the community to reference as well (see Appendix D).

Through these combined efforts of collaborating and interacting with the community, we intend to prove our dedication, and overall goal of community improvement to the people of the MGV. Interaction outside of the vertical gardening project work will also allow us to connect with community members on a deeper level. These interactions ideally promoted conversations, bonding, and the trust required to truly make a difference. We used these connections to encourage people to participate in the vertical gardening initiative. We were inspired by the source from Loisaida, New York, as described in section 2.3, in which the participation of the residents in gardening solidified the longevity of their programs. The movement from the community to implement a community garden made their initiative sustainable (Schmelzkopf, 1995). We hoped that by including the community in the project and giving them ownership of the initiative, it would be better sustained after we left. The first participants we worked with were handpicked by Ronell due to their willingness to be involved. However, for the initiative to be sustainable and last beyond our time in Maitland Garden Village, we had to inspire the wider community to get involved with gardening.

Based on the challenges encountered when building the initial vertical gardens, we formulated the training materials which were distributed to the rest of the community (see Appendix C and Appendix D). General design parameters were outlined in this guideline, in which a variety of different materials could potentially be used to fill a certain role within the structure. The main components we included in the guideline were a structure, soil container, and fastener for each garden. We also included step by step guides for building some of the gardens we built for the initial volunteers. This will allow future participating members who do not know where to start to gather ideas for their gardens. Our aim was to create accessibility for a multitude of designs that are adaptable to many different home environments. To keep interest in the initiative at a high as our project came to a close, we scheduled a showcase for participating members. This gave the initial participants an opportunity to show off the gardens they have created, and hopefully inspire others to use our training to create gardens of their own. This acted as our final presentation with our sponsor in MGV, and allowed community members to see the work that has been done in both the

community garden and with the individual gardens. This gave our initial participants an opportunity to share their gardens and inspire others to join the initiative by handing out training pamphlets and seedlings. By allowing the community members to take the reins in the training distribution, it put the control of the sustainability of the vertical gardening project in their hands.

4.0 Findings

We begin by discussing the importance that stemmed from our communication with the residents of the MGV community and the decisions we made to develop successful methods. We will then share what we learned through our interactions with the community that further guided us in a direction that aligned with the values of the MGV community. Then we showcase the work that we had completed in both the restoration of the community garden and the construction of our volunteers' vertical gardens. Finally, we discuss what we learned about sustaining the program in the future.

4.1 Communication and Investigation

Communications with our volunteers and other members of the MGV, along with our sponsor, were the primary sources of our data collection. Our project began with communication and investigation of the MGV and its history as our research depicted a community of once flourishing gardens. We wanted to learn as much as we could about the community and its strengths and limitations. Once we understood the complexities of this, we were able to make educated decisions for the direction of our project and what the community felt would make the biggest difference. To understand why we made each decision, it is best to first show what we learned from these important interactions within the MGV community.

As we began our research with interviews with our initial six volunteers, we faced challenges involving language and availability. Many of our volunteers expressed fear/shyness towards participating in an interview as they were afraid that their English was not sufficient to communicate with us. To help with this, Ronell volunteered to translate for us. An additional benefit to Ronell's presence at the interviews was that she is familiar with all our volunteers. The volunteers were happy to see her, and we believe that her introduction of us built the trust of the volunteers more quickly than if she was not there. We also had some difficulty arranging times for some interviews, since some volunteers did not have cell phones or had other commitments they had to attend. We found ourselves on a few occasions walking door to door at volunteers houses to check to see if they were home. On days we could not contact the volunteers we had

not yet spoken with, we decided to begin our work in the community garden instead. Even with these challenges, we were able to complete our interview process in the first two weeks.

From our interactions with the community, we concluded that the more relaxed attitude of the community would not translate well to formal gatherings or surveys. We acknowledged the distinctive nature of the community, adjusting our approach to be more inclusive and respectful of its local customs. We had initially planned to distribute a survey to the community but determined that we had received sufficient information concerning the data we would collect from a survey through our observations and conversations within the village.

