

Better In Belize Construction Planning Guide

April 2020

Table of Contents

Foreword.....	2
Plan of action	4
Pre-design and construction guidelines.....	7
Site selection and site planning	10
Material and product selection.....	14
Appliance selection.....	16
Energy performance.....	18
Water management	25
Waste management	28
Appendix A Example of Eco Home Plans	30
Appendix B (1) EAB House Plan Checklist	39
(2) EAB Eco Construction Site Checklist..	40
Appendix C Covenants, Conditions and Restrictions (CCRs)	41
to which owners agree upon signing their Deed of Conveyance	

Foreword

Welcome to Better in Belize. We have created this special space and development to address the needs of builders for our generation and our children's future. This document has been prepared as a resource and guide to help the homeowner make wise choices and decisions before beginning to draw lot and house plans

Creative paradigm shifts. With exploding population growth, construction of new homes is a major source of environmental degradation, with the impact being felt worldwide on the global ecosystem. The long lives of structures being built extends the impact over several generations, so immediate intervention, at the planning stage and from this point forward is of great importance. The dynamics and the collapse of current ecological and economic systems mean that we need to make major creative paradigm shifts in our thinking and development processes. The many possible forms of eco-housing provide a flexible, bottoms-up approach that could reverse these negative non-sustaining trends in the construction sector.

The eco-community concept has now caught the attention of decision makers the world over, but a lack of real examples has prevented its adoption on a larger scale. To meet this need in Belize, and to serve as a role model for future projects, the developer of Better in Belize facilitated the establishment of an Ecological Advisory Board (EAB) to establish design, construction and living guidelines for the project.

Use this document as a guide to help you, as a landowner at BIB, adopt the principles of ecological sustainability in the design of your living and work spaces. Eco-housing integrates several mature disciplines and design objectives that need to be applied during the entire life cycle of a housing project design, including construction, maintenance and "end of life" activities (the recycling of buildings which have reached the end of their usefulness). It also works to merge traditional and modern-day architectural practices.

Bioclimatic features and socio-cultural aspects. Many of the concepts of eco-housing have been used by humans for centuries to ensure comfortable conditions in their habitats. But the guidelines cannot be rigid, needing to blend and complement the bioclimatic features and socio-cultural aspects of the site.

Key elements of eco-housing include:

- *Site selection*
- *Material selection*
- *Energy performance*
- *Water management*
- *Waste management*

Integrating and implementing these objectives and disciplines requires an effective interdisciplinary team with good project management skills.

Eco-housing targets. At the very least, the goal of a good eco-housing design is to create minimum disturbance to the existing site and minimize the use of natural resources, energy and water. More challenging eco-housing targets would be to enhance the existing site features and even be net producers of energy, water etc., within the traditional framework of economic efficiency.

The goal of Better in Belize. When all is said and done, the design, construction, and maintenance of houses create a major impact on our environment and natural resources. Huge amounts of natural resources and energy are consumed throughout a traditional building's life cycle, polluting air, water, and land. The rapid growth of the global economy and the rising trends in population, urbanization and rural migration are contributing to the expansion of the built-up environment, threatening natural habitats and wildlife. The goal of Better in Belize and other visionary eco-developments must be to attempt to lessen this impact on the earth. Take this document as a trail into this new land; let us together create the future.

Changing times. Things change over time: best practices, supplies, equipment, websites, state-of-the-art, and general circumstances. While we do our best to keep this document up to date, it remains the responsibility of the homeowner to make sure they access the most recent information possible. With the web, this is relatively easy to do. Happy planning!!!!

BIB Construction Planning Guide

This guide is intended to give you, the land owner at BIB, an overview of sustainable building designs, methods, materials and techniques that are accessible and doable at Better in Belize. The techniques and materials available in this small country may not be the same as those in your country of origin, so these also must be taken into consideration in order to facilitate the construction of your own sustainable project.

To avoid unpleasant surprises, it is up to you, the owner, to determine which techniques and materials are different before starting to build. For example, skylights and insulation in Belize bear no resemblance to the skylights and insulation of more “advanced” countries. Other building materials and techniques can be just as different and surprising. For example, concrete is preferred to wood as a building material since it offers superior protection against termites, mold and dry rot, major menaces to structures in the tropics. Many similar elements are key to well-planned tropical dwellings, so you must make yourself aware of them before even starting to design your dwelling.

A good website to enlarge your eco-construction background may be accessed at: <https://www.wbdg.org/resources/green-principles-residential-design>. Please study the information on that site and other similar sites as a foundation for your planning process before beginning your building plans. If your plans have advanced past that point, many of the ideas introduced on the site can still be retroactively added or adjusted to meet your needs and the criteria of BIB’s eco-construction guidelines.

The term "project" will be used in this document, because in sustainable design **the building, the land, and the surrounding ecosystem** must all be considered together in the design, planning and construction process for successful habitation.

The development of BIB's overall site, each individual site, and their evolution together into a viable community, will be an organic process of growth and change, following basic eco-construction guidelines firmly overseen and governed by the Ecological Advisory Board (EAB).

The basis and foundation of this workbook will consist of seven tenets of eco-construction as follows:

1. Pre-design guidelines
2. Site planning and construction
3. Material and product selection
4. Appliance selection
5. Energy performance
6. Water management
7. Waste management

Plan of Action: what, where, when, why, who and how

You've bought your lot at Better in Belize. Now what? Learn all you can about the climate, people, house styles, etc. Listen carefully to experiences of those who live and work in Belize. Print out this Building Guide and your CCRs (attached to your deed when you bought the lot), and use them for constant reference.

- **WHAT.** BIB has a relatively open housing code. You can build whatever type of house you want, as long as it blends into the surroundings and doesn't offend the viewer. That makes it even more important to educate yourself about choosing a style that suits both you and the subtropical rainforest climate that characterizes Belize.

People that come to live in a jungle tend to have unconventional attitudes, so there are already a wide variety of construction styles in place. Driving around BIB and peeking down driveways you will see examples of container homes, earthbag dwellings, pre-fab Mennonite homes (hailed into place), straw-bale structures, concrete block/cement homes, and more traditional building styles that wouldn't look out of place in any suburb.

- **WHERE.** You've already chosen your lot, and you are aware that it is in a rainforest, so you probably realize that you will need to take into account the climate, weather and obstacles your building will face. While temperatures don't vary greatly in Belize, which has an average annual maximum temperature of 86° Fahrenheit (30.0° Celsius) and an average annual minimum temperature of 72° Fahrenheit (22.0° Celsius), the average annual rainfall at BIB is about 60. Humidity can climb to 100% on occasion. Unless you have lived in a similar environment and understand how your acclimation to a wet climate can lower your "I'm chilly!" threshold, it is hard to believe that you might welcome the warmth of a fireplace on a wet day in the rainy season.

So listen to those who have built here, your Belizean contractor, and whatever you read that will help you select a good building and details you can add to make you comfortable in this climate.

- **WHEN.** Building is difficult during the rainy season (typically June-November, but not reliably). Much of the building done before the roof goes up is either exposed to the weather or done under tarps. Best results are achieved if workers are dry and comfortable during this phase, so factor that into your building plans if possible. Also, keep in mind that heavy rain periods, ordering of parts, and difficulties caused by Belize's remote location can cause delays. Local people may be more complacent about delays than the average person from a more developed country, so *assume that there will be delays*. Your building experience will be best if you take this into account and understand that not all of your deadlines will be met. Have a backup plan, and *expect to use it*. If you plan ahead for setbacks, you will be much happier with your situation. Spend as much time onsite as you possibly can, from lot clearing through all building phases.

- **WHY.** If you've never built for the tropics, listen carefully to those who have, to understand why it is important to, for instance, have a clear accessible and visual expanse of concrete between the ground and any wood parts of your building. If you don't, termites will have quick and easy access to your building, and you won't see them in time to halt their progress. If someone says "Have LOTS of windows," pay attention – they're needed for cooling, dehumidifying, and to let light into your house during cloudy periods when days are gray.
- **WHO.** Make sure you select an architect and builder who know Belize and how to design and build for it. They will understand what supplies, labor and equipment are available in Belize for the types of buildings needed for this climate. Talk with people at Better In Belize who have already built here to get their input on what works and does not work, and why. Pay attention to advice you get from people who have lived in this climate, ask lots of questions, and be prepared to take their advice into account when you plan your house.
- **HOW.** Keep in mind at all times that you are building in an eco-community. Using earth-friendly building materials and following green principles are of paramount importance to keep the environment at Better In Belize as close as possible to the wild and lovely place you encountered on your first visit. This is a jungle. It is not a suburban development suitable for heavy landscaping. In fact the goals of the eco-community are to keep the environs as natural as possible by maintaining the 10' NO disturbance zone around each lot and discouraging the clearing away of natural vegetation within that border except where needed to situate buildings and such things as cisterns and solar panels.

