UNIVERSIDAD PARA LA COOPERACION INTERNACIONAL
(UCI)

PROJECT MANAGEMENT PLAN FOR THE DESIGN AND CONSTRUCTION OF A GREEN, CLIMATE-RESILIENT, SINGLE-FAMILY HOME IN RURAL BELIZE

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DEDICATION

I dedicate this final graduation paper to my children, partner, and family; this would not have been possible without your unconditional support and understanding. I appreciate all the encouragement provided to me during difficult times and celebrating the joyous.

I also thank my friends for their unwavering support given to me throughout the entire program.

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This paper would not have been possible without the guidance, assistance, support, and encouragement of the following persons, to whom I wish to express my gratitude. Firstly, I want to thank God for his blessings and for giving me the strength and perseverance to complete the paper and program.

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I am forever grateful to my family and friends, who have allowed me to follow my dreams and assisted me in some way during this program.

ABSTRACT

The call for sustainability has been around for decades. Policymakers, non-governmental organizations, and environmentalists agree that we are using up the planet's resources faster than they can be replenished. Many world leaders believe we must go beyond sustainability, using a more holistic approach to ensure that future generations can enjoy the same if not better, resources than we currently enjoy.

According to the World Green Building Council (n.d.), buildings are responsible for approximately one-third (1/3) of the world's energy consumption and carbon emissions. In Belize, buildings consume more than ninety percent (90%) of the country's total electricity consumption. Research shows that green buildings can reduce, optimize energy demand, and use renewable energy sources that will drastically reduce energy consumption and carbon emissions from buildings. The Caribbean Community Climate Change Center (2017) estimates that pilot green building activities will decrease the country's electricity consumption by twenty percent (20%).

Green architecture has gained significant traction due to its potential environmental impacts (Kubba, 2017). When green architecture is correctly applied, operational costs decrease, and buildings last longer. More importantly, it protects our natural resources and ecosystem and contributes to a better way of life. Therefore, a project management plan that aligns with the principles and knowledge areas of the Project Management Body of Knowledge (PMBOK® Guide) must be developed to complete such projects successfully. This document was created using a qualitative approach and primary and secondary data to develop a project management plan for designing and constructing a green, climate-resilient, single-family home in rural Belize per the PMBOK® Guide.

Keywords: climate-resilient, green architecture, Leadership in Energy and Environmental Design (LEED), project management, regenerative, renewable energy, sustainability

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ABBREVIATIONS AND ACRONYMS

5Cs:	Caribbean Community Climate Change Center
BREEAM:	Building Research Establishment Environmental Assessment Method
CBA:	Central Building Authority
CCB:	Change Control Board
CPI:	Cost Performance Index
CV:	Cost Variance
CSQM:	Construction Safety & Quality Management
EEA:	European Environment Agency
ESG:	Environmental, social, and governance
EVM:	Earned Value Management
GDP:	Gross Domestic Product
GHG:	Greenhouse Gas Emissions
GPM:	Green Project Management
LEED:	Leadership in Energy and Environmental Design
OSHA:	Organizational Safety & Health Authority
PAHO:	Pan American Health Organization
PMBOK®:	Project Management Body of Knowledge
PMI:	Project Management Institute
SPI:	Schedule Performance Index
TCPI:	To-complete Performance Index
UCI:	University for International Cooperation
UN:	United Nations

EXECUTIVE SUMMARY

Green Building Solutions Belize Ltd. is a private construction firm formed through a partnership with four experts in Belize's construction sector. Belize is a country prone to hurricanes and flooding, which cause significant damage to the country's infrastructure. These experts believed that buildings in Belize were not being built to withstand these catastrophes and that the construction sector needed to incorporate green construction or climate resiliency into building designs and construction. They also believed that key players in the construction industry must take on crucial roles in combating climate change and the negative impacts that the industry has on the environment. The partners saw this as an opportunity and created the company to provide sustainable architectural services to its customers.

The company provides customers with effective, efficient, and rigorous building designs and constructions using sustainable products and materials that minimize the industry's impact on climate change while meeting customers' demands. The company is on a mission to deliver a sustainable future for the world through sustainable architecture and envisions becoming Belize's most innovative, customer-focused, inclusive, and sustainable architectural firm. The company recently completed a green building to be used as office space for the country's Ministry of Sustainable Development, Climate Change, and Disaster Risk Management; and is aware of the government's plan to initiate policies for more sustainable economic development, including green, climate-resilient family homes.

Belize's population has grown tremendously since the last census, leading to migration from urban to rural areas that have not yet been developed for housing purposes. This, coupled with the need for more sustainable construction practices and incorporating climate resilience into building designs and construction, has led to a need to build affordable, climate-resilient, sustainably developed housing initiatives.

Green Building Solutions Belize Ltd. is apt to capitalize on this need. As such, the company required a comprehensive project management plan to design and construct green, climate-resilient, single-family homes. There were no similar guidelines, building standards, or project management plans for designing and constructing green, climate-resilient homes in Belize. Creating the project management plan was also important, as it was used to develop minimum standards for sustainable architecture in Belize.

The general objective of this document was to create a project management plan following the Project Management Body of Knowledge to design and construct a green, climate-resilient single-family home in rural Belize. The project management plan integrated sustainable processes and practices, green technologies, and expertise from design to construction. The specific objectives were in alignment with the general objective and were as follows: to develop an Integrated Management Plan, inclusive of a project charter, which will coordinate all the elements of the project needed to complete the project successfully, develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully, develop a Schedule Management Plan

to define the timeline for the project deliverables to ensure the project's timely completion, develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources, develop a Quality and Safety Management Plan to ensure all project deliverables meet stakeholders' expectations, develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully, develop a Communications Management Plan to ensure effective communication with project stakeholders and to record all project communications, develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks, develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team, develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure their expectations are understood, recorded, and considered throughout the project life cycle, to develop a change management plan to establish, communicate, manage, and control changes that are likely to occur during the project's lifecycle, and conduct a P5 Impact Analysis to ensure that the FGP actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.

Green Building Solutions developed this project management using a qualitative approach and primary and secondary data for designing and constructing a green, climate-resilient, single-family home in rural Belize, per the PMBOK®. The methodology ensures that the plans' specific objectives and deliverables are met. All subsidiary plans of the project management plan were successfully developed for consideration during the planning and execution of the project to ensure the successful completion of the project. It is recommended that the project manager and the project team follow the subsidiary plans developed for the project using the relevant project management tools and techniques, prescribe the fundamental principles of green building design and construction, and conduct effective monitoring and evaluation of the project execution which will ensure successful completion of the project.

1 INTRODUCTION

Belize is a small, English-speaking country located in Central America. The country faces the Caribbean Sea in the east, identifies as a Caribbean country, and, as such, is a member of the Caribbean Community (CARICOM). As a low-lying coastal country, Belize is vulnerable to climate change and climate-related natural disasters. In 1961, the country was hit by a category four (4) hurricane, which caused severe damage to Belize City, the country's capital at the time. This prompted the government to relocate the capital city inland to Belmopan.

However, Belize City is still considered the financial capital of the country and the largest urban community within the country (Belize City Council, n.d.) and is still very susceptible to hurricanes and flooding. In 2002, after a post-mortem of the damages caused by Hurricane Iris in 2001, the country's Association of Professional Engineers stated that there is nothing that can be done to completely prevent damage from a hurricane because the country cannot afford the costs of those types of construction (News 5, 2002). However, the Association concedes that a balance can be achieved between economy and safety by adhering to its recommendations, which can curb the significance of the damages caused by natural disasters.

More recently, in 2022, Belize was struck by a category five (5) hurricane, which did significant infrastructural damage, like its predecessors. As with the 1961 and 2001 hurricanes, many of the country's residents were left homeless due to their homes being wholly or partially destroyed (PAHO, 2022). Belize's population has also increased significantly since the last population census. This has led to a migration from urban to

rural areas. Underdeveloped and remote areas of the country currently without electricity and tap water are being used to build homes and haphazard housing communities.

The following sections of this chapter will provide background and historical information on the topic under investigation. It discusses the problem, solutions, purpose, and objectives of developing a project management plan for the specific project.

1.1. Background

According to the Statistical Institute of Belize (2021), the construction sector accounts for $180.8 million in Belize dollars, or 4.3% of Belize's Gross Domestic Product (GDP). Albeit a small contribution to the GDP, the industry employs roughly 7.6% of the total employed persons in the country. Many government projects are focused on large-scale infrastructural development, including building construction (Press Office of Belize, 2022).

Research shows that over one-third (1/3) of total energy use and associated greenhouse gas (GHG) emissions are attributed to buildings (European Environment Agency [EEA], 2022). Although Belize is a minute contributor to greenhouse gas emissions (United Nations, 2011), its building sector currently consumes more than ninety percent (90%) of total electricity consumption (Caribbean Community Climate Change Center, 2017). This makes it the country's second-largest source of GHG emissions (Caribbean Community Climate Change Center, 2017).

According to Green Project Management (GPM) Global (2019), we consume more resources than the planet can provide, and the cost of living, electricity, and housing has

rapidly increased since 2000. Policymakers and consumers are starting to heed the warnings that we must be more environmentally and socially conscious. Consumers are looking for sustainable products and solutions, and conscious consumerism is rising (Petro, 2022). The government of Belize has initiated policies for more sustainable economic development and continues to seek accreditation from international financial institutions that offer green financing. Local development banks now have portfolios offering attractive products for implementing renewable or solar energy technologies to curb the country's energy use.

1.2. Statement of the Problem

With a growing population, the need to construct homes that are resilient against climate-related natural disasters, and the need to have more sustainable practices of development, there is a need for affordable, climate-resilient, sustainably developed housing initiatives in Belize. At present, Belize has no green or sustainable construction policies, and not much is being done outside the cities and towns to enforce building standards.

Green Building Solutions Belize Limited sees this as an opportunity for the company to capitalize on the country's need to build resilience to extreme weather-related catastrophes by becoming the premier sustainable architectural service provider. To offer sustainable products and services to buyers and homeowners that better enable them to manage their exposure to climate-related threats and building materials that cause little to no harm to the environment. Creating a project management plan in accordance with the

guidelines proposed by the Project Management Institute's Project Management Body of Knowledge can increase the company's chances of achieving this goal.

1.3. Purpose

Green Building Solutions Belize Limited was created with a mission to provide affordable, sustainable architectural services to its customers. Currently, there are no similar guidelines or project management plans for designing and constructing green, climate-resilient homes in Belize. This study aims to develop a project management plan to design and construct a green, climate-resilient, single-family home in rural Belize in accordance with the knowledge areas described in the Project Management Body of Knowledge. Green Building Solutions Belize Limited intends that this project management plan can be used as a guideline for future green building construction projects.

Since Belize currently has no standards for green or sustainable architecture, it is also intended that, through a collaboration between the relevant authorities and an analysis of green building standards, the project management plan will develop minimum standards for sustainable architecture in Belize. Research has shown that green building construction reduces electricity consumption (Rahman, 2022), and it is expected that pilot activities of green building construction will reduce Belize’s electricity consumption by twenty percent (20%) (Caribbean Community Climate Change Center, 2017).

Developing the project management plan according to the principles and knowledge areas prescribed by the Project Management Body of Knowledge will enable the company to succeed in establishing mechanisms and standard operating procedures. These

established practices will allow for efficiency and sustainable practices in successfully executing current and future projects. Another benefit of developing the project management plan is that the company can assess the supply chain management of procuring sustainable building materials. It will also focus on community-based adaptation initiatives to reduce common climate risks faced by the community.

1.4. General Objective

The general objective is to create a project management plan in accordance with the Project Management Body of Knowledge to design and construct a green, climate-resilient single-family home in rural Belize that integrates sustainable processes and practices, green technologies, and expertise from design to construction.

1.5. Specific Objectives

The specific objectives which are aligned to the general objectives are as follows:

1. Develop an Integrated Management Plan, inclusive of a project charter defining key input elements, to coordinate all the elements of the project needed to successfully complete the project.
2. Develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully.
3. Develop a Schedule Management Plan to define the timeline for the project deliverables to ensure the project's timely completion.
4. Develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources.

5. Develop a Quality and Safety Management Plan to ensure that all project deliverables meet stakeholders' expectations.
6. Develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully.
7. Develop a Communications Management Plan to ensure effective communication with project stakeholders and to record all project communications.
8. Develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.
9. Develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team.
10. Develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure that their expectations are understood, recorded, and considered throughout the project life cycle.
11. Develop a Change Management Plan to establish, communicate, manage, and control changes that are likely to occur during the project’s lifecycle and assess their impacts on budget, schedule, scope, stakeholders, and resources.
12. Conduct a P5 Impact Analysis to ensure that the FGP actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.

2 THEORETICAL FRAMEWORK

This chapter provides relevant information about the company's framework, background, mission and vision statements, organizational structure, and products offered. The chapter also focuses on relevant project management concepts, theoretical frameworks, and other relevant literature regarding the project to construct green, climate-resilient homes in Belize.

2.1 Company/Enterprise Framework

This section provides information on Green Solutions Belize Limited's background, mission and vision statements, values, organizational structure, and governance. These are the guiding factors in how the company functions.

2.1.1 Company/Enterprise Background

Green Building Solutions Belize Limited is a registered private construction company operating in Belize. The company was incorporated on September 1st, 2020, under the Belize Companies Act (Revised Edition 2022). The primary purpose of the business is to provide sustainable architectural services to its customers. The company is owned and operated by four (4) members who have years of experience in engineering and architecture and are very knowledgeable about Belize's construction industry. Its principal office is in Belmopan.

Green Building Solutions has a wealth of experience completing small-scale renovations, larger projects, and developments. Its first major project was designing and constructing a green building to act as the office for the Ministry of Sustainable

Development, Climate Change, and Disaster Risk Management and other departments and statutory bodies that fall within that ministry's purview. The company is now looking towards designing and constructing green, climate-resilient single-family homes. The company is also working with the government of Belize to accomplish one of the goals set out in its Medium-Term Development Plan to construct ten thousand resource-efficient, climate-resilient homes in various areas of the country.

2.1.2 Mission and Vision Statements

2.1.2.1 Mission.

Green Building Solutions Belize Limited recognizes that protecting our environment is critical and requires the company to be committed to sustainability to meet its environmental, social, and governance (ESG) goals. The company also recognizes that consumers increasingly demand more sustainable products and solutions. The company is mandated to reduce waste, improve energy efficiency, and provide safer and high-performing sustainable products. The mission statement for the company is as follows:

"To deliver a sustainable future for the world through our sustainable architecture expertise and collaboration with our partners."

Developing a project management plan to construct a green, climate-resilient single-family home in rural Belize is linked directly to the company's mission, vision, and values. The project management plan, in accordance with the Project Management Body of Knowledge, will better equip the company to successfully complete this project and successfully bid and deliver other green buildings across the country.

2.1.2.2 Vision.

Green Building Solutions Belize Limited wants to become a leader in providing sustainable architectural services in Belize. Its vision is to be Belize's most innovative, customer-focused, inclusive, and sustainable architectural firm. To meet its vision, it has seen the need to create a project management plan to design and construct green, climate-resilient homes using innovative, quality, and sustainably sourced materials to provide its customers with all the amenities of traditional houses.

2.1.2.3 Values.

The fundamental beliefs of the company, depicted in Figure 1, align with its mission and vision and guide how the company will carry out its mission and meet its vision.

Figure 1

Green Building Solutions Belize Ltd. Company Values

Note: Own Source

2.1.3 Organizational Structure

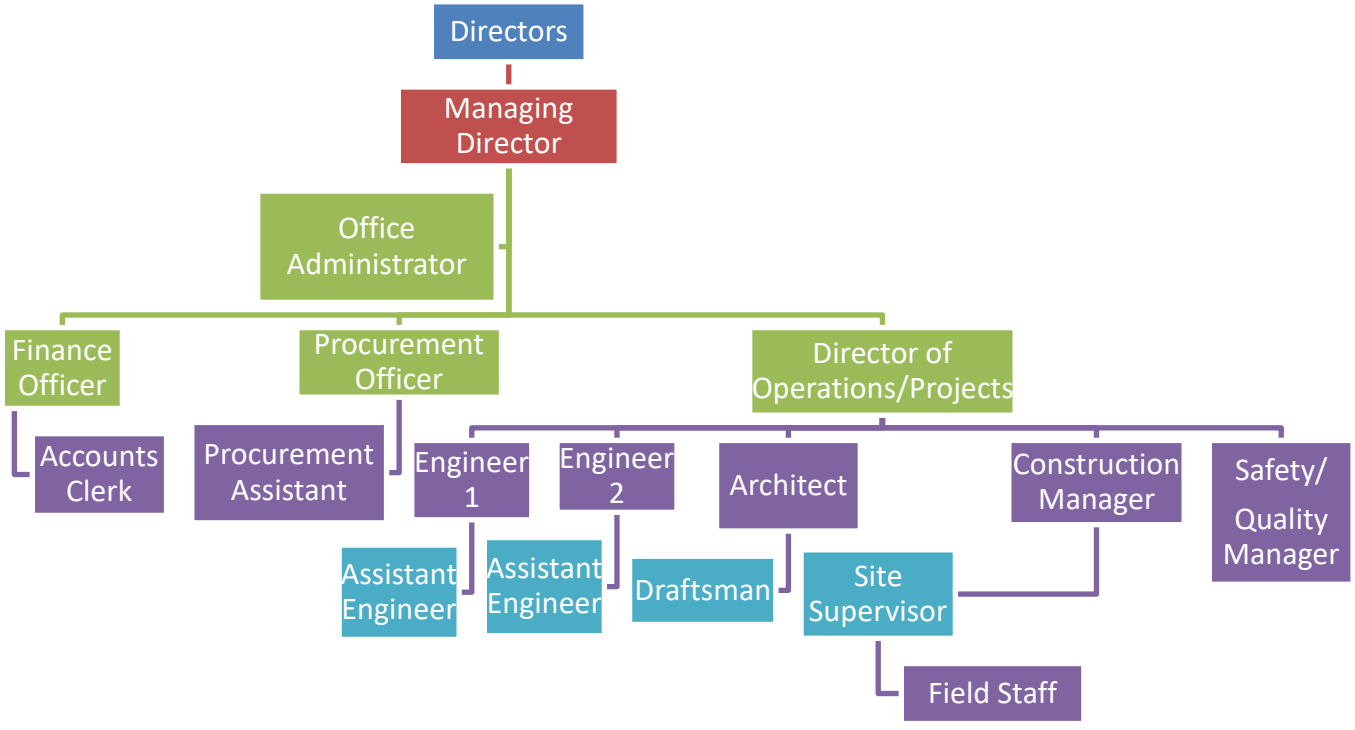
Green Building Solutions Belize Limited is a small, newly established company operating in the construction industry. As such, roles and functions are sometimes bundled together but separated by departments in a functional hierarchy. This makes the operations more efficient and can lead to faster organizational development through the specialization of each department. The functional hierarchy also provides well-defined control lines and communication paths.

The company is directed by a Board of Directors, as depicted in Figure 2. One of the directors also acts as the Managing Director of the company. The Office Administrator is responsible for the company's day-to-day administrative management, including personnel issues, and reports to the Managing Director. The Finance Officer, Procurement Officer, and Director of Operations/Projects each report directly to the Managing Director. The Finance Officer is responsible for managing each project's cash flow, and the Procurement Officer is responsible for procuring materials and managing the supply chain. Each has one assistant that they are responsible for supervising. The Director of Operations/Projects oversees a unit that consists of two (2) Engineers, an Architect, a Construction Manager, and a Safety Manager. Each engineer has an Assistant Engineer, and the architect oversees the draftsman's work. The Construction Manager is responsible for the projects at a high level. He oversees the Site Supervisor, who is responsible for supervising the day-to-day execution of project activities and supervising the field staff. The Safety/Quality Manager works closely with the Construction Manager and the Site Supervisor.

The company treats each job it receives as a project, and the Director of Operations/Projects is responsible for managing each project. He is also responsible, with the help of his team, for preparing the bidding documents associated with bidding for projects. His team is also responsible for the overall execution of the project from design to finishing. The other personnel in the company play a supporting role in the execution of the project. As previously mentioned, the procurement manager ensures that the materials ordered comply with the Bill of Quantity (BOQ) and arrive on time. The Finance Officer manages each project's cash flow, ensures a line item for each procurement process, and assesses variances.

Figure 2

Organizational Structure



Note: Own creation.

2.1.4 Products Offered

In Belize, the building sector is the second-largest source of Green House Gas emissions (Caribbean Community Climate Change Center, 2017). Green Building Solutions Belize Limited recognizes that members of the construction industry must take on key roles in tackling climate change. The company is passionate about providing customers with effective, efficient, rigorous, sustainable building designs and constructions that minimize the industry's impact on climate change and meet its customers' demands. Buildings designed and constructed by the company are also easy and cost-effective to maintain. Sustainable products play a vital role in reducing carbon dioxide emissions, and the company uses carbon-efficient technologies that lower emissions. The company also uses sustainable water-saving products when selecting urinals, showers, and tap fittings. Green Building also incorporates green spaces into all its designs.

2.2 Project Management Concepts

Projects and project management have existed since immemorial (PMI, 2017). However, it was not until the mid-20th century that project managers sought recognition of project management as a profession, as they used a unique set of skills to deliver projects successfully (PMI, 2017). Today, the terms projects and project management are commonly and widely used. Many organizations believe that projects are the best means of attaining organizational goals and implementing various business strategies (Sundqvist, 2019). The knowledge of experts from the project management profession has been incorporated into a Project Management Body of Knowledge (PMBOK®) published by the Project Management Institute (PMI) and published every four (4) years. The PMBOK®

provides project management practitioners with proven traditional, innovative, and generally accepted good practices that can be successfully applied in the project management field.

The Project Management Institute (2017) defines projects as temporary endeavors to create unique products, services, or results that can enable value creation for the entity. Project management is "the application of knowledge, skills, tools, and techniques to project activities to meet project requirements" (PMI, 2021, p. 34). Project management also involves guiding the project activities to achieve the project's intended outcomes which can be achieved using a broad range of approaches (PMI, 2021). Applying project management's knowledge, skills, tools, and techniques to project activities is essential in meeting project requirements and executing projects effectively and efficiently (PMI, 2017). One important factor to note is that projects may vary in size, magnitude, level, and objectives, but the project management knowledge, tools, and skills are applicable regardless of these factors.

This section details the principles and domains of project management. It also discusses the different approaches and processes involved in project management. It identifies how these concepts relate to the project management plan to design and construct a green, climate-resilient single-family home in rural Belize.

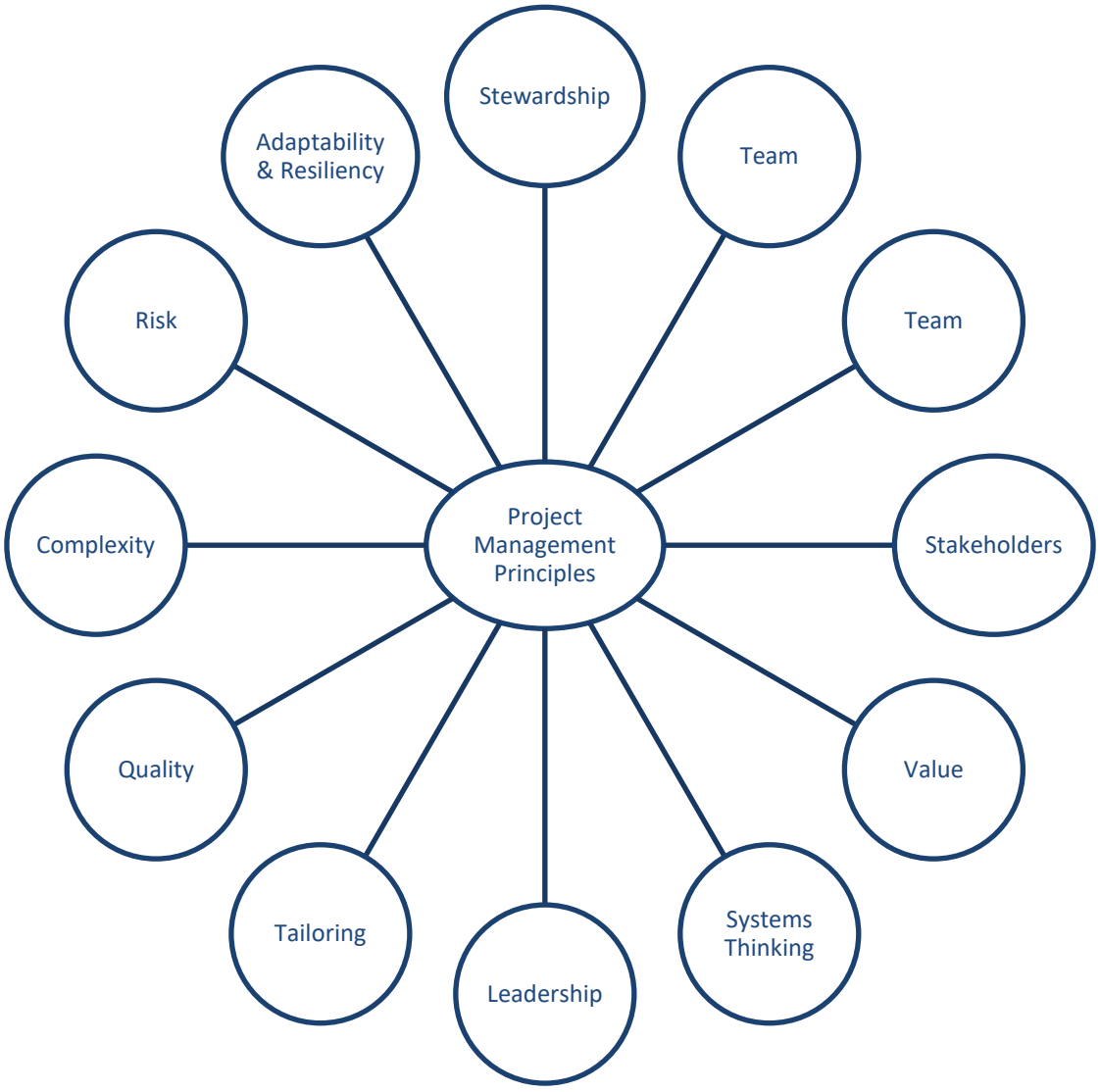
2.2.1 Project Management Principles

The Project Management Body of Knowledge, seventh (7th) edition (PMI, 2021), lists twelve (12) project management principles, as depicted in Figure 3. These principles are not prescriptive but can be used as a guide for project management practitioners. These

principles will guide the development of the project management plan to design and construct a green, climate-resilient, single-family home in rural Belize.

Figure 3

Twelve Principles of Project Management



Note: Adapted for the Project Management Body of Knowledge (PMI, 2021).

The principles put forth by the Project Management Institute are similar to the values held by the company; as such, these principles are already ingrained in the company's culture and can easily be incorporated into the project management plan. The principle of stewardship embodies three primary guiding values of the company: to carry out all activities with integrity, in compliance with all regulatory requirements, with care for the planet and people, and to be respectful. The company treats all its jobs as projects and, as such, fosters collaboration and teamwork within the organization and with relevant stakeholders. Green Building Solutions embraces all team members' professional and personal development and uses project management processes to complete project activities. There is clarity in the roles, responsibilities, and authority of each team member, as well as accountability.

Green Building Solutions considers all its stakeholders and how they are impacted during its project phases. The company ensures that it fosters an environment that encourages stakeholder engagement. With this project, Green Building Solutions will work closely with all stakeholders to discuss standards, practices, and quality control policies for constructing green buildings in Belize.

The company ensures that all projects create value by meeting a business need or working towards the company's overall strategic objectives. These projects also provide value to the stakeholders affected by the project. The construction industry is dynamic, with new technologies being introduced almost daily, and the company takes a holistic approach when dealing with changes. Leadership is another important principle for the

company, and effective leadership is encouraged at all levels of the organization and within project teams.

Construction is all about tailoring and meeting the needs of individual clients while providing quality. Each project the company takes on is unique with its own set of complexities, and project success is often based on adaptability.

2.2.2 Project Management Domains

According to the Project Management Institute (2021), eight (8) project performance domains exist. The Project Management Institute describes project performance domains as a set of interrelated, interdependent, and interactive activities for effective project outcomes. The performance domains run simultaneously throughout the project, and each is necessary throughout the project's lifecycle (PMI, 2021). Table 1 lists and describes the eight (8) project performance domains and states how each will be incorporated into the project.

Table 1

Project Management Domains

Project Performance Domains	Description
Stakeholders	This performance domain addresses activities associated with stakeholders. The communication and stakeholder engagement plan will address how stakeholders will be identified, kept engaged, and updated on project activities.
Team	The team project performance domain addresses activities and functions associated with those responsible for project deliverables. Green Building Solutions considers its team high-performing and has promoted an environment of shared values and vision since its inception. This performance domain is incorporated into the project's resources and risk management plans.

Project Performance Domains	Description
Development Approach and Life Cycle	This performance domain deals with developing approaches consistent with project deliverables and using a project life cycle that provides value to stakeholders throughout the project—the project's scope and schedule management plans address this domain.
Planning	The planning performance domain organizes and coordinates the project activities throughout the project's life cycle. The project management plan developed for the project will manage and coordinate the project work, considering the scope, estimation of resources needed, budget, market conditions, schedule, etc.
Project Work	This domain is associated with all activities that establish the project processes for getting the project work, from requesting bid document, holding bidders' conferences, completing bid document, managing resources to executing the project work. These are incorporated in the scope, cost, schedule, quality, procurement, stakeholder, and resource management plans.
Delivery	The project delivery performance domain focuses on meeting the requirements, scope, and quality expectations that will deliver the project's expected outcome. This domain is addressed in the scope, schedule, and quality management plans.
Measurement	The measurement performance domain assesses project performance and implements appropriate actions to rectify situations that do not meet optimal performance. This domain is addressed in the schedule, quality, cost, and resource management plans.
Uncertainty	This performance domain deals with the risks and uncertainties associated with projects. The project's risk management plan addresses uncertainties and risks associated with the project.

Note: Table 1 shows the project performance domains according to the guide to the Project Management Body of Knowledge (Project Management Institute, 2021)

2.2.3 Predictive, Adaptive and Hybrid Projects

According to the Project Management Institute (2021), the three frequently used development approaches are predictive, hybrid, and adaptive. These three approaches can

be viewed as a spectrum with predictive at one end, hybrid in the middle, and adaptive at the other end of the spectrum (PMI, 2021).

The predictive approach is also referred to as the waterfall approach. This approach is often used "when the project and product requirements can be defined, collected, and analyzed at the start of the project" (PMI, 2021, p. 113). Using this approach allows for the scope, schedule, cost, resource needs, and risks to be well-defined in the early phases of the project, reducing the level of uncertainty. The predictive approach is predictable as it follows the project management plan created just before starting the project.

The hybrid approach uses a mixture of predictive and hybrid approaches. It uses elements from both approaches to deliver project outcomes. This approach is often used when uncertainty or risks are associated with the project requirements (PMI, 2017). Hybrid approaches often use an incremental development approach that allows for clarification of requirements or investigation of other options before the final iteration (PMI, 2021).

The adaptive approach also uses iterations, but they are usually much shorter than those used under a hybrid approach. Adaptive approaches typically start with an initial known requirement which evolves over time based on stakeholders' feedback. This approach is often used when there is high uncertainty, volatility, and the likelihood that changes will affect the project's final outcome.

The project to design and construct a green, climate-resilient home will use the predictive approach, as detailed planning will be carried out at the beginning. Many safety and environmental regulations must be adhered to in the construction industry, which

requires upfront planning to obtain necessary permits. The company cannot deviate from these plans during the execution of the project.

2.2.4 Project Management

Project management entails applying knowledge, skills, tools, and techniques to project activities, and it acts as a guide in achieving the intended project outcomes (PMI, 2021). These knowledge, skills, tools, and techniques are essential throughout a project's lifecycle (PMI, 2017), as they assist in planning, monitoring, and controlling all aspects of a project (Lester, 2021). Many organizations recognize that projects are a means of achieving strategic objectives and are implementing more projects in their organizations (Sundqvist, 2019). With more projects implemented, project management practitioners must be aware of proven and innovative practices. Project management tools and techniques provide structure and guidance in carrying out project activities.

According to Lester (2021), the project management plan is a "document which summarizes all of the main features encapsulating the Why, What, When, How, Where, and Who of a project" (p. 546). It is a formal document allowing the project team to direct, execute, monitor, and control project activities. The knowledge, tools, and techniques discussed in the project management plan to design and construct a green, climate-resilient home in Belize will be as per the knowledge areas, principles, and domains set out in the Project Management Body of Knowledge. It will guide the project team in effectively, efficiently, and sustainably achieving the project deliverables.

2.2.5 Project Management Knowledge Areas and Processes

According to the Project Management Institute (2017), a process is a series of project management activities consisting of inputs, tools and techniques, and outputs. The processes are grouped into five process groups. A process group is "a logical grouping of project management processes to achieve specific project objectives" (p. 23). The process groups are independent of project phases (PMI, 2017). The five process groupings, as identified in the PMBOK®, are as follows:

1. Initiating - processes performed to define a new project or to conduct a new phase of an existing project by seeking authorization to start the project or phase (PMI, 2017).
2. Planning - processes needed to determine the project's scope, refine the objectives, and define the course of action needed to achieve project objectives (PMI, 2017).
3. Executing - processes required to complete the work defined in the project management plan to satisfy the project requirements (PMI, 2017).
4. Monitoring and Controlling - are the processes that track, review, and regulate the progress and performance of the project. It also involves identifying any areas that require changes and how to initiate those changes (PMI, 2017).
5. Closing - processes performed to formally complete or close a project f, phase, or contract (PMI, 2017).

Additionally, processes are organized by knowledge areas. The Project Management Institute (2017) defines a knowledge area as "an identified area of project management defined by its knowledge requirements and described in terms of its

component processes, practices, inputs, outputs, tools, and techniques" (p. 23). The Project Management Institute has identified ten (10) knowledge areas related to project management as follows:

1. Project Integration Management - these are the processes and activities needed to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups (PMI, 2017).
2. Project Scope Management - these are the processes required to ensure the project includes all the work required, and only the work required, to complete the project successfully (PMI, 2017).
3. Project Schedule Management - includes the processes required to manage the project so that it is completed on time (PMI, 2017).
4. Project Cost Management - involves the planning, estimating, budgeting, financing, funding, managing, and controlling costs so the project can be completed within the approved budget (PMI, 2017).
5. Project Quality Management - these are the processes for incorporating the organization's quality policy regarding planning, managing, and controlling project and product quality requirements to meet stakeholders' expectations (PMI, 2017).
6. Project Resource Management - these are the processes that identify, acquire, and manage the resources needed for the successful completion of the project (PMI, 2017).
7. Project Communications Management. - includes the processes required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval,

management, control, monitoring, and ultimate disposition of project information (PMI, 2017).

8. Project Risk Management - the processes required to conduct risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project (PMI, 2017).
9. Project Procurement Management - the processes necessary to purchase or acquire products, services, or results needed from outside the project team (PMI, 2017).
10. Project Stakeholder Management - includes the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, analyze stakeholder expectations and their impact on the project, and develop appropriate management strategies for effectively engaging stakeholders in project decisions and execution (PMI, 2017).

Table 2 summarizes the project management processes by groups and knowledge area. These processes and knowledge areas are incorporated within the project management for the design and construction of a green, climate-resilient home in Belize, but since Green Building Solutions operates in the construction industry, financial, health, and safety management will also be incorporated into its project management plan.