Moving around the MGV to speak with new people allowed us to make observations, as well. From our observations, we noticed that it is rare for the community to gather in larger groups. During our time helping to pass out food, we observed that members would stop by at their own convenience and there were never more than a few people with us at a time. This observation was supported by a personal conversation with Ronell after she attended a community meeting. She expressed the disbelief and pride she felt after seeing so many MGV community members come together to support a cause, and when we asked if this was common, she said no. Soon after, in an attempt to host a focus group, we again found it difficult to get all of our participants in one place, so rather than running traditional focus groups we chose to meet with each participant individually at their homes. This worked in our favor as we were able to measure and observe their space while discussing designs.

From the information we collected during our interviews and observations, we identified several recurring themes concerning the community's identity, their barriers to gardening, and their available materials. These themes helped us to identify criteria for the vertical gardens and the sustainability of the initiative.

4.2 MGV Gardening History and Hinderance

Interviews from the older demographic of the community made it abundantly clear that the village has deep roots of gardening embedded in its identity and history, but in recent years, there have been many barriers preventing the continuation of these gardens. Some of our interviewees still have beautiful gardens in their yards, while others had stopped theirs recently. Those who continued their gardens did so out of a true love for the hobby that they grew up

surrounded by. Interviewees who stopped gardening described instances of garden theft or the lack of space available. From visiting each participant's home, where we conducted the interviews, we were able to see the reality behind the paved over backyards and structures we had previously researched (see Figure 9). The lack of outdoor space that was not monopolized by concrete or structures justified the need for vertical gardens as a method to bring gardening back to the community on a wider scale.

Figure 9: Examples of the paved over backyards and additional structures present in many yards of MGV.

The small spaces available demanded a compact solution, while the fear of theft required the gardens to have the ability to be secured in place if the user chose to do so. Another common thread between all the interviews was the abundance of drug abuse within the community. Many of our interviewees brought up the drug problem amongst the youth as a concern that they hope gardening would have the potential to help in the future. A popular belief among the community is that the addition of more activities would deter the younger population from drug use because their time would be better used in a more productive manner.

4.3 Resource Availability

In addition to the lack of space, interviews also revealed the lack of available materials, new or recycled, within the community, since practically everything is reused or repurposed. Interviewees mentioned that all the extra materials they had were being saved for the construction of structures. This required us to replan our approach to finding materials for the gardens, as we initially planned to use materials that the volunteers had on hand. We needed to be sure that any way we got materials could be replicated by the members of the MGV community. This meant that we still could not purchase new materials since this could be inaccessible to those looking for a low-cost solution.

We were able to find some materials during our clean up at the community garden such as 5-Liter water bottles, old gutters, tires, and wire fencing. We then visited a local roofing company that offers scrap wood and pallets for free. We were able to get all the necessary wood for the gardens in one visit. In addition, our sponsor generously offered some of her own materials which included crates and all the compost that we used for planting in the volunteers' gardens. We were also able to collect donated 5-liter water bottles from other IQP teams in our cohort. However, the wood, although accessible, presented an unexpected obstacle — it was treated, complicating our construction processes. Drilling and hammering became arduous tasks, demanding additional effort and time.

4.3 Old Roots New Branches

Our physical deliverables from this project consist of the community garden restoration and the six vertical gardens belonging to our volunteers. While the MGV already has the roots of a rich gardening history, we wanted the newly introduced vertical gardening initiative to give it new branches that would grow stronger than past initiatives that had failed. The challenges we faced during the creation of these two deliverables taught us techniques that can be beneficial future participants of the program.

4.3.1 Community Garden Restoration

When we arrived at MGV for the first time, Ronell explained the state and history of the community garden as a previous project of the GLP. The garden was quite unkempt; from the overgrown weeds to the array of trash throughout the garden, it was clear that the space had been neglected for an extended period. This was the result of water shortages, the pandemic, and its location on private property. Through our first few days working the garden, we identified it as a potential location for the training sessions we aimed to hold toward the end of our project. To achieve this goal, we cleared out the beds of the overgrown weeds and mowed the lawn (see Figure 10).

Figure 10: (left) The initial state of the community garden. (right) The community garden after seeds were planted.