The internet is an extremely valuable resource, and this Building Guide will direct you to places for more research and information. Study this guide until you have a handle on the kind of house that will meet both your needs and the demands of the environment.

NOTE: The CCRs and this Building Guide may contain links to internet websites that have fallen by the wayside. Nevertheless, you should be able to find good substitutes with a search engine.

1. Pre-design Guidelines

Ongoing discussion and goal setting are beneficial to the project over its entire life cycle. This defines goals, charters project direction, and provides opportunities for cost optimization to achieve the desired goals in innovative ways.

Before selecting your team or going very far on your design plans, visit and take notes at the Belize Central Building Authority's (CBA) official website, <http://www.cbabelize.org/> to make sure your plans are viable under existing rules.

The following is an example of the kind of information you will find at the CBA:

Requirements for Signature of Technicians, Architects and/or Engineers For buildings less than one thousand (1,000) sq. ft and not more than one (1) story

A Technician's signature is acceptable; they do not need the signature of an architect or engineer.

The technician preparing and submitting the documents must stamp and sign each page of the documents being submitted indicating that he/she is accepting responsibility for the accuracy and correctness of the information

EXCEPTION: Depending on the complexity and use of the building, the CBA reserves the right to require that plans and specifications for certain building less than one thousand (1,000) sq. ft. be prepared, designed, stamped and signed by an architect who is a corporate member of the Association of Professional Architects of Belize (APAB), and/or a civil or structural engineer who is a corporate member of the Association of Professional Engineers of Belize (APEB).

For buildings between one thousand (1,000) sq. ft. – three thousand (3,000) sq. ft. and up to two (2) story's

The CBA requires that plans and specifications be prepared, designed, stamped and signed by either a Professional Architect who is a corporate member of APAB, or a Professional Civil or Structural Engineer who is a corporate member of APEB.

Obviously, it is important to conform to all of the requirements of the Belizean building codes and authorities. That being said, the following steps in the pre-design state will be to:

- 1) Select an effective design team.** The team should include the owner, architect, engineer, and subject consultants. Acquaint them with the essence of the site, its uniqueness, and how your idea of sustainability will enhance and coexist within its natural beauty and bio-diversity. The size and make-up of your team will be determined by the size and complexity of the building you are planning. Having a knowledgeable Belizean member of your team is essential, as the plans you design must be applicable to the building supplies and the capabilities of the labor pool available in Belize.

2) Finalize appropriate procedures for contracting and contractor selection.

Appropriate guidelines, specifications and procedures, as found in the Covenants, Conditions and Restrictions (CCRs, which you signed upon purchase of your lot) and this Construction Guide, must be contained within the contract document to meet eco-design objectives.

3) Develop design goals, which include the following:

a) **A vision statement that clearly sets out your goals, objectives, and processes.** It should be based on careful site analysis, resource availability, available best practices and technologies, and cost effectiveness. The project must also identify if the design goals intended to achieve eco-improvements over the conventional standards, e.g., better envelope standards than minimum energy goals, better water efficiency, etc., than most developers use. Consult with your architect and contractor to evaluate what is affordable, available, and feasible in Belize. The fact that a company has a 200 ft. crane does not mean it can come down Hydro Rd.!

b) **Prioritization of goals based on the BIB community's guidelines, your site's needs, your projects constraints, and the relative importance of the criteria.** Water quality and biodiversity conservation are a priority at Better In Belize. The preservation of maximum forest and wildlife habitat is of paramount importance in order to retain the rainforest ambiance that has drawn current homeowners to this site.

c) **Laws, codes, and standards:** Become familiar with and adhere to applicable codes, standards, and laws relevant to your project, contained in the BIB eco-guidelines and environmental guidelines of the Government of Belize which may include:

- Rules or by-laws related to water and waste management
- Energy codes/standards
- Relevant building codes
- Environmental clearances required, if any, and disaster mitigation measures.

4) Identify the damage reversals that need to be addressed prior to implementation of the eco-housing project (e.g., groundwater contamination, erosion, fire hazard areas). List the actions required to address these issues, including a list of contacts with roles and responsibilities.

5) Before beginning drawings, submit a proper topographical land survey sketch of the lot to the BIB Ecological Advisory Board (EAB). Note climate and hydrology conditions on the site, as well as archaeological features, trees with a diameter of more than 6" within the projected footprint of the building/s, game trails and other factors which may significantly affect the layout and design. Avoid planning construction that would necessitate the removal of large trees, or destroy on-site Mayan structures.

- 6) **For structures of more than 1000 sq/ft**, final construction plans for contract bid shall be submitted by the owner from a professional firm and bear official seal or stamp of that firm.
- 7) **The plans shall include:** all architectural, electrical, mechanical drawings and landscape architecture with labels and specifications so EAB can clearly identify location, layout materials, and design guidelines of proposed structure, ancillary buildings, and landscaping (see Appendix A).
- 8) **Pets at Better In Belize.** If you plan to have canine pets at your house, please consider a securely fenced yard unless you are dedicated to multiple dog walks per/day and have plans for dog-sitting when you aren't at home. A screened veranda is recommended for cats that previously were allowed to roam free. Keep in mind that rules for their confinement are a serious matter and enforced. No pets or livestock (chickens, rabbits, etc.) are allowed to run free, in order to avoid conflicts with neighbors and because they will soon become dinner for rainforest predators.

Seriously consider your neighbors if you are thinking of bringing pets to BIB. Barking dogs can damage neighborhood relations very quickly, and there are a lot of things for a dog to bark at in a rainforest.

- 9) **Sharing and collaboration – the BIB community ethic.** With that in mind, all participants in the community are encouraged to share their knowledge, experiences in building and procuring building materials, and dreams, contributing to the goal of sustainability and regenerative design within the community.

Typical advice from the community would include such things as:

1. Construction will not proceed until sufficient money is on hand to begin project, but do not make entire amount available at beginning of project
2. Never pay in full for a project until work has been entirely completed
3. A crane with a 150' boom is the largest size that can safely travel down Hydro Road
4. Gravity feed is the best water system, requiring a tank positioned above house, either on hill or on stilts, with a pump to charge it from a cistern below the house.
5. Water storage should be no less than 2000gal for one person, 3000gal for two. If an additional cistern is planned, a 5000gal capacity is recommended for fire safety and landscape watering. Solar panels can be mounted on cisterns for best use of space.
6. Ask questions of homeowners for other gems of wisdom learned through hard experience!

2. Site Planning and Construction

The purpose of sustainable site planning is to integrate design and construction strategies by modifying both the site and building to achieve a viable combination of greater human comfort and operational efficiency. It ensures minimum site disruption; maximum usage of microclimate features; minimum requirement for intra/inter-site transportation; appropriate erosion and sedimentation control plans; and appropriate landscaping. In all cases, the sun, rain and wind from the macro to micro scale should be accounted for in each lot design.

The climate in Belize is a combination of humid tropical and extremely dry tropical, and the microclimate of Better In Belize is “foothill” tropical. This means that the builder not only has to consider arid and humid situations, but very hot to exceptionally (for the tropics) cool. At Better in Belize, the climate is generally cooler and not as humid as that of Benque Viejo, a mere ten miles distant but situated at a lower altitude along a river.

Basic tenets. As a result of all these conditions, all designs for this climatic zone should consider the following basics:

- Build home close to hills or elevated sites for better air circulation
- Have good slopes on roofs to evacuate rainwater and leaves
- Put leaf deflectors on gutters with trees overhead to reduce frequency of gutter cleaning.
- Provide for shade on the house’s roof where possible, either by mounting solar panels on the roof, or by placing the solar panels in a sunny spot elsewhere and letting trees shade the house.
- Make sure all buildings on property have adequate spacing to allow for wind circulation
- Use insect-, moisture- and mold-resistant natural building materials
- Build wide veranda/s around home for rain protection and to facilitate outdoor living
- Elevate the ground floor to avoid excessive earth moisture and humidity
- Alternatively, build with cement floors.
- Install large, louvered windows for greater ventilation and to discourage molds, fungus, bacteria and viruses.
- Plant greenery or leave natural vegetation around the house to promote natural cooling
- Plan a driveway that does not expose your house to view from the road if at all possible.