Table 2

Summary of Project Management Process Groups and Knowledge Areas

Project Management Process Groups					
Knowledge Areas	**1. Initiating Process Group**	**2. Planning Process Group**	**3. Executing Process Group**	**4. Monitoring and Controlling Process Group**	**5. Closing Process Group**
1. Project Integration Management	• Develop Project Charter	• Develop Project Management Plan	• Direct and Manage Project Work • Manage Project Knowledge	• Monitor and Control Project Work • Perform Integrate Change Control	• Close Project or Phase
2. Project Scope Management		• Plan Scope Management • Collect Requirements • Define Scope • Create WBS		• Validate Scope • Control Scope	
3. Project Schedule Management		• Plan Schedule Management • Define Activities • Sequence Activities • Estimate Activity Durations • Develop Schedule		• Control Schedule	
4. Project Cost Management		• Plan Cost Management • Estimate Costs • Determine Budget		• Control Costs	

Project Management Process Groups					
Knowledge Areas	**1. Initiating Process Group**	**2. Planning Process Group**	**3. Executing Process Group**	**4. Monitoring and Controlling Process Group**	**5. Closing Process Group**
5. Project Quality Management		• Plan Quality Management	• Manage Quality	• Control Quality	
6. Project Resource Management		• Plan Resource Management • Estimate Activity Resources	• Acquire Resources • Develop Team • Manage Team	• Control • Resources	
7. Project Communications Management		• Plan Communications Management	• Manage Communications	• Monitor Communications	
8. Project Risk Management		• Plan Risk Management • Identify Risks • Perform Qualitative Risk Analysis • Perform Quantitative Risk Analysis • Plan Risk Responses	• Implement Risk Responses	• Monitor Risks	
9. Project Procurement Management		• Plan Procurement Management	• Conduct Procurements	• Control Procurements	
10. Project Stakeholder Management	• Identify Stakeholders	• Plan Stakeholder Engagement	• Manage Stakeholder Engagement	• Monitor Stakeholder Engagement	

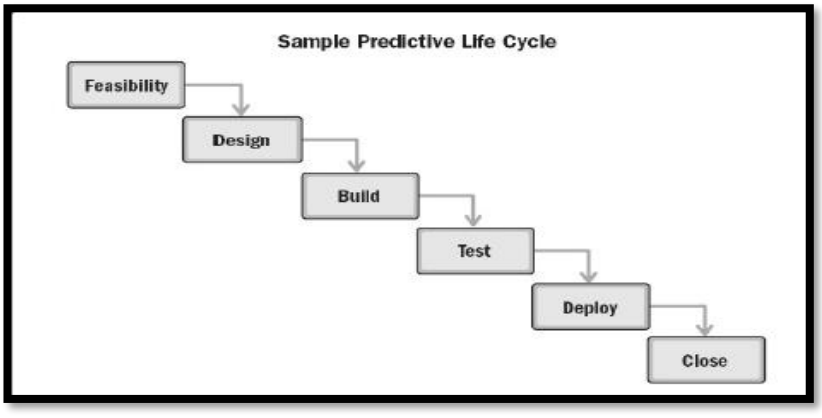
Note: Summary of the project management process within knowledge area and process groups. Adapted for the Project Management Body of Knowledge (PMI, 2021).

2.2.6 Project Life Cycle

The Project Management Institute (2021) defines a project life cycle as all the phases a project passes through from start to finish. Lester (2021) concurs with that assessment and defines a project's lifecycle as "all the processes and phases between the conception and termination of a project" (p. 546). The type and number of phases in a project's lifecycle depend on many factors, including the development approach used (PMI, 2021). Figure 4 depicts a typical predictive project life cycle. Under a predictive approach, completing one phase allows the project team to move on to the next phase. Heldman (2018) describes a predictive life cycle as a "phase-to-phase progression" (p. 19); the handoff at the end of each phase serves as a checkpoint to determine whether the project should continue. Under an adaptive approach, several sprints that repeat project phases are used until the final deliverable is met (PMI, 2021).

Figure 4

Sample Predictive Life Cycle

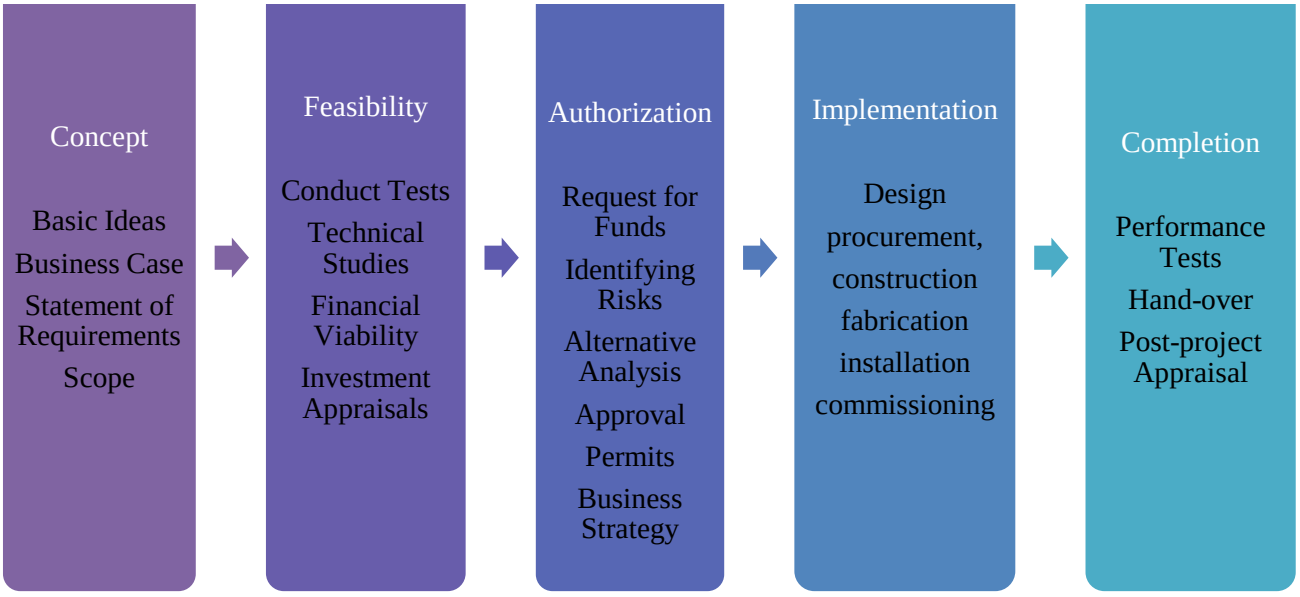


Note: A generic predictive life cycle. (Extracted from the Project Management Body of Knowledge, (PMI, 2021, p. 120)

The project to design and construct a green, climate-resilient home in rural Belize uses a predictive approach. As such, each phase of the life cycle will be completed once, and prior phases must be completed before moving to the next phase. The project will have one final deliverable. Figure 5 depicts the project life cycle that will be utilized in the project to design and construct a green, climate-resilient home in rural Belize.

Figure 5

Project Life Cycle



Note: the proposed project life cycle to be used by Green Building Solutions Belize Ltd.

2.2.7 Company Strategy, Portfolios, Programs and Projects

According to the Project Management Institute (2021), business strategy is the reason for executing projects. Projects are used to achieve strategic objectives and a company's vision. Lester (2021) claims that a coherent and supporting relationship exists between a company's projects, portfolios, policies, and business strategies. Wheelen et al.

(2018) describe strategy as a comprehensive master approach describing how a corporation will achieve its mission and objectives, maximize competitive advantage, and minimize competitive disadvantage.

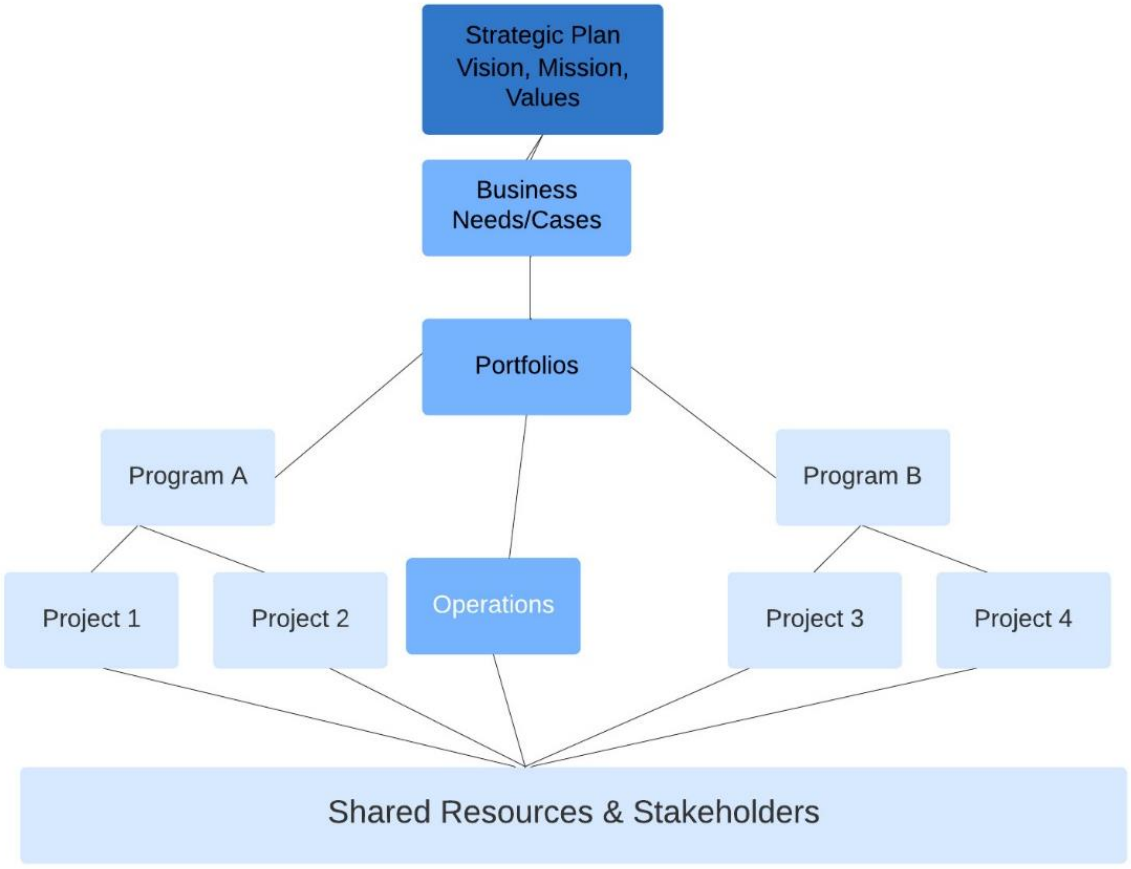
Portfolios consist of projects, programs, sub-portfolios, and operations managed as a group to achieve strategic objectives (PMI, 2021). In contrast, programs are projects, subsidiary programs, and program activities that are related and managed in a coordinated manner to obtain benefits not otherwise available by managing them individually (PMI, 2021). As discussed earlier, projects are temporary endeavors to create unique products, services, or results (PMI, 2021).

At Green Building Solutions, each job is treated as a project under its primary green building design and construction portfolio. Since Green Building Solutions is relatively new, it currently does not have any programs developed. However, in the future, Green Building Solutions hopes to partner with the government of Belize to build low-income, green, climate-resilient homes across the country of Belize. Green Building also recognizes that procuring green, climate-resilient, and sustainable building materials is difficult in Belize, and is considering becoming a distributor of sustainable building materials. These aspirations align with Green Building's strategic plan to deliver a sustainable future. Designing, constructing, and becoming a green building material provider will be sub-programs under Green Building's umbrella portfolio. Figure 6 depicts the Green Building Solutions framework, showing the relationship between its strategy, portfolio, and projects.

This framework helps ensure that projects, programs, and portfolios support the organization's overall goals.

Figure 6

Green Building Solutions Ltd. Strategy, Portfolio, Program, Project Framework



Note: Graphical representation of Green Building Solutions strategy in relation to its portfolios, programs, and projects. Adapted for the Project Management Body of Knowledge (PMI, 2021).

2.3 Other Applicable Theory/Concepts Related to the Project Topic and Context

This section discusses the theories and concepts related to developing a project management plan to design and construct a green, climate-resilient, single-family home in rural Belize. It presents the current situation and explains why such a project is needed. This section also delves into previous research on designing and constructing green, climate-resilient buildings.

2.3.1 Current Situation of the Problem or Opportunity in Study

Petro (2022) noted that conscious consumerism is significantly rising, and that more consumers are looking for sustainable products and solutions. A study by First Insights (2022) also found that Gen-Z's influence will continue to increase as they reach adulthood. This means that businesses must align their objectives to meet these growing needs. The directors of Green Buildings Solutions have operated in the construction industry for over twenty years. They are aware of the construction industry's negative environmental impacts, from design to deconstruction. It is acknowledged that over one-third of total energy use and associated greenhouse gas (GHG) emissions are associated with buildings (European Environment Agency [EEA], 2022). Currently, the building sector consumes more than ninety percent (90%) of total electricity consumption in Belize - making it the second-largest source of GHG emissions (Caribbean Community Climate Change Center, 2017). Green Building Solutions was born from a need to minimize these negative impacts by offering green architectural services to the country.

Additionally, Belize has a growing population, which has significantly risen since the last population census, leading to underdeveloped and more remote areas of the country without electricity and tap water being used as housing communities. The government of Belize is surveying and subdividing large tracts of undeveloped land to develop housing communities. These areas are currently without electricity and water. Green Building Solutions is poised to use this opportunity to provide the country with low-income, green, climate-resilient homes. Development Banks have also started lending consumer loans for implementing renewable or solar energy technologies and will be extending to green buildings for them to meet accreditation requirements with international funding agencies.

Belize is also prone to natural disasters such as hurricanes and floods, and there is a need for climate-resilient homes that can withstand these natural disasters. The last major hurricane to hit Belize cause significant infrastructural damage, from which the country has still not recovered. The government estimates the total infrastructural damages to be US$110 million, of which US$10 million is estimated for private homes and houses (Pan American Health Organization [PAHO], 2022). The total number of homes completely destroyed was estimated to be five hundred (500), and five thousand (5,000) homes were partially destroyed (PAHO, 2022).

A project management plan to construct green, climate-resilient homes is required because there is a need for affordable, climate-resilient, sustainably developed housing initiatives in Belize. Pilot project activities in green building construction are estimated to reduce electricity consumption by twenty percent (20%). There are no similar guidelines or project management plans for designing and constructing green, climate-resilient homes in

Belize, and creating a project management plan per the guidelines proposed by the Project Management Institute's Project Management Body of Knowledge can increase the project's chances of success.

2.3.2 Previous Research Done for the Topic in Study

This section covers previous research done on designing and constructing green buildings.

2.3.2.1 National Research on Green Architecture.

Preliminary research indicates that little research on this topic has been conducted or documented. The Central Building Authority, an autonomous body that grants all the necessary permits to construct buildings in Belize's cities and towns, currently has no standards or policies for constructing green or sustainable buildings. However, the Caribbean Community Climate Change Center (2021) has indicated that pilot project activities in green building construction are estimated to reduce electricity consumption by twenty percent (20%).

2.3.2.2 International Research on Green Architecture.

Developed nations, like the United States, have conducted numerous research and delivered many projects relating to green or climate-resilient homes, as documented in the work of Ghosh et al. (2022). Ghosh et al. (2022) document twenty-four (24) individual case studies developed by Georgetown Climate Center as a means of combating climate change. These projects were studied as the State of Louisiana was embarking on a project

to increase the state's, particularly New Orleans's, resilience to natural disasters and incorporate nature-based solutions into designing and constructing low-income houses. These studies described the best-emerging practices and tools to help with these complex and challenging issues. They provided transferable lessons and ideas for addressing housing and mitigating flood risk. It is important to note that the report states that there is no one size fits all solution when it comes to building sustainable resilience.

The United Kingdom Green Building Council has also conducted numerous studies on green buildings and the effects of traditional buildings on the environment. It has recommended substantial changes in its "New Homes Policies Playbook." The Council states that homes in the United Kingdom account for twenty percent (20%) of greenhouse gas emissions. New construction accounts for up to half of the carbon impacts associated with the building over its lifecycle. The Council concludes that good design is a crucial aspect of sustainable development as it creates better places to live and work.

2.3.3 Other Theory Related to the Topic in Study

This section discusses all other relevant theories related to the design and construction of a green, climate-resilient home.

2.3.3.1 Green Architecture.

Green or sustainable architecture is defined as buildings designed and constructed to limit humanity's environmental impact. Green buildings are described as structures created using environmentally responsible and resource-efficient processes throughout the building's life cycle, from siting to design, construction, operation, maintenance,

renovation, and deconstruction. A Green building is also known as a sustainable or high-performance building. Glavinich (2008) notes that there cannot be a green building without a green design; therefore, green architecture encompasses both the design, construction, and lifespan of the building. The author also states that green architecture has been primarily reactive as owners are beginning to demand more environmentally sustainable products and services. However, as the public becomes increasingly concerned about the environment, practitioners in the construction industry must become more proactive and make the environment a key element in their business strategy and operations. Green architecture involves using practices and processes that are environmentally responsible and resource-efficient during construction. There are many green building accreditation bodies that exist such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), and Green Globe.

2.3.3.1.1 Principles of Green Architecture.

According to Wright (2022), best practices are guidelines related to carrying out tasks that, when used, are known to produce good outcomes. Practitioners of green building construction established several fundamental principles to serve as best practices for developing and designing green construction projects. These principles provide an integrated and comprehensive approach organized around the lifecycle of green buildings to include design, construction, operation, and deconstruction. These principles, which will be discussed in detail in subsequent sections, are vital to sustainable construction. However, the guiding principle of green architecture is designing and constructing resource-efficient and energy-efficient buildings that are in tune with the environment in

which they exist. Generally, this allows for designing and constructing environmentally sound and resource-efficient buildings.

A summary of the fundamental principles of green architecture is presented in the following sections. These principles will act as a guide for the planning and execution of this specific project.

2.3.3.1.1.1 Sustainable Siting.

This section addresses the environmental considerations related to a building's landscape, hardscape, and exterior building issues. Many practitioners of green architecture believe that for a building to be considered green, it must consider the climatic and geographic conditions of the location where the building is being constructed (Glavinich, 2008). A good understanding of the proposed location's year-round climate and weather conditions allows the design to be in harmony with the existing conditions. This is also important to measure the project's success in achieving sustainability by comparing results to the baseline conditions that were established prior.

Before selecting a site, the project team must consider the project goals, which will assist in identifying and selecting a site that will provide the most opportunities and fewest barriers for the project (Glavinich, 2008). Once a site has been selected, a thorough assessment must be conducted to determine the site's design characteristics. This approach will optimize the development and use of the land to reduce adverse impacts and minimize the building's ecological footprint. This assessment should also consider the following:

1. How will the project protect and retain the existing landscape and its natural features,
2. The transportation needs of the occupants,
3. The project's ability to provide positive social, economic, and environmental benefits to existing community members and any potential negative impacts.

2.3.3.1.1.2 Water Efficiency.

One aspect of sustainability in green architecture is water efficiency (Glavinich, 2008), a technique to decrease the demand for fresh water and the amount of wastewater generated by the building. Water-efficient strategies aim to minimize potable water usage, which can be achieved by utilizing water strategies with optimized landscaping, integrated rainwater catchments, gray water recycling, and wastewater treatment systems. These strategies allow for the use of recycled water for flushing toilets, rainwater catchment, and non-potable water for irrigation use. Achieving water efficiency can also be done by using fixtures that conserve water (Glavinich, 2008). According to the Food and Agriculture Organization of the United Nations [FAO] (2021), the earth's water systems are stretched to the limit. There is a need to implement water management systems that provide for better synergy and reverse the deterioration and depletion of water systems and their effect on land and soil systems. This makes it increasingly important to ensure that efficiency measures are in place to conserve water. Some water efficiency measures that can be incorporated into green architecture are as follows:

1. Utilizing ultra-low-flush toilets, low-flow shower heads, and other water-conserving fixtures that will minimize wastewater
2. Using dual plumbing systems that use recycled water for toilet flushing
3. Incorporating a gray water system that recovers rainwater or other non-potable water for site irrigation.
4. Using recirculating systems for centralized hot water distribution
5. Using a water budget approach that schedules irrigation systems
6. Using self-closing nozzles on hoses and state-of-the-art irrigation controller
7. Employing micro-irrigation techniques

2.3.3.1.1.3 Energy Efficiency.

The World Green Building Council (n.d.) estimates that buildings are responsible for approximately one-third (1/3) of the world's energy consumption and carbon emissions. Kubba (2017) surmises that energy efficiency is the most important issue related to green buildings. He also maintains that it is one of the elements in a construction project that can significantly reduce operating costs (Kubba, 2017). Energy-efficient techniques aim to reduce energy consumption and the negative environmental impacts of buildings. It incorporates passive design strategies relating to the building's size, shape, and orientation to incorporate natural lighting, heating, and ventilation. Energy-efficient strategies also utilize renewable and alternative energy sources. Some energy-efficient strategies that can be incorporated into green architecture are:

1. Incorporate renewable energy sources such as solar, wind, or other alternative energy,
2. Use an energy-efficient heat/cooling system,
3. Using passive design strategies, including building shape and orientation, passive solar design, and the use of natural lighting,
4. Install high-efficiency lighting systems.

2.3.3.1.1.4 Material Efficiency and Resource Conservation.

Globally, buildings are responsible for fifty percent (50%) of resource consumption (World Green Building Council, n.d.). Green architecture aims to reduce the resources needed to construct and operate buildings. It is also concerned with the quality of the resources used in building construction and addresses waste by seeking to increase product delivery and transportation efficiencies. Construction products and materials are selected based on the following characteristics: longevity, sustainably and locally produced, zero or low emissions and toxicity, reusable, recyclable, and durable characteristics (Glavinich, 2008). Green architecture practitioners recommend adequate preplanning to order only what is needed, close coordination with suppliers, using standard-size material wherever possible, and continuous monitoring of upcoming work and building material inventories to minimize waste (Kubba, 2017).

2.3.3.1.1.5 Environmental Air Quality.

Green architecture also focuses on the air quality in the building and the environment; buildings with good indoor air quality (IAQ) reduce the rate of respiratory

disease, allergies, asthma, and sick-building symptoms, leading to increased worker productivity (Kubba, 2017). Practitioners should not only consider the building's ventilation in the design phase (Glavinich, 2008). However, they must also ensure that the construction materials have zero emissions and toxicity. Other characteristics to consider under air quality are construction products and materials that are moisture-resistant and can be healthfully maintained.

2.3.3.1.1.6 Building Operation and Maintenance.

Long-term operations and building maintenance are also fundamental principles of green architecture. A comprehensive building operation plan should address heating, cooling, lighting, humidity, and safety (Kubba, 2017). This will ensure that the building operates and delivers on what it intended. Proper maintenance allows a building to perform at optimum levels as designed. The cost of operating and maintaining the building must be viable for sustainability. A key characteristic of green buildings is reduced maintenance and replacement requirements.

2.3.3.2 Construction Project Management.

Project construction management is specific to the construction industry. It incorporates project management principles, financial management, and business management concepts and makes them specific to the construction industry. Project construction management also captures sustainability concepts related to the construction industry and its environmental impacts. The project manager's role in a construction project is crucial, from planning to handing over. This makes construction project

management distinct from project management. According to Addyman and Smyth (2023), most project management knowledge books "are linear in conception, primarily reflecting the tools, techniques, behaviors, and goals of successful completion, especially around time, cost, and quality through a life-cycle model" (p. xvii). The authors claim that this approach is limited and does not fully cover the dynamic nature of construction projects in practice. Construction project management also considers the firm-project interface since it covers a significantly heterogeneous group of activities such as house building, commercial development, and infrastructure (Addyman & Smyth, 2023).

3 METHODOLOGICAL FRAMEWORK

Methodology refers to the general approach to carrying out a research project (Leedy & Ormrod, 2021). The method chosen to carry out a research project dictates the tools that will be utilized (Leedy & Ormrod, 2021). The methodology offers a clear description of how the research will be conducted and how the research questions will be answered. Appropriate designs and methods often depend on the research questions (Leedy & Ormrod, 2021). Most researchers plan their research design and the methods to be used in a way that allows them to acquire relevant data relating to their research problem. This chapter will outline the research methods, sources of information, tools, assumptions, constraints, and deliverables relating to the project.

3.1 Information Sources

To effectively answer research questions, a researcher must know about previous research and current perspectives related to the topic. The literature review is the section of a report or study that describes the theoretical perspectives and previous research findings related to the problem under investigation. Reviewing literature allows the researcher to see if a solution has already been put forth to the problem under investigation. It can also offer new ideas and perspectives not previously considered by the researcher and identify research gaps on the topic.

Leedy and Ormrod (2021) note that information is ever-changing and may not be relevant permanently, indicating that researchers must conduct a thorough literature review to ensure that the information being used is currently relevant to their studies. As the name

suggests, sources of information are any sources that provide knowledge or data on the research topic under investigation. Sources of information can be categorized as primary and secondary (Leedy & Ormrod, 2021), as will be discussed in the following two sections.

3.1.1 Primary Sources

Leedy and Ormrod (2021) define primary sources of information as information that emerges directly from the source, a first-hand account. Salkind (2018) describes primary sources of information as "the original reports of the original work or experience" (p. 46). According to Salkind (2018), primary sources of information are the most important source of information, as they provide information on actual research that has been conducted. Some examples of primary sources of information are Journals, abstracts, scholarly books, and technical reports (Salkind, 2018).

Technical reports from the Central Building Authority, Ministry of Sustainable Development, Climate Change and Disaster Risk Management, Ministry of Infrastructure Development and their affiliate departments, and the Caribbean Community Climate Change Center were used as the primary sources of information for developing the project management plan for the design and construction of a green, climate-resilient home in Belize. These technical reports provided essential information on the status and policies relating to building standards, current and proposed housing infrastructure projects, and Belize's climate-resiliency action plans.

3.1.2 Secondary Sources

Secondary sources of information are second-hand in nature (Salkind, 2018). These are often scholarly summaries or research on a particular topic that can be used as an additional reference source. Leedy and Ormrod (2021) describe a secondary source of information as primary information that has already been processed, analyzed, or interpreted.

Examples of secondary sources of information used in the development of a project management plan for the design and construction of a green, climate-resilient, single-family home in rural Belize are project management guides from the Project Management Institute, green building standards, construction project management textbooks, and other recognized organizations on past studies done relating to the topic. Specific information on how these secondary sources contribute to developing the project management plan can be observed in Table 3.

Table 3

Types of Information Sources

Objectives	Information sources	
	Primary	**Secondary**
1. Develop an Integrated Management Plan, inclusive of a project charter defining key input elements, to coordinate all the elements of the project needed to successfully complete the project. 2. Develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully. 3. Develop a Schedule Management Plan to define the timeline for the project deliverables to ensure the project's timely completion. 4. Develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources. 5. Develop a Quality and Safety Management Plan to ensure that all project deliverables meet stakeholders' expectations. 6. Develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully.	• GBSL Engineering, Architectural, Construction and Safety personnel • Central Building Authority • Caribbean Community Climate Change Center • Ministry of Sustainable Development, Climate Change and Disaster Risk Management/Departments • Ministry of Infrastructure, Development & Housing Technical Documents & Reports • GBSL Engineering, Architectural, Construction and Safety personnel • Central Building Authority • Caribbean Community Climate Change Center • Ministry of Sustainable Development, Climate Change and Disaster Risk Management/Departments Expert Judgment (Meetings & Brainstorming Sessions) • GBSL Engineering, Architectural, Construction and Safety personnel • Central Building Authority • Caribbean Community Climate Change Center	Guide to the Project Management Body of Knowledge, PMI (2017). The GPM P5 Standard for sustainability in project management, GPM Global (2019). Code of practice for project management for the built environment (6 ed.), Chartered Institute of Buildings (2022). Construction project management: An integrated approach (3rd ed.), Fewings et al. (2019). Handbook of Green Building Design and construction: LEED, BREAMM, and Green Globes (2nd ed.), Kubba (2017). Project management in construction (7th ed.), Levy (2018). Construction extension to the PMBOK® guide, PMI (2016). Process groups: A practice guide, PMI (2023). Project management, planning and control: Managing engineering, construction, and manufacturing projects to PMI, APM, and BSI Standards (8th ed.), Lester (2021).

Objectives	Information sources	
	Primary	**Secondary**
7. Develop a Communications Management Plan to ensure effective communication with project stakeholders and record all project communications.	• Ministry of Sustainable Development, Climate Change and Disaster Risk Management/Departments • Ministry of Infrastructure, Development & Housing Technical Documents & Reports • GBSL Engineering, Architectural, Construction and Safety personnel • Central Building Authority • Caribbean Community Climate Change Center • Ministry of Sustainable Development, Climate Change and Disaster Risk Management/Departments • Ministry of Infrastructure, Development & Housing.	Construction extension to the PMBOK® guide, PMI (2016). Construction extension to the PMBOK® guide, PMI (2016). Building Procurement (3rd Ed.), Moreledge et al. (2021) Sustainable Construction: Green building design and construction, Kibbert (2016). The GPM P5 Standard for sustainability in project management, GPM Global (2019).
8. Develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.		
9. Develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team.		
10. Develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure that their expectations are understood, recorded, and considered throughout the project life cycle.		
11. Develop a Change Management Plan to establish, communicate, manage, and control changes that are likely to occur during the project's lifecycle and assess their impacts on budget, schedule, scope, stakeholders, and resources.		
12. Conduct a P5 Impact Analysis to ensure that the FGP actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.		

Note: Summary of the information sources in relation to the FGP. (Author's own production)

3.2 Research Methods

Saunders et al. (2019) define research as “a process that is undertaken in a systematic way with a clear purpose, to find things out" (p. 5). This definition indicates that research is logical. The authors state that methodology "is a theory of how research is undertaken” (p. 4), while methods are the tools and techniques used to acquire and analyze data.

Combining the terms infers that a research method is a logical design or plan to collect and analyze data that can answer the research questions under investigation (Sekaran & Bougie, 2016). This section answers the question of how the research was conducted. Saunders et al. (2019) outline three methodological choices for conducting research: quantitative, qualitative, and mixed methods, as described in the subsequent sections.

3.2.1 Quantitative Method

The quantitative research method involves numerical data. Its purpose is to explain, predict, confirm, validate, or test a theory (Leedy & Ormrod, 2021). The nature of quantitative research is focused, with established guidelines and standardized instruments that allow the researcher to measure the variable(s) of interest objectively and reliably. This method relies on objectivity; as such, the data is analyzed using statistical software. Quantitative research mainly uses deductive reasoning to draw logical conclusions, from general to specific. However, inductive reasoning can also be used. The findings of quantitative research are usually presented in a formal scientific report that uses impersonal language.

3.2.2 Qualitative Method

Qualitative research is used to describe, explain, interpret, or build a theory. It is a holistic approach with flexible guidelines and unknown variables. According to Leedy & Ormrod (2021), qualitative researchers seek to understand complex situations better. Qualitative research uses data collection tools and techniques such as observation and interviews. Unlike quantitative research, qualitative research primarily uses inductive reasoning to draw logical conclusions. Inductive reasoning is a process that allows the researcher to look at specific phenomena and make generalizations. Leedy and Ormrod (2021) also describe qualitative data as subjective; however, this approach "can reveal the complex and multilayered nature of certain situations, settings, processes, relationships, systems, or people" (p. 260).

3.2.3 Mixed Methods

A mixed-methods research design combines attributes of both quantitative and qualitative research methods (Saunders et al., 2018). A mixed methods research design may use a deductive, inductive, or abductive approach to theory development. The abductive approach allows researchers to explore a phenomenon, identify themes, and explain patterns to generate a new– or modify an existing theory that is subsequently tested.

3.2.4 Research Methodology for this Study

The method used for this study was the qualitative method, which allowed for a holistic approach to gathering and interpreting data for the study. This method was also chosen because it allowed the researcher to conduct one-on-one interviews, focus groups, and document analysis.

Table 4

Research Methods

Objectives	Research methods		
	One-on-One Interviews	Focus Group	Document Analysis
1. Develop an Integrated Management Plan, inclusive of a project charter defining key input elements, to coordinate all the elements of the project needed to successfully complete the project.	One-on-one interviews to determine scope needs and requirements and to provide detailed information on how best to integrate the components relating to managing the project. This information was analyzed to develop the integrated management plan.	Key/ expert players formed the focus group to get their personal and organizational standpoints on matters relating to green architecture. The focus group provided insight on best practices for integrating the project management components.	Documents were analyzed to assess the current situation and determine the scope, needs, and requirements. Collecting, interpreting, and analysis of secondary information sources on best practices for project integration.
2. Develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully.	One-on-one interviews were conducted with key/expert players to determine scope needs and requirements.	Key/ expert players formed the focus group to get their personal and organizational standpoints on matters relating to green architecture.	Collecting, interpreting, and analysis of secondary information sources for developing a scope management plan.
3. Develop a Schedule Management Plan to define the timeline for the project deliverables to ensure the project's timely completion.	This method provided knowledgeable and expert information, which was analyzed and compiled to develop the schedule management plan.	The focus group provided insight on best practices for developing a schedule for the project.	Collecting, interpreting, and analysis of technical reports and guides for developing the schedule management plan.
4. Develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources.	One-on-one interviews was used to obtained valuable insight to develop costs and create a cost management plan for the project.	The focus group discussed and analyzed contributions for creating the cost management plan.	Collecting, interpreting, and analysis of technical reports and guides for developing the cost management plan.
5. Develop a Quality and Safety Management Plan to ensure that all project deliverables meet stakeholders' expectations.	This method provided knowledgeable and expert information, which was analyzed and compiled to develop the quality and safety management plan.	The focus group provided expert knowledge on best practices for ensuring quality and safety measures in executing the project.	Collecting, interpreting, and analysis of technical reports and guides for developing the quality and safety management plan.
6. Develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully.	One-on-one interviews were used to obtain valuable insight to determine the resources needed for the project and to create a cost management plan for the project.	The focus group discussed and analyzed contributions to determine the resources needed.	Collecting, interpreting, and analysis of technical reports and guides for developing the resource management plan.
7. Develop a Communications Management Plan to ensure effective	This method provided knowledgeable and expert information, which was analyzed and	The focus group assisted in providing information on best practices to use in	Collecting, interpreting, and analysis of technical reports and

Objectives	Research methods		
	One-on-One Interviews	Focus Group	Document Analysis
communication with project stakeholders and record all project communications.	compiled to develop the communication management plan.	developing a communication management plan for the project.	guides for developing the communication management plan.
8. Develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.	This method provided knowledgeable and expert information, which was analyzed and compiled to develop the risk management plan.	The focus group provided valuable information from past experiences about the risks that could occur with the project. These risks were analyzed and discussed on the best ways to handle the risks.	Collecting, interpreting, and analysis of technical reports and guides for developing the risk management plan.
9. Develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team.	This method provided knowledgeable and expert information, which was analyzed and compiled to develop the procurement management plan.	This method allowed for valuable information from past experiences to be shared and discussed, and how best to incorporate and develop the procurement management plan.	Collecting, interpreting, and analysis of technical reports and guides for developing the procurement management plan.
10. Develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure that their expectations are understood, recorded, and considered throughout the project life cycle.	This method provided knowledgeable and expert information, which was analyzed and compiled to develop the stakeholder management plan.	The focus group provided valuable information on best practices for interacting and engaging with project stakeholders.	Collecting, interpreting, and analysis of technical reports and guides for developing the stakeholder management plan.
11. Develop a Change Management Plan to establish, communicate, manage, and control changes that are likely to occur during the project's lifecycle and assess their impacts on budget, schedule, scope, stakeholders, and resources.			
12. Conduct a P5 Impact Analysis to ensure that the FGP actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.	Provided expert knowledge in conducting the P5 impact analysis as well as understanding the tool.	Provided robust discussion on the importance of the P5 impact analysis and how it is to be conducted.	Collecting, interpreting, and analyzing secondary information sources for conducting the analysis.

Note: Summary of the research methods used in the FGP. (Author's own production)

3.3 Tools

Greene and Stellman (2018) describe project management's tools and techniques as the process or work to turn project management's inputs into outputs. These tools help the project team carry out and organize tasks effectively and efficiently. In the Project Management Body of Knowledge, each area has its own set of tools and techniques considered as good practices for that specific knowledge area.

This section describes the tools and techniques used in developing the project management plan for designing and constructing a green, climate-resilient, single-family home in rural Belize that follows the Project Management Body of Knowledge to meet the proposed deliverables and objectives. Table 5 summarizes the tools and techniques used in developing the project management plan.