The community garden is located between two schools in the village, the primary school, and the preschool, which brought great benefit to our project but also presented some limitations. On the one hand, interacting with the kids and being in a central location allowed us to connect with the community on another level and show that we were serious about helping the community. We were able to talk to the children about growing their own food and even gave them extra seeds. This was in the hope that they would bring them home to inspire their families to start gardening. However, we did have to be cognizant of how much noise we made during

school hours as the young children were sleeping. It was because of this that we decided against our initial plan of using the garden as a training location. Other challenges were present in the form of equipment availability. For instance, we had to wait to cut the grass, and even had to pull weeds by hand, for multiple days because we were missing pieces of the weed wacker. These setbacks forced us to spend more time at the community garden than we initially planned, and we spent most of the second and third week in the garden, instead of dedicating just Mondays to this work.

Through discussion with Ronell and an understanding of a limited timeline, we decided to use the community garden space as a nursery for seedlings to be transplanted into the vertical gardens. In our interviews, we asked the community what they would want to grow and were given answers such as tomatoes, potatoes, herbs, and onions. We took these suggestions, as well as knowledge from our research, to decide on plants to begin growing our final selection of spinach, tomatoes, herbs, peppers, onions, marigolds, green beans, and zucchini. Because of the limited soil depth in vertical gardens, we decided against growing potatoes, but we are hopeful that the community could utilize the community garden to grow them along with other crops that require more soil depth. We purchased all our seeds at a local nursery and used the opportunity to take pictures of gardens there for inspiration.

Another challenge we faced in the garden was the soil itself. After years of being unkept in a dry environment, the soil was very dry and did not soak up water initially. During planting we had to flood the gardens and mix the dirt until it absorbed water. Then, after planting, we had to soak the soil again. This meant we were using much more water than we wanted to, however, we had access to the school's rainwater collection system so there was no concern about overusing water. We counted the number of times we filled the watering can on the day of planting, and it totaled 26 times in a single day. This meant that we were spending much more time and resources watering the garden than we had planned. Additionally, not all the homes in the MGV have access to rainwater collection or unlimited water supply, so we concluded that using just the soil from the garden would not work for the vertical gardens. Fortunately, Ronell donated compost that we could mix with the soil which allowed it to better absorb water, facilitating overall healthier plant growth whilst also being sustainable.

4.3.2 Vertical Garden Construction

After we had planted our crops in the community garden, we took inventory of what materials we had at our disposal to use in the vertical gardens. Then, keeping in mind the criteria we had formed from interviews involving size and accessibility, we prototyped designs to show to the volunteers. Due to lack of extra materials, our prototypes were held together with metal wire or held up by us and we took the pictures, shown in Figure 11 below, of the potential structures for the volunteers to look at.

Figure 11: The four designs of gardens we prototyped and showed to participants before construction.

As seen above, we developed unique prototypes to satisfy the needs of a multitude of different spaces. The design on the left demonstrates a shelving system that uses old tires for the main structure and wooden shelves. We found this garden to be very accessible as there are many spare tires throughout the community. However, it is larger than the others and is not fit for narrow spaces. We also wanted to incorporate wire fencing left over from the community garden into our designs to hang pots or to act as support for taller plants as seen in the second and last images. We aimed to vary our gardens to fit an array of unique spaces. The third image shows a wider design to fit in a corner or be placed as a center piece, while the fourth image uses gutters that can fit in narrow spaces or walkways.

As discussed in section 3.1, we met with each volunteer individually to show them our prototypes, which helped them visualize what they wanted for their gardens. We noticed that the tire design was very successful and there were minimal changes requested, while others, such as the second image in Figure 11, were not as popular due to their less space efficient construction

and small size. By encouraging our volunteers to share their ideas for their gardens or make changes to any of our prototypes, we were able to change our designs where necessary to create personalized gardens for each person. In addition, we noticed a spark of excitement from our volunteers as their ideas came to life.

Overall, volunteers were pleased with the designs that we shared with them. Design requests included factors such as stability, since many of the homes had unlevel surfaces where the gardens were to be placed, as well as accessibility. Some of our volunteers had physical limitations that made it hard for them to reach too high or too low, and these limitations had to be considered when we were building our gardens. The final result was six unique gardens, as shown in Appendix E. Two of our gardens shown in Figure 12 depict some of the design factors we considered including space constraints and unlevel ground.