“The 10 foot setback will be a NO disturbance area except for pathways and one access road to the building.” This rule in the CCRs is strongly enforced by the BIB. Leaving a ten foot perimeter of

untouched vegetation, including trees, shrubs and groundcovers, around each lot ensures that BIB retains its rainforest aspect, that homes are hidden from view, and that wildlife can travel the natural vegetation corridors that allow them to move through the rainforest without exposing themselves to danger. It is up to the lot owner to advise their builder of this important provision so that the No Disturbance area is not breached or covered with debris during the site preparation or building.

There have been occasions before the full activation of the EAB that this provision has been breached, but this is no longer acceptable. If the No Disturbance perimeter is accidentally breached during building, it is the responsibility of the lot owner to arrange replanting as quickly as possible. However, do not let this happen carelessly, as replanting is not the same as leaving original vegetation undisturbed. If you are uncertain about what to replant, please discuss this with the EAB.

Protect Existing Vegetation on your lot. If at all possible, one of your first steps in planning and siting your house on your lot should be to personally visit and acquaint yourself with the characteristics of the terrain. Most of the sites at BIB are vegetated, and this can make visualization difficult. However, in the interests of retaining BIB's wild flavor, you will not be permitted to clear the lot so you can see it better. You may RAKE the lot, but you may not cut out any vegetation without approval from the EAB.

Lots at BIB don't come with a plat plan, so take the BIB Map that came with your deed and scan or photocopy your section of the map, enlarging it so you can use it to make siting decisions. With that map, a pencil, measuring tape, flagging ribbon and string you should be able to sufficiently survey your options.

Before you can clear your lot, you must map all the existing trees over 6" in diameter on your lot plan. While there will usually be some collateral damage to surrounding vegetation during site preparation, if care is used it can be contained and kept to a minimum if builder and owner agree on the goals.

Go over CCR requirements with your contractor before beginning site preparation and make sure they are aware of requirements to preserve vegetation that is not destined for removal during excavation of septic systems, foundations, and other building practices before starting to prepare the lot for building. If at all possible, be present during site preparation.

Before beginning work on the site, talk to your builder about on-site sanitation. Builders in Belize are not subject to **OSHA** (Occupational Safety and Health Administration) rules observed in many other countries. As a result, while it is required in the CCRs that builders provide toilet facilities for their workers, this is not generally done. To avoid unsanitary conditions on your building site, speak to the builder about providing a toilet for the workers.

This can be as simple as a 5-gallon bucket half-filled with sawdust, and a small enclosure for privacy and to ward off rain, or it could be a rented porta-potty. If using a bucket, an area should be set aside on your property as a composting spot in order to deal with the contents.

Please make sure this is provided for the workers, as you do not want your property used as a latrine. The cost of proper sanitation should be included in the construction costs, and fines can be levied

against the homeowner if this is not done.

Occasionally during the initial site excavation, conditions will be found that require major deviations from the original plan approved by the EAB. Such conditions might include encountering large, immovable boulders or bedrock, an unexpected seep or spring, or a Mayan cave or structure, which might halt construction. If this happens, site excavation must stop and no major deviation may be made until the site has been inspected by the EAB and a new plan approved.

Make sure that your builder observes the following guidelines:

- When possible, protect tree roots by avoiding excavating right next to tree. Keep excavation as far from the base of the tree as possible.
- Do not cover the soil under a tree with additional soil, gravel, or rocks, as this can suffocate and eventually kill the tree.
- Do not deposit or lean large boulders against the tree or on the root area around the tree.
- In order that the tree can continue to receive enough rainfall to survive, do not pour cement over more than 30% of a tree's root area.
- When cutting down EAB-approved trees, determine whether vines need to be detached first, as they can pull down adjacent trees if they form a strong network.
- When trimming trees to allow solar insolation, avoid damage to surrounding vegetation by specifying that the tree trimmer lower large cut branches on ropes to the ground.
- Instead of solid concrete driveways and walkways, consider permeable pavers or surfaces which allow grass or vegetation to grow between or through them. These are especially good for paving over tree roots.
- Do not alter the existing drainage pattern on your site. Existing grades should be maintained around existing vegetation. Maintenance activities should be performed as needed to ensure that the vegetation remains healthy.

Driveways and Paths. A main consideration in your lot planning should be an attractive entrance and a place to park your vehicle/s. Each lot is allowed one driveway, and one path per border. This can give you a path to the road and paths to a neighbor on each side if desired. Paths should be kept to a maximum of three feet in width (this allows a comfortable walk side-by-side for two people), and may be paved with cement or left natural.

Driveways should be 10'-12' in width, with a maximum of 15' in special cases. If the situation of your lot permits, the driveway should be curved to hide the house from the road. Since there is a 10' NO

disturbance zone along the front of your property, if you plan to parallel the road with your driveway, the driveway entrance must be perpendicular to the road and extend in twenty feet before curving to parallel the road. This preserves in its entirety the NO disturbance zone.

Light Pollution. No one wants their neighbors' lights to be affecting their enjoyment of the night-time jungle. As well, it is important to use as little outdoor lighting as possible to avoid disrupting the reproductive cycles of the rainforest inhabitants.

Motion-sensitive lighting is recommended for all uses, and all lights must be directed downward and aimed to illuminate only the exact area needing light. Design all exterior lighting so that all exterior lights with more than 1000 lumens are well shielded and all lights with more than 3500 lumens meet full cut-off 2 IESNA3 classification (See <https://www.penglight.com/what-are-light-distribution-types-defined-by-iesna-and-nema/> for explanation). Any light within a distance of 2.5 times its mounting height from any property boundary must be shielded so that that no illumination from the light crosses the boundary.

Hazardous Waste. Hazardous wastes include pesticides, paints, cleaners, petroleum products, etc. Create a spill-prevention and control plan that clearly states what measures you will use to stop the source of the spill, contain the spill, and dispose of the contaminated material. Pollutants from construction areas and material storage sites must not be allowed to mix with storm water runoff from undisturbed areas. To avoid this, hazardous waste from construction areas and material storage sites shall be collected in 5-gallon lidded buckets, kept covered at all times, and delivered to a specified area for collection and delivery to the transfer station.

Solar Access and Wind Protection. The site layout should allow for wind protection and solar access in winter and at the same time, adequate sun protection and ventilation in summer. Carefully design vegetation wind funnels to adjust airflows in and around a building. Good design allows free rear ventilation as well as funneling at front and through sides, creating an air jet of increased velocity. Use neighboring land forms, structures, or vegetation to increase exposure to cooling winds. Use a building design that incorporates verandas, overhangs and sloped roofs to capture wind. Landscaping may also provide the required shading for outdoor areas, but be aware of how it modifies the micro-climate. Take care to avoid an increase in humidity levels by excessive plantations. Selection of plant species should be based on their sun/shade and water requirements and the micro climatic benefits that should result from them.

Preventing Erosion and Sedimentation. The most effective way to stabilize soil in order to prevent soil erosion and sedimentation is by planting or leaving intact the original vegetative cover. The foliage and roots of plants provide dust control and a reduction in erosion potential by increasing infiltration, trapping sediments, stabilizing soil, and dissipating the energy of hard rain. Temporary

seeding can be used in areas disturbed after rough grading to provide soil protection until the final cover is established. Permanent seeding/planting will be needed in buffer areas, along roadsides, vegetated swales, and on steep slopes.

Most sites have both hard or impervious surfaces (roads, solid pavements for sidewalks and parking, exposed or lightly covered bedrock, etc.) and soft, pervious surfaces (vegetative cover, and pavements, parking, and walkways made of pervious materials). A steep site with a high proportion of impervious surface can result in damaging runoff that can undercut adjacent earth and structures.

Mulching. Use of organic mulches may be required to enhance soil stabilization and stabilize soil temperature. Organic mulches include shredded bark, coir (the fibrous husk of the coconut), wood chips, composted leaves, biochar, etc., but care must be taken to not introduce alien species. Inorganic mulches such as pea gravel, crushed granite, or pebbles can be used in unplanted areas (i.e. stairs, driveways, etc.). Pervious surfaces allow rainwater to seep through them while impervious or hard surfaces prevent it. Stone mulches are not advisable adjacent to building as they store and transmit heat and cause glare.