Table 5

Summary of Tools and Techniques used for each Specific Objective

Objectives	Tools
1. Develop an Integrated Management Plan, inclusive of a project charter defining key input elements, to coordinate all the elements of the project needed to successfully complete the project. 2. Develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully. 3. Develop a Schedule Management Plan to define the timeline for the project deliverables to ensure the project's timely completion. 4. Develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources.	Expert Judgment – (Interviews) • Central Building Authority Technical Staff • National Climate Change Officer (Ministry of Sustainable Development, Climate Change, and Disaster Risk Management • Chief Engineer (Ministry of Infrastructure, Development and Housing) Data Gathering (Meetings) • GBSL Staff • Technical Committees Data Analysis (Technical Reports) • GBSL Engineering, Architectural, Construction and Safety personnel • Central Building Authority • Caribbean Community Climate Change Center • Trend Analysis • Variance Analysis

Objectives	Tools
5. Develop a Quality and Safety Management Plan to ensure that all project deliverables meet stakeholders' expectations. 6. Develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully. 7. Develop a Communications Management Plan to ensure effective communication with project stakeholders and for recording all project communications. 8. Develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks. 9. Develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team. 10. Develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure that their expectations are understood, recorded, and considered throughout the project life cycle. 11. Develop a Change Management Plan to establish, communicate, manage, and control changes that are likely to occur during the project's lifecycle and assess their impacts on budget, schedule, scope, stakeholders, and resources. 12. Conduct a P5 Impact Analysis to ensure that the FGP actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.	• Alternative Analysis • Reserve Analysis • Schedule Network Analysis • Cost Benefit Analysis • Cost of Quality Change Control Forms Data Representation • Mind Map • Affinity Diagram Sequence Diagrams Decomposition Estimating • Analogous • Bottom-up • Parametric • Three-point Critical Path Method Lead and Lags Decision-making • Benchmarking • Brainstorming (Meetings) o GBSL Staff o Technical Committees Matrix Diagrams GBSL Check sheets Inspections Evaluations Quality Audits Individual and team assessments Trainings Communication Requirement Analysis Communication Model Expert Judgment- Communication Specialist Communication Technology Meetings Communication Methods • Flyers • Progress Reports • Print/Media Data Analysis • Document Analysis • SWOT Analysis • Assumptions and constraint analysis • Root Cause Analysis Risk Probability and Impact Assessment Decision Tree Analysis Audits Stakeholder Engagement Meetings Stakeholder Mapping Data Analysis • Document Analysis o Green Standards and Codes o Green Project Management Guide

3.4 Assumptions and Constraints

Assumptions and constraints are two critical factors in project management. According to Usmani (2021), project assumptions and constraints are identified at the beginning of projects. However, those assumptions and constraints will be refined and reanalyzed throughout the project lifecycle. Usmani (2021) defined assumptions as something we believe to be true or anticipated events that will happen during the project lifecycle, while constraints are limitations the project may face during its lifecycle. Assumptions and constraints must be documented, verified, and validated for accuracy to determine their effects on project success (Goodrich, n.d).

A summary of the assumptions and constraints related to developing a project management plan to design and construct a green, climate-resilient, single-family home in rural Belize is outlined in Table 6.

Table 6

Assumptions and Constraints

Objectives	Assumptions	Constraints
1. Develop an Integrated Management Plan, inclusive of a project charter defining key input elements, to coordinate all the elements of the project needed to successfully complete the project.	• Access to green building standards will be non-restricted and there will not be limitations to its use for academic purposes. • The staff of Central Building Authority (CBA) will support and assist with the identification of green, climate-resilient building standards. • Information about green, climate-resilient homes in the country is organized and available. • The estimated budget will be sufficient to carry out the study and create the project management plan.	• The quantity and quality of information on green buildings in the country is limited. • Scheduled trainings and annual fiscal budget preparation during the months of February and March may limit CBA staff availability to contribute to the study. • Commercial and institutional buildings will not be part of the analysis.
2. Develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully.		
3. Develop a Schedule Management Plan to define the timeline for the project deliverables to ensure the project's timely completion.		
4. Develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources.		
5. Develop a Quality and Safety Management Plan to ensure that all project deliverables meet stakeholders' expectations.		
6. Develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully.		
7. Develop a Communications Management Plan to ensure effective communication with project stakeholders and for recording all project communications.		

Objectives	Assumptions	Constraints
8. Develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.	Access to green building standards will be non-restricted and there will not be limitations to its use for academic purposes. • The staff of Central Building Authority (CBA) will support and assist with the identification of green, climate-resilient building standards. • Information about green, climate-resilient homes in the country is organized and available. • The estimated budget will be sufficient to carry out the study and create the project management plan.	• The quantity and quality of information on green buildings in the country is limited. • Scheduled trainings and annual fiscal budget preparation during the months of February and March may limit CBA staff availability to contribute to the study. • Commercial and institutional buildings will not be part of the analysis.
9. Develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team.		
10. Develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure that their expectations are understood, recorded, and considered throughout the project life cycle.		
11. Develop a Change Management Plan to establish, communicate, manage, and control changes that are likely to occur during the project's lifecycle and assess their impacts on budget, schedule, scope, stakeholders, and resources.		
12. Conduct a P5 Impact Analysis to ensure that the FGP actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.		

Note: Summary of the assumptions and constraints used in developing FGP. (Author's own production)

3.5 Deliverables

Deliverables are measurable and verifiable outcomes, results, products, or capabilities that must be produced for a project or one of its phases to be considered completed (PMI, 2021; Heldman, 2018). Heldman (2018) emphasizes that deliverables are tangible items that can be measured and easily proven. Table 8 outlines the deliverables for each specific objective of developing a project management plan to design and construct a green, climate-resilient, single-family home in rural Belize.

Table 7

Deliverables

Objectives	**Deliverables**
1. Develop an Integrated Management Plan, inclusive of a project charter defining key input elements, to coordinate all the elements of the project needed to successfully complete the project.	Integrated Management Plan – written document to coordinate all the necessary elements of the project to successfully complete the project. The project charter is a written acknowledgment and recognition that the project exists with resource allocation specified.
2. Develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully.	Scope Management Plan - written document to establish the work required, and only the work required, to complete the project successfully.
3. Develop a Schedule Management Plan to define the timeline for the project deliverables to ensure the project's timely completion.	Schedule Management Plan - which defines the timeline for the project deliverables to ensure the project's timely completion
4. Develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources.	Cost Management Plan - to plan, estimate, and manage the budget for all project activities, deliverables, and resources.
5. Develop a Quality and Safety Management Plan to ensure that all project deliverables meet stakeholders' expectations.	Quality and Safety Management Plan – plan that ensures that all project deliverables meet stakeholders’ quality and safety expectations.

Objectives	Deliverables
6. Develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully.	Resource Management Plan – which identifies, acquires, and manages all the resources needed to successfully complete the project.
7. Develop a Communications Management Plan to ensure effective communication with project stakeholders and record all project communications.	Communications Management Plan – a plan that ensures effective communication with project stakeholders and record all project communications.
8. Develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.	Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.
9. Develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team.	Procurement Management Plan - documents the development and administration of agreements for products and/or services needed from outside the project team.
10. Develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure that their expectations are understood, recorded, and considered throughout the project life cycle.	Stakeholder Management Plan - a plan that identifies all groups and/or individuals potentially affected by the project and ensures that their expectations are understood, recorded, and considered throughout the project life cycle.
11. Develop a Change Management Plan to establish, communicate, manage, and control changes that are likely to occur during the project's lifecycle and assess their impacts on budget, schedule, scope, stakeholders, and resources.	Change Management Plan - a plan that establishes, communicates, manages, and control all changes that are likely to occur during the project's lifecycle and assess their impacts on budget, schedule, scope, stakeholders, and resources.
12. Conduct a P5 Impact Analysis to ensure that the FGP actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.	P5 Impact Analysis - an assessment to ensure that the development of the project management plan actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.

Note: Summary of deliverables related to the FGP. (Author's own production)

4 RESULTS

This section was developed per the Project Management Body of Knowledge and is centered around the project management knowledge areas and processes considered good practices on most projects. These project management plans will guide the project's planning, execution, and closing phases to design and construct a green, climate-resilient home in rural Belize.

4.1 Project Integration Management

Green Building Solutions Belize Ltd. recognizes the importance of integration throughout a project's lifecycle. Many processes and disciplines make up the day-to-day work of the project and must be integrated throughout the project's lifecycle. The processes of the integration plan will be discussed in the subsequent sections and will include information on each of the following:

- Project charter
- Project management plan
- Directing and managing project work
- Managing project knowledge
- Monitoring and controlling project work
- Integrated change control
- Closing the project

Incorporating these subsidiary plans will guide the project team in completing the project.

4.1.1 Project Charter

Green Building Solutions uses the project charter as the official written document to recognize the project existence. This document approves the project, provides authority to the project manager, and commits funds and resources to execute it. The project charter also addresses the needs or demands the project will meet. The project charter provides an overview of the project and its goals, describing its purpose and listing high-level deliverables. This also ensures that everyone involved with or affected by the project is on the same page, eliminating confusion and uncertainty when the purpose and objectives are clearly stated. Table 8 is a depiction of the project charter for this specific project.

Table 8

Project Charter

PROJECT CHARTER	
Date	**Name of Project**
May 1, 2023	Design and Construction a Green, Climate-resilient, Single-family home in Rural Belize.
Type of project:	Predictive
Knowledge areas/process groups	**Application area (Sector / Activity)**
Scope Management, Schedule Management, Cost Management, Quality Management, Resource Management, Communications Management, Risks Management, Procurement Management, Stakeholders Management, Integration Management **5 process groups are applicable**: i. Initiating ii. Planning iii. Executing iv. Monitoring and Control v. Closing	**Sector:** Construction **Sub-sector:** Housing

Tentative start date	Tentative completion date	Duration (months)
November 1, 2023	August 14, 2024	9.5 months

Project objectives (general and specific)

General objective

To design and construct a green, climate-resilient, single-family home in rural Belize that integrates sustainable processes and practices, green technologies, and expertise from design to construction that can be used as a prototype for the government of Belize's proposed climate-resilient housing initiative within a budget of US$60,000 during a period not exceeding nine (9) months.

Specific objectives

1. Assemble the project team prior to the commencement of the project within a scheduled time of 0.5 month.
2. Conduct and assessment/analysis of Belize's building codes and regulations for green buildings and determine the best possible green standards that are applicable to the country within a scheduled time of 1.5 months.
3. Design 1,200 square feet, 3-bedrooms, 2 bathrooms, green, climate-resilient home within a period of 1 month.
4. Construct 1,200 square feet, 3-bedrooms, 2 bathrooms, green, climate-resilient home within a schedule time of 6.5 months.

Justification or purpose of the project (Contribution and expected results)

According to Green Project Management (GPM) Global (2019), we consume more resources than the planet can provide. The organization also notes that the cost of living, electricity, and housing has rapidly increased since 2000. It is acknowledged that over one-third of total energy use and associated greenhouse gas (GHG) emissions are associated with buildings. The growing trend is for more sustainable practices to implement change. As a developing country, Belize has also been affected by these factors. Belize's population has significantly risen since the last population census, leading to underdeveloped and more remote areas of the country without electricity and tap water being used as housing communities. Belize is also prone to natural disasters such as hurricanes and floods.

Belize's building sector currently consumes more than ninety percent (90%) of total electricity consumption - making it the second-largest source of GHG emissions. Pilot project activities of green building construction are estimated to reduce electricity consumption by twenty percent (20%). Coupled with the fact that there is a need for affordable, climate-resilient, sustainably developed housing initiatives in Belize, developing a prototype of such a home and executing the project following the guidelines proposed by the Project Management Institute's Project Management Body of Knowledge will provide a better chance of success in replicating the homes on a larger scale.

Description of the product or service that the project will generate - Final project deliverables
1. Final Report on current green building regulations that exist in Belize and recommendations for applicable green building standards that can be adopted. 2. The project team would ensure the completion of the project in accordance with time, schedule, and budget. 3. Final design and construction plans for a green, climate-resilient home that can be mass-constructed. 4. Construction of a 1,200 square foot, three-bedroom, two-bathroom, green, climate-resilient home for a single family in rural Belize. 5. Exterior finish using sustainable materials. 6. Rooftop solar energy installation with renewable energy battery support in accordance with best practices. 7. Interior finishes using sustainable, environmentally friendly materials. 8. Equipped kitchen with energy star rated stainless steel appliances. 9. Integrated, intelligent control systems for lighting, heating, ventilation, and air conditioning (HVAC), high-speed internet, and entertainment.
Assumptions
1. The funding for the project will remain in place for the entire duration of the project. 2. All construction materials and equipment needed for the project's completion are readily available, can be easily sourced, are of good quality, and/or are in good working condition throughout the life of the project. 3. Qualified personnel, including sub-contractors and consultants, will be hired and will remain with the project until their specific deliverables are met, or the phase is complete. 4. The Environmental and Social Standards (ESS) will follow all National Laws and incorporate all applicable green building standards as set out in the final report. 5. Green homes will lead to a reduction in electricity consumption and GHG emissions.
Constraints
1. The timeframe for the project will not exceed nine (9) months for project completion. 2. The total cost of the project should not exceed US $60,000,000. 3. Construction challenges: climatic and topographical conditions 4. Health and safety, social, and environmental challenges 5. Difficulty in obtaining green building standards that are applicable to Belize.
Restrictions
1. Government procedures and policies. 2. Environment Impact Assessment. 3. Remote location of the construction site.
Preliminary identification of risks
● Incomplete designs and drawings. ● Poorly defined scope

- Unexpected increases in material costs
- Adverse weather conditions and natural disasters

General resources and budget

Deliverable	Name of the resource (can be human, equipment, material, supply, infrastructure, contracting)	Unit	Total cost
Compilation of Green Building Standards	Human	2	5,000
Construction	Material, infrastructure, contracting	1	35,000
Kitchen Equipment	Equipment, supply	1	3,000
Exterior Finish, & Solar System Installation	Materials	1	5,000
Project Management Unit	Human	8	12,000
		TOTAL	60,000

Milestone #	Milestone name
1	Compilation of Green Building Standards
2	Construction of 1,200 square foot, 3-bedroom, 2-bathroom house
3	Exterior finish and installation of solar panels
4	Equipped kitchen with energy star rated kitchen appliances

Relevant historical information

Belize is a low-lying coastal country that is prone to natural disasters such as hurricanes and flooding. The country has a growing population and faces rapid urbanization, ad hoc settlements, and infrastructural requirements of unplanned communities. One of the country's development goals is to protect communities from damage caused by flooding and sea level rise by implementing its Land Use Policy and supporting green and grey infrastructure. This objective is in line with the Sustainable Development Goal to have sustainable cities and communities.

The government of Belize is in the process of drafting a programme to construct sustainable, climate-resilient homes for the low-income and middle-income population. This is to meet the need to construct homes that are resilient against climate-related natural disasters, and the need to have more sustainable development practices. The government recognizes that there is a need for affordable, climate-resilient, sustainably developed housing initiatives in Belize.

Green Building Solutions Belize Ltd. Sees this as an opportunity to design and construct a prototype green, climate-resilient home. At present, Belize has no green or sustainable construction policies, and not much is being done outside the cities and towns to enforce building standards. As such, the company will also embark on reviewing the country’s current building standards and collaborate with the Central Building Authority to compile green

building standards that are applicable to Belize and that will meet the requirements of GoB proposed housing initiatives.

Identification of groups of interest (stakeholders)

Name	Position	Organization
Mr. Gabriel Flores	Director	Green Building Solutions Belize Ltd.
Mr. Patrick Thurton	Director	Green Building Solutions Belize Ltd.
Mr. Neil Young	Director	Green Building Solutions Belize Ltd.
Mr. Oswald Young	Director	Green Building Solutions Belize Ltd.
Hon. Orlando Habet	Minister	Ministry of Sustainable Development, Climate Change, & Disaster Risk Management
Dr. Kenrick Williams	CEO	Ministry of Sustainable Development, Climate Change, & Disaster Risk Management
Ms. Evonlee Tench	Policy Analyst	Ministry of Sustainable Development, Climate Change, & Disaster Risk Management
Dr. Lennox Gladden	Director	National Climate Change Office
Hon. Julius Espat	Minister	Ministry of Infrastructure Development & Housing
Mr. Jose Espat	CEO	Ministry of Infrastructure Development & Housing
Mr. Seremei Cayetano	Director	Central Building Authority
Mr. Naldo Romero	Chief Inspector	Central Building Authority
Mr. Hector Carillo	Architect	Central Building Authority
Mr. Shane Zuniga	Policy Analyst	Ministry of Infrastructure Development & Housing

Hardware Stores	Suppliers	Private Business
Construction Sub-Contractors	Contractors	Private Contractors
	Project Team	

Project Manager: Ms Tenesha Reynolds
Signature:

Name and title of the authorizing person:
Signature:

Note: Depiction of the formal project initiation document.

4.2 Scope Management Plan

The company uses a scope management plan to describe how the project scope and the work breakdown structure will be defined, developed, executed, and managed. Scope management also involves defining what is out of scope and specifying how the project will manage changes. Devising the scope management plan involves:

- developing the project scope statement,
- decomposing the project,
- determining what constitutes a scope change,
- maintaining the work breakdown structure and scope baseline, and
- defining the level of acceptance for project deliverables.

The following sections outline the scope management plan for designing and constructing a green, climate-resilient, single-family home in rural Belize.

4.2.1 Collect Requirements

To execute the project, the company must identify and analyze the stakeholders' needs, this is the collect requirement process which allows for measuring and tracking requirements. This document will be used to describe how requirements are prioritized and to develop the requirement traceability matrix. This process is essential as it details stakeholders' expectations in determining if the project has met its goals. The project team will use the assumption log, lessons learned, and stakeholder register templates to collect requirements accurately. This document contains these forms in Annex 5. The requirements management approach that will be used for this project will be broken down into four areas:

- Requirements Identification - The project team will use various methods to identify the stakeholders' requirements and ensure that all requirements are captured, including interviews, focus groups, facilitated workshops, group creativity techniques, questionnaires, surveys, etc.
- Requirements Analysis - The project team will analyze requirements to determine if the requirements can be broken down into work packages and to determine acceptance criteria. These acceptance criteria will determine when a requirement has been met at an acceptable level and if the project's quality standards have been fulfilled.
- Requirements Documentation - All identified and analyzed requirements will be documented and assigned to the team member under whose responsibility they fall. The project team will use the requirements to

develop the project scope statement and determine what methodologies will be used to track and report on the status of each need. The Requirements Traceability Matrix, which includes a listing of all the project requirements, will be used throughout the project.

- Ongoing Requirements Management - Throughout the project lifecycle, the project manager will ensure all team members report on the status of each requirement and that appropriate measures are taken for any issues or concerns that may arise. The project team will follow the established change control process to propose any changes to requirements and receive approval from the change control board. Ongoing requirements management also involves reviewing the completion status of all requirements as part of project closure.

Table 9 details the stakeholders' requirements for the project to design and construct a green, climate-resilient, single-family home in rural Belize.

Table 9

Requirements Documentation Form

REQUIREMENTS DOCUMENTATION							
Date			**Name of Project**				
May 1, 2023			Project Management Plan for the Design and Construction a Green, Climate-resilient, Single-family home in Rural Belize				
Project No:			GBS202301				
Project Manager:			**Tenesha Reynolds**				
ID	Requirement	Stakeholder	Category	Priority	Acceptance Criteria	Test or Verification	Phase or Release
R001	Best Practices Defined and Approved	Project Team/Central Building Authority	Technical	High	Green Building Standards Report approved by the CBA	Verification	
R002	Approved Final Infrastructure Designed	Architect/Draftsman /Client	Technical	High	Client Sign off	Verification	
R003	Site Preparation	Project Team/Construction Crew	Manual	High	Site is cleared for construction work to begin	Verification	
R004	Construction of 1,200 sq. ft. Foundation	Project Team/Construction Crew/Suppliers	Technical	High	Foundation complete and structurally sound	Test/Verification	
R005	Framing & Exterior Walls	Project Team/Construction Crew/Suppliers	Technical	High	Exterior walls and framing complete and structurally sound	Test/Verification	

ID	Requirement	Stakeholder	Category	Priority	Acceptance Criteria	Test or Verification	Phase or Release
R006	Roofing	Project Team/Construction Crew/Suppliers	Technical	High	Roofing and ceiling complete and structurally sound	Test/Verification	
R007	Plumbing Installed	Project Team/Licensed Plumber/Suppliers	Technical	Medium	Plumbing installed	Test	
R008	Electrical Installed	Project Team/Licensed Electrician/Suppliers	Technical	Medium	Electrical Installed	Test	
R009	HVAC Installed	Project Team/Licensed HVAC Technicians	Technical	Medium	HVAC installed	Test	
R010	Plastering Complete	Project Team/Construction Crew/Suppliers	Technical	Medium	Plastering complete	Verification	
R011	Exterior & Interior Finishing	Project Team/Construction Crew/Suppliers	Technical	Medium	Painting and tiling complete, trimmings, furniture, fittings, and cabinetry installed	Verification	
R012	Solar Panel Installed	Project Team/Solar Panel Technician/Supplier	Technical	Medium	Solar Panel Installed	Test	

Note: Completed requirements documentation form for the project to design and construct a green, climate-resilient, single-family home in rural Belize.

The requirement traceability matrix tracks each requirement's attributes throughout the project life cycle. The information from the requirements documentation is used to trace how those requirements are addressed throughout the project. This project will utilize a requirement traceability matrix to show the link between the project objectives, WBS deliverables, and how the metrics will be measured and validated.

Table 10 depicts the stakeholder requirements traceability matrix for this specific project.

Table 10

Requirement Traceability Matrix

Requirement Traceability Matrix								
Requirement Information					Relationship Traceability			
ID	Requirement	Responsibility	Priority	Category	WBS	Deliverable	Verification	Validation
R001	Base document for best practices	Engineers	High	Technical	1.1	Final version of Green Building Standards for Belize	Official Document	Approved
R002	Final Infrastructure Designed	Architects/Draftsmen	High	Technical	1.2	Final Infrastructure Design	Official Building Plans	CBA /Client Approval
R003	Site preparation	Project Team	High	Technical	1.3	Site prepared and ready for construction	Inspection	Engineer Sign off

ID	Requirement	Responsibility	Priority	Category	WBS	Deliverable	Verification	Validation
R004	Construction of 1,200 sq. ft. Foundation	Project Team/Construction Crew/Suppliers	High	Technical	1.3.1	Foundation complete and structurally sound	Inspection	Engineer Sign off
R005	Framing & Exterior Walls	Project Team/Construction Crew/Suppliers	High	Technical	1.3.2	Exterior walls and framing complete and structurally sound	Inspection	Engineer Sign off
R006	Roofing	Project Team/Construction Crew/Suppliers	High	Technical	1.3.2.3	Roofing and ceiling complete and structurally sound	Inspection	Engineer Sign off
R007	Plumbing Installed	Project Team/Licensed Plumber/Suppliers	Medium	Technical	1..3.3.3	Plumbing installed	Inspection	Engineer Sign off
R008	Electrical Installed	Project Team/Licensed Electrician/Suppliers	Medium	Technical	1.3.2.3	Electrical Installed	Inspection	Engineer Sign off
R009	HVAC Installed	Project Team/Licensed HVAC Technicians	Medium	Technical	1.3.2.4	HVAC installed	Inspection	Engineer Sign off

ID	Requirement	Responsibility	Priority	Category	WBS	Deliverable	Verification	Validation
R010	Plastering Complete	Project Team/Construction Crew/Suppliers	Medium	Technical	1.3.2.2	Plastering complete	Inspection	Engineer Sign off
R011	Exterior & Interior Finishing	Project Team/Construction Crew/Suppliers	Medium	Technical	1.3.4	Painting and tiling complete, trimmings, furniture, fittings, and cabinetry installed	Inspection	Engineer Sign off
R012	Solar Panel Installed	Project Team/Solar Panel Technician/Supplier	Medium	Technical	1.3.4.4	Solar Panel Installed	Inspection	Engineer Sign off

Note: Table 10 shows the stakeholder requirements traceability matrix.

4.2.2 Scope Statement

The purpose of the project scope statement is to document the goals and deliverables of the project Which will be used as a baseline for the project. The project scope statement should contain at least the following information:

- Project scope description
- Project deliverables
- Project acceptance criteria
- Project exclusions

Table 11 depicts the project scope statement for this project.

Table 11

Project Scope Statement

PROJECT SCOPE STATEMENT	
Date	**Name of Project**
May 1, 2023	Project Management Plan for the Design and Construction a Green, Climate-resilient, Single-family home in Rural Belize
Project No:	GBS202301
Project Manager:	**Tenesha Reynolds**
Project Overview: According to Green Project Management (GPM) Global (2019), we consume more resources than the planet can provide. Over one-third of total energy use and associated greenhouse gas (GHG) emissions are associated with buildings. However, the growing trend is for more sustainable practices to implement change. In Belize, buildings are responsible for approximately 90% of electricity consumption and are the second largest GHG emissions source. The country has seen a significant rise in its population, leading to underdeveloped and more remote areas of the country without electricity and tap water being used as housing communities. Belize is also prone to natural disasters such as hurricanes and floods. There is a need for affordable, climate-resilient, sustainably developed housing initiatives in Belize. The concept of this project is to design and construct a green, climate-resilient, single-family home in rural Belize that integrates sustainable processes and practices, green	

technologies, and expertise from design to construction that can be used as a prototype for the government's future housing initiatives that are currently being proposed.

Project Goals & Objectives:

To design and construct a green, climate-resilient, single-family home in rural Belize that integrates sustainable processes and practices, green technologies, and expertise from design to construction that can be used as a prototype for the government of Belize's proposed climate-resilient housing initiative within a budget of US$60,000 during a period not exceeding six (6) months.

Specific objectives

1. Assemble the project team prior to the commencement of the project within a scheduled timeframe of 0.5 months.
2. Conduct and assessment/analysis of Belize's building codes and regulations for green buildings and determine the best possible green standards that are applicable to the country within a scheduled time of 1.5 months.
3. Design 1,200 square feet, 3-bedrooms, 2 bathrooms, green, climate-resilient home within a period of 1 month.
4. Construct 1,200 square foot, 3-bedroom, 2 bathroom, green, climate-resilient home within a schedule time of 6.5 months.

Comprehensive List of Project Deliverables:

1. Final Report on current green building regulations that exist in Belize and recommendations of applicable green building standards that can be adopted.
2. The project team would ensure the completion of the project in accordance with time, schedule, and budget.
3. Final design and construction plans for a green, climate-resilient home that can be mass-constructed.
4. Construction of 1,200 square foot, three-bedroom, two-bathroom, green, climate-resilient home for a single family in rural Belize.
5. Exterior finish using sustainable materials.
6. Rooftop solar energy installation with renewable energy battery support in accordance with best practices.
7. Interior finishes using sustainable, environmentally friendly materials.
8. Equipped kitchen with energy star rated stainless steel appliances.
9. Integrated, intelligent control systems for lighting, heating, ventilation, and air conditioning (HVAC), high speed internet, and entertainment.

Comprehensive List of Project Requirements:

1. Final Report on current green building regulations that exist in Belize and recommendation of applicable green building standards that can be adopted.
2. Approved Designs & Building Plans
3. Site Preparation
4. Foundation
5. Framing
6. Roofing
7. Plumbing
8. Electrical
9. Plastering
10. Exterior Prep and Painting
11. Interior Prep and Painting
12. Flooring & Ceiling
13. Solar Panel Installation

Exclusions from Scope:

1. Any paving of driveways or related paved areas
2. Maintenance and inspection after handing-over
3. Garage
4. Utilities Connection
5. Landscaping

Time and Cost Estimates:

Deliverable	Name of the resource (can be human, equipment, material, supply, infrastructure, contracting)	Unit	Timeframe	Total (US$)
Compilation of Green Building Standards	Human	2	2 months	5,000
Design & Construction	Material, infrastructure, contracting	1	5.5 months	35,000
Kitchen Equipment	Equipment, supply	1	1 month	3,000
Exterior Finish, Landscape & Solar System	Materials	1	1 month	5,000
Project Management Unit	Human	8	Project Life Cycle	12,000
			TOTAL	**60,000**

Roles and Responsibilities:

Director of Operations/Projects – The Director of Operation is responsible for managing each project and for the overall execution of projects from design to finishing. He is also responsible, with the help of his team, for preparing the bidding documents associated with bidding for projects. The Director of Operations is also responsible for reporting project status in accordance with the communications management plan and evaluating the performance of all project team members. He is also responsible for acquiring the human resources and the necessary material resources for the project through proper coordination with the Finance and Procurement Officers.

Engineers – The engineers will be responsible for coordinating and supervising the technical components of projects. The engineers will also be responsible for reviewing and compiling green building practices that are applicable to Belize and will collaborate with the Central Building Authority to get these practices approved. They are also responsible for the compilation of the final report for approval. The engineers will also oversee field inspections to ensure compliance with standards, quality, and schedule.

Architect – The architect is responsible for the planning, development, and design of a structurally-sound building based on the recommendations from the engineers. The architect will be the primary contact for the Director of Operations for all architectural issues. The architect supervises the draftsman who assists with structural development, planning, drawings, and code compliance.

Construction Manager – is responsible for projects at a high-level and works closely with the engineers to ensure compliance with standards, quality, and schedule. The construction Manager supervises the Site Supervisor.

Site Supervisor – The site supervisor is responsible for supervising the day-to-day execution of project activities and supervising the field staff.

Quality/Safety Manager - The Quality/Safety Manager works closely with the Construction Manager and the Site Supervisor to ensure compliance with the quality and safety standards set forth by the project. The Quality and Safety manager is responsible for quality and quality control.

Assumptions:

1. The funding for the project will remain in place for the entire duration of the project.
2. All construction materials and equipment needed for the project's completion are readily available, can be easily sourced, are of good quality, and/or are in good working condition throughout the life of the project.
3. Qualified personnel, inclusive of sub-contractors and consultants, will be hired and will remain with the project until their specific deliverables are met, or the phase is complete.

4. The Environmental and Social Standards (ESS) will follow all National Laws and incorporate all applicable green building standards as set out in the final report.
5. Green homes will lead to a reduction in electricity consumption and GHG emissions.

Project Acceptance Criteria:
The acceptance criteria for each of the specific deliverables are based on the requirements listed in the Requirements Documentation and described in detail in the Quality Metrics documentation.

Milestone #	Milestone name
1	Compilation of Green Building Standards
2	Construction of 1,200 square foot, 3-bedroom, 2-bathroom house
3	Exterior finish and installation of solar panels
4	Equipped kitchen with energy star rated kitchen appliances

Project Manager: Ms. Tenesha Reynolds
Signature:

Name and title of the authorizing person:
Signature:

Note: Project Scope Statement.

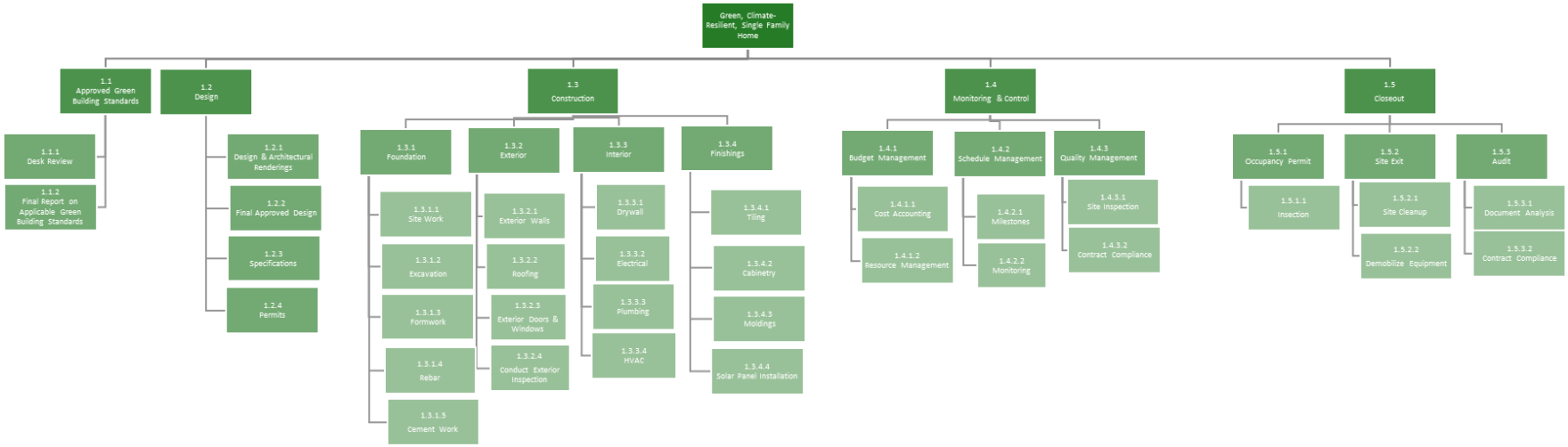
4.2.3 Work Breakdown Structure

Green Building Solutions uses the work breakdown structure (WBS) as a tool to provide a graphical and hierarchical display of project deliverables. The concept of the WBS is to start with the project and then break it down into smaller, more manageable units at each subsequent level. The work breakdown structure allows the company to identify the work the project team must do to achieve project deliverables and objectives. The lowest level of the WBS is called work packages (PMI, 2017). Once approved, the WBS, WBS dictionary, and project scope statement make up the scope baseline for the project.

Figure 7 depicts the work breakdown structure for the project to design and construct a green, climate-resilient, single-family home in rural Belize.

Figure 7

Work Breakdown Structure



Note: Representation of the project's work breakdown structure. (Author's own depiction).

4.2.4 WBS Dictionary

The WBS dictionary supports the work breakdown structure and lists all the activities and tasks included in it. The company uses unique numbers to identify each element of the WBS, which will help the company keep track of the costs associated with each activity.

Table 12 presents the WBS dictionary for the project to design and construct a green, climate-resilient, single-family home in rural Belize. Included in the WBS dictionary is a description of the work, responsibility, milestones, estimated duration, accepted criteria, and resources that will be needed to complete each work package.