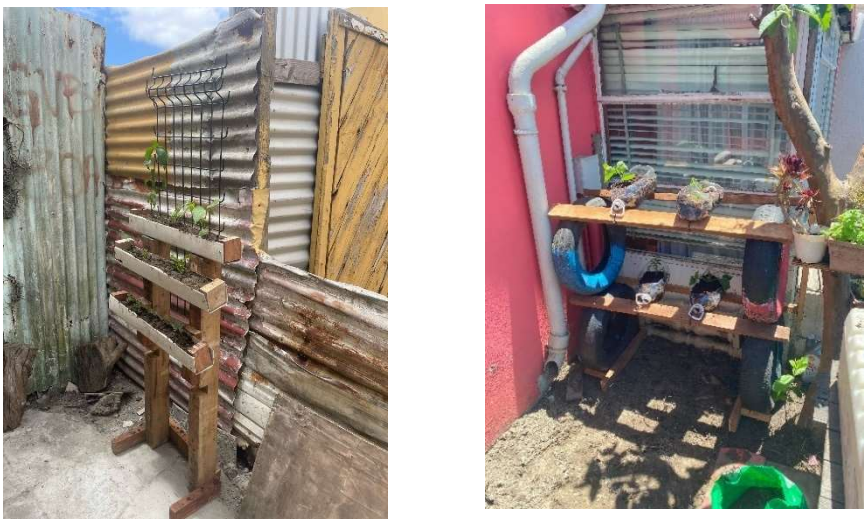

Figure 12: Examples of two completed vertical gardens.

4.4 Keeping it Watered

While we intended to make our training manuals more of a guideline, our process of prototyping and building informed us about what would work best with the community. We felt as though making a step-by-step manual for the different designs with suggestions for alternate materials would work better since many community members lack design experience and could benefit from a more detailed explanation. We believed that community members could be inspired by our designs and could gain the skills and knowledge to design a more personalized

garden if they first had the opportunity to review a guide. We developed a training manual that is included in a link on the website. As shown in Figure 13, the GLP website now has a subsection of the gardening section that defines a vertical garden. The post then invites the reader to click on the image that will direct them to a PDF copy of the full training document shown in Appendix D.

Figure 13: A screenshot of the vertical gardening section of the website.

At the final showcase, we encouraged attendees to hand out seedlings along with the flyers shown in Appendix C, to engage their peers and spread the word about vertical gardening. The flyers are a summary of the information provided on the website and we kept inclusivity in mind by making the flyers available in both English and Afrikaans.

This showcase displayed immediate results related to community engagement and a reborn passion for gardening. Community members who were not involved before began asking questions on how to start their own garden, and many attendees were excited to take home a seedling. Volunteers and new participants expressed interest in becoming advocates for the initiative and we were again impressed by the happy childhood memories that gardening resurfaced for the MGV community.

Prior to this showcase, the effects of our presence in the village were made known through spreading enthusiasm for vertical gardening. When we distributed the gardens to all our volunteers, one of them had already constructed their own vertical garden in addition to the one we constructed with their guidance (see Figure 14). Additionally, in speaking with Ronell, we learned that through discussion in the community, other members had learned of our work and had expressed interest in constructing their own vertical gardens. We hope that through the distribution of training materials and guidance through our volunteers, this spreading interest and participation will grow throughout the community to make this a sustainable initiative.

Figure 14: A vertical garden constructed by one of the initial volunteers.

4.5 Demographics & Youth Engagement

While exact census data is not recorded within the Maitland Garden Village, from our time in the village, it has been observed that demographics tend to skew both older and female. This factor is also representative of those who we observed to be the most active within the community, as those who attended weekly GLP events, and all but two of our vertical gardening participants, were older women. This notion points to a larger problem for the future of both the MGV and Green Light Project, as both have struggled to engage and motivate younger generations. As the median age within the village continues to grow, the question of how to capture youth engagement and divert it away from more destructive habits, such as addiction and crime, remains. This question will grow increasingly more important to address in the future, as a

new generation of community leaders and advocates must “receive the torch” and carry on efforts to aid in the development and growth of the MGV.