Drainage. *Conventional* drainage methods-transport water as fast as possible to a drainage point and are generally unsuited to tropical construction. *Sustainable* drainage systems work to slow down the accumulation and flow of water, and spread it out for reabsorption or delivery into an established watercourse. Building plans at Better in Belize must feature sustainable drainage.

This results in a more stable ecosystem as the water level and the water flow speed is more stable, and less erosion will take place. Absolutely avoid creating or encouraging standing and stagnant pools, as these are fertile conditions for mosquito breeding. Create drains where possible. In this climate type, your building should ideally be located at a high point (or at least not at the lowest point) for water runoff.

3. Material and Product Selection

Some of the building materials commonly used in Belize will be unfamiliar to people from temperate climates, insulation and skylights being two good examples. You will notice other examples as your building is under construction.

Insulation. Insulation serves to quiet the drum of raindrops on metal (zinc) roofing, is commonly installed between the metal outer roof and the inside wood ceiling. Don't skip this vital element, as rain can be noisy enough to drown conversation or intrude on sleep without it. It also prevents downward radiation of sunlight on metal roofing, which can be intense on a hot day. Insulation comes in various forms, most of which are unfamiliar to people from colder climates, so rely on the experience of your builder to choose the right insulation for your needs.

Earthbag houses, with 12"-14" adobe-style walls also provide excellent insulation, keeping the house's insides cool on hot days, then releasing heat into the rooms during the cooler nights. Discuss an earthbag house with your builder if this is of interest to you.

Skylights. "Skylights" in Belize are simply plastic roofing panels, not the shaped plastic domes seen on homes in other countries. They have the advantage of being extremely simple to install during construction and to later replace, and are relatively leak-proof compared to standard skylights. *Transparent* (clear) panels are not recommended, as they let in sunshine, which then heats the inside of the house. *Translucent* (white) panels let in light, but considerably less heat. Inserting numerous translucent white skylight panels in your building will make a considerable improvement in the ambiance inside the house on a cloudy day, and completely eliminate the need for indoor lighting on sunny days – highly recommended when living with solar power. Skylight panels in the roof over your veranda will brighten your veranda without heating it up. Tip: put skylights in closets so you can see your clothes.

Eco-friendly building materials. Using eco-friendly materials created with low energy techniques is essential when creating an eco-habitat. They are also convenient for recycling and reuse, and have low emissions. Some building products are produced from recycled resources. These allow savings in consumption of raw materials, energy and labor. Selection of appropriate materials is driven by local/regional availability and cost effectiveness.

Recommendations for material and product selection

- Use materials with low-embodied energy content ("low-embodied" means that the materials required less energy than comparable materials in their manufacture or production)
- Use locally available materials and technologies, thus employing the local work force
- Reuse/recycle construction debris -- if you can't use it, make it available to others
- Use composite wood products made from recycled wood scrap or salvaged timber and reused wood products.
- Use materials/products made from rapidly renewable small-diameter trees ("bush sticks") and fast-growing, low utilized species harvested within a ten-year cycle or shorter. However, observe local harvesting customs to avoid getting substandard wood.
- Use products made from wastes such as wood waste and agricultural wastes; and natural fibers, such as sisal, coir, and glass fiber in inorganic combination with gypsum, cement, and other binders.
- Use concrete for its permanent qualities and resistance to termites and other tropical maladies. It also can be a cooler solution to the hot seasons.

- Use water-based acrylics for paints.
- Use water-based urethane finishes on wooden floors.
- Use acrylics, silicones, and siliconized acrylic sealants for interior use.
- Use adhesives with low emissions for indoor use, including acrylics or phenolic resins such as phenol formaldehydes.
- Use particleboard made with phenol-formaldehyde resin rather than urea formaldehyde, to control indoor volatile organic compound (VOC) emissions.
- Minimize the use of metallic surfaces and metallic pipes, fittings and fixtures, because water condenses on these and encourages mold growth and deterioration on and around them.
- Use products and materials with reduced packaging and/or encourage manufacturers to reuse or recycle their original packaging materials.
- Your house will need windows, not just screens. BIB is located in the Mayan foothills, and foggy chilly mornings aren't uncommon in the rainy season. Although the climate is generally warm and comfortable, on rainy days or during chilly nights it's nice to be able to temporarily shut out the chill and moisture. As well, during dry season field burning, it is good to be able to shut out the smoke.
- While many residents of tropical areas spend a high percentage of their time on the outdoor veranda, indoor environmental quality is an important parameter in a sustainable habitat. In Belize warm, humid conditions provide an excellent environment for breeding of dust mites, molds, and fungi. Leave windows open whenever possible, as it's better for your health and will help combat mold during the rainy season.
- High ceilings without attics are recommended, as rising heat will keep lower levels cooler. If storage is needed, half lofts serve this function well. Ensure that any and all storage spaces are well ventilated and open. Slatted shelves help with air flow.
- A small fireplace or wood heating stove in the main living area is advisable. This will provide welcome warmth and will help dry the air and reduce humidity during wet, rainy times. You may not use it often, but when you do you will be exceptionally glad you installed it.

4. Appliance Selection

As you plan your house, it is important to consider what appliances you expect to need and use, and what types will best serve your needs and give you the best service.

Refrigerator. You will need to decide whether or not to have an electric or a butane refrigerator (butane takes the place of propane in Belize, but works essentially the same although it requires a different orifice).

At BIB we find that an electric refrigerator usually gives better service over the long term compared with most of the current butane refrigerators available. It requires less maintenance, is easier to turn on, and uses surprisingly little solar energy if you select a model with low energy consumption. A gas refrigerator can be difficult to light, its exhaust pipe may require insulation or careful placement near walls, and the butane tank must be regularly recharged, which is problematical if lifting and transporting butane bottles is difficult for the homeowner. However, we are beginning to see better butane appliances, so do your homework and ask other BIB homeowners what they recommend.

Kitchen Range. A butane stove is recommended, since electric stoves use a fairly large amount of electricity and will drain the solar battery supply quickly – especially when baking. When you are planning your house, be sure to include areas in which to tuck butane tanks. Check tank measurements before finalizing building plans, because Belizean tanks may be a different size than what you are familiar with. Make sure each tank is easily accessible and close to transport for refilling. A large tank is quite heavy, and you won't want to carry it far. Consider two smaller tanks instead.

Hot Water Heater. Standard storage hot water heaters are problematical because they use a comparatively large amount of energy to keep water hot. On-demand water heaters, which light when the hot water faucet is turned on, are very conservative on gas, and don't waste electricity heating water you aren't using right away. They can provide plenty of very hot water on a few seconds' notice. They'll cost a bit more initially, but can last twice as long as a conventional water heater and have lower operating costs, as well as not over-taxing your solar system. HOWEVER, they do require sufficient water pressure to operate properly, and they attract ant colonies, which can damage them to the point that they need replacement within three or four years. Placement and ventilation are critical to longer appliance life. Consider your hot water heater options carefully, and talk with people who have experienced both.

Microwave. When the sun is shining, a small microwave can generally be used without a problem if you have at least 2kw of power from your solar panels. However, to avoid running the generator, it is wise to not use the microwave after the sun stops recharging the solar panels. Plan to cook meals that require microwave use only when you have sun on the panels, with an optional plan for cloudy/rainy days.

Power Tools and Appliances (drills, saws, blenders, hair dryers, irons, etc.). Generally speaking, and depending on the size of your solar system, it may make better sense to run power tools off a generator than the house solar system, as they tend to gobble up power, leaving insufficient electricity for other uses. You will want to research the amount of power individual tools and appliances use. Some kitchen and bathroom appliances are okay for limited use, but you'll need to find out what works best with your solar system. In some cases, you can use the tools while the sun is

shining directly on the panels, and pause if/when the sky clouds over. Ask yourself if you really need that appliance or tool.

Generator. Even though manufacturers claim that their generators run quietly, all generators are an intrusive element in the rainforest experience, so get the quietest machine you can afford and design a sound-proof enclosure to house it in to avoid disturbing the neighborhood and wildlife. Plan to use your generator as little as possible for this reason.