Table 12

WBS Dictionary

WBS Code	Work Package Name	Description of Work	Responsibility	Deliverables	Accepted Criteria	Assigned Resources
1.1	**Approved Green Building Standards**	**Compilation of best practices of green architecture applicable to Belize.**	**Project Team**	**Green Building Standards for Belize**	**Report on Applicable Green Building Standards for Belize**	**Engineers**
1.1.1	Desk Review of Best Practices	Analysis of international best practices for green buildings and of Belize's current building standards	Project Team	Documentation of Analysis	Analysis Report on international best practices and Belize's current building standards	Engineers

WBS Code	Work Package Name	Description of Work	Responsibility	Deliverables	Accepted Criteria	Assigned Resources
1.1.2	Final Report on Applicable Green Building Standards	Prepare report on applicable green building standards	Project Team	Report on applicable green building standards accepted/approved by the Central Building Authority	Report on Applicable Green Building Standards for **Belize**	Engineers
1.2	**Design**	**Include all the works, drawings, renderings for a green, climate-resilient building**	**Project Team**	**Building designs**	**Approved Building Designs**	**Architects/Draftsmen**
1.2.1	Design & Architectural Renderings	Final Infrastructure Design	Project Team	Renderings submitted to client	Client's Approval	Architects/Draftsmen
1.2.2	Plans & Drawings	Final Infrastructure Design	Project Team	Plans & Drawings submitted to CBA	CBA's Approval	Architects/Draftsmen
1.2.3	Specifications	List of specification based on approved design	Project Team	List of Specifications	Engineers' Approval	Architects/Draftsmen/Engineer
1.2.4	Permits	All applicable permits applied for	Project Team	Permits	Permits Granted	Director of Operations/Projects
1.3	**Construction**	**Include all the works and services required for construction, inclusive of finishing works**	Project Team	**Construction Completed**	**Final Inspection Approval**	**Project Team**

WBS Code	Work Package Name	Description of Work	Responsibility	Deliverables	Accepted Criteria	Assigned Resources
1.3.1	Foundation	Construction of structurally sound 1,200 sq. ft. foundation	Project Team	Foundation Complete	Inspection Passed	Project Team/material & Supplies
1.3.1.1	Site Work	Clearing of construction site and site layout of building		Site Work Complete		
1.3.1.2	Excavation	Excavation of building site		Excavation completed		
1.3.1.3	Formwork			Formwork completed		
1.3.1.4	Rebar	Iron and steel installed		Rebar installed		
1.3.1.5	Cement	Cement poured and casting complete		Foundation complete		
1.3.2	Exterior	Construction of exterior walls, inclusive of roofing, windows, and doors installation		Exterior walls complete		
1.3.2.1	Framing	Installation of upright, beams, columns etc.		Framing completed		
1.3.2.2	Exterior Walls	Laying of blocks to construct exterior walls		Exterior walls completed		
1.3.2.3	Roofing	Install roof and ceiling		Roof Installed		
1.3.2.4	Exterior Doors & Windows	Installation of windows and exterior doors		Windows & Doors Installed		
1.3.3	Interior	Completion of exterior works		Interior works completed		

WBS Code	Work Package Name	Description of Work	Responsibility	Deliverables	Accepted Criteria	Assigned Resources
1.3.3.1	Drywall	Install Drywall	Project Team	Drywall Installed	Inspection Passed	Project Team/material & Supplies
1.3.3.2	Electrical	Install Electrical		Electrical Installed, Electricity connection		
1.3.3.3	Plumbing	Install Plumbing		Plumbing Installed, water connection		
1.3.3.4	HVAC	Install HVAC		HVAC Installed and functional		
1.3.4	Finishing	Include all the finishing works, inclusive of painting		Finishing completed		
1.3.4.1	Tiling	Install and lay tiles		Tiles Installed		
1.3.4.2	Cabinetry	Install Cabinetry and kitchen equipment		Cabinetry and kitchen equipment installed		
1.3.4.3	Moldings	Install Moldings		Molding installed		
1.3.4.4	Solar Panel Installation	Install solar panels		Solar Panels installed and functional		
1.4	**Monitoring & Control**	**Include all the services and work required to monitor and control the project**	**Director of Operations**		**Auditing & Inspection**	**Project Team**

WBS Code	Work Package Name	Description of Work	Responsibility	Deliverables	Accepted Criteria	Assigned Resources
1.4.1	Budget Management	Include all the works necessary to manage the budget	Director of Operations	Budget/Financial Report	CPI within 0.95 and 1.1	Finance Officer
1.4.1.1	Cost Accounting	Tracking of project expenditure	Director of Operations	List of expenditure by work packages	Updated listing	Finance Officer
1.4.1.2	Resource Management	Tracking of all project resources	Director of Operations	Resource Management Report	Approved report	Functional managers
1.4.2	Schedule Management	Include all the works necessary to manage the project schedule	Director of Operations	Project Schedule	SPI within 0.95 and 1.1	Engineer
1.4.2.1	Milestone Management	Include all the works necessary to manage the project milestone	Director of Operations	Milestone Report	Milestone on schedule	Project team
1.4.2.2	Monitoring	Include all the works necessary to monitor the project	Director of Operations	Monitoring & Evaluation Report	Project within applicable standards	Safety & Quality Manager
1.4.3	Quality and Safety Management	Include all the works necessary to monitor the quality and safety of the project	Director of Operations	Monitoring & Evaluation Report	Project within applicable standards	Safety & Quality Manager
1.4.3.1	Site Inspection	Include all the works necessary to inspect the work	Director of Operations	Inspection Report	Project within applicable standards	Safety & Quality Manager
1.4.3.2	Contract Compliance	Include all the works necessary to ensure contract compliance	Director of Operations	Compliance Report	Processes follow the contracts as stipulated	Functional Managers

WBS Code	Work Package Name	Description of Work	Responsibility	Deliverables	Accepted Criteria	Assigned Resources
1.5	**Closeout**	**Include all the work necessary to close the project**	**Director of Operations**	**Project Closure Report**	**Project handed over and accepted by client**	**Project Team**
1.5.1	Occupancy Permit	Occupancy permit granted	Director of Operations	Occupancy Permit Approved	Occupancy Permit Approved	Project Team
1.5.1.1	Inspection	Final inspection by regulatory authority	Director of Operations	Final Inspection Report	Final Inspection Approved	Project Team
1.5.2	Site Exit	Include all the works to exit the site	Construction Manager	Exit Report	Sign off by Client	Project Team
1.5.2.1	Site Clean-up	Clean up of site	Construction Manager	Exit Report	Sign off by Client	Project Team
1.5.2.2	Demobilize Equipment	Demobilization of equipment	Construction Manager	Exit Report	Sign off by Client	Project Team
1.5.3	Audit	Include all the works and services required to audit the project documents	Director of Operations	Audit Report	Audit Report approved	Functional Managers
1.5.3.1	Document Analysis	Include all the works and services required to audit the project documents	Director of Operations	Audit Report	Audit Report approved	Functional Managers
1.5.3.2	Contract Compliance	Include all the works and services required to audit the project documents	Director of Operations	Contract Compliance Report	Contract Compliance Report approved	Functional Managers

Note: Table 12 shows the WBS dictionary for the project to design and construct a green, climate-resilient, single-family home in rural Belize (Author's own depiction).

4.2.5 Scope Control

Although the project will be carefully planned, there is no way to predict every possible task that the project team will have to complete to execute the project. However, it is expected that there will be some changes that need to happen, which will affect the baseline. To accommodate those changes, the project will implement a process for controlling changes to the scope to ensure that only the needed modifications are approved and that all relevant stakeholders are aware of the consequences of those changes. The WBS dictionary will be used to help control the project scope. The team will ensure they perform only the work and deliverables listed in the WBS dictionary. The Director of Operations will ensure that the team follows the control scope process.

The control scope process must be carried out for all recommended changes. Stakeholders or a project team member can request changes to the project scope. The change requests are to be submitted to the Director of Operations/Projects through the formal change request form, which can be found in Appendix 5. The Director of Projects will conduct an impact analysis before submitting the change request to the Change Control Board.

Once the Change Control Board approves the changes, the Director of Operations must replan the work, update all the necessary documents to reflect the changes, and update the team. The project will continue using the new baseline. The Change Management Plan for this project discusses the change control process in further detail.

4.3 Schedule Management Plan

The Schedule Management Plan will define the development of the project's schedule for the scope of work as outlined in the project charter and detailed in the baseline work breakdown structure. It will dictate how the project schedule will be developed, monitored, and controlled to manage the project for timely completion. The schedule management plan also establishes the process for the ongoing maintenance of the schedule, including reporting of work performed, project progress, and variances. The schedule management plan is the roadmap for how the project team will execute the project.

The project schedule is an essential aspect of a project as it provides a detailed plan of how and when the project deliverables and objectives will be delivered as outlined in the project scope and can be used as a basis for measuring performance. The project schedule contains detailed information, it will also be flexible to adapt to acquired knowledge and increase understanding.

The schedule management plan for the project to design and construct a green, climate-resilient, single-family home will be created using MS Project. The plan also provides a means for regular progress reporting, work performed, and any schedule adjustments that may be needed.

Table 13

Schedule Management Plan

SCHEDULE MANAGEMENT PLAN	
Date	**Name of Project**
May 1, 2023	Project Management Plan for the Design and Construction of a Green, Climate-resilient, Single-family home in Rural Belize
Scheduling Methodology	The project manager will create a schedule model for the project using Microsoft (MS) Project. The schedule will be developed using the critical path method (CPM). It will be stored in an open document repository and updated on a weekly basis. The initial schedule will be based on high-level estimates that will be refined at set intervals as requirements are defined for the project. The schedule will be baselined whenever a change request is approved.
Tools & Techniques	
1. Decomposition 2. Analytical Techniques 3. Expert Judgment 4. Meetings	
Level of Accuracy	
The initial schedule model is expected to be accurate by +/– 10%. As each week passes, the schedule update increases in accuracy because the project team will have more information on the project. At the time the foundation is laid, the schedule model will be +/– 3% accurate. This overage will be included in the team's overall estimate as a contingency to assist in risk mitigation.	
Units of Measure	**Define Activities**
All duration is listed in calendar days, weeks, or month.	Activities were identified through expert judgment, team meetings, and analysis of the following documents: 1. Project Charter 2. Work Breakdown Structure 3. WBS Dictionary 4. Scope Statement 5. Best Practices for Green Buildings

Sequence Activities
The project schedule model will follow the organizational outline provided by the WBS and: 1. The sequencing of activities will be based on the codification of each element, top to bottom, and from work packages to activities, respectively. 2. The project's main activities are determined and diagrammed to show the relationship and dependencies between activities. 3. Calculate Slack to identify the critical paths of the project. 4. Use MS Projects to visualize the activities and organize dependencies.
Estimate Resources
1. The type, quantity, and resource duration required for each deliverable is estimated and documented. 2. Constraints and assumptions for each activity are analyzed. 3. Historical information and project records are analyzed for estimating resources.
Estimate Activity Duration
1. Estimate the duration of human resources required for each activity. 2. Estimate the quantity of the material resources needed for each activity.
Develop Schedule
The schedule will be developed based on the estimated resources, activity duration, and the sequencing of activities. The project schedule will be developed using MS Projects and will indicate the project end date.
Schedule Updates
All schedule status reports will follow the format provided in the WBS. The project schedule is controlled, monitored, and updated via: 1. Daily Clerk of Work Reports 2. Weekly Project Progress Reports 3. Meetings 4. Project Manager will update the project schedule model with individual % complete numbers on tasks to keep the schedule up to date. Changes to the project schedule may result in change requests to the scope baseline and other components of the project management plan. Change requests are processed for review and treatment through the process of performing integrated change control. Preventive actions may include recommended changes to eliminate or reduce the likelihood of negative schedule variances.

Note: Table 13 details the project's schedule management plan (author's own depiction).

4.3.1 Defining and Sequencing of Activities

After the WBS has been developed and the work packages identified, the project team can start identifying the tasks or activities needed to complete the work packages. Activities are derived from the work package level of the WBS.

Activity attributes are the details that are progressively elaborated as the planning process progresses. These attributes show the logical relationship and the resources required to complete the activity. Activity sequencing is done after all the project activities have been identified and refers to putting the activities in a logical order by keeping similar types of work together. Identifying and sequencing activities also allows the project manager to define estimates and costs and determine the skills needed for the work of the project. Table 14 shows the activity list for the project sequentially.

Table 14

Sequence of Activities

Project Name:			Project Management Plan for the Design and Construction a Green, Climate-resilient, Single-family home in Rural Belize			
Date:			May 1, 2023			
Project Manager:			Tenesha Reynolds			
Number	Code	Activity	Predecessors	Successors	Duration (Days)	Milestone
0	0	Start	0	1		
1.1 Approved Green Building Standards						
1.1.1 Desk Review						
1	1.1.1.1	Desk Review of Best Practices	0	2	10	
2	1.1.1.2	Compilation of Best Practices Applicable to Belize	1	3	10	Draft Report on Best Practices
3	1.1.1.3	Seek CBA approval for adaptation of Best Practices	2	4	10	

Project Name:			Project Management Plan for the Design and Construction a Green, Climate-resilient, Single-family home in Rural Belize			
Date:			May 1, 2023			
Project Manager:			Tenesha Reynolds			
Number	Code	Activity	Predecessors	Successors	Duration (Days)	Milestone
4	1.1.1.4	Make necessary revisions based on recommendations from CBA	3	5	5	
1.1.2 Final Report on Applicable Green Building Standards						
5	1.1.2.1	Submission of Revised report on applicable best practices	4	6	5	Approved Green Building Standards
1.2 Design						
6	1.2.1	Develop Design & Architectural Renderings	5	7	5	
1.2.2 Final Approved Design						
7	1.2.2.1	Create Plan and drawings based on adopted green building standards	6	8	7	
8	1.2.2.2	Seek Client Approval	7	9	3	Approved Design & Building Plans
9	1.2.3	List building specification	8	10	5	
10	1.2.4	Apply for Building Permits	9	11	10	Approved Permits
1.3 Construction						
1.3.1 Foundation						
1.3.1.1 Site Work						
11	1.3.1.1.1	Clear and grub lot	10	12	1	
12	1.3.1.1.2	Install temporary power service	11	13	2	
13	1.3.1.1.3	Mark Layout	12	14	2	
14	1.3.1.2	Excavation	13	15	3	
15	1.3.1.3	Formwork	14	16	5	
16	1.3.1.4	Rebar	15	17	3	
1.3.1.5 Cement Work						
17	1.3.1.5.1	Pour Cement	16	18	10	

Project Name:			Project Management Plan for the Design and Construction a Green, Climate-resilient, Single-family home in Rural Belize			
Date:			May 1, 2023			
Project Manager:			Tenesha Reynolds			
Number	Code	Activity	Predecessors	Successors	Duration (Days)	Milestone
18	1.3.1.5.2	Perform foundation inspection	17	19	1	Foundation Complete
1.3.2 Exterior						
1.3.2.1 Exterior Walls						
19	1.3.2.1.1	Framing	18	20	2	
20	1.3.2.1.2	Casting of Columns	19	21	4	
21	1.3.2.1.3	Block Laying	20	22	15	
22	1.3.2.1.4	Plastering of Exterior Walls	21	23	3	
23	1.3.2.2	Roofing	22	24	5	
24	1.3.2.3	Installation of Exterior doors and windows	23	25	3	
25	1.3.2.4	Conduct Exterior Inspection	24	26	1	Exterior Complete
1.3.3 Interior						
1.3.3.1 Drywall						
26	1.3.3.1.1	Installing Drywall	25	27	8	
27	1.3.3.1.2	Inspect Drywall	26	28	1	
1.3.3.2 Electrical						
28	1.3.3.2.1	Install Electrical	27	29	7.5	
29	1.3.3.2.2	Conduct Electrical Inspection	28	30	1	
1.3.3.3 Plumbing						
30	1.3.3.3.1	Install Plumbing	29	31	7.5	
31	1.3.3.3.2	Conduct Plumbing Inspection	30	32	1	
1.3.3.4 HVAC						
32	1.3.3.4.1	Install HVAC	31	33	7	
33	1.3.3.4.2	Conduct HVAC Inspection	32	34	1	Interior Complete
1.3.4 Finishings						
34	1.3.4.1	Tiling	33	35	7	
1.3.4.2 Cabinetry						
35	1.3.4.2.1	Install Cabinetry	34	36	10	

Project Name:			Project Management Plan for the Design and Construction a Green, Climate-resilient, Single-family home in Rural Belize			
Date:			May 1, 2023			
Project Manager:			Tenesha Reynolds			
Number	Code	Activity	Predecessors	Successors	Duration (Days)	Milestone
36	1.3.4.2.2	Install Appliances	35	37	2	
37	1.3.4.3	Install Crown Moldings and Trims	36	38	3	
38	1.3.4.4	Install Solar Panel	37	49	3	Construction Complete
1.4 Monitoring & Control						
1.4.1 Budget Management						
39	1.4.1.1	Cost Accounting	1		199	
40	1.4.1.2	Resource Management	1		199	
1.4.2 Schedule Management						
41	1.4.2.1	Milestone Management	1		199	
42	1.4.2.2	Monitoring & Evaluation	1		199	
1.4.3 Quality and Safety Management						
43	1.4.3.1	Site Inspection	11		129	
44	1.4.3.2	Contract Compliance	11		129	
1.5 Project Closeout						
1.5.1 Occupancy Permit						
45	1.5.1.1	Site Inspection	38	46	5	Occupancy Permit Granted
1.5.2 Site Exit						
46	1.5.2.1	Site Clean-Up	45	47	3	
47	1.5.2.2	Demobilization of Equipment	46	48	1	
48	1.5.2.3	Handing over to Client	47	49	1	
1.5.3 Audit						
49	1.5.3.1	Document Analysis	48		5	
50	1.5.3.2	Contract Compliance	48		3	Project Complete

Note: Table 14 provides details on the sequence of activities, estimated duration and project milestones (Author's own creation).

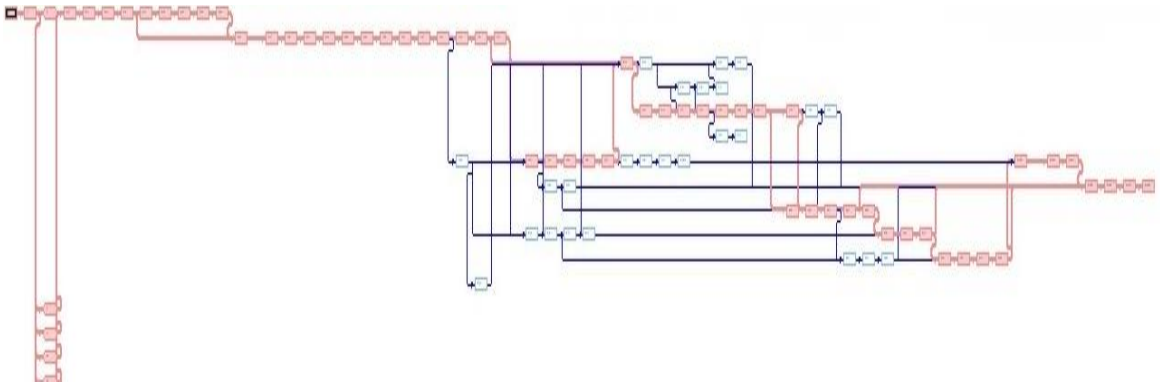
4.3.2 Project Network Diagram

The project will use a network diagram to visualize the relationships and dependencies between the project activities as shown in Figure 8. Activities dependent on each other must be sequenced in the correct order since activities with dependencies cannot start until a previous activity is completed. Although different types of dependency relationships can exist between the activities, the finish-to-start (FS) is the most predominant for this project.

The finish-to-start relationship is where the dependent activity must be finished before the dependent activity can start. A network diagram for the project will be created in Microsoft Project. The diagram displays the critical path of the project.

Figure 8

Project Network Diagram



Note: The figure depicts the project network diagram and the critical path for the project (author's own source).

4.3.3 Responsibility Assignment Matrix

The responsibility assignment matrix (RAM) is used to show the different levels of participation in a work package by various project team members.

RACI is a type of RAM chart with the following designation:

R = Responsible for performing the work

A = Accountable, the one who oversees producing the deliverable or work package, approves or signs off on the work, and makes decisions regarding the work.

C = Consult, someone who has input into the work or decisions

I = Inform, someone who must be informed of the decisions or results

A RACI chart will be created for the project to show the relationship between project tasks and team members. The Director of Operations/Projects must review and approve all proposed changes to project responsibilities. The project documents and the chart will be updated as changes are made. The project's RACI chart is shown in Table 15.

Table 15
RACI Chart

Activity	Director of Operations	Engineers	Architects	Construction Manager	Site Supervisor	CBA	Quality Manager	Client
Green Building Standards	A	R	C	I	I	A	I	I
Architectural Design	A	C	R	I	I	A	I	A
Construction	A	C	C	C	R	I	I	I
Site Inspection	A	I	I	C	C	I	R	I
Risk Assessment	R	C	C	I	I	I	C	I
Final Acceptance	A	R	C	C	C	A	I	A

R – Responsible for completing the work
A – Accountable for ensuring task completion/sign off
C – Consulted before any decisions are made
I – Informed of when an action/decision has been made

4.3.4 Estimation of Activity Duration

Estimating the duration of each activity is essential, as it provides you with information about the time it will take to complete the project work. The scope and resources were considered in estimating the duration of each activity on the project's activity list.

Expert judgment, along with the Program Evaluation and Review Technique (PERT), was used to estimate the duration of the project activities. The PERT allows the project team to make three estimations for completing activities which is useful in planning for the three scenarios presented.

Table 16

Estimation of Activities

Number	Code	Activity	Predecessors	Most Likely (Days)	Optimistic Duration (Days)	Pessimistic Duration (Days)	Estimated Duration (Days)
	1.1	**Approved Green Building Standards**	-	-	-	-	-
	1.1.1	**Desk Review**					
1	1.1.1.1	Desk Review of Best Practices	0	10	8	12	10
2	1.1.1.2	Compilation of Best Practices Applicable to Belize	1	10	8	12	10
3	1.1.1.3	Seek CBA approval for adaptation of Best Practices	2	10	8	15	10.5
4	1.1.1.4	Make necessary revisions based on	3	5	2	8	5

Number	Code	Activity	Predecessors	Most Likely (Days)	Optimistic Duration (Days)	Pessimistic Duration (Days)	Estimated Duration (Days)
		recommendations from CBA					
	1.1.2	Final Report on Applicable Green Building Standards	-	-	-	-	-
5	1.1.2.1	Submission of Revised report on applicable best practices	4	5	1	9	5
	1.2	**Design**	-	-	-	-	-
6	1.2.1	Develop Design & Architectural Renderings	5	5	3	7	5
	1.2.2	Final Approved Design	-	-	-	-	-
7	1.2.2.1	Create Plan and drawings based on adopted green building standards	6	7	5	12	7.5
8	1.2.2.2	Seek Client Approval	7	3	1	5	3
9	1.2.3	List building specification	8	5	2.5	10	5.4
10	1.2.4	Apply for Building Permits	9	10	5	20	10.8
	1.3	**Construction**	-	-	-	-	-
	1.3.1	**Foundation**	-	-	-	-	-
	1.3.1.1	Site Work	-	-	-	-	-
11	1.3.1.1.1	Clear and grub lot	10	1	0.5	3	1.25

Number	Code	Activity	Predecessors	Most Likely (Days)	Optimistic Duration (Days)	Pessimistic Duration (Days)	Estimated Duration (Days)
12	1.3.1.1.2	Install temporary power service	11	2	1	6	2.5
13	1.3.1.1.3	Mark Layout	12	2	1	3	2
14	1.3.1.2	Excavation	13	3	2.5	8	3.75
15	1.3.1.3	Formwork	14	5	2.5	12	5.75
16	1.3.1.4	Rebar	15	3	1	5	3
	1.3.1.5	Cement Work	-	-	-	-	-
17	1.3.1.5.1	Pour Cement	16	10	6	20	11
18	1.3.1.5.2	Perform foundation inspection	17	1	0.5	2	1.08
	1.3.2	**Exterior**	-	-	-	-	-
	1.3.2.1	**Exterior Wall**	-	-	-	-	-
19	1.3.2.1.1	Framing	18	2	1.5	6	2.6
20	1.3.2.1.2	Casting of Columns	19	4	2.5	7	4.25
21	1.3.2.1.3	Block Laying	20	15	12	30	17
22	1.3.2.1.4	Plastering of Exterior Walls	21	3	2	7	3.5
23	1.3.2.2	Roofing	22	5	3.5	12	5.9
24	1.3.2.3	Installation of Exterior doors and windows	23	3	1.5	4	2.9
25	1.3.2.4	Conduct Exterior Inspection	24	1	0.5	1.5	1
	1.3.3	**Interior**	-	-	-	-	-

Number	Code	Activity	Predecessors	Most Likely (Days)	Optimistic Duration (Days)	Pessimistic Duration (Days)	Estimated Duration (Days)
	1.3.3.1	**Drywall**	-	-	-	-	-
26	1.3.3.1.1	Install Drywall	25	8	5	12	8.2
27	1.3.3.1.2	Inspect Drywall	26	1	0.5	1.5	1
	1.3.3.2	**Electrical**	-	-	-	-	-
28	1.3.3.2.1	Install Electrical	27	7.5	5	10	7.5
29	1.3.3.2.2	Conduct Electrical Inspection	28	1	0.5	1.5	1
	1.3.3.3	Plumbing	-	-	-	-	-
30	1.3.3.3.1	Install Plumbing	29	7.5	6	12	8
31	1.3.3.3.2	Conduct Plumbing Inspection	30	1	0.5	1.5	1
	1.3.3.4	**HVAC**	-	-	-	-	-
32	1.3.3.4.1	Install HVAC	31	7	4.5	12	7.4
33	1.3.3.4.2	Conduct HVAC Inspection	32	1	0.5	1.5	1
	1.3.4	**Finishings**	-	-	-	-	-
34	1.3.4.1	Tiling	35	7	5.5	11.5	7.5
	1.3.4.2	Cabinetry	-	-	-	-	-
35	1.3.4.2.1	Install Cabinetry	34	10	7	15	10.3
36	1.3.4.2.2	Install Appliances	35	2	1	7	2.7
37	1.3.4.3	Install Crown Moldings and Trims	36	3	1.5	6	3.25
38	1.3.4.4	Install Solar Panel	37	3	2	8	3.7

Number	Code	Activity	Predecessors	Most Likely (Days)	Optimistic Duration (Days)	Pessimistic Duration (Days)	Estimated Duration (Days)
	1.4	**Monitoring & Control**	-	-	-	-	-
	1.4.1	**Budget Management**	-	-	-	-	-
39	1.4.1.1	Cost Accounting	1	199	126	353	212.5
40	1.4.1.2	Resource Management	1	199	126	353	212.5
	1.4.2	**Schedule Management**	-	-	-	-	-
41	1.4.2.1	Milestone Management	1	129	100	152	128
42	1.4.2.2	Monitoring & Evaluation	1	129	100	152	128
	1.4.3	**Quality and Safety Management**	-	-	-	-	-
43	1.4.3.1	Site Inspection	12	129	100	152	128
44	1.4.3.2	Contract Compliance	11	129	100	152	128
	1.5	**Project Closeout**	-	-	-	-	-
	1.5.1	**Occupancy Permit**	-	-	-	-	-
45	1.5.1.1	Site Inspection	38	5	2	8	5
	1.5.2	**Site Exit**	-	-	-	-	-
46	1.5.2.1	Site Clean-Up	45	3	2	5	3.25
47	1.5.2.2	Demobilization of Equipment	46	1	0.5	3	1.25

Number	Code	Activity	Predecessors	Most Likely (Days)	Optimistic Duration (Days)	Pessimistic Duration (Days)	Estimated Duration (Days)
48	1.5.2.3	Handing over to Client	47	1	0.5	2	1.08
	1.5.3	**Audit**	-	-	-	-	-
49	1.5.3.1	Document Analysis	48	5	3	20	7.2
50	1.5.3.2	Contract Compliance	48	3	2	10	4

Note: Table 16 provides details on project's activities' duration using the PERT Method (Author's own creation).

4.3.5 Schedule Reserve

Schedule reserve is incorporated into the schedule management to accommodate the known unknowns that can cause delays in the project schedule (PMI, 2017). Belize is prone to inclement weather, which can significantly affect construction operations. Construction also highly depends on third-party services for inspection, approvals, and permits. Green Building recognizes from experience that this process can be bureaucratic and highly dependent on the workload of the public officer whose responsibility these services are tasked to.

Table 14 shows the time reserves by activity, defining the project's 10% schedule reserve.

Table 17

Reserve Analysis

Number	Code	Activity	Predecessors	Estimated Duration (Days)	Estimated Duration with 10% Schedule Reserve
	1.1	**Approved Green Building Standards**	-	-	-
	1.1.1	**Desk Review**	-	-	-
1	1.1.1.1	Desk Review of Best Practices	0	10	11
2	1.1.1.2	Compilation of Best Practices Applicable to Belize	1	10	11
3	1.1.1.3	Seek CBA approval for adaptation of Best Practices	2	10.5	11.6
4	1.1.1.4	Make necessary revisions based on recommendations from CBA	3	5	5.5
	1.1.2	Final Report on Applicable Green Building Standards	-	-	-
5	1.1.2.1	Submission of Revised report on applicable best practices	4	5	5.5
	1.2	**Design**	-	-	-
6	1.2.1	Develop Design & Architectural Renderings	5	5	5.5
	1.2.2	Final Approved Design	-	-	-
7	1.2.2.1	Create Plan and drawings based on adopted green building standards	6	7.5	8.25
8	1.2.2.2	Seek Client Approval	7	3	3.3
9	1.2.3	List building specification	8	5.4	6.0
10	1.2.4	Apply for Building Permits	9	10.8	12
	1.3	**Construction**	-	-	-
	1.3.1	**Foundation**	-	-	-
	1.3.1.1	Site Work	-	-	-
11	1.3.1.1.1	Clear and grub lot	10	1.25	1.4
12	1.3.1.1.2	Install temporary power service	11	2.5	2.75
13	1.3.1.1.3	Mark Layout	12	2	2.2

Number	Code	Activity	Predecessors	Estimated Duration (Days)	Estimated Duration with 10% Schedule Reserve
14	1.3.1.2	Excavation	13	3.75	4
15	1.3.1.3	Formwork	14	5.75	6.3
16	1.3.1.4	Rebar	15	3	3.3
	1.3.1.5	Cement Work	-	-	-
17	1.3.1.5.1	Pour Cement	16	11	12
18	1.3.1.5.2	Perform foundation inspection	17	1.08	1.2
	1.3.2	**Exterior**	-	-	-
	1.3.2.1	**Exterior Walls**	-	-	-
19	1.3.2.1.1	Framing	18	2.6	2.8
20	1.3.2.1.2	Casting of Columns	19	4.25	4.7
21	1.3.2.1.3	Block Laying	20	17	18.7
22	1.3.2.1.4	Plastering of Exterior Walls	21	3.5	3.85
23	1.3.2.2	Roofing	22	5.9	6.5
24	1.3.2.3	Installation of Exterior doors and windows	23	2.9	3.2
25	1.3.2.4	Conduct Exterior Inspection	24	1	1.1
	1.3.3	**Interior**	-	-	-
	1.3.3.1	**Drywall**	-	-	-
26	1.3.3.1.1	Install Drywall	25	8.2	9.0
27	1.3.3.1.2	Inspect Drywall	26	1	1.1
	1.3.3.2	Electrical	-	-	-
28	1.3.3.2.1	Install Electrical	27	7.5	8.25
29	1.3.3.2.2	Conduct Electrical Inspection	28	1	1.1
	1.3.3.3	Plumbing	-	-	-
30	1.3.3.3.1	Install Plumbing	29	8	8.8
31	1.3.3.3.2	Conduct Plumbing Inspection	30	1	1.1
	1.3.3.4	HVAC	-	-	-
32	1.3.3.4.1	Install HVAC	31	7.4	8.2
33	1.3.3.4.2	Conduct HVAC Inspection	32	1	1.1
	1.3.4	**Finishings**	-	-	-
34	1.3.4.1	Tiling	33	7.5	8.25
	1.3.4.2	Cabinetry			
35	1.3.4.2.1	Install Cabinetry	34	10.3	11.4
36	1.3.4.2.2	Install Appliances	35	2.7	3
37	1.3.4.3	Install Crown Moldings and Trims	36	3.25	3.6

Number	Code	Activity	Predecessors	Estimated Duration (Days)	Estimated Duration with 10% Schedule Reserve
38	1.3.4.4	Install Solar Panel	37	3.7	4.0
	1.4	**Monitoring & Control**	-	-	-
	1.4.1	**Budget Management**	-	-	-
39	1.4.1.1	Cost Accounting	1	212.5	233.75
40	1.4.1.2	Resource Management	1	212.5	233.75
	1.4.2	**Schedule Management**	-	-	-
41	1.4.2.1	Milestone Management	1	128	140.8
42	1.4.2.2	Monitoring & Evaluation	1	128	140.8
	1.4.3	**Quality and Safety Management**	-	-	-
43	1.4.3.1	Site Inspection	11	128	140.8
44	1.4.3.2	Contract Compliance	11	128	140.8
	1.5	**Project Closeout**	-	-	-
	1.5.1	**Occupancy Permit**	-	-	-
45	1.5.1.1	Site Inspection	38	5	5.5
	1.5.2	**Site Exit**	-	-	-
46	1.5.2.1	Site Clean-Up	45	3.25	3.5
47	1.5.2.2	Demobilization of Equipment	46	1.25	1.4
48	1.5.2.3	Handing over to Client	47	1.08	1.2
	1.5.3	**Audit**	-	-	-
49	1.5.3.1	Document Analysis	47	7.2	8
50	1.5.3.2	Contract Compliance	47	4	4.4

Note: Table 17 provides details on project's activities' duration inclusive of the 10% schedule reserve (Author's own creation).

4.3.6 Schedule Development

The schedule is one of the most important tools for managing projects, as it combines everything to determine project activities' start and finish dates (PMI, 2017). The project will use the critical path method to estimate the minimum duration of the project and determine the level of flexibility in the programming of the network paths calculated with the start, finish, early, and late dates (PMI, 2017)

Table 18 details the project calendar, while Figure 9 depicts the project schedule as a Gantt chart.

Table 18

Project Chronology

	Task Name	Duration	Start	Finish	Predecessors
1.	**1 Construction of a Green, Climate-Resilient, Single-Family Home**	**223 days**	**Wed 01/11/23**	**Fri 06/09/24**	
2.	**1.1 Approved Green Building Standards**	**45 days**	**Wed 01/11/23**	**Tue 02/01/24**	
3.	**1.1.1 Desk Review**	**36 days**	**Wed 01/11/23**	**Wed 20/12/23**	
4.	1.1.1.1 Desk Review of Best Practices	10 days	Wed 01/11/23	Tue 14/11/23	
5.	1.1.1.2 Compilation of Best Practices Applicable to Belize	10 days	Wed 15/11/23	Tue 28/11/23	4
6.	1.1.1.3 Seek CBA approval for adaptation of Best Practices	10.5 days	Wed 29/11/23	Wed 13/12/23	5
7.	1.1.1.4 Make necessary revisions based on recommendations from CBA	5 days	Wed 13/12/23	Wed 20/12/23	6
8.	**1.1.2 Final Report on Applicable Green Building Standards**	**5 days**	**Thu 21/12/23**	**Wed 27/12/23**	
9.	1.1.2.1 Submission of Revised report on applicable best practices	5 days	Thu 21/12/23	Wed 27/12/23	7
10.	**1.2 Design**	**32 days**	**Wed 27/12/23**	**Fri 09/02/24**	
11.	1.2.1 Develop Design & Architectural Renderings	5 days	Wed 27/12/23	Wed 03/01/24	9
12.	**1.2.2 Final Approved Design**	**11 days**	**Wed 03/01/24**	**Thu 18/01/24**	

	Task Name	Duration	Start	Finish	Predecessors
13.	1.2.2.1 Create Plan and drawings based on adopted green building standards	7.5 days	Wed 03/01/24	Fri 12/01/24	11
14.	1.2.2.2 Seek Client Approval	3 days	Mon 15/01/24	Wed 17/01/24	13
15.	1.2.3 List building specification	5 days	Thu 18/01/24	Wed 24/01/24	14
16.	1.2.4 Apply for Building Permits	11 days	Thu 25/01/24	Thu 08/02/24	15
17.	**1.3 Construction**	**133 days**	**Fri 09/02/24**	**Tue 13/08/24**	
18.	**1.3.1 Foundation**	**34 days**	**Fri 09/02/24**	**Wed 27/03/24**	
19.	**1.3.1.1 Site Work**	**8 days**	**Fri 09/02/24**	**Tue 20/02/24**	
20.	1.3.1.1.1 Clear and Grub Lot	2 days	Fri 09/02/24	Mon 12/02/24	16
21.	1.3.1.1.2 Install temporary power service	2.5 days	Tue 13/02/24	Thu 15/02/24	20
22.	1.3.1.1.3 Mark Layout	2 days	Fri 16/02/24	Mon 19/02/24	21
23.	1.3.1.2 Excavation	4 days	Tue 20/02/24	Fri 23/02/24	22
24.	1.3.1.3 Formwork	6 days	Mon 26/02/24	Mon 04/03/24	23
25.	1.3.1.4 Rebar	3 days	Tue 05/03/24	Thu 07/03/24	24
26.	**1.3.1.5 Cement Work**	**15 days**	**Thu 07/03/24**	**Wed 27/03/24**	
27.	1.3.1.5.1 Pour Cement	11 days	Fri 08/03/24	Fri 22/03/24	25

	Task Name	Duration	Start	Finish	Predecessors
28.	1.3.1.5.2 Perform foundation inspection	1 day	Mon 25/03/24	Mon 25/03/24	27
29.	**1.3.2 Exterior**	**37.5 days**	**Tue 26/03/24**	**Thu 16/05/24**	
30.	**1.3.2.1 Exterior Walls**	**27.5 days**	**Tue 26/03/24**	**Thu 02/05/24**	
31.	1.3.2.1.1 Framing	2.5 days	Tue 26/03/24	Thu 28/03/24	28
32.	1.3.2.1.2 Casting of Columns	4.5 days	Thu 28/03/24	Wed 03/04/24	31
33.	1.3.2.1.3 Block Laying	17 days	Thu 04/04/24	Fri 26/04/24	32
34.	1.3.2.1.4 Plastering of Walls	3.5 days	Mon 29/04/24	Thu 02/05/24	33
35.	1.3.2.2 Roofing	6 days	Thu 02/05/24	Fri 10/05/24	34
36.	1.3.2.3 Installation of Exterior doors and windows	3 days	Fri 10/05/24	Wed 15/05/24	35
37.	1.3.2.4 Conduct Exterior Inspection	1 day	Wed 15/05/24	Thu 16/05/24	36
38.	**1.3.3 Interior**	**35 days**	**Thu 16/05/24**	**Thu 04/07/24**	
39.	**1.3.3.1 Drywall**	**9 days**	**Thu 16/05/24**	**Wed 29/05/24**	
40.	1.3.3.1.1 Install Drywall	8 days	Thu 16/05/24	Tue 28/05/24	37
41.	1.3.3.1.2 Inspect Drywall	1 day	Tue 28/05/24	Wed 29/05/24	40
42.	**1.3.3.2 Electrical**	**8.5 days**	**Wed 29/05/24**	**Mon 10/06/24**	