5.0 Conclusions

Over the past decade, the Maitland Garden Village experienced a significant downturn in the gardening practices which once defined the community. Community members believe that this decrease has caused community identity and healthy lifestyles to diminish substantially. With growing instances of food insecurity and lack of green space both in Cape Town and in urban areas worldwide, vertical gardening has become more prevalent as a method to combat these struggles. Vertical gardens allow for the cultivation of edible produce in smaller confined spaces commonly available in urban settings. We concluded that the implementation of a vertical gardening initiative within the MGV was a beneficial technique for targeting these challenges within the community. In our conclusions, we consider how these initiatives can benefit the MGV and how they can be sustained post our departure. Recommendations focus on fostering community advocates, planning for GLP's future succession, and addressing continuity challenges. Strategies for future researchers highlight the significance of effective interviews and scheduling in the MGV. We suggest potential funding avenues for the GLP in future IQP projects. A well-structured plan and organizational foundation are imperative for the ongoing success of vertical gardening initiatives within the community.

5.1 Benefits of Vertical Gardening in the MGV

Our hope for the community garden is for it to continue to serve as a nursery for the MGV community as well as give the village a space to grow crops that require more soil space than the vertical gardens can provide, such as carrots or potatoes. We have found this to be a challenge as there seems to be an issue with access and continuity of the community garden. The passing of the previous caretaker left it overgrown when we arrived, and without a new caretaker, the garden may fail. We recommend that the GLP finds a trustworthy volunteer who is excited to continue the garden and can teach others so the garden may continue.

Our gardening initiative has the potential to address food insecurity within the MGV; as the plants in the vertical gardens flourish, so will the community’s access to much sought-after herbs, fruits, and vegetables. This will provide access to nutritious, homegrown food that may

otherwise be expensive and in some cases unobtainable. Moreover, our project has the potential to address ongoing social problems within the community, such as drug use among the youth. We believe that by offering them an alternative outlet through gardening, we can channel their energy and creativity into something positive. This not only benefits the youth but also contributes to a safer and healthier community for all. While we acknowledge that our gardening initiative may not entirely resolve the complex issue of youth drug use, recognizing the challenges involved in steering them away from such behaviors, we see it as a meaningful step in the right direction, providing a positive alternative that, over time, may contribute to fostering healthier choices and opportunities for the youth in the community.

5.2 Succession and Continuity

Our time in the MGV has made it clear that Ronell is the only active member of the Green Light Project and its initiatives. Without Ronell, all current programs would cease and the GLP would no longer exist. While Ronell claims that if she were to have a public space for the program, things would improve, we have found that this issue is much deeper than that. We learned from personal conversations and interviews that the community is excited about the efforts of the GLP, but there is a lack of members that are available and willing to work towards any new initiatives. There is a history of passionate community members stepping in for a short amount of time to help, but then they get a job and no longer have the time to participate. Additionally, the members of the community who are willing to participate and step forward tend to sway more toward the older, female population, calling back to the demographic issue of participation mentioned in section 4.5. This brings up questions about the continuity of the GLP and if there are any plans for succession once Ronell is no longer able to participate.

Reflecting on our findings, sustainability emerges as a central theme. The question of continuity beyond our involvement is crucial, highlighting the need for a structured organizational plan within the Green Light Project. Recognizing the necessity for community advocates and the challenges of continuity, we stress the importance of a robust succession plan. This involves appointing multiple community members who will act as leaders and carry on the programs.

We recommend the GLP acts towards the organizational methods and funding advice from the previous project team to ensure financial sustainability. This includes applying for a tax-exemption form through SARS and applying for government funding. More information on these recommendations can be found in the research paper titled *Improving the organizational systems of the Green Light Project* written by the 2022 project team.

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Appendix A: Interview Questions

Introduction Statement and Informed Consent:

"Hello, thank you for agreeing to meet with us. [Introduce Names] We are a group of students from Worcester Polytechnic Institute in the United States who are working with Ronell and the Green Light Project to reimplement gardening into Maitland Garden Village through the introduction of vertical gardens. Vertical gardening is a method of gardening that uses structures to build gardens upwards instead of in a traditional garden bed. Currently we are conducting an interview of community members to gauge interest in participation in the design and implementation of these gardens.