The CCRs allow 75decibel butane generator use, but only for *emergency* backup power. Diesel and gas generators are discouraged. Make sure you plan for sufficient solar to meet all your needs, since daily or frequent use of a generator takes it out of the “emergency” category and into the “inadequate planning” category, and complaints may be made about noise levels from your generator. If everyone in the vicinity uses a generator on a cloudy day, the community will sound like a truck-stop. Please make sure you do not contribute to this unfortunate scenario.

While a generator can recharge solar batteries after an extended period of rainy days or when power tools are being used, many people in the eco-community do not use a generator, and instead regulate their electrical requirements and usage so that firing up a generator is almost never necessary. The gentle light of kerosene lamps and candles can be a very pleasant option when solar batteries are low.

Consider sharing a generator with other homeowners since its use is designated for emergencies only.

5. Energy Performance

Solar Power. Two kilowatts are considered the minimum-size system acceptable for a small household. This will require at least 6-9 panels and sufficient deep-cycle batteries to store the solar power. If your solar panels don't receive a full day's worth of sunshine, you may need more panels and batteries. A careful site inspection will be required to determine what your solar needs are likely to be. Plan to include a solar room in your house to accommodate the batteries and the wall-mounted inverter, which turns the direct current (DC) into alternating current (AC) used by house wiring. LED lights continue to be improved and are recommended for all outlets, and in fact incandescent lights are not permitted in this ecovillage. Several local solar companies are willing to install solar panels and inverter setups at BIB.

Alternative 12V Lighting. If you have a minimal solar system, consider installing an alternate system of LED lights alongside your regular lights. Use these if the solar charge is low at night or during cloudy days, as they use almost no power. They provide a huge amount of illumination for the amount of power used. Designed to run on DC, they bypass the inverter and the AC wiring completely. The lighting in the Student Center on Lot 7 provides an example of such an alternate system. A system like this is

easily installed by the homeowner on a trial basis, clipped to the solar batteries with alligator clips.

Energy Efficiency and Demand. The primary function of a building is to protect its occupants from sun and rain, and to provide thermal and visual comfort for work and leisure. To achieve comfortable conditions, it may be desirable to provide energy-consuming space conditioning and lighting devices. An eco-building should have an optimum energy performance and yet provide the desirable thermal and visual comfort. The energy usage of the built environment can be improved by **a)** better energy management and by **b)** use of renewable energy sources.

Fundamental strategies to optimize energy performance can be broadly classified as follows:

- a) Reduction in energy demand
- b) Improving energy efficiency

Reducing energy demand. Reduction in energy demand requires adopting designs and habits which reduce or eliminate air conditioning, lighting, and water-heater use. Window-mount air conditioners are prohibited at Better in Belize. The first step to reduce the energy demand is to design for the macro and microclimate of the site by using appropriate bio-climatic design principles. Because of their heavy electrical requirements most of the houses at BIB have no air conditioning since this would necessitate many extra solar panels and batteries with their associated costs and upkeep. Being in the Maya Mountain foothills, BIB is about ten degrees cooler than Benque, just ten miles down the road, and most residents get by with fans during the hotter time of year. Air conditioning is seldom missed.

Improving energy efficiency. Buildings designed for Better in Belize need to reduce the solar gain (the amount of heat caused by sunshine) by incorporating shaded walls (accomplished with roof overhang and/or verandas); external wall and roof insulation (solar panels can help shade the roof); or use of design elements like solar chimneys, wind towers, etc., to maximize ventilation. Windows need to be large enough to admit plenty of air and light, but they also need to be shaded by deep overhangs, at least 18," or open onto a veranda so that sunlight doesn't enter to heat the house during the hot part of the day.

Ponds, fountains, and roof gardens are not recommended in a humid climatic zone such as Belize. Pools in particular pose a problem with regard to mosquito populations, as mosquitoes will breed and reproduce in a pool of still water of any size, increasing the chances of spreading such diseases as malaria, zika virus and dengue fever.

Addressing site characteristics. Each building site at BIB has distinct topography, vegetation, wind-flow pattern, solar and daylight access. The design should be able to address these site conditions and requirements. Maximizing the energy efficiency of the building system offers further opportunity for energy savings. Use of efficient LED or 12V lighting fixtures, fans, and on-demand water heating systems can reduce the energy use in a building by huge amounts. The broad design areas of environmental

architecture, including passive design, are listed below:

- 1. Siting.** It is important to situate the building to take maximum benefit of sunshine, wind, and daylight. This includes proper orientation to enable solar access, and air flows.
- 2. Window design.** Windows are a very important component of any building. They contribute to daylight (ambient light) and airflow, but may also let in heat. Proper window design is required to keep the heat away during the day and yet allow air flow (if desirable) and ambient light in.
- 3. Passive cooling** with natural ventilation includes incorporating natural or induced ventilation strategies. In warm and wet climates high-air velocities are needed to increase the efficiency of sweat evaporation and to avoid, as far as possible, discomfort due to moisture on skin and clothes.

Strategies for natural ventilation, wall/roof construction and ambient lighting: Many of the lots in lower forested areas of BIB receive little wind, while others on ridge tops may receive considerably more. A building may be oriented at any convenient angle between 0 – 30 degrees with regard to prevailing winds without losing any beneficial aspect of the breeze. A building can be oriented at 35 degrees to the incident wind so as to diminish the conical-vortex flow and solar heat, sacrificing only slightly the reduction in indoor air motion.

Large openings, doors, and windows are an advantage in a warm-wet climate if they are effectively protected from the sun, driving rain, and insects. Inlet openings in buildings should be well-distributed and should be located on the windward side at a low level. Outlet openings should be located both high and low on the leeward side. Placing inlet and outlet openings at only a high level would only clear the air at that level without producing air movement at the level of occupancy.

For a total area of openings (inlet and outlet) of 20%- 30% of floor area, the average indoor wind velocity is about 30% of the outdoor velocity. Further increase in the window size increases the available velocity but not in the same proportion. In fact, even under most favorable conditions, the maximum average indoor wind speed does not exceed 40% of the outdoor velocity. Where the direction of wind is constant and dependable, the size of the inlet should be kept within 30%-50% of the total area of openings and the building should be oriented perpendicular to the incident wind. Where the direction of the wind is variable, the openings may be arranged equally on all sides where possible. Thus, no matter what the wind direction may be, some openings would be directly exposed to the wind pressure and others to air suction and effective air movement through the building would be assured. Windows of living rooms should open directly to an open space. In places where this is not possible, open space could be created in buildings by providing adequate courtyards.

Cross-ventilation. In case of rooms with only one wall exposed to the outside, two windows on the wall are better than one window. For the best ventilation, locate windows diagonally opposite each other with the windward window near the upstream corner. A single-side window opening can

ventilate a space up to a depth of twenty feet. With cross-ventilation, a depth up to 45 feet may be naturally ventilated. Integration with an atrium or chimney to increase the 'stack effect' can also ventilate deeper plan spaces.

Managing air movement. Horizontal louvers or a sunshade atop a window, deflect any incoming breeze upward and reduce air motion inside the living zone. Roof overhangs help promote air motion in the living zone inside buildings. Verandas open on three sides are best as this increases room air motion with respect to the outdoor wind. Air motion in a building is not affected by constructing another building of equal or smaller height on the down-wind side, but it is slightly reduced if the building on the downwind side is taller than the upwind block.

While it is recommended that you construct your building with good ventilation, it is also necessary to install ways to close off or greatly reduce air flow during high wind or stormy periods in order to protect your belongings from being blown around the house or damaged by blown-in rain.

Interaction of building to surroundings. Ventilation indoors can be improved by constructing the building on an earth mound, having a slanted surface with a slope of 10 degrees on the upstream side. Raising the building on stilts is an advantage in a warm and wet climate to enable cooling of the floor from below, which is particularly beneficial at night. Hedges and shrubs can deflect air away from the inlet openings and cause a reduction in the indoor air motion. Trees with large foliage mass and trunks bare of branches up to the top level of the windows deflect the outdoor wind downward and promote air motion in the downwind portion of buildings.