	Task Name	Duration	Start	Finish	Predecessors
43.	1.3.3.2.1 Install Electrical	7.5 days	Wed 29/05/24	Fri 07/06/24	41
44.	1.3.3.2.2 Conduct Electrical Inspection	1 day	Mon 10/06/24	Mon 10/06/24	43
45.	**1.3.3.3 Plumbing**	**9 days**	**Tue 11/06/24**	**Fri 21/06/24**	
46.	1.3.3.3.1 Install Plumbing	8 days	Tue 11/06/24	Thu 20/06/24	44
47.	1.3.3.3.2 Conduct Plumbing Inspection	1 day	Fri 21/06/24	Fri 21/06/24	46
48.	**1.3.3.4 HVAC**	**8.5 days**	**Mon 24/06/24**	**Thu 04/07/24**	
49.	1.3.3.4.1 Install HVAC	7.5 days	Mon 24/06/24	Wed 03/07/24	47
50.	1.3.3.4.2 Conduct HVAC Inspection	1 day	Wed 03/07/24	Thu 04/07/24	49
51.	**1.3.4 Finishings**	**28 days**	**Thu 04/07/24**	**Tue 13/08/24**	
52.	1.3.4.1 Tiling	7.5 days	Thu 04/07/24	Mon 15/07/24	50
53.	1.3.4.2 Cabinetry				
54.	1.3.4.2.1 Install Cabinetry	10 days	Tue 16/07/24	Mon 29/07/24	52
55.	1.3.4.2.2 Install Appliances	3 days	Tue 30/07/24	Thu 01/08/24	54
56.	1.3.4.3 Install Crown Moldings and Trims	3.5 days	Fri 02/08/24	Wed 07/08/24	55
57.	1.3.4.4 Install Solar Panel	4 days	Wed 07/08/24	Tue 13/08/24	56

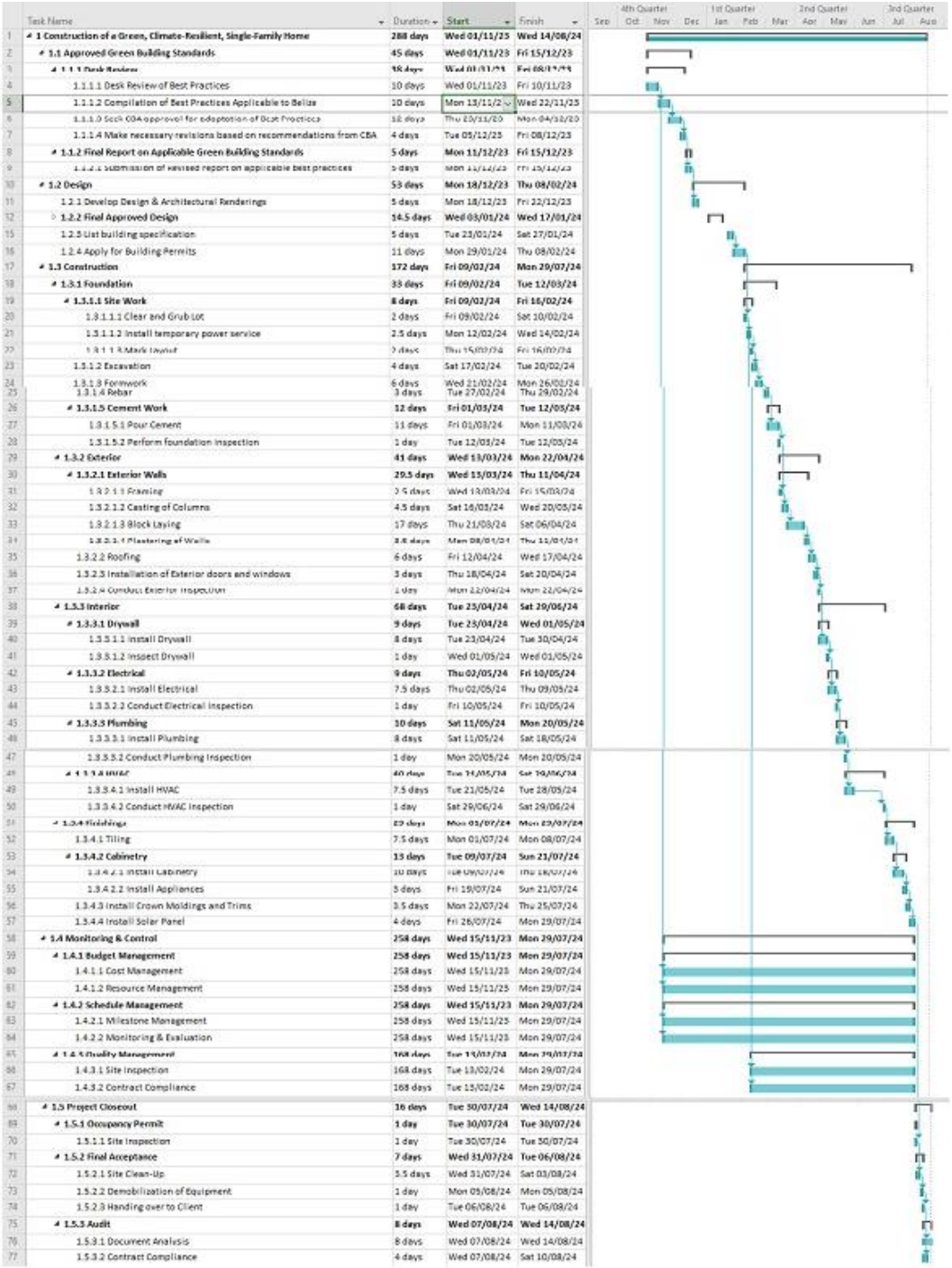
	Task Name	Duration	Start	Finish	Predecessors
58.	**1.4 Monitoring & Control**	**204 days**	**Wed 15/11/23**	**Mon 26/08/24**	
59.	**1.4.1 Budget Management**	**195 days**	**Wed 15/11/23**	**Tue 13/08/24**	
60.	1.4.1.1 Cost Management	195 days	Wed 15/11/23	Tue 13/08/24	4
61.	1.4.1.2 Resource Management	195 days	Wed 15/11/23	Tue 13/08/24	4
62.	**1.4.2 Schedule Management**	**204 days**	**Wed 15/11/23**	**Mon 26/08/24**	
63.	1.4.2.1 Milestone Management	195 days	Wed 15/11/23	Tue 13/08/24	4
64.	1.4.2.2 Monitoring & Evaluation	195 days	Wed 15/11/23	Tue 13/08/24	4
65.	**1.4.3 Quality and Safety Management**	**131 days**	**Tue 13/02/24**	**Tue 13/08/24**	
66.	1.4.3.1 Site Inspection	131 days	Tue 13/02/24	Tue 13/08/24	20
67.	1.4.3.2 Contract Compliance	131 days	Tue 13/02/24	Tue 13/08/24	20
68.	**1.5 Project Closeout**	**18.5 days**	**Tue 13/08/24**	**Fri 06/09/24**	
69.	**1.5.1 Occupancy Permit**	**1 day**	**Tue 13/08/24**	**Wed 14/08/24**	
70.	1.5.1.1 Site Inspection	1 day	Tue 13/08/24	Wed 14/08/24	57
71.	**1.5.2 Final Acceptance**	**5.5 days**	**Wed 14/08/24**	**Wed 21/08/24**	
72.	1.5.2.1 Site Clean-Up	3.5 days	Wed 14/08/24	Mon 19/08/24	70

	Task Name	Duration	Start	Finish	Predecessors
73.	1.5.2.2 Demobilization of Equipment	1 day	Tue 20/08/24	Tue 20/08/24	72
74.	1.5.2.3 Handing over to Client	1 day	Wed 21/08/24	Wed 21/08/24	73
75.	**1.5.3 Audit**	**12 days**	**Thu 22/08/24**	**Fri 06/09/24**	
76.	1.5.3.1 Document Analysis	8 days	Thu 22/08/24	Mon 02/09/24	74
77.	1.5.3.2 Contract Compliance	4 days	Tue 03/09/24	Fri 06/09/24	76

Note: Table 18 shows the project chronology, duration, start and end dates (Author's own creation).

Figure 9

Project Schedule



	Task Name	Duration	Start	Finish
1	1 Construction of a Green, Climate-Resilient, Single-Family Home	288 days	Wed 01/11/23	Wed 14/08/24
2	1.1 Approved Green Building Standards	45 days	Wed 01/11/23	Fri 15/12/23
3	1.1.1 Desk Review	38 days	Wed 01/11/23	Fri 08/12/23
4	1.1.1.1 Desk Review of Best Practices	10 days	Wed 01/11/23	Fri 10/11/23
5	1.1.1.2 Compilation of Best Practices Applicable to Belize	10 days	Mon 13/11/23	Wed 22/11/23
6	1.1.1.3 Seek CDA approval for adaptation of Best Practices	12 days	Thu 23/11/23	Mon 04/12/23
7	1.1.1.4 Make necessary revisions based on recommendations from CBA	4 days	Tue 05/12/23	Fri 08/12/23
8	1.1.2 Final Report on Applicable Green Building Standards	5 days	Mon 11/12/23	Fri 15/12/23
9	1.1.2.1 Submission of revised report on applicable best practices	5 days	Mon 11/12/23	Fri 15/12/23
10	1.2 Design	53 days	Mon 18/12/23	Thu 08/02/24
11	1.2.1 Develop Design & Architectural Renderings	5 days	Mon 18/12/23	Fri 22/12/23
12	1.2.2 Final Approved Design	14.5 days	Wed 03/01/24	Wed 17/01/24
15	1.2.3 List building specification	5 days	Tue 23/01/24	Sat 27/01/24
16	1.2.4 Apply for Building Permits	11 days	Mon 29/01/24	Thu 08/02/24
17	1.3 Construction	172 days	Fri 09/02/24	Mon 29/07/24
18	1.3.1 Foundation	33 days	Fri 09/02/24	Tue 12/03/24
19	1.3.1.1 Site Work	8 days	Fri 09/02/24	Fri 16/02/24
20	1.3.1.1.1 Clear and Grub Lot	2 days	Fri 09/02/24	Sat 10/02/24
21	1.3.1.1.2 Install temporary power service	2.5 days	Mon 12/02/24	Wed 14/02/24
22	1.3.1.1.3 Mark layout	2 days	Thu 15/02/24	Fri 16/02/24
23	1.3.1.2 Excavation	4 days	Sat 17/02/24	Tue 20/02/24
24	1.3.1.3 Formwork	6 days	Wed 21/02/24	Mon 26/02/24
25	1.3.1.4 Rebar	3 days	Tue 27/02/24	Thu 29/02/24
26	1.3.1.5 Cement Work	12 days	Fri 01/03/24	Tue 12/03/24
27	1.3.1.5.1 Pour Cement	11 days	Fri 01/03/24	Mon 11/03/24
28	1.3.1.5.2 Perform foundation inspection	1 day	Tue 12/03/24	Tue 12/03/24
29	1.3.2 Exterior	41 days	Wed 13/03/24	Mon 22/04/24
30	1.3.2.1 Exterior Walls	29.5 days	Wed 13/03/24	Thu 11/04/24
31	1.3.2.1.1 Framing	2.5 days	Wed 13/03/24	Fri 15/03/24
32	1.3.2.1.2 Casting of Columns	4.5 days	Sat 16/03/24	Wed 20/03/24
33	1.3.2.1.3 Block Laying	17 days	Thu 21/03/24	Sat 06/04/24
34	1.3.2.1.4 Plastering of Walls	3.5 days	Mon 08/04/24	Thu 11/04/24
35	1.3.2.2 Roofing	6 days	Fri 12/04/24	Wed 17/04/24
36	1.3.2.3 Installation of Exterior doors and windows	3 days	Thu 18/04/24	Sat 20/04/24
37	1.3.2.4 Conduct Exterior Inspection	1 day	Mon 22/04/24	Mon 22/04/24
38	1.3.3 Interior	68 days	Tue 23/04/24	Sat 29/06/24
39	1.3.3.1 Drywall	9 days	Tue 23/04/24	Wed 01/05/24
40	1.3.3.1.1 Install Drywall	8 days	Tue 23/04/24	Tue 30/04/24
41	1.3.3.1.2 Insect Drywall	1 day	Wed 01/05/24	Wed 01/05/24
42	1.3.3.2 Electrical	9 days	Thu 02/05/24	Fri 10/05/24
43	1.3.3.2.1 Install Electrical	7.5 days	Thu 02/05/24	Thu 09/05/24
44	1.3.3.2.2 Conduct Electrical Inspection	1 day	Fri 10/05/24	Fri 10/05/24
45	1.3.3.3 Plumbing	10 days	Sat 11/05/24	Mon 20/05/24
46	1.3.3.3.1 Install Plumbing	8 days	Sat 11/05/24	Sat 18/05/24
47	1.3.3.3.2 Conduct Plumbing Inspection	1 day	Mon 20/05/24	Mon 20/05/24
48	1.3.3.4 HVAC	40 days	Tue 14/05/24	Sat 29/06/24
49	1.3.3.4.1 Install HVAC	7.5 days	Tue 21/05/24	Tue 28/05/24
50	1.3.3.4.2 Conduct HVAC Inspection	1 day	Sat 29/06/24	Sat 29/06/24
51	1.3.4 Finishings	23 days	Mon 01/07/24	Mon 29/07/24
52	1.3.4.1 Tiling	7.5 days	Mon 01/07/24	Mon 08/07/24
53	1.3.4.2 Cabinetry	13 days	Tue 09/07/24	Sun 21/07/24
54	1.3.4.2.1 Install Cabinetry	10 days	Tue 09/07/24	Thu 18/07/24
55	1.3.4.2.2 Install Appliances	5 days	Fri 19/07/24	Sun 21/07/24
56	1.3.4.3 Install Crown Moldings and Trims	3.5 days	Mon 22/07/24	Thu 25/07/24
57	1.3.4.4 Install Solar Panel	4 days	Fri 26/07/24	Mon 29/07/24
58	1.4 Monitoring & Control	258 days	Wed 15/11/23	Mon 29/07/24
59	1.4.1 Budget Management	258 days	Wed 15/11/23	Mon 29/07/24
60	1.4.1.1 Cost Management	258 days	Wed 15/11/23	Mon 29/07/24
61	1.4.1.2 Resource Management	258 days	Wed 15/11/23	Mon 29/07/24
62	1.4.2 Schedule Management	258 days	Wed 15/11/23	Mon 29/07/24
63	1.4.2.1 Milestone Management	258 days	Wed 15/11/23	Mon 29/07/24
64	1.4.2.2 Monitoring & Evaluation	258 days	Wed 15/11/23	Mon 29/07/24
65	1.4.3 Quality Management	168 days	Tue 13/02/24	Mon 29/07/24
66	1.4.3.1 Site Inspection	168 days	Tue 13/02/24	Mon 29/07/24
67	1.4.3.2 Contract Compliance	168 days	Tue 13/02/24	Mon 29/07/24
68	1.5 Project Closeout	16 days	Tue 30/07/24	Wed 14/08/24
69	1.5.1 Occupancy Permit	1 day	Tue 30/07/24	Tue 30/07/24
70	1.5.1.1 Site Inspection	1 day	Tue 30/07/24	Tue 30/07/24
71	1.5.2 Final Acceptance	7 days	Wed 31/07/24	Tue 06/08/24
72	1.5.2.1 Site Clean-Up	5.5 days	Wed 31/07/24	Sat 03/08/24
73	1.5.2.2 Demobilization of Equipment	1 day	Mon 05/08/24	Mon 05/08/24
74	1.5.2.3 Handing over to Client	1 day	Tue 06/08/24	Tue 06/08/24
75	1.5.3 Audit	8 days	Wed 07/08/24	Wed 14/08/24
76	1.5.3.1 Document Analysis	8 days	Wed 07/08/24	Wed 14/08/24
77	1.5.3.2 Contract Compliance	4 days	Wed 07/08/24	Sat 10/08/24

Note: Figure 8 depicts the project schedule (Author's own creation).

4.3.7 *Schedule* Control

The project team will review and update the schedule weekly with the actual start, finish, and percentage completed, which the task owners will provide. The Director of Operations/Projects will hold weekly progress meetings to provide schedule updates, determine the schedule status and variances, and discuss schedule change requests. Project team members must participate in the weekly progress meetings. They must be able to provide schedule updates and communicate any changes that will affect project activities' start or finish dates. The schedule performance index and variance will measure and track the project's schedule. Functional managers must know the project's schedule status for ongoing budgeting and resource allocation purposes. The format for meetings is detailed in the Communications Management Plan of the project management plan. The information should also be documented in the project's monthly status report.

4.3.8 Schedule Changes

The Director of Operations/Projects must be informed of all changes which impact the project's schedule. The Director will meet with the project team to review and evaluate the necessity of the change. The project team must determine which activities are impacted, the variance resulting from the potential change, and any alternatives that can be employed. The team must also determine how these factors affect the scope, schedule, and resources. If it is determined that the proposed changes affect the scope, a schedule change request must be submitted to the Director of Operations/Projects for approval. However, if

the proposed changes meet any of the following conditions, the schedule change request must be submitted to the project sponsor for approval:

- The proposed change is estimated to impact a milestone on the Milestone Chart by 10% or more.
- The change is estimated to increase the duration of the overall baseline schedule by 10% or more.

The Director of Operations/Projects is responsible for adjusting the schedule for all approved changes and must communicate all changes to the project team and relevant stakeholders. All change requests must be documented in the Change Log.

4.4 Cost Management Plan

The Cost Management Plan is developed to plan, estimate, and manage the budget for all project activities, deliverables, and resources. The plan specifies how the project costs will be estimated, structured, monitored, and controlled. Detailed estimates of the project costs will be developed and compiled into a budget to ensure the project stays within budget. The Finance Officer will track the project expenses against the budget as the work is executed and update the Director of Operations/Projects accordingly.

The overall goal of the cost management plan is to outline the methodology by which the costs associated with the project's activities are planned, organized, and controlled throughout the project's lifecycle. The cost management plan establishes the format and standards for measuring, reporting, and controlling the project's costs. Cost management is essential to the project to design and construct a green, climate-resilient, single-family home in rural Belize to maintain control over the resources necessary to

adequately complete the activities that make up the schedule. The Cost Management Plan will outline metrics, cost variance considerations, and reporting activities to which the project team and other stakeholders must adhere.

4.4.1 Estimate Activity Costs

Cost estimates provide information on the cost of the resources necessary to complete project work, including labor, equipment, supplies, services, facilities, and materials. The scope baseline and WBS will be used to estimate and manage the costs of this project. Cost estimates will be determined using expert judgment, parametric, analogous, and bottom-up estimates. Once derived, activity cost estimates are aggregated into the work packages, into the Control Accounts, and finally into the entire project Cost Baseline. The estimates will also include a contingency reserve to account for risks related to uncertainty in the cost estimates or resource availability, as well as considerations for the cost of quality and any indirect costs associated with the project.

The activity cost estimate for each activity for the project is shown in Table 19.

Table 19

Cost Estimates

Code	Activity	Assigned Resources	Quantity	Unit of Measure	Unit Cost (US $)	Total Costs per Activity (US $)	Totals Costs (US $)
1	**Construction of a Green, Climate-Resilient, Single-Family Home**						**$60,000**
1.1	**Approved Green Building Standards**						**4,050**
1.1.1	**Desk Review**					**$3,240**	
1.1.1.1	Desk Review of Best Practices	Engineers	10	$/day	$90	$900	
1.1.1.2	Compilation of Best Practices Applicable to Belize	Engineers	10	$/day	$90	$900	
1.1.1.3	Seek CBA approval for adaptation of Best Practices	Project Manager	10.5	$/day	$90	$990	
1.1.1.4	Make necessary revisions based on recommendations from CBA	Engineers	5	$/day	$90	$450	
1.1.2	**Final Report on Applicable Green Building Standards**	**Engineers**	**9**	$/day		**$810**	
1.1.2.1	Submission of Revised report on applicable best practices	Engineers	9	$/day	$90	$810	
1.2	**Design**					**$3,950**	**$3,950**
1.2.1	Develop Design & Architectural Renderings	Architect/Draftsman	5	$/day	$150	$750	
1.2.2	**Final Approved Design**					**$1,800**	

Code	Activity	Assigned Resources	Quantity	Unit of Measure	Unit Cost (US $)	Total Costs per Activity (US $)	Totals Costs (US $)
1.2.2.1	Create Plan and drawings based on adopted green building standards	Architect/Draftsman	7.5	$/day	$225	$1,800	
1.2.2.2	Seek Client Approval	Project Manager	3	$/day	$0	$0	
1.2.3	List building specification	Architect/Draftsman Engineer	5	$/day	$130	$650	
1.2.4	Apply for Building Permits	Architect/Draftsman	1	$/Permit	$750	$750	
1.3	**Construction**		**133**	**$/day**			**$42,000**
1.3.1	**Foundation**		**34**	**$/day**		**$7,500**	
1.3.1.1	**Site Work**						
1.3.1.1.1	Clear and grub lot	Labor	2	$/day	$100	$200	
1.3.1.1.2	Install temporary power service	BEL	1	$/fee	$75	$75	**$475**
1.3.1.1.3	Mark Layout	Labor/Material	2	$/day	$100	$200	
1.3.1.2	**Excavation**	**Labor/Machinery**	**4**	**$/day**	**$150**	**$600**	**$600**
1.3.1.3	Formwork	Labor/Material	6	$/day	$100	$600	**$600**
1.3.1.4	Rebar	Labor/Material	3	$/day	$250	$750	**$750**
1.3.1.5	**Cement Work**		**15**				
1.3.1.5.1	Pour Cement	Labor/Material	14	$/day	$357	$5,000	**$5,075**
1.3.1.5.2	Perform foundation inspection	Labor	1	$/day	$75	$75	
1.3.2	**Exterior**		**37.5**	**$/day**		**$20,000**	
1.3.2.1	**Exterior Wall**		**27.5**	$/day			
1.3.2.1.1	Framing	Labor/Material	2.5	$/day	$175	$438	
1.3.2.1.2	Casting of Columns	Labor/Material	4.5	$/day	$300	$1,350	**$10,813**
1.3.2.1.3	Block Laying	Labor/Material	17	$/day	$500	$8,500	
1.3.2.1.4	Plastering of Exterior Walls	Labor/Material	3.5	$/day	$150	$525	

Code	Activity	Assigned Resources	Quantity	Unit of Measure	Unit Cost (US $)	Total Costs per Activity (US $)	Totals Costs (US $)
1.3.2.2	Roofing	Labor/Material	6	$/day	$1,083	$6,500	**$6,500**
1.3.2.3	Installation of Exterior doors and windows	Labor/Material	3	$/day	$871	$871	**$2,687**
1.3.2.4	Conduct Exterior Inspection	Labor	1	$/day	$75	$75	
1.3.3	**Interior**		**35**	$/day		**$9,500**	
1.3.3.1	**Drywall**		**9**	$/day			
1.3.3.1.1	Install Drywall	Labor/Material	8	$/day	$100	$800	**$875**
1.3.3.1.2	Inspect Drywall	Labor	1	$/day	$75	$75	
1.3.3.2	**Electrical**		**8.5**	$/day			
1.3.3.2.1	Install Electrical	Labor/Material	7.5	$/day	$400	$3,000	**$3,075**
1.3.3.2.2	Conduct Electrical Inspection	Labor	1	$/day	$75	$75	
1.3.3.3	**Plumbing**		**9**	$/day			
1.3.3.3.1	Install Plumbing	Labor/Material	8	$/day	$350	$2,800	**$2,875**
1.3.3.3.1	Conduct Plumbing Inspection	Labor	1	$/day	$75	$75	
1.3.3.4	**HVAC**		**8.5**	$/day			
1.3.3.4.1	Install HVAC	Labor/Material	7.5	$/day	$347	$2,600	**$2,675**
1.3.3.4.1	Conduct HVAC Inspection	Labor	1	$/day	$75	$75	
1.3.4	**Finishings**		**28**	$/day		**$13,000**	
1.3.4.1	Tiling	Labor/Material	7.5	$/day	$234	$1,750	**$1,750**
1.3.4.2	Cabinetry	Labor/Material		$/day			
1.3.4.2.1	Install Cabinetry	Labor/Material	10	$/day	$250	$2,500	**$5,500**
1.3.4.2.2	Install Appliances	Labor/Material	3	$/day	$1,000	$3,000	
1.3.4.3	Install Crown Moldings and Trims	Labor/Material	3.5	$/day	$500	$1,750	**$1,750**
1.3.4.4	Install Solar Panel	Labor/Material	4	$/day	$1,000	$4,000	**$4,000**
1.4	**Monitoring & Control**		**204**	$/day			
1.4.1	**Budget Management**		195	$/day			

Code	Activity	Assigned Resources	Quantity	Unit of Measure	Unit Cost (US $)	Total Costs per Activity (US $)	Totals Costs (US $)
1.4.1.1	Cost Accounting	Labor	195	$/day	0	0	0
1.4.1.2	Resource Management	Labor	**195**	$/day	0	0	0
1.4.2	**Schedule Management**		204	$/day			
1.4.2.1	Milestone Management	Labor	195	$/day	0	0	0
1.4.2.2	Monitoring & Evaluation	Labor	**195**	$/day	0	0	0
1.4.3	**Quality and Safety Management**		131 days	$/day			
1.4.3.1	Site Inspection	Labor	131 days	$/day	0	0	0
1.4.3.2	Contract Compliance	Labor	**131**	$/day	0	0	0
1.5	**Project Closeout**		**18.5**	$/day			**$2,000**
1.5.1	**Occupancy Permit**		1	$/day		**$250**	
1.5.1.1	Site Inspection	CBA	**1**	$/day	$250		**$250**
1.5.2	**Site Exit**			$/day		**$750**	
1.5.2.1	Site Clean-Up	Labor	3.5	$/day	$100	$350	**$750**
1.5.2.2	Demobilization of Equipment	Labor	1	$/day	$400	$400	
1.5.2.3	Handing over to Client		**1**	$/day	0	0	0
1.5.3	**Audit**		12	$/day		**$1,000**	
1.5.3.1	Document Analysis	Labor	8	$/day	$83	$668	**$1,000**
1.5.3.2	Contract Compliance	Labor	4	$/day	$83	$332	

Note: Table 19 depicts the estimated costs of the activities to carry out the project. Note that some figures in the table are rounded up.

4.4.2 Determining the Budget

The project's budget is developed using the basis of estimates and the cost estimate for project activities. The project will use cost aggregation to roll up the estimated project costs into control accounts, making it easier to know the cost of each work package. The project will use expert judgment, and data gathered from a project risk analysis to determine the amount of contingency and management reserve to be included in the project's budget. Contingency reserves are funds added to the budget to pay for unexpected events due to identified risks, while management reserves are funds added to the cost baseline for unidentified risks. The project team has identified a three percent (3%) contingency reserve and a management reserve, respectively. The project will also use a cost baseline to monitor the project's financial performance. During the execution of the project, the actual costs will be measured against the budgeted costs for each activity.

Table 20 depicts the project budget, inclusive of contingencies and management reserves.

Table 20

Project Budget

Code	Activity	Total Costs (US $)
1.1	**Approved Green Building Standards**	**4,050**
1.1.1	Desk Review	$3,240
1.1.2	Final Report on Applicable Green Building Standards	$810
1.2	**Design**	**$3,950**
1.2.1	Develop Design & Architectural Renderings	$750
1.2.2	Final Approved Design	$1,800
1.2.3	List building specification	$650
1.2.4	Apply for Building Permits	$750
1.3	**Construction**	**$50,000**
1.3.1	Foundation	$7,500
1.3.2	Exterior	$20,000
1.3.3	Interior	$9,500
1.3.4	Finishing	$13,000
1.4	**Monitoring & Control**	**$0.00**
1.4.1	Budget Management	-
1.4.2	Schedule Management	-
1.4.3	Quality and Safety Management	-
1.5	**Project Closeout**	**$2,000**
1.5.1	Occupancy Permit	**$250**
1.5.2	Site Exit	**$750**
1.5.3	Audit	**$1,000**
Total Activity Costs		$60,000
Contingency Reserve (3%)		$1,800
Sub-Total		$61,800
Management Reserve (3%)		$1,854
Total Budget		**$63,654**

Table 20 depicts the project's total budget inclusive of contingency and management reserves.

4.4.3 Cost Control

The project manager will control the project's costs, and how the project schedule is maintained. Changes that delay the schedule can also cause the project's costs to exceed the budget. The controlling costs process will allow the team to know how the project is performing financially and provide insight into how to make the necessary adjustments. The project's performance will be monitored and measured using earned value management (EVM), performance reviews, forecasting, and the to-complete performance index (TCPI).

These tools and techniques will help the project team determine areas where they can make changes and determine preventative and corrective actions. The project's schedule will be used to determine the project's planned value and to see how far off or on track the project costs are compared to the schedule. Earned value is a primary cost control technique that tells how much value a project has delivered at a particular time. The project will use the cost performance index (CPI) to determine whether the project is under or over budget and will use the cost variance (CV) to determine the difference between budget and actual costs. TCPI will determine how well the project must perform to stay within the budget and help with forecasting. The project team and functional managers must know the project's financial performance to adequately forecast and advise during the team's weekly project review meetings. The format for project review meetings is detailed in the Communications Management Plan of the project management plan. The information should also be documented in the project's monthly status report.

Table 21 shows how the CPI of the project will be evaluated, and the actions required, if necessary.

Table 21

Cost Performance Index

Cost Performance Index	If between 0.95 and 1.1	Acceptable
	If less than 0.95 or greater 1.1	Project Manager must explain the exception and provide a detailed corrective plan to bring the project performance back to acceptable levels.

Note: Table 21 depicts the acceptable level of the cost performance index and the measures required.

4.4.4 Cost Changes

The Director of Operations/Projects must be informed of all changes which impact the project's budget and cost baseline. The cost control threshold for the project is a CPI of 0.95; a cost variance corrective action plan is required whenever there is a CPI below the cost control threshold. The corrective action plan will detail the actions necessary to bring the project back within budget and how the effectiveness of the actions in the plan will be measured. The Director of Operations will present the corrective action to the team and all relevant stakeholders, outlining the options available. Once adopted, the corrective plan becomes part of the project management plan, which will be updated to reflect the changes.

The cost change control process will follow the established project change request process. The project sponsor must grant approval for any changes that affect the overall project cost baseline.

4.5 Quality and Safety Management Plan

Completing a project on schedule and within budget is not enough in construction. Quality and safety are also important factors that must be taken into consideration. One of project management's most critical quality concepts is conformance to the project's requirements. The project's construction safety and quality management (CSQM) plan incorporate all the information available at the beginning of the project and the company's policies, procedures, processes, and guidelines to prevent defects, measure, and control quality, and ensure safety. For the purpose of this plan, the term safety also refers to health and security. The construction safety and quality management plan also focus on continuous improvement. It ensures that the contract conditions meet the legal and technical quality and safety specifications and integrate with project risk and environmental management processes to accomplish the project's stated objectives.

This CSQM plan defines safety and quality assurance, control activities, and acceptable safety and quality standards, which apply to all project construction activities.

4.5.1 Safety and Quality Management Approach

The project's safety and quality management approach will ensure that safety and quality are planned for both the product and its processes. The project will meet its safety and quality objectives by using an integrated approach to define safety and quality standards, measure safety and quality, and continuously improve safety and quality. The project team will determine the quality requirements for the project using tools and techniques such as benchmarking, expert judgment, cost of quality, cost-benefit analysis, and team meetings. The safety requirements for the project will be guided by the

company's health, safety, and security standards and policies. The focus is on the project's deliverables, and the standards and criteria used will ensure the product meets the established standards and the client's satisfaction. The company's process quality will determine how the project deliverables will be produced, inspected, and accepted, ensuring that all activities conform to an organizational standard.

The project team will work closely with the company's Safety Manager to define and document all project-specific safety and quality standards for the final product and processes. All safety and quality documentation will form part of the project management plan.

4.5.2 Safety and Quality Standards

The construction of a green, climate-resilient home will commence upon the approval of the Central Building Authority for the green building standards for Belize. As such, this document, and the parent standards referenced therein, will form the basis of minimal quality standards minimal for this project. The project goal is to exceed these standards wherever feasible and prudent. However, deliverables meeting the standards outlined in this code are acceptable.

Proof of adherence to the standards in both product and process will be the responsibility of the producing party and verified by the Safety and Quality Manager. In cases where process quality is different from the recommended standards outlined in the Green Building Standards, the processes in question will cease until a resolution is reached, ensuring all work is done at or above standards to avoid rework where possible.

The metrics listed below were identified as a means of measuring safety and quality throughout the execution of the project. The Safety and Quality Manager will work with the project team to define these metrics, conduct measurements, and analyze the results. The Safety and Quality Manager will update the project team on the metrics in the weekly progress review meetings and monthly status reports. Metrics will include:

1. **Quality**
    1. cost efficiency
    2. schedule efficiency
    3. Resource efficiency
    4. waste minimization
    5. structural strength
    6. inspections
2. **Safety**
    a. Work hour limitation
    b. drug and alcohol screening
    c. dust control
    d. noise control
    e. material safety data sheets
    f. Potable water
    g. Portable restrooms
    h. Personal Protective Equipment
    i. pre-site preparation

j. ongoing training

k. traffic management

l. OSHA Compliance

m. Standard operating procedures

n. Recycling/waste management

o. hazardous waste material

p. site drainage

4.5.3 Safety and Quality Assurance

The quality assurance section explains how the project will define and document the safety and quality requirements auditing process. The section also focuses on the processes used to design and construct a green, climate-resilient home. To ensure quality, the project team will use an iterative process that will include measuring process metrics, analyzing process data, and continuously improving the processes throughout the project's lifecycle.

The Safety and Quality Manager will perform assessments and documentation audits at planned intervals throughout the project to ensure all processes are correctly implemented and executed. The project manager may supervise audits on occasion to ensure objectivity. Key performance metrics for safety and quality were listed in the previous section and can also be found in the quality checklist.

Table 22 is an example of the quality assurance metrics documentation that the project will use.

Table 22

Quality Assurance Metrics

Process Action	Acceptable Process Standards	Process Phase	Assessment Interval
Laser levelling of frame components	- Before installation of each component - After installation of each component - Upon completion of each major section	Framing	Daily during framing
Anchoring of horizontal beams	- Using approved brackets - Done before any weight applied - Strength tested upon completion	Framing	Daily during framing
Voltage testing of electrical circuits	- Tested by installer - Tested by master electrician - Re-Tested by code compliance agent	Electrical	Completion of electrical installation

Note: The table depicts examples of quality assurance metrics that will be used during the execution of the project.

The Safety and Quality Manager will report any discrepancies to the Director of Operations/Projects for review. The weekly progress review meetings will contain a section reviewing the project processes and addressing all discrepancies and audit findings. The project team will discuss ways to improve the processes to meet the set standards. The Director of Operations/Project will document all process improvement efforts and communicate the changes to all stakeholders as outlined in the project's communication plan.

4.5.4 Safety and Quality Control

Safety and quality control is monitoring and recording the results of quality and safety activities to assess performance and recommend necessary changes. This section defines and documents the process for monitoring and recording quality activities. It includes the acceptable standards and performance for the product and how to conduct these measurements. The quality performance standards for the project are per the organizational performance standards of all design and construction projects and as outlined in the approved green building standards.

Table 23 is an example of the quality control mechanism that the project will use.

Table 23

Quality Assurance Standards

Product	**Physical/Performance Standards**	**Quality Assessment Activities**	**Assessment Intervals**
Framing uprights	> 300 N/m2 Tensile Strength	field testing	Per each upright section
Hot water copper Tubing	1.5” +/- 0.01” diameter	Measurement	Per every 5 feet of tubing
Wall insulation	3” thick	Measurement	Per each wall section

Note: The table depicts examples of quality control standards that will be used during the execution of the project.

The project team will perform all physical measurements on the construction materials. The Safety and Quality Manager will conduct audits to ensure the project meets all physical and performance requirements and assist the project team with creating or updating all documentation related to product quality. The weekly progress review meetings will contain a section reviewing the project processes and addressing all

discrepancies and audit findings. The project team will discuss improving the processes to meet the set standards and achieve the highest level of client satisfaction. The Director of Operations/Project will document all process improvement efforts and communicate the changes to all stakeholders as outlined in the project's communication plan.

All the project's deliverables must be tested and inspected. The project's products and processes must be measured and fall within the established standards and tolerances. The project team will use the logs listed below to conduct these measurements and maintain the records as supporting documentation for the project's acceptance.

Table 24

Quality Assurance Check Sheet

Audit #	Date	Process Measured	Required Value	Actual Measured	Acceptable? (Y/N)	Recommendation	Date Resolved

Note: template of the quality assurance check sheet.

Table 25

Quality Control Check Sheet

Inspection #	Date	Item Measured	Required Value	Actual Measured	Acceptable? (Y/N)	Recommendation	Date Resolved

Note: template of the quality control check sheet.

4.6 Resource Management Plan

This section of the project management plan focuses on the tools the company needs to acquire the best team, keep them motivated, and lead them to complete the project successfully. Additionally, the resource management plan will define the roles and responsibilities of team members, how to resolve conflicts, and the training of team members. The resource management plan also guides how the project's physical resources will be allocated and managed.