Your participation in this interview is entirely voluntary, and you may withdraw participation throughout any part of the process. All answers to questions will remain anonymous to other participating members of the study, and no personal information will be published in project reports unless consented to. The information collected will be used solely to gauge community interest and gather data about available materials and space."

Interviewees: 10 Initial participating members of this initiative

Introduction Questions

1. What language would you prefer to be interviewed in?
2. Could you tell us your name and a little bit about yourself before we begin?

Gardening Experience

3. Have you gardened in the past? (if yes, can you tell us more and what made you stop?)
4. Were you aware of the community garden located at the creche? Did you participate in it? If so, what went well? What didn't go well? Were there any problems we should be aware of for this project? What would you have done differently?
5. How did the community feel about the community garden? Was there interest or a lack thereof? Why?

Interest in Vertical Gardening Initiative

6. Why are you interested in participating in vertical gardening?

7. What would you like to grow?

Resources and Space Availability

8. Could you describe available space you have for your garden?
9. What kinds of materials do you have available to build your garden with? What kind of training resources do you think would be the most helpful for you and why? (one on one sessions, group sessions, distributed documents)

Closing Questions

10. Is there anything else you would like to share about the MGV community or the GLP's gardening initiative?

Appendix B: Individual Prototyping Meeting Script

Introduction Statement and Informed Consent:

"Hello, thank you for agreeing to meet with us again. We are excited to start building your vertical garden!

As a reminder, your participation in this interview is entirely voluntary, and you may withdraw participation throughout any part of the process. All answers to questions will remain anonymous to other participating members of the study, and no personal information will be published in project reports unless consented to. The information collected will be used solely to gauge community interest and gather data about available materials and space."

Script outline for introducing prototypes.

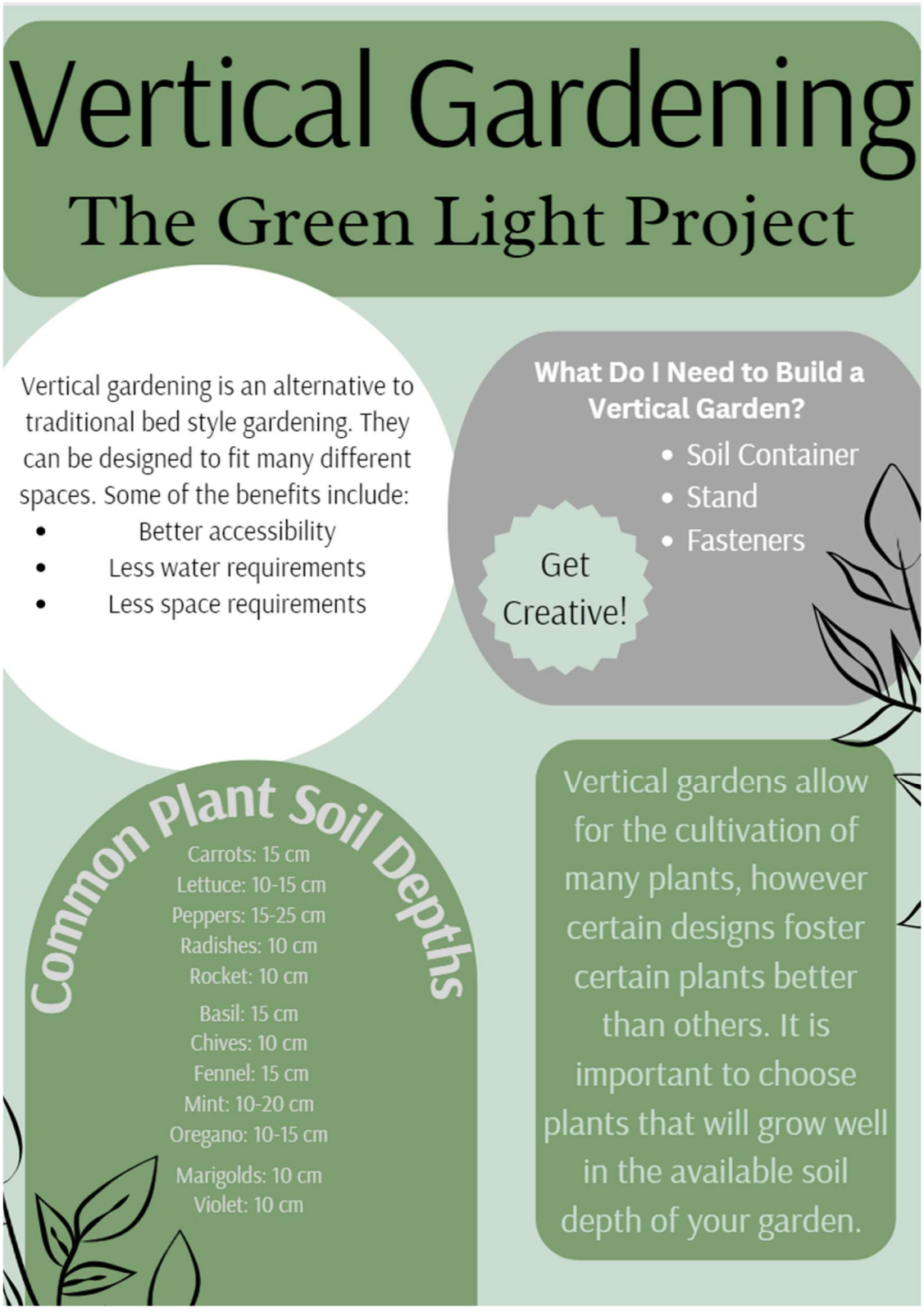
"We've prototyped some ideas based on information from our last interviews, and we'd love to hear your feedback on these designs. You do not have to choose from one of these though! If you have any ideas that you are envisioning for your garden, we want to hear it so that your final garden is what works best for you."