Heat accumulation. To avoid accumulation of heat in the daytime and its subsequent release in the night time, external walls and roofs with high thermal resistance, and the use of insulation are recommended to minimize the heat flow from external surfaces warmed by the sun. (Earth bag houses have proven to be exceptionally good in this respect.) The main heat flow from roof to the space below is due to radiation. Ceiling, wall-mounted or portable fans can be used for forced ventilation. However, fans do not reduce heat or humidity, and may put a strain on solar reserves, so good building design must complement them. Roof vents at the highest point of the ceiling, built and situated to allow venting of heat but to exclude the entry of rain, are also a good idea.

Zinc roofing. The norm in Belize is a metal "zinc" roof. Zinc panels can be ordered in a large number of colors or can be repainted light instead of dark. Light color helps reflect ambient and solar heat. Use roof coat paints that are energy-efficient, energy-saving, flexible coatings, made from water-based pure acrylic resins. These coatings are non-toxic, friendly to the environment, and form a seamless membrane that bridges hairline cracks. They have high reflectance and high emittance as well as a very low conductivity value. Roof coats greatly reduce thermal shock and heat penetration by keeping roof surfaces much cooler in hot humid weather. More information about roof paints can be found

here: <https://www.metalconstructionnews.com/articles/why-re-coat-a-metal-roof>. An added advantage of roof paints is that they also seal roofs somewhat against leakage caused by the expansion and contraction of the zinc panels.

Natural lighting. All rooms should have good access to daylight. Translucent white skylights can improve the lighting in a house enormously, and for this reason single story houses have the advantage in lighting by skylight. Translucent skylights can be placed so that the light they admit hits a wall instead of the floor, which avoids heating the house to a large extent. Windows should be optimized for day-lighting and thermal comfort. Day-lighting goals should be based on the intended usage of the room.

Artificial lighting. The following discussion offers guidelines for getting the best use from artificial lighting and minimizing energy consumption. When designing your house, good design and using natural sources to reduce energy consumption should help you avoid the need for much artificial lighting. Avoid too many light fixtures inside to avoid draining your storage batteries. However, artificial lighting is obviously necessary after dark. So wherever possible, install LED and 12volt lighting devices, which use very little electricity, in light fixtures and lamps for internal lighting. Keep external lighting to a minimum and directed downward to avoid attracting insects and spoiling the many-starred night sky view for others (please review CCRs for specific requirements for outdoor lighting).

Outdoor lights should be on only when necessary. Consider your actual needs carefully with community relations in mind. Many people are annoyed by their neighbors' lights, so install timers or motion activated lights to turn outdoor lights off when you don't actively need them and to keep lit hours to a minimum. In terms of protecting the environment, night lighting can disrupt the reproductive cycles of insects, which can have a deleterious effect on a widening circle of other insects, birds, and other wildlife dependent on them. Don't use night lights you don't actually need, and use the lowest wattage possible. An inexpensive walkway light that might meet your needs consists of solar LED string lights in a Mason jar similar to those shown here: <https://www.amazon.com/Aubasic-Waterproof-Firefly-Pack-Mason-Included/dp/B07B9141X1>. They are inexpensive, give a pleasant, low volume light, and can be quickly moved/replaced at any time.

Water heater use vs. lifestyle. Up to twenty-five percent of energy use in a typical home is used to heat water in traditional hot water heaters, but smaller solar systems cannot support a regular electric water heater in addition to other electrical appliances. By installing a butane or on-demand hot water heater, though, you can save money and reduce greenhouse gas emissions without compromising your lifestyle. Depending upon showering and bathing habits, as much as half of hot water use is in the bathroom, a third is in the laundry and the remainder is in the kitchen. Installing water efficient showerheads and taps is the simplest way to use both energy and water wisely.

Building needs are different on every site. Solar can provide most or all of the energy at BIB. A solar panel and battery system collects and stores electricity, then wiring distributes it through the building. But generation is possible only when the sun is shining or at least the sky is bright, so batteries are needed to store electricity and use it at night and during periods of insufficient sunshine (the rainy season in particular).

Solar array placement. In areas with dense forest where it is necessary to cut or trim trees to get sunlight to solar arrays, several adjacent homeowners can join forces to specify a common area for solar panels. If they run electrical wires to their homes from their own solar panels situated on the common site, fewer trees will need to be cut to allow light to charge the solar panels. An inverter is required to convert the DC current into AC current, which is required by such appliances as refrigerators, fans, etc. Solar arrays are normally mounted on special-support structures, but they can also be mounted on buildings or even be made an integral part of the building envelope. Roofs can easily support the panels, and the panels provide a barrier against sun, cooling the roof underneath them.

Building Integrated Photo Voltaic (BIPV) Innovations. New products are being developed with PV (photovoltaic — energy from the sun) as an integral component, such as active shading elements, building glazing, or roof tiles. By definition, each Building Integrated Photo Voltaic (BIPV) product is either integrated into a building element or completely replaces existing building elements.

Benefits of PV roofs. In the building context, PV can be regarded as multi-functional building elements that provide both shelter and power. For instance, the BIPV as roof serves the following functions in addition to meeting part or all of the electrical load of the building:

- provides structural stability and durability
- provides protection against chemical and mechanical damage
- provides fire prevention
- gives protection against rain, sun, wind, and moisture
- allows heat absorption and heat storage
- controls diffusion of light

Wind Power. An important decision when considering wind power is determining whether or not your chosen site has enough wind to generate the power for your needs, whether it is available consistently, and if it is available in the season that you need it. Wind power is feasible only on some ridge top sites at BIB. On other sites, the trees keep wind to a minimum at ground level.

Wind power details. The power available from wind varies as the cube of the wind speed. If the wind speed doubles, the power of the wind (ability to do work) increases 8 times. For example, a 10 mile per hour wind has one eighth the power of a 20 mile per hour wind. ($10 \times 10 \times 10 = 1000$ versus

20 x 20 x 20 = 8000). One of the effects of the cube rule is that a site with an average wind speed reflecting wide swings from very low to very high velocity may have twice as much or more than the energy potential of a site with the same average wind speed which experiences little variation. This is because the occasional high wind packs a lot of power into a short period of time. Of course, it is important that this occasional high wind come often enough to keep your batteries charged. If you are trying to provide smaller amounts of power consistently, you should use a wind generator that operates effectively at slower wind velocities. Generally your site needs at least 12 MPH of wind velocity.

Energy efficient appliances. Do not buy appliances that you don't really need. If you need to buy an appliance, choose one that is the right size for your needs and is as efficient as possible. Appliance rating schemes can help you to select the most efficient appliance, such as "EnergyStar" etc. Purchase the most efficient appliance available by choosing the highest rating product. Turn appliances off when not in use, preferably at the power outlet. Many appliances continue to draw standby power when switched off, contributing up to ten per cent of household electricity use. Purchase the most efficient appliance available by choosing the highest rating for each product. Think about the best layout and placement of appliances to maximize efficiency when designing the laundry or kitchen.

Insufficient solar capacity. If your appliance use outstrips the capacity of your solar input and reserve, you will have to fire up your generator. *If this happens frequently, you should invest in additional solar panels and/or batteries to avoid disturbing the neighborhood with the noise.* The manufacturers claim their generators are quiet, but they definitely are not, and will disturb the peace and solitude of everyone within hearing distance with every session. They will also drive away wildlife, which is why many people choose to live at Better in Belize. So try to keep your generator's use to a minimum, and run it only long enough to charge up your batteries — then turn it off.

Future possibilities. It's possible that future home owners and designers of BIB homes will develop distributed energy renewable energy systems so that each home isn't reliant on its own solar collection alone. Use of renewable forms of energy based on solar, and possibly wind energy available at BIB, will help reduce demand for polluting, conventional fossil fuel based energy. At present, fossil fuels supply 80 percent of the world's primary energy, but resource depletion and long term environmental impacts will curb their use in future. Policy makers are increasingly turning to renewable energy as a more sustainable option. In 2015, renewable energy such as hydropower, solar energy, wind energy, biomass and geothermal energy supplied 22% of global energy needs.

It is hoped that designers and owners will collaborate on designs with all other owners in Better in Belize to plan either stand-alone or distributable renewable energy systems. The EAB will make every effort to coordinate such activities for the ultimate benefit of the community for resource

sharing and pooling. The most likely application of renewable energy in the residential sector would be based on solar and wind energy. A mini-grid of distributed renewable energy sources refers to small power plants that supply three-phase AC electricity through low-tension distribution networks to households for domestic power. State-of-the-art batteries and inverters are used to ensure long life and reliable field performance.