The resource management plan aims to achieve project success by acquiring appropriate resources. The plan contains two main sections: human resources and material resources. The human resources section details how personnel will be identified and acquired, their roles and responsibilities, training opportunities, team building strategies, performance appraisals, rewards, and recognition programs, and how to effectively manage the project team’s activities. The materials and resources section details the types, amounts, and timing of the project's required supplies, materials, and equipment.

4.6.1 Human Resource Management

Green Building Solutions recognizes that putting the project team together is one of the most essential jobs in projects, but it also recognizes that it is necessary to keep the project team working well throughout the entire project. A successful team requires careful planning and consideration of the necessary skills, expertise, and personalities.

4.6.1.1 Roles & Responsibilities.

The company clearly defines team members' and stakeholders' roles and responsibilities for all its projects. Project team members represent many different sections of the company and have varying degrees of authority and responsibility. The following sections outline:

- Role – description of the portion of the project for which the member is accountable.
- Authority – the level at which the member may make decisions, apply project resources, or make approvals.
- Responsibility – the work a team member must perform to complete assigned work activities.
- Competency – the skill(s) required to complete assigned project activities.

These roles and responsibilities are essential for completing the project, and all team members must clearly understand their roles and responsibilities to perform their portion of the project successfully. The following roles and responsibilities were established for this project:

1. **Director of Operations/Projects** – The Director of Operation is responsible for managing each project and for the overall execution of projects from design to finishing. He is also responsible, with the help of his team, for preparing the bidding documents associated with bidding for projects. The Director of Operations is also responsible for reporting project status in accordance with the communications management plan and evaluating the performance of all project team members. He

is also responsible for acquiring the human resources and acquiring the necessary material resources for the project through proper coordination with the Finance and Procurement Officers.

2. **Engineers –** The engineers will be responsible for coordinating and supervising the technical components of projects. The engineers will also be responsible for reviewing and compiling green building practices that are applicable to Belize and will collaborate with the Central Building Authority to get these practices approved. They are also responsible for the compilation of the final report for approval. The engineers will also oversee field inspections to ensure compliance with standards, quality, and schedule.
3. **Architect** – The architect is responsible for the planning, development, and design of a structurally-sound building based on the recommendations from the engineers. The architect will be the primary contact for the Director of Operations for all architectural issues. The architect supervises the draftsman, who assists with structural development, planning, drawings, and code compliance.
4. **Construction Manager –** is responsible for projects at a high-level and works closely with the engineers to ensure compliance with standards, quality, and schedule. The construction Manager supervises the Site Supervisor.
5. **Site Supervisor –** The site supervisor is responsible for supervising the day-to-day execution of project activities and supervising the field staff.
6. **Quality/Safety Manager** - The Quality/Safety Manager works closely with the Construction Manager and the Site Supervisor to ensure compliance with the quality

and safety standards set forth by the project. The Quality and Safety manager is responsible for quality and quality control.

7. **Functional Managers** - While not part of the project team, functional managers such as the Finance and Procurement Officers are responsible for providing resources according to the project staffing plan. Functional managers work with the Director of Operations/Projects to acquire and manage resources.

4.6.1.2 Project Organizational Chart.

The RACI chart is a graphical display of the project tasks and team members, which aims to illustrate the responsibilities of team members as they relate to the project tasks. The following RACI chart shows the relationship between project tasks and team members. The Director of Operations/Projects must review and approve any proposed changes to project responsibilities. Changes will be proposed per the project's change control process, and all changes made must be reflected in the relevant project documents.

RACI Chart

Activity	Director of Operations	Engineers	Architects	Construction Manager	Site Supervisor	Central Building Authority	Quality Manager	Client
Green Building Standards	A	R	C	I	I	A	I	I
Architectural Design	A	C	R	I	I	A	I	A
Construction	A	C	C	C	R	I	I	I
Site Inspection	A	I	I	C	C	I	R	I
Risk Assessment	R	C	C	I	I	I	C	I
Final Acceptance	A	R	C	C	C	A	I	A

R – Responsible for completing the work
A – Accountable for ensuring task completion/sign off
C – Consulted before any decisions are made
I – Informed of when an action/decision has been made

4.6.1.3 Staff Acquisition.

Key personnel for this project will consist entirely of internal resources. Subcontractors for technical areas will be hired as needed using the company's pre-approved list of contractors. The Director of Operations/Projects is responsible for the project team and will liaise with other functional officers to acquire all the resources necessary to complete the project successfully. Most of the manual labor required for this project will be acquired from within the community where the project is located. The laborers will be hired per the company's organizational policies, screening practices, and in adherence to the country's labor laws.

4.6.1.4 Work Programs.

The project is scheduled to be completed in nine (9) months. Some resources are required before the project can begin, and others will be acquired as the project progresses. Work Programs will be prepared one (1) month in advance, showing the types and amounts of resources required based on the identified scheduled activities. The work programs will include the materials, supplies, and equipment required to ensure that the correct individuals are on-site to utilize the specific equipment and supplies needed for the activities shown on the project schedule and network diagrams.

4.6.1.5 Training.

The company has adequate staff with the skill sets required to execute the project; as such, training is not directly related to this project. The manual laborers hired are also expected to possess the necessary skill set to perform their duties. If the new green

building standards require a new technique to be learned or training requirements are identified, funding will be available from the project reserve.

4.6.1.6 Performance Appraisals.

Each team member will be aware of his or her assigned tasks and expectations of the work to be performed at the project's inception. This will be the basis for team members' performance appraisals, which evaluate how efficiently and effectively they complete the assigned work tasks set out at the start of the project. These performance appraisals will be submitted to the Office Administrator to be filed in the employees' personnel file.

4.6.1.7 Recognition and Rewards.

The recognition and reward policy of the company will be used for this project. Upon successful completion of the project, a wrap party will be held for the project team and the construction workers. Project team members will receive a monetary reward if the final deliverable is delivered as specified and under the estimated budget. The company also provides several social activities throughout the year to build employees' morale and camaraderie.

4.6.2 Material Resource Management

The work packages defined on the WBS dictate the kinds of materials, supplies, and equipment needed for the project. The project team will use expert judgment and bottom-up estimating to determine the type and amount of resources required to complete the project successfully.

4.6.2.1 Estimate Material Resources.

The project team will identify the estimated material resources needed for each scheduled activity on the Activity List, including all supplies and equipment. At the end of the design phase, a specification list for the home was developed that will guide the project team in estimating the needed material resources. The estimated material must be associated with a work package outlined in the WBS. This will also assist with keeping track of the expenses for each work package and for ease of reference in compiling the project financial reports.

4.6.2.2 Acquire Material Resources.

After identifying the material resources needed to complete the project, the Director of Operations will liaise with the Procurement and Finance Officers to acquire the necessary resources. The materials will be acquired using the project's procurement management plan. The Finance Officer will ensure the necessary funds are available to acquire the resources.

4.6.2.3 Material Resources Calendar.

The work program will be created using the project schedule, schedule baseline, and milestone chart. Some material resources may be required before the project can begin, but most will be acquired as the project progresses. Work Programs will be prepared one (1) month in advance, showing the types and amounts of resources required based on the identified scheduled activities. The work program includes details on the human resources needed to ensure that the correct individuals are on-site to utilize the specific equipment and supplies needed for the activities shown on the project schedule and network diagrams.

4.6.3 Control Resources

Monitoring and controlling are essential in project management to make timely and accurate decisions. Control Resources allow for comparing the actual product data to the plan and adapting to changes as the project progresses. Work performance and status reports will provide all the necessary data about the project's resource usage. These reports will be used to ensure that resources are available as planned, forecast resources needed, and identify deviations and corrective actions. All identified changes must be submitted per the project's change control plan. All relevant project documents must be updated to reflect all approved change requests.

4.7 Communication Management Plan

The communication management plan for the project deals with the dissemination of information. The plan details who should receive what information and when and how the project team should share the information. This plan sets the communication framework for the project and aims to define the project's communication requirements and distribution of information.

The communication plan will serve as a communication guide throughout the project's lifecycle and will be updated as communication needs change. The plan identifies and defines the roles of those involved in this project and includes a communications matrix that maps the communication requirements of this project. The plan provides an in-depth guide for conducting meetings, detailing the communications rules and how to conduct successful meetings. Also included in this plan is a project team directory, which provides contact information for all stakeholders directly involved.

4.7.1 Communication Management Approach

Most of a project manager's time is spent communicating; as such, the Director of Operations/Projects is responsible for ensuring effective communication for the project. A solid communications management approach allows the project team to avoid many project management challenges. The communication requirements for the project are documented in the communications matrix illustrated in this document. The matrix will guide when, how, and to whom information will be communicated.

All project communication activities must be within the project's approved budget and schedule. The project manager must ensure that communication activities performed for the project are within the authorized budget. Communication activities will occur according to the frequencies detailed in the Communication Matrix to ensure the project adheres to schedule constraints. Green Building Belize Ltd. utilizes standardized templates for all its project communication.

The Director of Operations/Projects is responsible for disseminating all confidential information to outside parties. The Director of Operations/Projects is also responsible for managing all proposed and approved changes, updating the communications management plan and all relevant documents accordingly, and ensuring that all relevant stakeholders know and are informed of these changes. All communication change processes must follow the project's change management plan.

4.7.2 Communication Requirements

The Director of Operations/Projects will communicate with all identified stakeholders to determine their preferred method and frequency of communication. The stakeholder register will be updated to record this preference. All communication will follow the project's communication matrix and will adhere to the stakeholder communication requirements.

In addition to identifying communication preferences, stakeholder communication requirements must identify the project's communication channels and ensure stakeholders have access to these channels. If the project information is communicated securely or through internal company resources, all internal and external stakeholders must have the necessary access to receive project communications.

The project team will maintain all information in the stakeholder register upon identifying all stakeholders and establishing their communication requirements. The stakeholders register, and the project communication matrix will be used as the basis for all communications.

4.7.3 Project Team Directory

Table 26 provides the contact information for all persons identified in this communications management plan. The contact information listed in this table will be used to communicate with these persons.

Table 26

Project Team Directory

Name	Title	Organization/ Department	Email	Phone
Gabriel Flores	Managing Director	Green Building Belize	managingdirector@greenbuildingbelize.com	(501) 822-2934
Patrick Thurton	Director of Operations/Projects	Green Building Belize	p.thurton@greenbuildingbelize.com	(501) 822-2935
Neil Young	Engineer	Green Building Belize	n.young@greenbuildingbelize.com	(501) 615-2044
Oswald Young	Engineer	Green Building Belize	o.young@greenbuildingbelize.com	(501) 615-8368
Arnaldo Herrera	Architect	Green Building Belize	a.herrera@greenbuildingbelize.com	(501) 614-8121
Hector Hernandez	Construction Supervisor	Green Building Belize	h.hernandez@greenbuildingbelize.com	(501) 615-9004
Joseph Middleton	Site Supervisor	Green Building Belize	j.middleton@greenbuildingbelize.com	(501) 610-0289
Trudy Smith	Quality/Safety Manager	Green Building Belize	t.smith@greenbuildingbelize.com	(501) 822-2935
Project Stakeholders	See Stakeholder Register			

4.7.4 Communication Methods & Technologies

The project team will determine the communication methods and technologies to be used, which will follow Green Building Belize company policies. Other factors, such as stakeholder communication requirements and available technologies, will influence the chosen method of communication.

The company maintains a SharePoint folder for each of its projects. This folder will contain all relevant information and will be used to provide updates, collaborate on work, and access project data, reports, and templates. The company also uses a WhatsApp Group Chat for the core project team to communicate daily, in addition to email communication. Green Building Solutions Belize Ltd. has software licenses for MS Project, which will be used to develop, maintain, and communicate the project schedule. In addition to being maintained in the SharePoint folder, all project communication and documentation will be filed digitally on an external hard drive and in hardcopy files which the Office Administrator will maintain.

4.7.5 Communication Matrix

Table 27 shows the communications matrix detailing the type of information, to whom, when, and how it will be disseminated.

Table 27

Communication Matrix

Communication Type	Objective of Communication	Medium	Frequency	Audience	Owner	Deliverable	Format
Kick-off Meeting	Introduce the project team and the project. Review project objectives and management approach.	• Face to Face	Once	• Project Sponsor • Project Team • Stakeholders	Director of Operations	• Agenda • Meeting Minutes	• Soft copy archived in project SharePoint Folder • Hardcopy filed • Email
Progress Review Meetings	Review status of the project with the team.	• Face to Face • Conference Call	Weekly	• Project Team	Director of Operations	• Agenda • Meeting Minutes • Project schedule	• Soft copy archived in project SharePoint Folder • Hardcopy filed • Email
Architectural Design Meetings	Discuss and develop technical (architectural & engineering) design issues and considerations for the project.	• Face to Face	Bi-weekly	• Project Technical Staff • Subcontractors	Engineer	• Agenda • Meeting Minutes	• Soft copy archived in project SharePoint Folder • Hardcopy filed • Email
Monthly Project Status Meetings	Report on the status of the project to management.	• Face to Face • Conference Call	Monthly	• PMO	Director of Operations	• Slide updates • Project schedule	• Soft copy archived in project SharePoint Folder • Hardcopy filed • Email

Communication Type	Objective of Communication	Medium	Frequency	Audience	Owner	Deliverable	Format
Project Status Reports	Report the status of the project including activities, progress, costs, and issues.	• Email	Monthly	• Project Sponsor • Project Team • Stakeholders • PMO	Director of Operations	• Project Status Report • Project schedule	• Soft copy archived in project SharePoint Folder • Hardcopy filed • Email
Monthly Work Plan	Report upcoming activities and accomplishments for the month	• Email	Monthly	• Project Team • Stakeholders	Construction Manager	• Work Plan	• Soft copy archived in project SharePoint Folder • Hardcopy filed • Email
Site Visit Reports	Provide daily site reports	• Email	Weekly	• Project Team	Site Supervisor	• Site Visit Report	• Soft copy archived in project SharePoint Folder • Hardcopy filed • Email
Ex-Post (Closing) Report	Evaluation on the effectiveness of process used and sustainability of the project focused on deriving lessons learned and recommendations to improve the project as well as to help plan and implement more effective and efficient projects.	• Face to Face • Email	Once	• Project Sponsor • Project Team • Stakeholders • PMO	Director of Operations	• Ex-Post Report	• Soft copy archived in project SharePoint Folder • Hardcopy filed • Email

Note: Table 27 displays the project's communication matrix (author's own creation).

4.7.6 Communication Standards & Formats

Green Building Solutions Belize Ltd. has developed standard templates and formats for the various communication tools used in its projects. These templates ensure that project teams and stakeholders understand the expectations and communicate consistently and effectively. This project will utilize the company's standard project forms and templates in all formal project communications. The project team must follow the guidelines listed below:

- The project team will utilize the company's standard templates for meeting agendas and meeting minutes.
- Meeting agendas will be circulated to invitees three (3) days before the meeting.
- Meeting minutes must be compiled and circulated within one (1) week of the meeting and should be available by the next meeting for review and approval.
- The Director of Operations/Projects must designate a minute keeper before each meeting.
- A soft copy of each document must be archived in the project's SharePoint folder.
- A hard copy of each document will be filed in the company's record-keeping system.
- Informal project communication should be professional and effective.

Table 28

Sample Report Template

GREEN BUILDING
SOLUTIONS BELIZE

22 Toucan Street
City of Belmopan, Belize
Tel: 501-822-2934
Email: info@greenbuildingbelize.com

Engineering & Architectural Services

Site Visit Report

Client:		**Date of Visit:**	
Project:		**Visited By:**	

Labour Force:		**Others:**	

PROGRESS:	
OBSERVATIONS FROM INSPECTOR:	
CONCERNS FROM SITE SUPERVISOR:	
CONCERNS FROM END USER OR CLIENT:	
OTHER:	

Attachments:

Note: The table is a depiction of a sample report template to be used by the project team (author's own).

4.8 Risk Management Plan

Risk management involves identifying the risks and analyzing their potential impacts and the possibility that the risk will occur while executing the project. It also consists of creating a risk response plan to show how risks will be treated.

Risk management occurs throughout the project's lifecycle and is essential to completing the project successfully. A good risk management plan ensures that plans are in place to minimize potential threats or maximize project opportunities. The project will benefit as follows by practicing good risk management:

- Identification of potential project problems early and develop plans and strategies to help reduce or avoid their impacts.
- Identification of potential opportunities and take advantage of them.
- It enables a reduction in rework and keeps the project schedule and budget on track.
- It allows you to be proactive instead of reactive.
- It increases the likelihood of project success.

The risk management plan for this project is guided by the project scope statement, cost management plan, schedule management plan, communications plan, and the country's approved Green Building Standards. It establishes a framework by which the project team can identify risks and develop strategies to mitigate or avoid those risks.

4.8.1 Risk Management Methodology and Processes

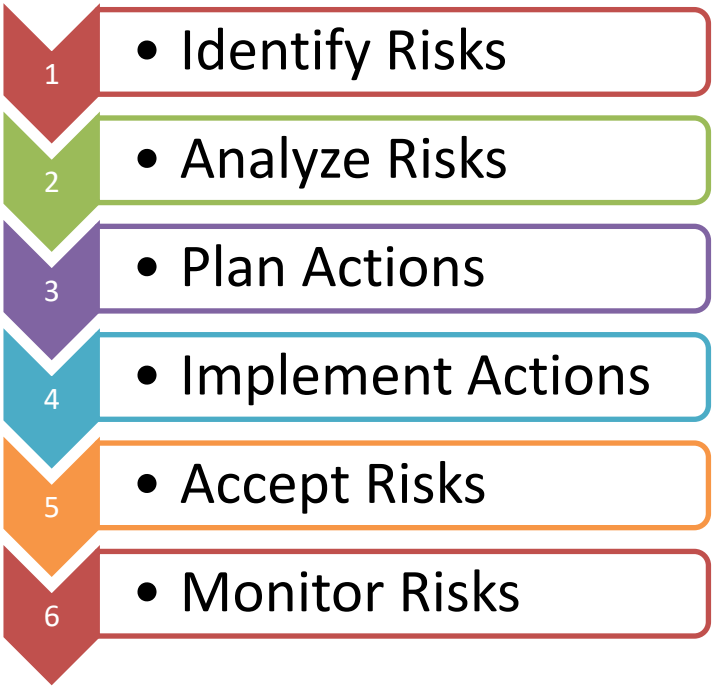
The project's approach to managing risks involves a methodical process through which the project team identifies, scores, and ranks the various risks. The process is

outlined in Figure 9. Proactive strategies developed for the most likely and highest-impact risks will be implemented as those risks arise or as determined by the Director of Operations.

Risk managers will provide status updates on specific risks during the weekly progress meetings. The risk register and report will be updated and presented to key project stakeholders. The project team will conduct risk reassessments at intervals determined by the Director of Operations, at which the team will review all identified risks and the overall risk management process. The analysis will allow the project team to identify improvements to the risk management process for current and future projects and update the lessons learned register to reflect the recommendations.

Figure 10

Risk Management Process



4.8.1.1 Roles and Responsibilities.

1. Risk Originators: any members of the project team, subcontractors, stakeholders, vendors, and customers involved in the project's activities who identify potential risks that could affect the outcome of the project's scope.
2. Risk Owner: the person or entity responsible for controlling, mitigating, or avoiding risks and executing responses. The risk owner must develop and document a risk resolution action, meet resource and timeline requirements established in project documents, communicate any deviations from documented requirements to the Director of Operations/Project, and update the risk management tracking sheet.
3. Functional Teams/Subcontractors: Any group performing work within the project. Functional teams (including administrative and support staff) and subcontractors will analyze risks, determine the addressable cause, determine the impact on the implementation of activities, and promptly communicate the result of this analysis to the Director of Operations/Projects. Teams and subcontractors are responsible for effectively managing all risks inherent in the task for which they are obligated. All risks that can't be managed by the functional team/subcontractors must be reported immediately.
4. Director of Operations/Projects: is responsible for reviewing and validating all risks and developing proposed mitigation solutions and closure criteria. The Director of Operations/Project is also responsible for:
    - assigning risk owner,
    - communicating time requirements for risk mitigation,

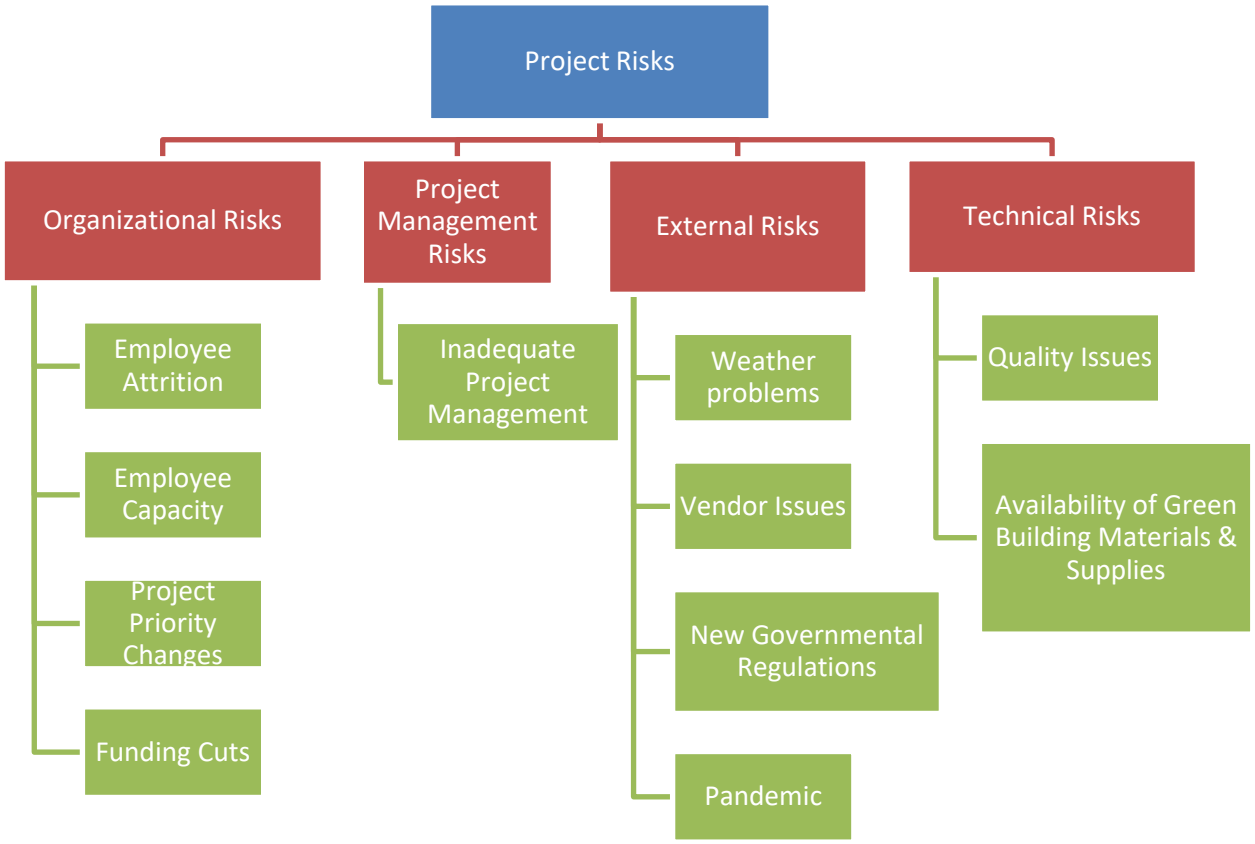
- reviewing all activity documentation to ensure accuracy and completeness,
- coordination with the stakeholder, customers, and any outside organization to facilitate the project,
- approving the mitigation activities,
- communicating the status of risks and mitigation strategies to appropriate offices.

4.8.2 Risk Breakdown Structure

The risk breakdown structure (RBS) allows the project team to build guidelines for the project's risk categories and is presented in a hierarchy. Figure 10 outlines the risk breakdown structure for the project to design and construct a green, climate-resilient, single-family home in rural Belize.

Figure 11

Risk Breakdown Structure (RBS)



Note: Figure 9 shows the project's risk breakdown structure (Author's own).

4.8.3 Identify Risks

Several data-gathering techniques were used to identify the risks associated with this project. Several experts were interviewed for this project, revealing some risks and strategies that can be used to mitigate the risks. A historical review of the company's past projects was also conducted to determine the most common risks and their respective mitigation plans. A risk assessment meeting was held with key team members and

stakeholders to identify, discuss, evaluate, and categorize identified risks. The project team is responsible for identifying and communicating potential risks, which requires constant attention to ensure accuracy. As much as possible, the project will utilize proactive strategies to mitigate the risks associated with the project. The Director of Operations/Projects is responsible for ensuring that all identified risks are added to the project plan and Risk Register. A sample of the project's risk register is outlined in Table 29.

Table 29

Risk Register

Risk Number	Identified Risk	Impact	Potential Response	Root Cause	Category	Priority	Urgency
PR-001	Planning conditions impact on budget	Increased budget	Extent of conditions known and to be reviewed and managed	Inadequate Planning	Project Management	High	High
PR-002	Electricity not available at project site	Project delay	Requests for electrical services have been placed with the utility company	Remoteness of project site	External	Medium	High
PR-003	Building permits not received in a timely manner	Revision of building design	Liaise with Building Inspectors	Missing information/inadequate submission	External	High	High
PR-004	Increased construction costs	Additional costs	Tender prices received and under review - Risk shall remain prominent where budget costs / provisional sums are included.	Impact of international markets following political decisions	External	High	High

Risk Number	Identified Risk	Impact	Potential Response	Root Cause	Category	Priority	Urgency
PR-005	Sub-contractor insolvency	Project delay	Contractor financial checks and subcontractor vetting to be carried out	Inadequate Review of bid submissions	External	Low	Low
PR-006	Unrealistic work programme submitted by project team	Project delay	Use expert judgement in developing project schedule	Inadequate Planning/Capacity	Project Management	High	High
PR-007	Programme delays; due to flood levels impacting construction	Project delay, budget implications	Review historic flood data, and issue to Contractor. Contingency plan to be developed.	Adverse Weather	External	Medium	Medium
PR-008	Discovering structural unknowns	Additional costs	Analyze utilities & surveys maps Careful excavation / groundwork when on site.	Remoteness of project site	Technical	Medium	Medium
PR-009	Outstanding defects remaining unresolved	Impact tenant's occupation / satisfaction	Ability to resolve within the building contract.	Improper Installation	Technical	High	High
PR-010	Costs exceeds allocated budget (Non-construction costs)	Additional costs	Review the non-construction costs prior to contract award and during the construction period.	Inflation	External	High	Medium
PR-011	Incorrect estimation, design errors and ambiguities	Budget overrun	Regular design and planning condition reviews	Inadequate Planning/Capacity	Organizational	High	High

Risk Number	Identified Risk	Impact	Potential Response	Root Cause	Category	Priority	Urgency
PR-012	Availability of specialist labour / equipment	Specification/ qualification changes	Higher-than expected demand for specialist/ equipment this time of year	Inadequate Planning	External	Medium	Medium
PR-013	Poor contractor performance during construction	Reworks and revisions	Contract to be signed to protect client - performance bonds to be obtained		Technical	High	High
PR-014	Design changes (including client changes/ variations	Budget overrun	Adequate contingency to be secured		External	Medium	Medium
PR-015	Weather delays	Project delay, budget implications	Contingency plan to be developed.	Adverse Weather	External	Medium	Medium

Note: The table outlines some of the major risks identified in the project (author's own).

4.8.4 Analyze Risks

Risk analysis prioritizes the identified risks in terms of probability and impact to concentrate efforts on those with highest priority. The Director of Operations/Projects and project team members are responsible for analyzing risks. Risks that are more likely to occur and have significant impacts on the project will be the highest priority, while those that are more unlikely or have a low impact will have a much lower priority. Scales have been established to classify the risks to obtain the probability and impact matrix, as outlined in Tables 30 and 31. Table 32 shows the significance of the impacts on the project's cost, schedule, and scope, while the impact matrix for the project is depicted in Table 33.

Table 30

Probability of Occurrence

Likelihood	Estimated Probability	Effect
Very Unlikely	0.05	outcome is almost non-existent
Unlikely	0.10	outcome is not likely to occur
Probable	0.50	outcome is likely to occur
Quite Likely	0.75	outcome is very likely to occur
Highly Likely	0.90	outcome is almost certain to occur

Note: The table depicts the scale used by the project to measure the probability of project risks occurring (author's own).

Table 31

Impact Levels

Impact	Rating	Effect
Very Low	0.06	Insignificant impact on cost, schedule, and scope
Low	0.01	Low impact on cost, schedule, and scope
Moderate	0.30	Moderate impact on cost, schedule, and scope
High	0.60	Significant impact on cost, schedule, and scope
Very High	0.80	Catastrophic impact on cost, schedule, and scope

Note: The table describes the impacts of the risks (author's own).

Table 32

Significance of Impact

Impact	Cost	Schedule	Scope	Quality
Very Low	Insignificant impact on project costs	Minimal or no impact on schedule	Minimal or no impact on project scope	Minimal or no impact on quality
Low	Deviation of project costs of less than 5%	Schedule impacted by less than 5%	Minor impact on project scope	Low impact on critical quality component
Moderate	Deviation of project costs between 5% to 10%	Deviation from project Schedule between 5% to 10%	Moderate impact on project scope	Moderate impact on the project's quality requirements
High	Deviation of project costs between 10% to 15%	Deviation from project Schedule between 10% to 15%	Does not meet project scope without major redress	Does not meet the project's quality requirements and requires client approval
Very High	Deviation of project costs greater than 15%	Deviation from project Schedule greater 15%	Unable to meet project scope	Does not pass the project's quality requirements and is unacceptable to client

Note: The table outlines the significance of impact on cost, schedule, scope, and quality (author's own).

Table 33

Probability and Impact Matrix

Impact	**Likelihood**				
	Very Unlikely 0.05	Unlikely 0.10	Probable 0.50	Quite Likely 0.75	Highly Likely 0.90
Very Low 0.06	0.00	0.01	0.03	0.05	0.05
Low 0.01	0.00	0.00	0.01	0.01	0.01
Moderate 0.30	0.02	0.03	0.15	0.23	0.27
High 0.60	0.03	0.06	0.30	0.45	0.54
Very High 0.80	0.04	0.08	0.40	0.60	0.72

Note: The table presents the project's probability and impact matrix (author's own).

4.8.5 Risks Response

The Director of Operations/Projects, with input from the relevant experts, will devise potential responses to the identified risks. Project risks will be managed and controlled within the triple time, scope, and cost constraints. Quality will also be a determining factor. Potential responses are also included in the risk register, and as risk owners are assigned, the Director of Operations/Projects will update the risk register. The potential responses are based on the risk response strategies listed in Table 34.

Table 34

Risk Response Strategies

Strategies	Description
Avoid	Changes to the project management plan to eliminate the threat. To find an alternative method of accomplishing tasks to do away with the risk
Mitigate	Reduce the likelihood or impact of a risks possibly to elimination. Mitigation can occur at any point in the project.
Transfer	Place responsibility for the risk on another organization, example: using contractual agreements, subcontractors assume the risk and provide warranties, or the customer assumes some of the risk.
Accept	Tolerate the risk while attempting to elude its consequences.
Exploit	Make every effort to take advantage of an opportunity.
Enhance	Increase the probability of an opportunity occurring.
Share	Share the opportunity with an external party.

Note: The table depicts the risk response strategies that guide the potential response for identified risks (Heldman, 2018).

The Director of Operations/Projects and the project team develop potential responses for each identified risk. Risks identified further in the planning or execution phases are qualified, and the team will develop avoidance and mitigation strategies that will be added to the risk register undergoing the same risk management process as other identified risks.

The Director of Operations/Projects will review all risks that have been mitigated and controlled and those with no significant impact on the project to determine whether to accept and close the risk. During the closure phase of the project, the Director of Operations/Projects will forward to the Office Administrator all risk management files, including final evaluations and acceptance of all risks for filing.

4.8.6 Monitor Risks

The project treats risk responses like it does changes; the change control process must be followed to implement risk responses. Risks and their triggers and responses are monitored in every progress meeting and progress report. Constant monitoring of the risk register allows the project team to identify secondary or residual risks and react promptly. The contingency and management reserves are used as a means to mitigate certain risks that the project may encounter. Both reserves were developed using historical data from past projects and expert judgments. The project team will use various data analysis techniques to monitor risks, including reserve analysis, performance analysis, project audits, and weekly progress meetings. Risk monitoring will be a continuous process throughout the life of this project. As risks approach as the project progresses, the Director of Operations will ensure that the appropriate risk owner provides the necessary status updates, which include the risk status, the identification of trigger conditions, and the documentation of the results of the risk response.

4.9 Procurement Management Plan

The procurement management plan describes the activities undertaken during the procurement process. It explains how the project will manage the procurement process, from developing procurement documents to contract closure. This plan identifies and defines the goods and services that the project will need to acquire from external sources, the items that will be procured, the types of contracts that the project will utilize, the approval process for contracts, and the matrices that will be used to determine the most suitable suppliers. The procurement plan will align with the project's scope, budget, and

schedule and establish firm contract deliverables and deadlines. The plan will also discuss procurement risk management and the project's procurement constraints.

This plan will always guide the project's procurement activities, and any deviation from this plan must be approved by the project's Change Control Board.

4.9.1 Procurement Management Strategy

The Director of Operations will work closely with the company's procurement team to carry out the procurement process for the project. The company's procurement policies will guide the project and will follow the following basic steps:

- The design team compiles a specification list based on the design.
- The construction team reviews the specification list and inputs baseline costs and justification for acquiring goods or services externally.
- The construction team develops a schedule for procuring the items and submits it to the Director of Operations.
- The Director of Operations approves the list of items and the timing of key procurement activities and submits it to the procurement team.
- The procurement team begins the vendor selection, purchasing, and contracting process in adherence to the company's guidelines.

The project team will use firm-fixed-price contracts to procure all goods and services under this project. The project team will work closely with the procurement team to develop a request for proposals (RFP) which defines the type of items or services required, their quantities, and required delivery dates. The procurement team will then

solicit RFPs from various prequalified vendors to procure the items within the required timeframe and at a reasonable cost.

All procurement activities have potential risks, such as unrealistic schedules and costs, the capacity capabilities of vendors, shipping delays, and inadequate vendor performance. The project team must manage these risks to ensure project success. Project risks will be addressed following the project's risk management plan.

4.9.1.1 Procurement Documents.

Green Building Solutions uses standardized forms and templates in its procurement process to manage procurement activities and contracts efficiently. These standard documents have been developed to provide the adequate detail necessary to manage the procurement process effectively. The Office Administrator maintains an electronic and hard-copy file for each project's procurement process. The following is a listing of the project's standard templates that will be used for project procurement activities:

- Request for Proposal Template
    - Background
    - Proposal process and timelines
    - Proposal guidelines
    - Proposal formats and media
    - Source selection criteria
    - Pricing forms
    - Statement of work
    - Terms and Conditions

- Vendor Selection Criteria evaluation forms
- Non-disclosure agreement
- Letter of intent
- Firm fixed price contract
- Procurement audit form
- Procurement performance evaluation form

4.9.1.2 Procurement Selection Criteria.

The following decision criteria will be the basis for selecting and awarding contracts under this project:

- Capability and capacity
- Quality
- Product cost and lifecycle costs
- Key staff qualifications, availability, and competence
- Expected delivery date
- Financial stability
- Past performance

A bid evaluation panel will convene to measure the criteria and select the successful bidder based on the weighted average of the specified criteria. The Managing Director will be responsible for reviewing and signing all contracts. Table 35 is a template of the bid evaluation matrix that will be used in the project.

Table 35

Vendor Selection Criteria Matrix

Vendor Selection Criteria							
Project Name:				**Date:**			
			1	2	3	4	5
Criterion 1							
Criterion 2							
Criterion 3							
Criterion 4							
Criterion 5							
	Weight	Bidder 1 Rating	Bidder 1 Score	Bidder 2 Rating	Bidder 2 Score	Bidder 3 Rating	Bidder 3 Score
Criterion 1							
Criterion 2							
Criterion 3							
Criterion 4							
Criterion 5							
Total							

Note: Table 34 is a template of the vendor selection criteria matrix to be used in the project (Dionisio, 2017)

4.9.2 Control Procurement

The procurement officers and the project team are responsible for managing all external suppliers to ensure that the selected vendors provide all the goods or services as specified in the RFP and the contract documents. The Director of Operations will hold weekly progress meetings to discuss the status of each procurement process until all items or services are delivered and considered acceptable. All documented specifications for each product will be reviewed and compared against actual deliverables to ensure compliance with the requirements established in the project specifications. Requirement changes will also be discussed at these meetings; however, all changes must follow the company's change management process. The project team will conduct performance reviews, inspections, and audits for each vendor based on the metrics and standards established by the project to analyze vendor and quality performance. This evaluation will form part of the project's repository and will be used in future projects to determine the vendor's eligibility to submit future bids.