Discussion questions:

1) Did you have any ideas for your vertical garden?
2) Did any of the prototyped designs stand out to you? If so, what did you like or dislike?
3) What style or materials do you feel will work best in your space?
4) What features are you looking for in your garden? This could involve soil depth, size, or accessibility.

Appendix C: Training Flyers



Tire Design

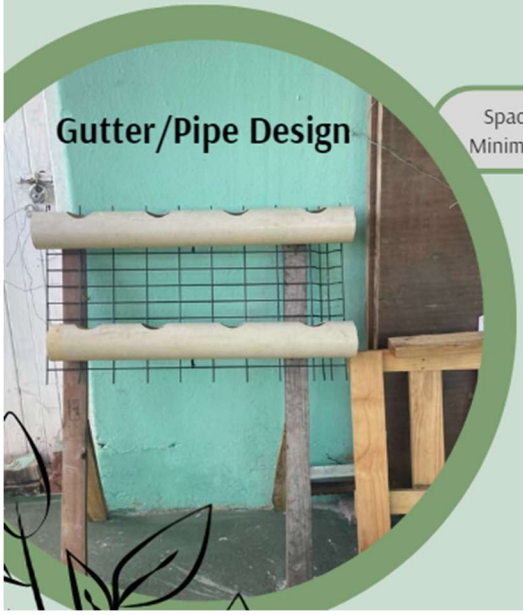
Holds a lot of plants
Good for large spaces

1. Stabilize the bottom tires by adding small pieces of wood to the bottom and sides of each tire
2. Attach first level of shelves, make sure that your bottle/container sits comfortably in between the 2 pieces of wood
3. Add second level of tires and stabilize, repeat step above
4. Add containers and fasten them to the wood by using zip ties/wire

Versatile Sizing
Easy Construction

Crate Design

1. Make a rectangular frame out of 4 pieces of wood (2 shorter 2 longer)
2. Connect 4 legs
3. Cut the crate in half
4. Attach it to the top of the frame as shelves
5. Add containers



Gutter/Pipe Design

Space Efficient
Minimal Materials

1. Connect the two long pieces of wood with the wire fencing
2. Cut holes in the top of PVC pipe
3. Connect the pipe to the wire fencing with cable ties
4. Use two smaller pieces of wood as legs to make the garden stand up

Die Hang Tuine

Die Greenlight Projek

Die hangende tuin is 'n verskillende manier of vorm om tuin te maak. Dit kom in alle style om enige spasie te pas of vul. Die voordele is:

- Maklik om by te kom
- Minder water word benodig
- Minder spasie word benodig

Wat Benodig Ek Om n Hangende Tuin Te Maak?