An appropriately designed mini-grid could easily supply power to the community. At the local level, the community would be expected to play a critical role in payment collection, monitoring usage, complaint resolution, etc. If the possibility of a mini-grid becomes reality at BIB, the EAB will hold community and owner discussions about coordinating the community resources and energy plans to create such a mini-grid.

6. Water Management

Water supply, water quality, and its management are important components when designing an ecofriendly and sustainable habitat. Belize is in a high rainfall zone, and rain falls throughout much of the year, although less during the dry period. Because rainwater is the only water available to most BIB residents, it is important to use and manage it efficiently.

Homes at BIB depend on water storage tanks. Rainwater drainage pipes transport rainwater from roof gutters to storage containers. A screen filter covering the end of the drain pipe prevents leaves and debris from entering the system further, and a first-flush device should be provided in the conduit before it connects to the storage container. Check with your builder to make sure that poisonwood or other trees with toxic leaves will not drop leaves onto your roof which could pollute your water.

Filters for drinking water. If stored water is to be used for drinking, an appropriate filter should also be provided. Reverse osmosis, UV treatment, or charcoal filters are currently in use. A simple purifier is the Berkey water filter (<https://www.berkeyfilters.com/>) which some households at BIB use for drinking water. But there are also other brands, or you can buy Berkey filters and a spigot and build your own filter using 5-gallon lidded buckets. It is not considered necessary to filter shower or hand-washing water.

Cisterns and tanks. While a single tank or cistern may suffice, a secondary cistern at a level higher than the dwelling is recommended to provide a gravity-fed water supply at the faucets. This avoids the use of running a pump each time the faucet is turned on, which can be problematical during overcast times when you want to limit the use of electricity from your solar batteries. Remember, if your battery shuts down, that means you also won't have water.

A storage tank or cistern situated above your house also extends the life of your pump considerably,

since it will not be forced to go off and on with every turn of the faucet. Water from the lower tank can be pumped to the upper tank during a sunny period, and gravity will deliver it when needed without using pump or battery power. If your lot is on a hillside, the second tank can be built at a higher level. If your lot is level, the tank can be on a raised platform

Rotoplas® (PVC) tanks are often used for storing rainwater, but concrete cisterns built of concrete blocks and cement are not subject to UV deterioration, and are less prone to damage if a branch or tree falls on them (a real hazard in the rain forest). The quantity of water stored in a rainwater-harvesting system depends on the size of the catchment area (the house roof) and the size of the storage tank which is based on the water requirements, the frequency and amount of rainfall, and catchment availability. Each tank must have an overflow system connected to the drainage/recharge system to direct excess water from a full tank away from the building's foundation. Rainwater is free of mineral pollutants like fluoride and calcium salt but may be contaminated by air and surface pollutants such as insects, bird droppings, and leaves.

Simple Rainwater Harvesting Formula - For every 1" of rain and 1,000 square feet of roof, about 620 gallons are generated. Meaning, you can capture about .62 gallons per sq ft. To figure out the square footage of a surface, multiply the width x length. The square footage of a roof is the same whether it is pitched or flat. The average annual rainfall at BIB is about 60." That being said, every year is different, with some drier and some wetter.

Faucets and water pressure. The use of conventional faucets results in flow rates as high as 20 lpm (liters per minute). Low-flow faucets are available which can result in withdrawal of water at a flow rate of 9.5 lpm at pressures of 80 psi (pound per square inch). Standard indoor U.S. water pressure is approx. 40-45 psi. Further reduction of water consumption is possible by using auto control valves, pressure reducing devices, aerators and pressure inhibitors for constant flow, and magic eye solenoid valve self-operating valves. However, if using an on-demand water heater, be sure to factor in the amount of pressure required by the heater – at least 30psi.

Fire "hydrants." Because BIB doesn't have a common water supply, protecting homes against wildfires is dependent upon water supplied, at least in part, by the affected and/or nearby homeowners. You are advised to install a pipe leading from your cistern or tank to an easily accessible roadside point. The pipe should have a valve that fire-fighters can connect to pumps and hoses to use your water to protect your house in case of forest fire. Contact the EAB for advice on fittings and the possible use of your water for this purpose.

Grey water and black water re-use. The most common use of waste water is to water gardens and landscaping. With appropriate treatment, waste water can be used even to wash clothes. Grey water is waste water from non-toilet fixtures such as showers, basins and taps, which does not contain

human excreta. It can be safely used for watering plants and gardens. Black water is wastewater containing human excreta, and is difficult to treat for re-use. On many sites at BIB there is no place for waste water to diffuse. Where the effluvia is likely to migrate downhill it could end up in the reservoir when the community expands. Therefore, flush toilets *are not recommended* at BIB.

Most home site lots at BIB are large and there is room for two or more cisterns on each, so it shouldn't be difficult to save sufficient water for easy living without having to reuse it. However, if needed, grey water from bathrooms and laundry (but not the kitchen) is the easiest to treat for reuse. Re-use of wastewater containing black water is permissible only outdoors for subsurface irrigation after suitable on-site treatment. If utilizing a sufficient water supply is not possible, BIB owners should consider-grey water recovery systems for reusing this resource and saving potable water.

Flush toilets may pose a problem for BIB. Because of the shallow nature of the soil, a rock substrate which does not allow absorption, and the frequent saturation of the soil by typical rainfall, septic drain fields do not give the same results here that they give in dryer climates with deeper soil. On level lots with heavy water use, the septic fluids may pool at or near the surface, creating odor and sanitation problems. On steeper lots, the effluent may drain off downhill before it is properly assimilated and detoxified by soil organisms. The most probable destination of the black water from toilets, if there is a failure of the septic system, is home sites further down the hill and eventually the reservoir at the foot of the development.

While a limited number of flush toilets may not overtax the terrain, if a large percentage of houses employ flush toilets, the effluent could eventually pollute the reservoir.

Composting toilets. There are various approaches to dealing with human waste without flushing. Composting toilets and humanure systems have the advantage that they do not require any water to function. They use biological processes to convert solids present in human waste into enriched soil. An assortment of composting toilets may be studied and compared here:

<https://www.thespruce.com/best-composting-toilets-4693560>

Humanure systems. Some households have experimented with Humanure systems, which collect and compost human waste for use on landscaping areas. Because of extraordinarily quick composting in this humid tropical locale, a humanure system is viable, and in many ways superior to flush toilets. An easily constructed setup, the humanure system is appealing to many DIY homeowners, and has a low impact on the environment. <https://humanurehandbook.com/manual.html>

NOTE: a composting toilet is not feasible for houses designed for use as B&B's.

7. Waste Management

Waste management is a perennial problem in any community. Waste consists of biodegradable, non-biodegradable, inert matter, and reusable items. Organic wastes include vegetable, food, animal, leafy, and agriculture wastes. Municipal solid waste is usually dumped in landfill sites, and sometimes burned, leading to soil, air and water pollution. Through efficient waste management methods, a significant amount of solid waste entering the landfill can be diverted and reused. Recycling in Belize is an on-again, off-again process, and not yet a reliable-means of disposing of our waste.

Organic and inorganic waste. In cooler, dryer climates, natural waste decomposition is a very slow process but in a tropical environment, such as that at BIB, organic waste will decompose in a matter of days, often without further management. The inorganic (or difficult to recycle) part of solid wastes, like paper, metals, and plastic should be recycled if possible. Recycling reduces the need to extract virgin natural resources. If organic waste gets mixed with the other components, it forms a nasty mixture that becomes difficult to handle. To avoid odors and to discourage coatis and opossums from raiding garbage cans, rinse all cans, jars, foil and plastic before discarding.

The transfer station near Benque which processes all the garbage in the area does minimal recycling. It recycles some plastics and a few other items, but it is still a work in progress. Even if homeowners separate their recyclable items (glass, plastic, metal, reusables, etc.) these items may subsequently be dumped back together at the transfer station and re-sorted by workers there.

Be aware that your waste will be re-handled at the facility. Please protect the local sanitation workers by bagging used bathroom tissues, swabs and other items that shouldn't be rehandled into transparent plastic bags, so that they can be inspected and identified without opening and the workers can avoid contact with them.

Management of energy, water, and waste at the household level quickly becomes second nature and soon falls mostly below the level of awareness. It is fine feeling to get your water and electricity from the sky and return your wastes back to the system where they came from.