4.10 Stakeholder Management Plan

The stakeholder management processes help the project team identify the stakeholders, determine engagement strategies, and manage the project to satisfy them. The company has developed a robust stakeholder management plan that helps with gaining support for a project and anticipating resistance, conflict, or competing objectives among the project's stakeholders.

The plan will identify and classify project stakeholders; determine stakeholder power, interest, and influence; and analyze the management approach and communication methodology for project stakeholders, allowing for the identification of influential stakeholders who can assist with project planning and champion the project to other stakeholders. As much as possible, the project will identify and communicate with stakeholders to effectively manage and balance stakeholders' interests and ensure project success.

4.10.1 Identify Stakeholders

The project team will conduct a brainstorming session to identify internal and external stakeholders for the project. Internal stakeholders are functional managers, design personnel, finance personnel, procurement personnel, construction crew, and other operation personnel affected by the project. External stakeholders are suppliers, clients, partner organizations, or other individuals outside of the company. The following criteria will determine if an individual is a project stakeholder:

a. Will this project directly or indirectly affect the person or their organization?
b. Can the person or organization influence the project?
c. Does the person impact the project's resources (materials, personnel, funding)?
d. Does the project require special skills or capabilities from the person or organization?
e. Is the project beneficial to the person or organization?
f. Is the person or organization in a position to resist the changes resulting from the project in such a way that it stalls the project?

All individuals who meet at least one of the criteria will be listed in the stakeholders register as a stakeholder.

4.10.1.1 Key Stakeholders.

Key stakeholders can have a significant influence, impact, or be significantly affected by the project. Key stakeholders may require a different communication and engagement strategy than non-key stakeholders. The project team will identify key stakeholders to gauge their necessary frequency, level of communication, and involvement in the further planning of the project. Key stakeholders can be included as members of focus groups, gate reviews, community meetings, and progress review meetings to ensure that they are abreast of the status of the project and that conflicting interests are managed. The stakeholder engagement plan will provide a robust communication process that addresses all the concerns of key stakeholders and ensures that their support for the project remains in place.

4.10.2 Stakeholder Analysis

The project team will analyze each identified project stakeholder to determine the stakeholders' level of power or influence on the project. The analysis will also determine the engagement strategies, appropriate communication levels, and stakeholder participation in the project. The project will categorize stakeholders into groups such as the project team, functional managers, contractors, sub-contractors, vendors, community groups, and regulatory organizations. A power/interest grid will determine which stakeholders have high or low power to affect the project and who have high or low interest. The project team

must ensure that stakeholders with high power are kept satisfied and those with high interest are kept informed. A stakeholder engagement assessment matrix will also be developed to understand stakeholders' motivation regarding the project and the management strategy that can be utilized for each type of stakeholder.

Tables 36 and 37 illustrate the level of power and interest the identified stakeholders hold in the project.

Table 36

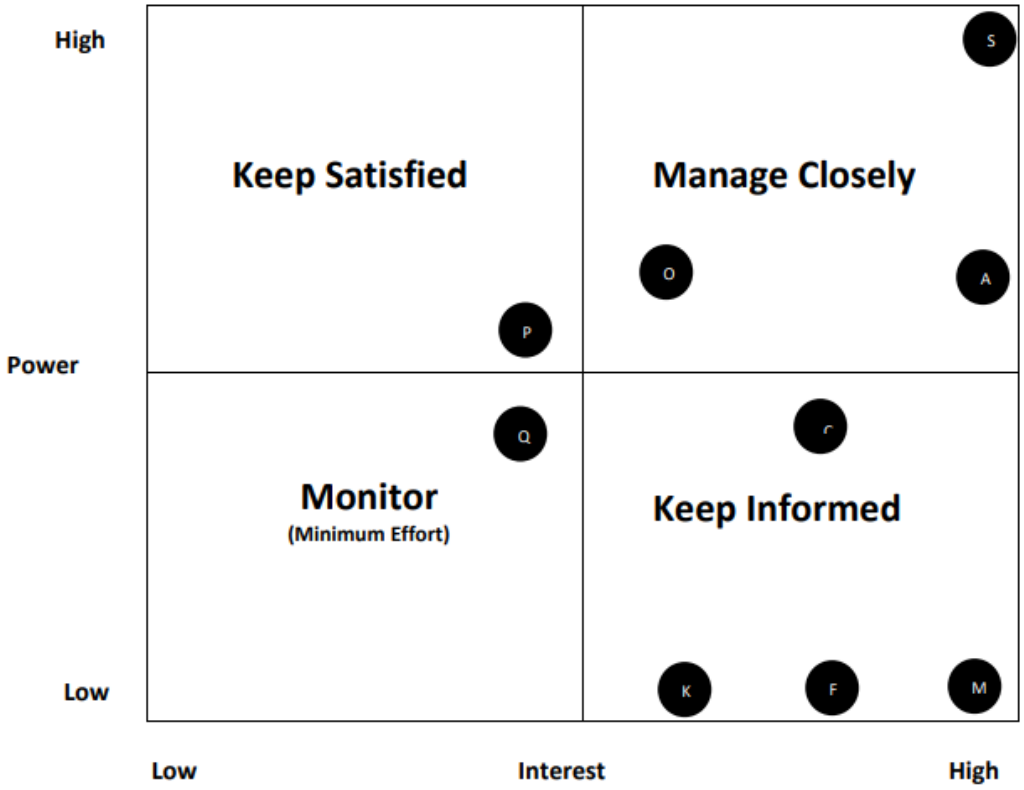
Power/Interest Analysis

Key	Name	Position/Interest	Power (1-5)	Interest (1-5)
a.	Gabriel Flores	Managing Director	3	5
b.	Patrick Thurton	Director of Operations/Projects	3	5
c.	Neil Young	Engineer	2	4
d.	Oswald Young	Engineer	2	4
e.	Arnaldo Herrera	Architect	2	4
f.	Hector Hernandez	Construction Supervisor	1	4
g.	Joseph Middleton	Site Supervisor	1	4
h.	Trudy Smith	Quality/Safety Manager	2	4
i.	Hon. Orlando Habet	Minister, Sustainable Development	1	4
j.	Dr. Kenrick Williams	CEO, Sustainable Development	1	4
k.	Ms. Evonlee Tench	Policy Analyst, Sustainable Development	1	3
l.	Dr. Lennox Gladden	Director, National Climate Change Office	1	4
m.	Hon. Julius Espat	Minister, MIDH	1	5
n.	Mr. Jose Espat	CEO, MIDH	1	4
o.	Mr. Seremei Cayetano	Director, CBA	3	3
p.	Mr. Naldo Romero	Chief Inspector, CBA	3	2
q.	Mr. Hector Carillo	Architect, CBA	2	2
r.	Mr. Shane Zuniga	Policy Analyst, CBA	2	2
s.	Client	Homeowner	5	5
t.	Hardware Stores	Supplier	1	4
u.	Contractors	Supplier	1	4
v.	Sub-contractors	Supplier	1	4
w.	Community Organizations	Activist Groups	1	5

Note: The table illustrates analysis of the level of power and interests held by the project's stakeholder (Authors' own source).

Table 37

Power/Interest Grid



Note: The chart depicts a graphical representation of the level of power and interest and how stakeholders will be managed (Author's own source).

Table 38

Stakeholder Strategy

Stakeholder	Quadrant	Strategy
a.	Manage Closely	Obtain stakeholders feedback on project planning. Frequent communication and addressing concerns are imperative. Provide frequent status reports and updates.
b.	Manage Closely	Obtain stakeholders feedback on project planning. Frequent communication and addressing concerns are imperative. Provide frequent status reports and updates.
c.	Keep Informed	Communicate project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
d.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
e.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
f.	Keep Informed	Communicate project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
g.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
h.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
i.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
j.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
k.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
l.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.

Stakeholder	Quadrant	Strategy
m.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
n.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
o.	Manage Closely	Obtain stakeholders feedback on project planning. Frequent communication and addressing concerns are imperative. Provide frequent status reports and updates.
p.	Keep Satisfied	Communicate requirements early and ensure that all relevant documents and permits are up to date.
q.	Monitor	Communicate the project schedule and specifications as required.
r.	Monitor	Communicate the project schedule and specifications as required.
s.	Manage Closely	Obtain stakeholders feedback on project planning. Frequent communication and addressing concerns are imperative. Provide frequent status reports and updates. Obtain the necessary approvals.
t.	Keep Informed	Communicate project schedule and material requirements.
u.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
v.	Keep Informed	Communicate the project schedule and material requirements. Allow technical staff to work with stakeholder to answer questions and address concerns.
w.	Keep Informed	Allow technical staff to work with stakeholder to answer questions and address concerns.

Note: The table depicts the different strategies that will be utilized for the various stakeholders (author's own creation).

4.10.3 Manage Stakeholder Engagement

The stakeholder engagement assessment matrix shows the current level of engagement and the desired level of engagement that will be needed for the project's success. Table 38 depicts the stakeholder engagement assessment matrix.

Table 39

Stakeholder Engagement Assessment Matrix

Key	Name	Unaware	Resistant	Neutral	Supportive	Leading
a.	Gabriel Flores				Current	Desired
b.	Patrick Thurton				Current	Desired
c.	Neil Young				Current	Desired
d.	Oswald Young				Current	Desired
e.	Arnaldo Herrera				Current	Desired
f.	Hector Hernandez				Current	Desired
g.	Joseph Middleton				Current	Desired
h.	Trudy Smith				Current	Desired
i.	Hon. Orlando Habet			Current	Desired	
j.	Dr. Kenrick Williams			Current	Desired	
k.	Ms. Evonlee Tench			Current	Desired	
l.	Dr. Lennox Gladden			Current	Desired	
m.	Hon. Julius Espat			Current	Desired	
n.	Mr. Jose Espat			Current	Desired	
o.	Mr. Seremei Cayetano			Current	Desired	
p.	Mr. Naldo Romero	Current			Desired	
q.	Mr. Hector Carillo	Current			Desired	
r.	Mr. Shane Zuniga	Current			Desired	
s.	Client	Current			Desired	
t.	Hardware Stores	Current			Desired	
u.	Contractors	Current			Desired	
v.	Sub-contractors	Current			Desired	
w.	Community Organizations	Current		Desired		

Note: The table shows the current level and the desired level of engagement of each stakeholder (Author's own source).

4.11 Direct and Manage Project Work

Direct and manage project work is an integration management knowledge area under the execution process group. This process is about performing activities to accomplish the project's requirements, creating the project deliverables, acquiring the relevant staff, training, and managing the project team, establishing and managing project communication channels, generating project data, issuing change requests, managing risks, and managing sellers and suppliers. This process will be performed throughout the project's lifecycle and will be beneficial to the overall management of the project. The following section outlines how the project will be directed and managed.

4.11.1 Work Performance and Inspection

Green Building Solutions will use site inspections to assess the project team's work performance in executing the project and meeting the project's established objectives. Site inspections ensure safety and quality throughout the project's lifecycle. Site inspections will also allow the project manager to monitor the project's progress and ensure regulation compliance.

The contracts issued under the project will be the primary documents for ensuring work performance and will be one of the bases for site inspection. The contracts provide the detailed scope of work, costs, schedule, and performance reviews to ensure compliance with quality, safety, environmental, and regulatory building codes. The project quality management plan outlines the safety and quality inspection audit program, this falls under the purview of the company's Safety and Quality Manager with assistance from the Construction Manager and the Site Supervisor. The project communications management

plan details the system that will be used for reporting, documenting, and communicating the results of the inspections and contract administration reporting.

The relevant personnel will analyze the inspection reports and provide insight if the work performed is meeting the acceptance criteria and justifications as the basis for contract payments and acceptance of project deliverables. The results of these analyses will indicate if there is a need for corrective actions, preventative actions, or defect repairs.

The Safety and Quality Manager, Construction Manager, and Site Supervisor will develop an inspection schedule that ensures timely and transparent inspection and reporting in line with the contracts and specific project requirements to monitor work performance. The project team will also use the work performance data of each project as feedback on lessons learned to improve the performance of future work packages.

4.12 Manage Project Knowledge

Manage project knowledge is an executing process that uses existing and new knowledge, which helps to achieve the project's objectives and contribute to organizational learning. Green Building Solutions utilize existing knowledge to perform tasks effectively to leverage and transform that knowledge into competitive advantages and improve project outcomes. Managing project knowledge is performed throughout the project's lifecycle, and it enhances organizational and individual learning, improves the way information is shared, and can lead to innovation. Knowledge, in the form of best practices and lessons learned from previous projects, can be beneficial in executing future projects. The following section outlines how the project will manage knowledge.

4.12.1 Knowledge Management

As a construction company, Green Building Solutions realizes that its projects generate substantial knowledge that can be shared and reused within and across its projects. Ensuring that the relevant personnel have access to relevant knowledge is vital to the company, and they have developed several practices that enhance knowledge management and better utilize lessons learned, best practices, and past experiences of personnel. Green Building Solutions uses active learning through formal training and coaching and knowledge transfer through reviews, planning workshops, etc. The monthly site visit report captures and stores all knowledge generated during the construction phase.

The company uses a SharePoint folder hosted on a secured intranet, which acts as a repository and allows for electronically sharing documents. This allows for an enhanced transfer of best practices and lessons learned across project teams and promotes sharing experiences throughout the organization. The information is centralized and managed by the Office Administrator. The Office Administrator also maintains paper-based project-related documentation stored in a fireproof, water-resistant file storage cabinet. The company also utilizes MS Project as its project management information system, which supplements and aids in accessing vital project knowledge.

4.13 Change Management Plan

Changes are inevitable in projects, so change management is an essential process in project management. Changes are not made arbitrarily but must follow the company's change control process outlined in this section. The process allows for all proposed changes to be vetted to ensure that they fall within the project's scope, are beneficial to the

project, and that all approved changes are effectively communicated to stakeholders. The change management plan also defines the change management process and explains the role and responsibilities of the change control board. It ensures that all proposed changes are clearly defined, reviewed, and approved, and that an appropriate implementation plan is developed. Project stakeholders must submit all change requests to the Director of Operation per the change management plan.

4.13.1 Definitions of Change

The different types of changes that will be considered under this project are listed below. Approved changes will impact at least one of the listed areas, and the change control board is responsible for understanding the significance of those impacts.

- Schedule Change: Define a schedule change versus a schedule revision. Indicate when a schedule variance needs to go through the change control process to be re-baselined.
- Budget Change: Define a budget change versus a budget update. Indicate when a budget variance needs to go through the change control process to be re-baselined.
- Scope Change: Define a scope change versus progressive elaboration. Indicate when a scope variance needs to go through the change control process to be re-baselined.
- Project Document Change: Define when updates to project management documents or other documents must go through the change control process to be re-baselined.

4.13.2 Change Control Board

A change control board (CCB) is a group of people that approves or rejects changes. The CCB decides whether to approve proposed changes. Approved changes are sent back to the project team for implementation. All proposed changes must be submitted to the Director of Operations using the project's change request form. The Director of Operations must log and submit all change requests to the CCB. Change control meetings are held every month on the 2nd and last Fridays. Table 40 identifies the CCB members for this project.

Table 40

CCB Roles & Responsibilities

Name	Position	Role	Responsibility
Gabriel Flores	Managing Director	Chair	• Approve all changes to budget/funding allocations. • Approve all changes to the schedule baseline. • Approve any changes in project scope.
Patrick Thurton	Director of Operations	Member	• Receive and log all change requests from project stakeholders. • Conduct a preliminary risk, cost, schedule, and scope analysis of change prior to CCB. • Seek clarification from change. requestors on any open issues or concerns. • Make documentation revisions/edits as necessary for all approved changes
Neil Young	Engineer	Member	• Approve all changes to budget/funding allocations. • Approve all changes to the schedule baseline.

			• Approve any changes in project scope.
Arnaldo Herrera	Architect	Member	• Approve all changes to budget/funding allocations. • Approve all changes to the schedule baseline. • Approve any changes in project scope.
Mr. Seremei Cayetano	Director, CBA	Co-Chair	• Approve all changes to budget/funding allocations. • Approve all changes to the schedule baseline. • Approve any changes in project scope.

Note: The table outlines the roles and responsibilities of the project's Change Control Board (Author's own source).

4.13.3 Change Control Process

The Change Control Process will follow the company's standard change process. The Director of Operations is responsible for executing the change management process for each submitted change request. The following steps allow the project team to get changes approved, effectively communicate changes, and update all relevant project documentation.

1. Change Request Submission: The stakeholder identifies a need for a change and submits a completed change request form to the Director of Operations.
2. Log Change Request: The Director of Operations will log all submitted change requests in the Change Request Log.
3. Evaluate Impact of Change Requests: The Director of Operations will analyze the change requests to ascertain the impact(s) the change may have on the project. The Director of Operations is also responsible for seeking any additional information that is necessary from the team members and stakeholders requesting the change.

4. Submit Change Requests to the Change Control Board: The Director of Operations will submit the change requests and the evaluation analysis to the Change Request Board for their review. The CCB will discuss the change at the next CCB meeting and decide on approving or denying the change request.
5. Communicate and Implement Change: The Director of Operations will communicate all approved changes to the project stakeholders and update all necessary project documentation to implement those changes.

4.14 Project Closure

Project integration management closing involves performing the project closure portion of the project management plan. During this process, all project activities are finalized to formally close the project and transfer the finished product to the client. The project team should ensure that each phase of the project is appropriately closed on a timely basis for contractual purposes and to avoid inadequately administering the project's administrative procedures. The project manager should be knowledgeable about the various phases of the project that can be closed before the final deliverable is achieved, especially considering all the procurement obligations that need to be closed in construction projects.

4.14.1 Closeout Documents

The project manager will deliver or ensure that upon project closure, the Office Administrator is in possession of the master set of documents for the project. This is inclusive but not limited to the following:

- material and production information
- inspection and testing records
- operations and maintenance manuals
- As-built records inclusive of final construction design, electrical and plumbing plans
- project punch list
- Occupancy permits
- project acceptance and handover documentation
- formal contract documentation (Contract closeout documents)

4.14.2 Final Project Report and Lessons Learned

The project manager is also responsible for submitting a final project report describing and documenting the project's history, lessons learned, and post-project analysis. The report will explain the processes that worked well and those that didn't, provide feedback and testimonials from stakeholders involved, and identify areas of improvement and preventive actions that could be utilized in future projects.

The information will be used to update the company's organizational process assets. After submitting and accepting the final project report, the company will archive the project files and closure documents, recording and distributing historical cost information for future cost estimating and procurement.

5 CONCLUSIONS

This project management plan provides the project's background, justification, conceptual frameworks, and objectives. It also outlines the necessary subsidiary plans required to carry out the project. The plan included the following:

1. A brief description of the fundamental principles of green building was included as a guide for developing green building standards for Belize. The developed green building standards will guide the planning and execution phases of the project.

2. The project charter was successfully developed, providing official acknowledgment and recognition of the project's existence, and giving authority to proceed with and commit resources to the project.

3. The integrated management plan was established to coordinate all the necessary elements to complete the project successfully.

4. The scope management plan was successfully created and established the work required, and only the work required, to complete the project successfully by providing a detailed description of the objectives to be achieved. This section also included a graphical illustration of the WBS components and their accompanying dictionary.

5. The schedule management plan was developed, defining the timeline for each project deliverable to ensure the project's timely completion. It established the process for the ongoing maintenance of the schedule, including reporting of work

performed, project progress, and variances. The project schedule was developed with MS Projects.

6. The cost management plan was successfully created, which estimates and manages the budget for all project activities, deliverables, and resources. It specified how the project costs would be estimated, structured, monitored, and controlled. The plan also provided detailed estimates of the project costs compiled into a budget to ensure the project stays within budget.

7. The Quality and Safety Management plan was created to ensure that all project deliverables meet stakeholders' quality expectations. The plan defined safety and quality assurance, control activities, and acceptable safety and quality standards for all project construction activities.

8. The resource management plan was established as a guide to identify, acquire, and manage all the resources needed to complete the project successfully.

9. The communications management plan was developed to ensure effective communication with project stakeholders and to record all project communications. This plan sets out the project's communication framework and defines the project's communication requirements and distribution of information.

10. The risk management plan was established to define how risks will be identified and analyzed to determine their potential impacts and the possibility that the risk will

happen while executing the project. The plan involved developing a risk response plan to show how risks will be treated.

11. The procurement management plan was developed to establish how the project will manage the procurement process, from developing procurement documents to contract closure. This plan identified and defined the goods and services the project will need to acquire from external sources, the items that will be procured, and the types of contracts the project will use.

12. The stakeholder management plan was successfully developed to identify all groups and individuals potentially affected by the project. It ensures their expectations are understood, recorded, and considered throughout the project life cycle.

13. The change management plan successfully outlines and defines the change management process and explains the role and responsibilities of the change control board. It ensures that all proposed changes are clearly defined, reviewed, and approved, and that an appropriate implementation plan is developed.

These subsidiary plans are in accordance with the PMBOK®, which is generally considered good practices that can enhance project success.

6 RECOMMENDATIONS

The following are recommendations addressed to the Director of Operations/Projects that should be considered during the planning and execution of the project to ensure successful completion of the project:

1. Use the fundamental principles of green building design and construction and the standards applicable to Belize as the basis for developing and executing the project.
2. Use the project management methodologies, processes, tools, techniques, and activities defined in this document for each of the specific plans: scope, schedule, costs, quality, resources, communications, risks, procurement, and stakeholders' management to complete the project and serve for constant monitoring of costs, time, quality, and risks.
3. Conduct effective monitoring of the project execution strategy, follow the change management process, and ensure that the project is implemented according to the approved plan.

7 VALIDATION OF THE FGP IN THE FIELD OF REGENERATIVE AND SUSTAINABLE DEVELOPMENT

The Green Project Management (2019) states that we consume more resources than the planet can provide. Even before this assertion, policymakers had already noted that there was a need for more sustainable development. However, the implemented solutions did not have as significant an impact as expected. Regenerative development goes beyond sustainability, and it takes on a more holistic approach to building the capacity of the existing support system and utilizing linkages for the improved well-being of society (Muller, n.d.). The Regenesis Group described regenerative development as an approach that enhances living things' ability to co-exist and co-evolve in ways that allow the planet to reach its full potential for diversity, complexity, and creativity (Mang, Haggard, & Regenesis, 2016).

Sustainable development, climate change, and regenerative development have taken project management into an era beyond the triple bottom line where success is concerned. Projects are no longer judged to be successful based on being finished on time, within budget, etc.; but success is also deemed successful based on their long-term sustainability, building capacities, and overall impact on society's well-being. Therefore, sustainability and regenerative development must be incorporated into the project management plan to implement, monitor, and deliver the project.

The project's core concept of designing and constructing a green, climate-resilient, single-family home is sustainability and building the country's resilience to climate change. The project will utilize sustainable materials and practices, which will not only be

beneficial in the execution phase of the project but will also have long-term sustainable benefits during the operation and maintenance phases. These concepts are also aligned with the Sustainable Development Goals and Belize's programme in its quest for accreditation from the Green Climate Fund, which will be discussed in the next section.

7.1 Belize's Country Programme for Sustainable Development

Belize has committed to contributing to global climate change efforts and aims to transform its "economy along a low-emission, climate-resilient pathway towards sustainable development" (Venturini et al., 2021. p. 11). The country programme highlights priority sectors and measures for adaptation and mitigation towards the Sustainable Development Goals and the Paris Agreement. Below are some of the country's objectives and developmental goals that align with the project to design and construct a green, climate-resilient, single-family home.

7.1.1 Land Use and Settlements

One of the country's development goals is to protect communities from damage caused by flooding and sea level rise by implementing its Land Use Policy and supporting green and grey infrastructure. This objective is in line with the Sustainable Development Goal to have sustainable cities and communities. However, this objective has some challenges as the country faces rapid urbanization, ad hoc settlements, and the infrastructural requirements of unplanned communities. As stated earlier, Belize is a low-lying coastal country, and implementing infrastructural defenses to flooding and other

climate-related catastrophes is costly. Furthermore, building codes are nonexistent, and climate resilience is not incorporated.

The project management plan to design and construct a green, climate-resilient, single-family home in rural Belize addresses some of the challenges faced by the country regarding land use and settlements. The plan addresses and defines minimum building codes that incorporate climate resilience and sustainable practices.

7.1.2 Disaster Risk Reduction

Disaster risk reduction is an essential objective because it is intrinsically linked to infrastructure and human settlements. It covers a broad spectrum of stakeholders and organizations for the creation of a comprehensive and enhanced disaster risk reduction and management plan. Deteriorating road infrastructure, housing, and poor drainage systems pose challenges to disaster risk reduction and lend to the severe economic losses to the country caused by hurricanes and flooding.

The project management plan intends to mitigate disasters and contribute to the country's disaster risks from climate-related activities by using sustainable, climate-resilient materials that will act as a defense mechanism against climate-related natural disasters. This project management plan can be used for similar future projects and to develop climate-resilient housing communities across Belize.

7.1.3 Energy

One of the Sustainable Development Goals is to provide affordable and clean energy. Belize's government foresees that electricity/energy consumption will increase as

temperatures increase. Fluctuations in oil prices also mean that the cost of electricity will become unstable. This, compounded by the changes in the hydrological cycle, will adversely affect hydropower production, leading to electricity becoming scarce and costly. Ad hoc urbanization and inadequate infrastructure associated with settlement expansion are challenges to lowering energy consumption in Belize.

Pilot activities of green building construction already show that green buildings can result in a twenty percent (20%) decrease in the country's energy consumption. Green buildings also use materials that reduce the energy needed to cool and warm the buildings and improve air circulation within the buildings. Having a well-documented and well-established project management plan for constructing a green building in Belize that can be used as a guide for designing and constructing green homes will further reduce the country's electricity consumption.

7.2 P5 Impact Analysis

The Green Project Management P5 Impact Analysis is a tool that can be used to incorporate sustainability into projects. One of the tool's primary purposes is to identify potential positive and negative sustainable impacts for analysis and decision-making. However, this tool also helps organizations align their strategies with sustainable performance through principle-based project management techniques while linking them to Sustainable Development Goals.

Below is a P5 impact analysis conducted for the project to design and construct a green, climate-resilient, single-family home in rural Belize.

Figure 12

P5 Impact Analysis

P5 Impact Analysis
Impacts

This impact will improve the project's outcome(s) from a sustainability persp
5 = Strongly agree 4 = Agree 3 = Neutral 2 = Disagree 1 = Strongly disa

Category / Subcategory / Element	Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
2.1 Product Impacts						
2.1.1 Lifespan of the product	There are no building standards (codes) for construction of a green, climate-resilient building.	The building will not meet standards to be considered a green building.	2	Develop minimum green, climate-resilient building standards that the project must adhere to.	5	3
2.1.2 Servicing of product	Traditional homes and buildings have high-level energy consumptions.	Level of energy consumption required throughout the lifesapn of the building will be high and costly to the homeowner.	2	Ensure that renewable energy is used wherever applicaple and that cost-saving, energy efficient fixtures are used.	5	3
2.2 Process (Project Management) Impacts						
2.2.1 Effectiveness of project processes	Lack of standardized or comprehensive documentation and cohesiveness amongst regulatory authorities that could be used to create a green project management plan.	Lack of standardized/comprehensive documentation and a documented project management plan can impact the effectiveness, efficiency and fairness of the processes involved with the project.	3	A well developed set of standards and a well defined project management plan incorporating green project management practices.	5	2
2.2.2 Efficiency of project processes						
2.2.3 Fairness of project processes						
		Product and Process Average	**2.3**		**5.0**	**2.7**
3 People (Social) Impacts						
3.1 Labor Practices and Decent Work						
3.1.1 Employment and staffing	Inadequate skilled workers to ensure effective implementation of project activities.	substandard work and increased expenditure due to corrective work to be done.	4	Request previous employment details and references before confirming employment and placement.	5	1
3.1.2 Labor/management relations	Non-adherance to the country's labour laws and regulations.	Penalties, lawsuit, loss of credibility, loss of contract, business license revoked.	4	Ensure Adherance to Labour Laws at all times.	5	1
3.1.3 Project health and safety	Non Adherance to Organizational Safety and Health (OSHA) requirements at work site	Illness, death, disrupted work schedule.	5	Adherance to Organizational Safety and Health (OSHA) requirements while on the Job.	5	0
3.1.4 Training and education	Staff may not have the capacity to adequately interpret drawings and sketches or execute project activities.	Incorrect or improper execution of project tasks or activities can lead to costly reworks.	4	Ensure an adequate chain of command, transfer of information, and training for new employees. Site supervisor is always on site and Construction Manager is on site for critical activities.	5	1
3.1.5 Organizational learning	Field Staff may not be aware of the latest green building technologies and what the organization is trying to achieve.	Staff may not be committed to the process and may divert from using green technologies	4	Engage staff of the intentions of the proposed project and the benifits derived from similar established projects. Provide learning opportunities for staff about green architecture.	5	1
3.1.6 Diversity and equal opportunity	Recruitment of male and female personnel	Low employee morale might slow down project activities	2	Create employment oportunities based on qualifications and experiences and not gender preference.	4	2
3.1.7 Local competence development	Hiring skilled labor from outside the country	Does not increase local competencies	4	Ensure prioritization of locally skilled residents.	5	1

3.2 Society and Customers							
3.2.1	Community support	Little to no community awareness on the project's impact.	Community may not support the project and its initiatives	3	Sentisize community and inform them of the benfits of the project through various campaign strategies.	5	2
3.2.2	Public policy compliance	No green building or climate-resilience standards in place. Building codes not enforced in rural areas.	May impact ability to obtain green building certification if nonexistent in the country.	2	Collaborate with regulatory authority to define green building standards to achive in-country certification.	4	2
3.2.3	Protection for indigenous and tribal peoples	N/A	N/A		N/A		
3.2.4	Customer health and safety	Project site is within a rural community	noise from construction may affect residents. Residents may enter construction site and cause damage or get injured.	4	Proper signage and enclosed work space and construction work with heavy noise to be done only during working hours when majority of residents are at school or work.	5	1
3.2.5	Product and service labeling	N/A	N/A		N/A		
3.2.6	Market communications and advertising	N/A	N/A		N/A		
3.2.7	Customer privacy	N/A	N/A		N/A		
3.3 Human Rights							
3.3.1	Non-discrimination	Few initiatives to promote equality and diversity in projects	Low employee morale might slow down project activities	3	Ensure that minimum standards of diversity and inclusion are upheld.	5	2
3.3.2	Age-appropriate labor	Underaged labours working on site.	Non-Compliance with Labour Laws.	3	Checklist of documents to produce for consideration for employment and verification of recieved document with regulatory agencies on legal age of employement.	5	2
3.3.3	Voluntary labor	N/A	N/A		N/A		
3.4 Ethical Behavior							
3.4.1	Procurement practices	Company's procurment and purchase manuals not being adhered to.	Improper procurement practice can lead to failed procurement processes, encourage corruption and decrease fair competition.	2	Ensure that project adheres to the Company's Procuremt Manual throughout the project and ensure that the evaluation panel are well-equipped to carry out the bid evaluation.	5	3
3.4.2	Anti-corruption					5	
3.4.3	Fair competition					5	
			People Average	**3.4**		**4.9**	**1.5**
4 Planet (Environmental) Impacts							
4.1 Transport							
4.1.1	Local procurement	Difficulty to obtain required quantity of building materials from local suppliers.	Delays in construction processess and project schedule	3	Look for suppliers within the vicinity that can provide supplies needed.	5	2
4.1.2	Digital communication	Excess use of paper and travel for project communication.	Increased CO2 emissions from travel.	3	Use of digital communication whenever possible, digital filing system.	5	2
4.1.3	Traveling and commuting	Difficulty of staff getting to the project site	Delays of project activities and schedule of activities on a daily basis.	4	Provide transportaion for workers to and from project site.	5	1
4.1.4	Logistics	Deficient planning	Wastage of materials, time, and money.	3	Practice bulk purchasing as much as possible	4	1

4.2 Energy							
4.2.1	Energy consumption	Use of fuel driven equipment during construction	Increase Co2 emmissions in the atmosphere	2	Using fuel efficient equipment	4	2
4.2.2	CO2 emissions	using fueled engines and lack of timely maintenance and servicing.	Increase Co2 emmissions in the atmosphere	2	Using fuel efficient equipment and practicing timely maintenance of equipment and machines.	4	2
4.2.3	Clean energy return	Lack of green energy harnessing and storage for reuse.	Increase consumption of fossile fuels and general atmopheric contamination.	2	Contract clean energy providers	4	2
4.2.4	Renewable energy	Increase operating cost due to high non renewable electricity consumption.	Increase contractors overall expenditure during the project.	2	Use PV panels and solar lighting for keeping the site weel lit and to harness and store energy for reuse.	4	2
4.3 Land, Water, and Air							
4.3.1	Biological diversity	No adherance to recommendations from Environmental Impact Assessment (EIA)	Destruction of biological diversity leading to imbalance in the ecosystems	2	Construction Manager to maintan a check list of reccommendation and adapt strict guidelines to implement reccommendations.	4	2
4.3.2	Water and air quality	No adherance to environmental health guidelines and recommendations.	Water and air pollution causing workers to get sick	2		4	2
4.3.3	Water consumption	No adherence to technical requirements for construction activities.	Disfunctional construction site prone to accidents occuring.	2		4	2
4.3.4	Sanitary water displacement	No adherence to technical requirements for construction activities.	Ground water pollution	2		4	2
4.4 Consumption							
4.4.1	Recycling and reuse	Lack of proper sorting of construction materials.	Compromising of recycling or Resusing processes.	3	Establish gabbage sorting procedure to be managed by site supervisor.	5	2
4.4.2	Disposal	Little or no application of set processes and procudures.	No adherence to technical standards and specifications.	3	Maintain correctly sized gabbage disposal bins on site and assure adherence to technical requirements on approved development plans.	5	2
4.4.3	Contamination and pollution	No adherence to technical requirements for construction activities.	Protracted and frequent illness slowing down project activities.	3	Construction Manager to maintan a check list of reccommendation and adapt strict guidelines to implement reccommendations.	4	1
4.4.4	Waste generation	No adherence to technical requirements for construction activities.	Destruction of biological diversity leading to imbalance in the ecosystems and a disfunctional construction site prone to accidents occuring.	3		4	1
			Planet Average	**2.6**		**4.3**	**1.8**

Prosperity (Economic) Impacts							
5.1 Business Case Analysis							
5.1.1	Modeling and simulation	N/A	N/A		N/A		
5.1.2	Present value	Financial analysis necessary	project may not be financially viable	3	Revise scope and budget	4	1
5.1.3	Direct financial benefits						
5.1.4	Return on investment						
5.1.5	Benefit-cost ratio						
5.1.6	Internal rate of return						

5.2 Business Agility							
	5.2.1 Flexibility/optionality	Lack of adaptability to changing circumstances.	unable to compete	3	Encouraging sharing of opinions and and brainstorming activities to adapt to changing circumstances.	4	1
	5.2.2 Business flexibility						
5.3 Economic Stimulation							
	5.3.1 Local economic impact	Local suppliers and skilled workers are not available	Local economy is not stimulated and project does not benefit the community	2	Consider local community a key stakeholder and identify opportunity to support the local economy wherever possible.	4	2
	5.3.2 Indirect benefits						
			Prosperity Average	**2.7**		**4.0**	**1.3**
			Overall Average	**2.9**		**4.6**	**1.7**

Note: Author's compilation of P5 Analysis for the specific project

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APPENDICES

Appendix 1: FGP Charter

CHARTER OF THE PROPOSED
FINAL GRADUATION PROJECT (FGP)

1. Student name

Tenesha Trisha Reynolds

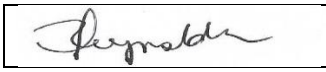
2. FGP name

Project Management Plan for the Design and Construction of a Green, Climate-Resilient, Single-Family Home in Rural Belize

3. Application Area (Sector or activity)

Green Construction

4. Student signature



5. Name of the Graduation Seminar facilitator

Roger Valverde Jimenez

6. Signature of the facilitator

7. Date of charter approval

26th February 2023

8. Project start and finish date

9th January 2023	8th July 2023

9. Research question

What approaches and elements of sustainability must be incorporated in the project management plan to construct a green, climate-resilient, single-family home?

10. Research hypothesis

It is possible to develop a project management plan that details the steps to design and construct a green, climate-resilient, single-family home in a timely and efficient manner.

11. General objective

To create a project management plan to design and construct a green, climate-resilient single-family home in rural Belize that integrates sustainable processes and practices, green technologies, and expertise from design to construction.