- Houer
- Rak
- Vas makers (tou/draad)

Algemene Plant Grond Diepte

Wortels/Carrots: 15 cm
Blaarslaai/Lettuce: 10-15 cm
Soetrissies/Peppers: 15-25 cm
Radyse/Radishes: 10 cm
Rucola/Rocket: 10 cm
Basiliekruid/Basil: 15 cm
Grasuie/Chives: 10 cm
Vinkel/Fennel: 15 cm
Kruisement/Mint: 10-20 cm
Oregano: 10-15 cm
Gousblomme/Marigolds: 10 cm
Violet: 10 cm

Hang tuine maak plek vir die groei van baie plante. Maar sekere style maak plante beter groei as ander. Dit is belangrik om die plant te kies wat goed sal groei in die grond diepte van jou tuin.

Die Wiel Styl

Hou baie plante
Is goed vir groot spasies

1. Stabiliseer die wiele met klein stukkies hout en heg dit aan die onderkant en sy kant van die wiele
2. Maak eers die onderste laag van die rak en maak seker dat die bottels vas sit tussen die twee stukke hout
3. Sit die tweede laag van wiele en stabiliseer, dan herhaal stap 2
4. Maak die bakke vas met kabel bande of draad

Veelsydige grootte
Maklik om te bou

Die Kraat Styl

1. Maak 'n reghoekige raam van 4 stukke hout (2 kort en 2 lank)
2. Heg die stukke aan mekaar
3. Sny die kraat in die helfte
4. Maak dit vas bo aan die raam
5. Sit die houers bo op

Die Pyp Styl

Genoeg Spasie
Baie min materiaal

1. Heg die 2 lang stukke hout bymekaar met draad
2. Sny gate in die pyp
3. Heg die pyp aan die draad met kabel bande
4. Gebruik die 2 kleiner stukke hout om die tuin regop te staan

Appendix D: Virtual Training Manual

Tire Design

Holds a lot of plants
Good for large spaces

Required Materials

- 4 long pieces of wood
- 2 medium sized pieces of wood
- 8 small pieces of wood
- 4 tires (preferably the same size)
- Nails or screws
- Water bottles (preferably 5 Litres)
- Cable ties

1. Stabilize the bottom tires by adding small pieces of wood to the bottom and sides of each tire
2. . Attach first level of shelves, make sure that your bottle/container sits comfortably in between the 2 pieces of wood
3. Add second level of tires and stabilize, repeat step above
4. Add containers and fasten them to the wood by using cable ties/wire

Alternate Materials

- Any long, strong material (wood, pipe, etc)
- Water bottles can be replaced with any sort of container for soil

Crate Design

Versatile Sizing
Easy Construction

Required Materials

- 8 pieces of wood for a frame structure
- Milk crate
- Screws or nails
- Water Bottles (preferably 5-Litre)

Alternate Materials

- Anything that can be used as shelves for the bottles to sit on
  - Pipes
  - Wood
  - Old table
- Water bottles can be replaced with any container for soil

1. Make a rectangular frame out of 4 pieces of wood (2 shorter 2 longer)
2. Connect 4 legs
3. Cut the crate in half
4. Attach it to the top of the frame as shelves
5. Add containers

Gutter Design

Space Efficient
Minimal Materials

Required Materials

- 2 tall planks of wood
- Wood scraps
- A gutter (cut into pieces)
- Wire fencing
- Screws or nails
- Cable Ties

1. Connect the two long pieces of wood with the wire fencing
2. Cut holes in the top of PVC pipe
3. Connect the pipe to the wire fencing with cable ties
4. Use two smaller pieces of wood as legs to make the garden stand up

Alternate Materials

- Pipe
- Wire fencing can be replaced with poles or dowels (for vines to grow up)

Appendix E: Final Vertical Gardens