12. Specific objectives

1. Create a project charter to define the key input elements required to develop the project management plan.
2. Develop an Integrated Management Plan to coordinate all the elements of the project needed to successfully complete the project.
3. Develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully.
4. Develop a Schedule Management Plan to define the timeline for the project deliverables to ensure the project's timely completion.
5. Develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources.
6. Develop a Quality and Safety Management Plan to ensure that all project deliverables meet stakeholders' expectations.
7. Develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully.
8. Develop a Communications Management Plan to ensure effective communication with project stakeholders and record all project communications.
9. Develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.
10. Develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team.
11. Develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure that their

expectations are understood, recorded, and considered throughout the project life cycle.

12. Conduct a P5 Impact Analysis to ensure that the FGP actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.

13. FGP purpose or justification

According to Green Project Management (GPM) Global (2019), we consume more resources than the planet can provide. The organization also notes that the cost of living, electricity, and housing has rapidly increased since 2000. It is acknowledged that over one-third of total energy use and associated greenhouse gas (GHG) emissions are associated with buildings. The growing trend is for more sustainable practices to implement change. As a developing country, Belize has also been affected by these factors. Belize's population has significantly risen since the last population census, leading to underdeveloped and more remote areas of the country without electricity and tap water being used as housing communities. Belize is also prone to natural disasters such as hurricanes and floods. A project management plan is required because:

a. There is a need for affordable, climate-resilient, sustainably developed housing initiatives in Belize, and creating a project management plan in accordance with the guidelines proposed by the Project Management Institute's Project Management Body of Knowledge can increase the project's chances of success.
b. There are no similar guidelines or project management plans for designing and constructing green, climate-resilient homes in Belize.
c. Currently, the building sector consumes more than ninety percent (90%) of total electricity consumption in Belize - making it the second-largest source of GHG emissions. Pilot project activities in green building construction are estimated to reduce electricity consumption by twenty percent (20%).

14. Work Breakdown Structure (WBS). In table form, describing the main deliverable as well as secondary, products or services to be created by the FGP.

FGP
1. Graduation Seminar
1.1 FGP Deliverables
1.1.1 Charter
1.1.2 Work Breakdown Structure
1.1.3 Chapter I: Introduction
1.1.4 Chapter II: Theoretical Framework
1.1.5 Chapter III: Methodological Framework
1.1.6 Annexes
1.1.6.1 Bibliography
1.1.6.2 FGP Schedule

1.2 Graduation Seminar Approval

2. Tutoring Process
   2.1 Tutor
      2.1.1 Tutor Assignment
      2.1.2 Communication
   2.2 Adjustments of Previous Chapters (as needed)
   2.3 Background & Good Practices Research
   2.4 Chapter IV: Project Management Plan
      2.4.1 Scope Management Plan
      2.4.2 Scope Management Plan
      2.4.3Schedule Management Plan
      2.4.4 Cost Management Plan
      2.4.5 Quality and Safety Management Plan
      2.4.6 Resource Management Plan
      2.4.7 Communication Management Plan
      2.4.8 Risk Management Plan
      2.4.9 Procurement Management Plan
      2.4.10 Stakeholder Management Plan
   2.5 Chapter V: Conclusions
   2.6 Chapter VI: Recommendations
   2.7 Chapter VII: Incorporation of Regenerative Development

3. Readers' Review
   3.1 Reviewers' Assignment request
      3.1.1 Assignment of two reviewers
      3.1.2 Communication
      3.1.3 FGP Submission to Reviewers
   3.2 Reviewers' 1 Work
      3.2.1 Reviewers' Work
         3.2.1.1 FGP Reading
         3.2.1.2 Reader 1 Report
      3.2.2 Reviewers' 2 Work
         3.2.2.1 FGP Reading
         3.2.2.2 Reader 2 Report

4. Adjustments
   4.1 Report for Reviewers
   4.2 FGP Update
   4.3 Second Review by Reviewers

5. Board of Examiners' Evaluation
   5.1 Final Review by Board
   5.2 FGP Grade Report

15. FGP budget

Detail the budget that you estimate is necessary to develop your FGP document (relevant costs).

Activity	Estimated Budget (US$)
Transportation & Food	$150
Communication	$100
Information Processing (Photocopying & Printing)	$30
Document Binding	$125
Total	**$405**

16. FGP planning and development assumptions.

a. Information about green, climate-resilient homes in the country is organized and available.
b. Access to green building standards will be non-restricted, and there will not be limitations to their use for academic purposes.
c. The staff of the Central Building Authority (CBA) will support and assist with the identification of green, climate-resilient building standards.
d. Researcher time for the FGP will be at least 15 hours per week during the FGP development process.
e. The estimated budget will be sufficient to carry out the study and create the project management plan.

17. FGP constraints

a. The maximum time frame to finalize the FGP is 12 weeks.
b. Commercial and institutional buildings will not be part of the analysis.
c. Scheduled trainings and annual fiscal budget preparation during the months of February and March may limit CBA staff availability to contribute to the study.
d. The quantity and quality of information on green buildings in the country is limited.

18. FGP development risks

a. An increase in COVID-19 cases in the country may limit access to the CBA's non-electronic files and in-person interviews and affect the delivery time of the FGP.
b. A natural disaster (floods) might delay site visits and field data, which could delay the development of the deliverables.
c. The transfer or resignation of key personnel can cause delays in the project deliverables.
d. Differences of opinion between the Graduation Seminar Advisor and the FGP Tutor can cause a delay in the timely completion of FGP deliverables.

19. FGP main milestones

Milestones are related to deliverables on the second level (deliverables) and third level (control accounts) of the WBS of Section 14 of this Charter. At the same time the deliverables are related to the specific objectives (in the case of the FGP please include the times for the tutorship reviews as well as for the readership).

Deliverable	**Finish estimated date**
1 Graduation Seminar	
1.1 FGP Deliverables	26.02.2023
1.2 Graduation Seminar Approval	05.03.2023
2 Tutoring Process	
2.1 Tutor	15.03.2023
2.2 Adjustments of Previous Chapters (as needed)	22.03.2023
2.3 Background & Good Practices Research	03.04.2023
2.4 Chapter IV: Project Management Plan	24.05.2023
2.5 Chapter 5: Conclusion	31.05.2023
2.6 Chapter 6: Recommendations	02.06.2023
2.7 Chapter VII: Incorporation of Regenerative Development	19.02.2023
3 Readers' Review	
3.1 Reviewers' Assignment request	07.06.2023
3.2 Reviewers' Work	22.06.2023
4 Adjustments	
4.1 Report for Reviewers	23.06.2023
4.2 FGP Update	28.06.2023
4.3 Second Review by Reviewers	04.07.2023
5 Board of Examiners' Evaluation	
5.1 Final Review by Board	17.07.2023
5.2 FGP Grade Report	20.07.2023

20. Theoretical Framework

20.1 Estate of the "Matter"

Research has shown a need for sustainable development (United Nations [UN], 2008; 2019). In fact, some research has shown that we need to move beyond sustainable development if we want to meet the demands of future generations (Mang et al., 2016). As such, the growing trend is for more sustainable practices to implement change to meet those goals. Belize is a developing country in Central America that faces the Caribbean Sea. The country's population has increased significantly since the last population census, leading to remote areas being used as housing communities. These remote areas are without tap water and electricity, and there is a need for safe, accessible homes in these areas with clean drinking water and amenities. Belize is also prone to hurricanes and flash floods, and as such, homes being built should be climate-resilient and able to withstand these natural disasters. Seeing these needs, policymakers and private organizations have developed strategies to meet some of those needs in silos. Development banks are now offering loans with attractive interest rates for implementing renewable or solar energy technologies. Non-governmental organizations are funding the purchase of solar panels and training women in some remote areas on installing solar panels.

As a developing country, Belize has not developed any green or climate-resilient policies and standards related to the construction industry. It is relevant to create a project management plan in accordance with the knowledge areas identified by the Project Management Institute and incorporate green and climate-resilient practices that can be adopted in Belize. This will assist future homeowners in constructing green, climate-resilient homes in Belize.

20.2 Basic Conceptual Framework

Climate-resilient - The ability to anticipate, prepare for, and respond to hazardous events, trends, and disturbances and lessen the impacts related to climate change.

Environmentally-friendly – using practices that do not harm the environment or practices that help the environment.

Green Building - is a structure created using environmentally responsible and resource-efficient processes throughout the building's life cycle, from siting to design, construction, operation, maintenance, renovation, and deconstruction. A Green building is also known as a sustainable or high-performance building.

Green Construction Practices - are the practices incorporated in creating building structures and using environmentally responsible and resource-efficient processes during construction.

Leadership in Energy and Environmental Design (LEED) - is a green building certification program created by the U.S. Green Building Council. It uses rating systems to design, construct, operate, and maintain buildings, homes, and neighborhoods to be environmentally responsible and resource efficient.

Project Management - is the application of knowledge, skills, tools, and techniques to initiate, plan, execute, and close project activities to achieve project requirements.

Renewable Energy - is energy from natural sources that is replenished at a rate higher than it is used.

Resource-efficiency - maximizing the use of money, materials, human resources, and other assets to function effectively, with minimum waste of natural resources, and using the Earth's limited resources sustainably to minimize environmental impact.

Sustainable Architecture – buildings designed to limit humanity's impact on the environment.

Sustainable Construction - is constructing or renovating buildings using less energy, water, and materials and generating less waste than typical construction practices.

21. Methodological framework

Objective	Name of deliverable	Information sources	Research method	Tools	Restrictions
Create a project charter to define the key input elements required to develop the project management plan.	Project Charter - a written acknowledgment and recognition that the project exists and gives the project manager authority to proceed with and commit resources to the project.	Primary Sources: • Field Interviews & Meetings Secondary Sources: • Reports • Guides	Qualitative. Written information analysis • One-on-One Interviews • Focus Groups Document Analysis	Expert Judgment – (Interviews) • Central Building Authority Technical Staff • National Climate Change Officer (Ministry of Sustainable Development, Climate Change, and Disaster Risk Management • Chief Engineer (Ministry of Infrastructure, Development and Housing) Data Gathering (Meetings) • GBSL Staff • Technical Committees	• The quantity and quality of information on green buildings in the country is limited. • Scheduled trainings and annual fiscal budget preparation during the months of February and March may limit CBA staff availability to contribute to the study.
Develop an Integrated Management Plan to coordinate all the elements of the project needed to successfully complete the project.	Integrated Management Plan – written document to coordinate all the necessary elements of the project to successfully complete the project.				
Develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully.	Scope Management Plan - written document to establish the work required, and only the work required, to complete the project successfully.				
Develop a Schedule Management Plan to define the timeline for the project deliverables to ensure the project's timely completion.	Schedule Management Plan - which defines the timeline for the project deliverables to ensure the project's timely completion				

Objective	Name of deliverable	Information sources	Research method	Tools	Restrictions
Develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources.	Cost Management Plan - to plan, estimate, and manage the budget for all project activities, deliverables, and resources.	Primary Sources: • Field Interviews & Meetings Secondary Sources: • Reports • Guides	Qualitative. Written information analysis • One-on-One Interviews • Focus Groups Document Analysis	Expert Judgment – (Interviews) • Central Building Authority Technical Staff • National Climate Change Officer (Ministry of Sustainable Development, Climate Change, and Disaster Risk Management • Chief Engineer (Ministry of Infrastructure, Development and Housing) Data Gathering (Meetings) • GBSL Staff • Technical Committees	• The quantity and quality of information on green buildings in the country is limited. • Scheduled trainings and annual fiscal budget preparation during the months of February and March may limit CBA staff availability to contribute to the study.
Develop a Quality and Safety Management Plan to ensure that all project deliverables meet stakeholders' expectations.	Quality and Safety Management Plan – plan that ensures that all project deliverables meet stakeholders' quality expectations.				
Develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully.	Resource Management Plan – which identifies, acquires, and manages all the resources needed to successfully complete the project.				
Develop a Communications Management Plan to ensure effective communication with project stakeholders and for recording all project communications.	Communications Management Plan – a plan that ensures effective communication with project stakeholders and for recording all project communications.				
Develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.	Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.				

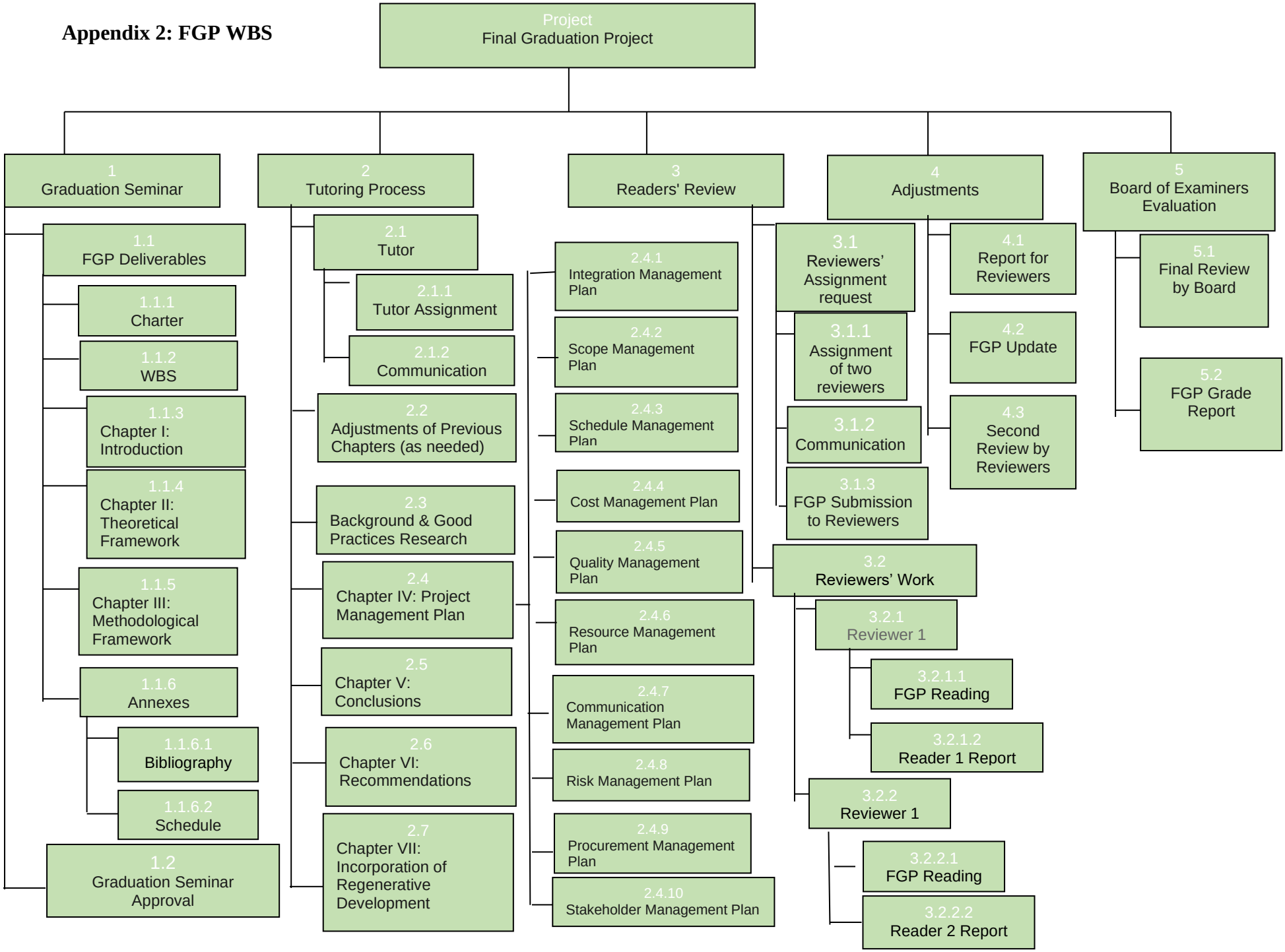
Objective	Name of deliverable	Information sources	Research method	Tools	Restrictions
Develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team.	Procurement Management Plan - documents the development and administration of agreements for products and/or services needed from outside the project team.	Primary Sources: • Field Interviews & Meetings Secondary Sources: • Reports • Guides	Qualitative. Written information analysis • One-on-One Interviews • Focus Groups Document Analysis	Expert Judgment – (Interviews) • Central Building Authority Technical Staff • National Climate Change Officer (Ministry of Sustainable Development, Climate Change, and Disaster Risk Management • Chief Engineer (Ministry of Infrastructure, Development and Housing) Data Gathering (Meetings) • GBSL Staff • Technical Committees	• The quantity and quality of information on green buildings in the country is limited. • Scheduled trainings and annual fiscal budget preparation during the months of February and March may limit CBA staff availability to contribute to the study.
Develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure that their expectations are understood, recorded, and considered throughout the project life cycle.	Stakeholder Management Plan - a plan that identifies all groups and/or individuals potentially affected by the project and ensure that their expectations are understood, recorded, and considered throughout the project life cycle.				
Conduct a P5 Impact Analysis to ensure that the FGP actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.	P5 Impact Analysis - an assessment to ensure that the development of the project management plan actively complies with the principles of sustainable development to minimize and, if possible, eliminate any processes, resources, or outcomes that could cause further harm to the environment.				

22. Validation of the work in the field of regenerative and sustainable development.

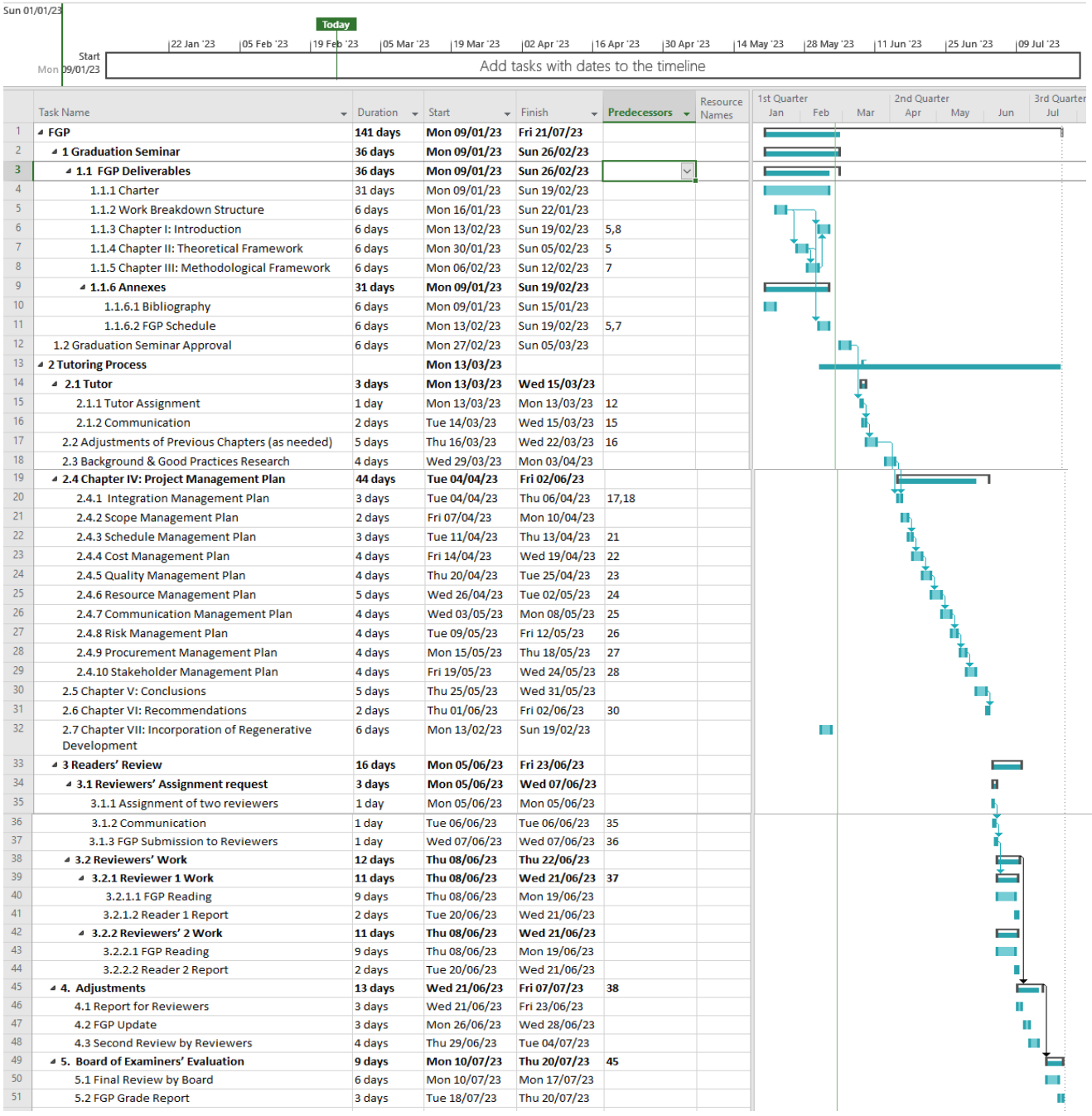
The project's core concept of designing and constructing a green, climate-resilient, single-family home is sustainability and building the country's resilience to climate change. The project will utilize sustainable materials and practices, which will not only be beneficial in the execution phase of the project but will also have long-term sustainable benefits during the operation and maintenance phases. Using materials that cause little harm to the environment is one concept of sustainability. Also, materials that mitigate impact or reduce energy consumption are features of sustainability. The project is aligned with Belize's country programme for sustainable development:

1. Land Use and Settlements - Belize is a low-lying coastal country with little to no building codes for design and construction. Climate-resilience is not incorporated into any known building codes. The project management plan to design and construct a green, climate-resilient, single-family home in rural Belize addresses and defines minimum building codes incorporating climate resilience and sustainable practices.
2. Disaster Risk Reduction - As a low-lying coastal country, Belize is vulnerable to climate-related disasters and as such, the country would like to minimize the impacts of these natural disasters. However, there is no strict building codes or incorporation of climate resilience in place. A project management system that can assist with mitigating the impacts and contribute to the country's disaster risks reduction from climate-related activities by using sustainable, climate-resilient materials that will act as a defense mechanism against climate-related natural disasters.
3. Energy – Buildings are Belize's highest consumers of energy and, one of the development goals is to provide clean and affordable energy. Designing and constructing green buildings reduces energy consumption. Having a well-documented and well-established project management plan for constructing a green building in Belize that can be used as a guide for designing and constructing green homes will further reduce the country's electricity consumption.

Appendix 2: FGP WBS



Appendix 3: FGP Schedule



	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	**FGP**	**141 days**	**Mon 09/01/23**	**Fri 21/07/23**		
2	**1 Graduation Seminar**	**36 days**	**Mon 09/01/23**	**Sun 26/02/23**		
3	**1.1 FGP Deliverables**	**36 days**	**Mon 09/01/23**	**Sun 26/02/23**		
4	1.1.1 Charter	31 days	Mon 09/01/23	Sun 19/02/23		
5	1.1.2 Work Breakdown Structure	6 days	Mon 16/01/23	Sun 22/01/23		
6	1.1.3 Chapter I: Introduction	6 days	Mon 13/02/23	Sun 19/02/23	5,8	
7	1.1.4 Chapter II: Theoretical Framework	6 days	Mon 30/01/23	Sun 05/02/23	5	
8	1.1.5 Chapter III: Methodological Framework	6 days	Mon 06/02/23	Sun 12/02/23	7	
9	**1.1.6 Annexes**	**31 days**	**Mon 09/01/23**	**Sun 19/02/23**		
10	1.1.6.1 Bibliography	6 days	Mon 09/01/23	Sun 15/01/23		
11	1.1.6.2 FGP Schedule	6 days	Mon 13/02/23	Sun 19/02/23	5,7	
12	1.2 Graduation Seminar Approval	6 days	Mon 27/02/23	Sun 05/03/23		
13	**2 Tutoring Process**		**Mon 13/03/23**			
14	**2.1 Tutor**	**3 days**	**Mon 13/03/23**	**Wed 15/03/23**		
15	2.1.1 Tutor Assignment	1 day	Mon 13/03/23	Mon 13/03/23	12	
16	2.1.2 Communication	2 days	Tue 14/03/23	Wed 15/03/23	15	
17	2.2 Adjustments of Previous Chapters (as needed)	5 days	Thu 16/03/23	Wed 22/03/23	16	
18	2.3 Background & Good Practices Research	4 days	Wed 29/03/23	Mon 03/04/23		
19	**2.4 Chapter IV: Project Management Plan**	**44 days**	**Tue 04/04/23**	**Fri 02/06/23**		
20	2.4.1 Integration Management Plan	3 days	Tue 04/04/23	Thu 06/04/23	17,18	
21	2.4.2 Scope Management Plan	2 days	Fri 07/04/23	Mon 10/04/23		
22	2.4.3 Schedule Management Plan	3 days	Tue 11/04/23	Thu 13/04/23	21	
23	2.4.4 Cost Management Plan	4 days	Fri 14/04/23	Wed 19/04/23	22	
24	2.4.5 Quality Management Plan	4 days	Thu 20/04/23	Tue 25/04/23	23	
25	2.4.6 Resource Management Plan	5 days	Wed 26/04/23	Tue 02/05/23	24	
26	2.4.7 Communication Management Plan	4 days	Wed 03/05/23	Mon 08/05/23	25	
27	2.4.8 Risk Management Plan	4 days	Tue 09/05/23	Fri 12/05/23	26	
28	2.4.9 Procurement Management Plan	4 days	Mon 15/05/23	Thu 18/05/23	27	
29	2.4.10 Stakeholder Management Plan	4 days	Fri 19/05/23	Wed 24/05/23	28	
30	2.5 Chapter V: Conclusions	5 days	Thu 25/05/23	Wed 31/05/23		
31	2.6 Chapter VI: Recommendations	2 days	Thu 01/06/23	Fri 02/06/23	30	
32	2.7 Chapter VII: Incorporation of Regenerative Development	6 days	Mon 13/02/23	Sun 19/02/23		
33	**3 Readers' Review**	**16 days**	**Mon 05/06/23**	**Fri 23/06/23**		
34	**3.1 Reviewers' Assignment request**	**3 days**	**Mon 05/06/23**	**Wed 07/06/23**		
35	3.1.1 Assignment of two reviewers	1 day	Mon 05/06/23	Mon 05/06/23		
36	3.1.2 Communication	1 day	Tue 06/06/23	Tue 06/06/23	35	
37	3.1.3 FGP Submission to Reviewers	1 day	Wed 07/06/23	Wed 07/06/23	36	
38	**3.2 Reviewers' Work**	**12 days**	**Thu 08/06/23**	**Thu 22/06/23**		
39	**3.2.1 Reviewer 1 Work**	**11 days**	**Thu 08/06/23**	**Wed 21/06/23**	**37**	
40	3.2.1.1 FGP Reading	9 days	Thu 08/06/23	Mon 19/06/23		
41	3.2.1.2 Reader 1 Report	2 days	Tue 20/06/23	Wed 21/06/23		
42	**3.2.2 Reviewers' 2 Work**	**11 days**	**Thu 08/06/23**	**Wed 21/06/23**		
43	3.2.2.1 FGP Reading	9 days	Thu 08/06/23	Mon 19/06/23		
44	3.2.2.2 Reader 2 Report	2 days	Tue 20/06/23	Wed 21/06/23		
45	**4. Adjustments**	**13 days**	**Wed 21/06/23**	**Fri 07/07/23**	**38**	
46	4.1 Report for Reviewers	3 days	Wed 21/06/23	Fri 23/06/23		
47	4.2 FGP Update	3 days	Mon 26/06/23	Wed 28/06/23		
48	4.3 Second Review by Reviewers	4 days	Thu 29/06/23	Tue 04/07/23		
49	**5. Board of Examiners' Evaluation**	**9 days**	**Mon 10/07/23**	**Thu 20/07/23**	**45**	
50	5.1 Final Review by Board	6 days	Mon 10/07/23	Mon 17/07/23		
51	5.2 FGP Grade Report	3 days	Tue 18/07/23	Thu 20/07/23		

Appendix 4: Preliminary bibliographical research

Chartered Institute of Building (2022). Code of practice for project management for the built environment (6 ed.). John Wiley & Sons Ltd.

Justification: This text provides comprehensive references on construction project management covering the principles and practice of project management in construction and development, incorporating the knowledge areas of project management. It also provides information on new technologies, changes, and challenges faced in the construction industry.

Chan, A.P., Darko, A., & Ameyah, E. E. (2017). Strategies for promoting green building technologies adoption in the construction industry: An international study. *Sustainability, 9*(969).

Justification: This article provides important information on strategies to promote and incorporate sustainability in construction projects. This research is essential as the focus of the project management plan is to design and construct a green building.

Fewings, P., Fewings, P., & Henjewele, C. (2019). Construction project management: An integrated approach (3rd ed.). Routeledge.

Justification: This book provides a management approach to leading construction projects and the effective choice and use of project management tools and techniques. It also underlines best practices using holistic approaches that are in line with the theories of project management.

Ghosh, S., Zhou, L., Gignoux, N., Elliott, J. McCormick, K., Li, J. Cruce, K., Cook, C. (2022). City of New Orleans, Louisiana: Resilient housing prototype in the seventh ward.

Justification: This report describes the City of New Orleans plan to design and construct resilient homes and provides insight on twenty-four (24) similar case studies that describe best and emerging practices, tools, and examples from Louisiana and other U.S. jurisdictions. These case studies are meant to provide transferable lessons and ideas for addressing housing and mitigating flood risk as integrated parts of comprehensive community resilience strategies and provides a list of tools and approaches that can be used to facilitate these efforts. It will be beneficial to see the work done in the US on climate-resilient homes and how those approaches can be transferred to building a climate-resilient home in Belize.

Green Project Management (2019). The GPM P5 Standard for sustainability in project management. GPM Global.

Justification: This guide will provide valuable insight to developing a project management plan that are in line with the recommendations of the GPM for achieving sustainability in project management.

Kibert, C. J. (2016). Sustainable Construction: Green building design and construction (4th ed.). John Wiley & Sons Inc.

Justification: This text provides in-depth details on the emerging trend of sustainable and ethical construction. It provides the rationale for high-performance green buildings, ecological design, and the progress and obstacles faced in green construction. This book will be essential in understanding the impact of sustainable construction on the project management plan.

Kubba, S. (2017). Handbook of Green Building Design and construction: LEED, BREAMM, and Green Globes (2nd ed.). Elsevier Butterworth-Heinemann.

Justification: This textbook provides in-depth descriptions on the concepts of green building construction as well as dispels myths as it relates to green building. It also provides a comprehensive analysis of green design, project cost monitoring, and green building material that are essential for the development of the project management plan.

Lester, A. (2021). Project management, planning and control: Managing engineering, construction, and manufacturing projects to PMI, APM, and BSI Standards (8th ed.). Elsevier Ltd.

Justification: This textbook discusses the principles and techniques of managing engineering and construction projects from the initial conceptual phase, design and construction to completion. It also highlights the importance of project management and quality management to meet stakeholders' expectations.

Levy, S. (2018). Project management in construction (7th ed.). McGraw-Hill Education.

Justification: This textbook provides in-depth analysis of project management tailored to the construction industry. The information provided in the text will assist in creating the project management plan and provide insight on estimating costs, quality control, quality assurance, green building design, and construction.

Morledge, R., Smith, A. J., & Appiah, S. Y. (2021). Building Procurement (3rd Ed.). Wiley-Blackwell.

Justification: Procurement is crucial in construction projects, many of the problems which impact construction projects can be traced back to the procurement phase. This text provides an understanding of the methods of procurement and the development of a procurement strategy that can be used for a successful project.

Ngwakwe, C. C. (2019). Environmental and economic benefits of compliance to green buildings. *International Journal of Green Economics*, *13*(3/4), 288-299.

Justification: This article gives an analysis of the environmental and economic benefits of sustainable construction and delves into how green construction can be incorporated into project management plans.

Project Management Institute (2016). Construction extension to the PMBOK® guide. Project Management Institute.

Justification: This industry-specific guide is specific to the construction industry and will provide supplemental knowledge and practices that are generally accepted as good practices in the construction industry. It also includes knowledge areas such as Project Health, Safety, Security, and Environmental Management; and Project Financial Management which are not included in the PMBOK®.

Project Management Institute (2021). A guide to the project management body of knowledge. Project Management Institute.

Justification: This guide presents and details the twelve (12) principles project management and the eight project performance domains which are essential for effective delivery of projects.

Project Management Institute (2023). Process groups: A practice guide. Project Management Institute.

Justification: This guide supplements *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)* and will identify the processes that are considered important for good practices for project management.

Appendix 5: Other relevant information

This section contains that standard forms and templates to be used in the project.

Assumption Log

Assumption Log							
Project Title:				**Date**			
ID	*Category*	*Assumptions/Constraints*	*Responsible Party*	*Due Date*	*Actions*	*Status*	*Comments*

Stakeholder Register

Stakeholder Register						
Project Title:			**Date**			
Name	*Position/Role*	*Telephone*	*Email*	*Requirements*	*Expectations*	*Classification*

Quality Metrics Form

Quality Metrics			
Project Title:		**Date**	
ID	*Item*	*Metrics*	*Measurement Method*

Issue Log

Issue Log									
Project Title:				**Date**					
ID	*Type*	*Description*	*Priority*	*Impact*	*Responsible Party*	*Status*	*Resolution Date*	*Final Resolution*	*Comments*

Change Request Form

Change Request Form

Project Name: **Date of Request:**
Requestor Name: **Date Request Approved/Denied:**
Requestor Contact Info: **Change Request Tracking #:**

Section I: To be completed by the Requestor

Description of Change Request:	
Business Justification:	
Impacts of Not Making the Change:	
Alternatives to Change:	

Section II: To be completed by the Director of Operations
Impacts of the Change

Scope	Increase ☐	Decrease ☐	Modify ☐
Description			
Quality	Increase ☐	Decrease ☐	Modify ☐
Description			
Requirements	Increase ☐	Decrease ☐	Modify ☐
Description			
Cost	Increase ☐	Decrease ☐	Modify ☐
Description			
Schedule	Increase ☐	Decrease ☐	Modify ☐
Description			

Alternatives to Change:	
Recommendation to Change Control Board	

Section II: To be completed by the Change Control Board

Recommendations:

Date of Review: _____

Signatures:

Change Log

Change Log						
Project Title:		**Date**				
ID	*Category*	*Description*	*Requestor*	*Submission Date*	*Responsible Party*	*Status*

Lesson Learned Register

Lesson Learned Register					
Project Title:		**Date**			
ID	*Category*	*Trigger*	*Lesson*	*Responsible Party*	*Comments*

Quality Audit

1. AREA AUDITED

<Tick the area(s) that have been audited. Blanks are provided to add an area not on the list.>

[ ] Adherence to Project Methodology	*[ ] Quality Management*
[ ] Project Specific Processes	*[ ] Resource Management*
[ ] Change Management	*[ ] Scope Management*
[ ] Configuration Management	*[ ] Testing (unit & user)*
[ ] Project Planning	*[ ] Training*
[ ] Project Documentation	*[ ]*

2. good practices to share

<List the good practice that you have found. Include whether any of the practice will be shared and/or added to the organizations project methodology.>

What worked well?	***Why did it work well?***	***Will this be shared and if so, how?***

GENERAL FEEDBACK on what went well.

<Add your general/overall comments and observations.>

3. Areas for improvement

<Describe what didn't work so well and why. Try to explain how this can be improved/corrected in future.>

What didn't work so well?	***Why did it go wrong?***	***Will this be shared and if so, how?***

GENERAL FEEDBACK on what didn't go well.

<Add your general/overall comments and observations.>

4. DEFICIENCIES OR DEFECTS

<List any items that need to be corrected following the quality audit.>

ID	***Defect***	***Action***	***Responsible party***	***Due date***

Earned Value Management

EARNED VALUE ANALYSIS REPORT

Project Title: _____ **Date Prepared:** _____

Budget at Completion (BAC): _____ **Overall Status:** _____

	Current Reporting Period	Current Period Cumulative	Past Period Cumulative
Planned value (PV)			
Earned value (EV)			
Actual cost (AC)			
Schedule variance (SV)			
Cost variance (CV)			
Schedule performance index (SPI)			
Cost performance index (CPI)			
Root Cause of Schedule Variance:			
Schedule Impact:			
Root Cause of Cost Variance:			
Budget Impact:			
Percent planned			
Percent earned			
Percent spent			
Estimates at Completion (EAC):			
EAC w/CPI [BAC/CPI]			
EAC w/ CPI*SPI [AC + ((BAC - EV)/ (CPI*SPI))]			
Selected EAC, Justification, and Explanation			
To complete performance index (TCPI)			

Page 1 of 1