At some point, arrangements will be put into place to help homeowners minimize toxic wastes by recycling items such as ballasts, mercury-based lighting products, used oil, unusable batteries, etc. You will be notified when this service becomes available.

Possibilities for the future: As time goes by, techniques are developed, and the community becomes larger and more diverse, we may see movement toward improvements in our efforts to be an eco-community.

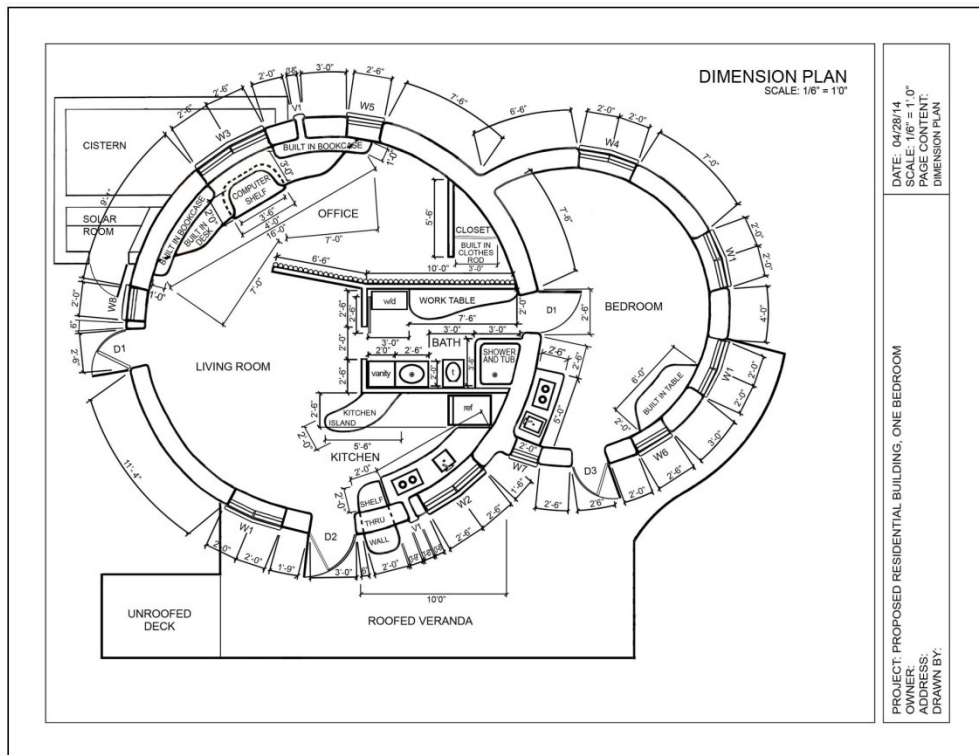
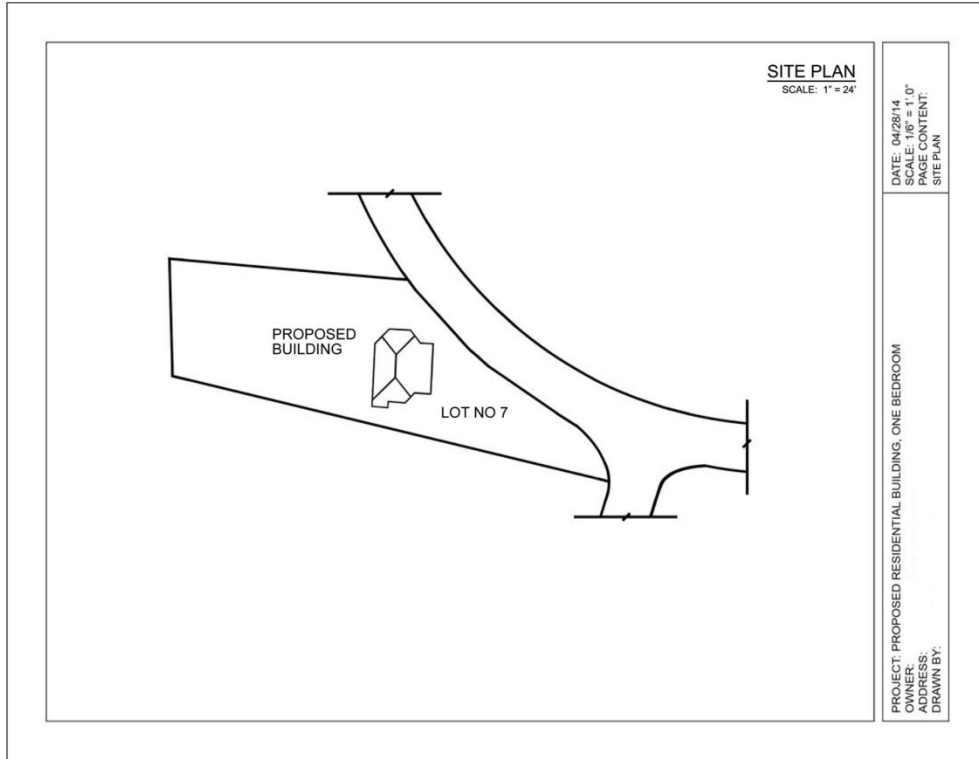
Since the BIB Community is located where traditional septic field design is not usable, designers may guide us toward examination of alternative septic designs which include: aerobic septic systems, composting, incinerating & waterless toilets, evaporation-transpiration (ET) septic systems, septic media filters, grey water systems, mound or raised bed septic systems, pressure dosing septic systems, sand bed filters, peat beds, constructed wetlands, wastewater lagoons, and septic disinfection systems.

Alternative onsite wastewater disposal systems can reduce the soil absorption area or leach field size requirements substantially and can in some cases reduce the needed area to zero. The alternative septic system designer would conduct the site and soil inspection and testing, prepare the system design and installation plan, supervise the septic system construction, and certify that the system was installed as designed.

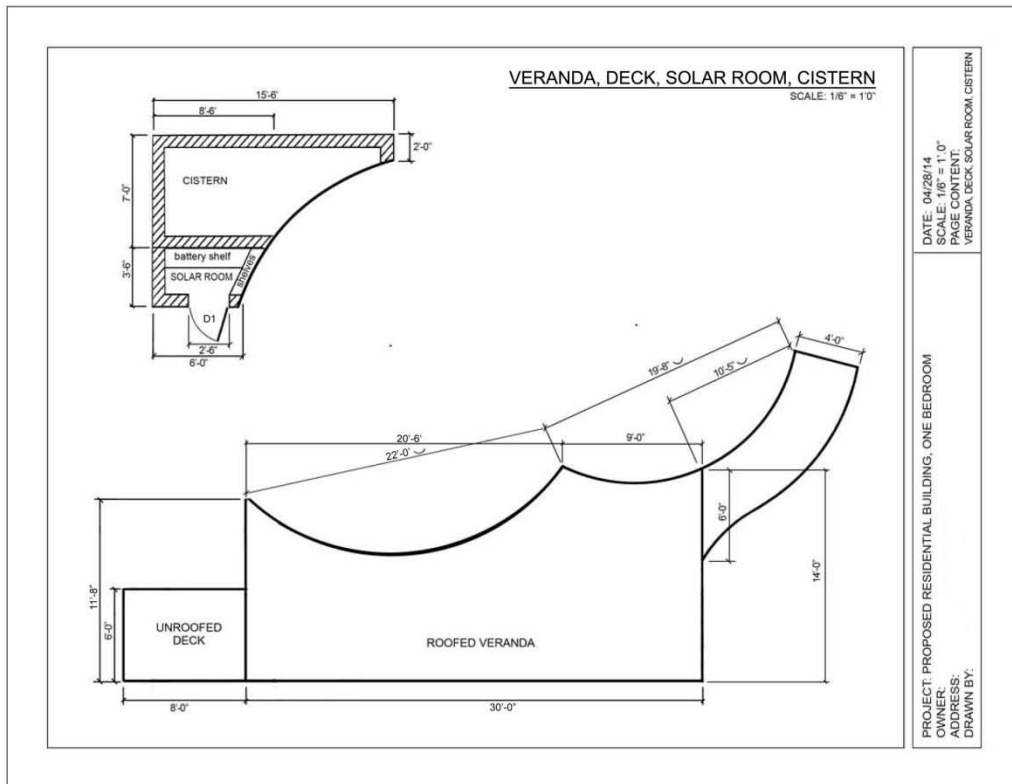
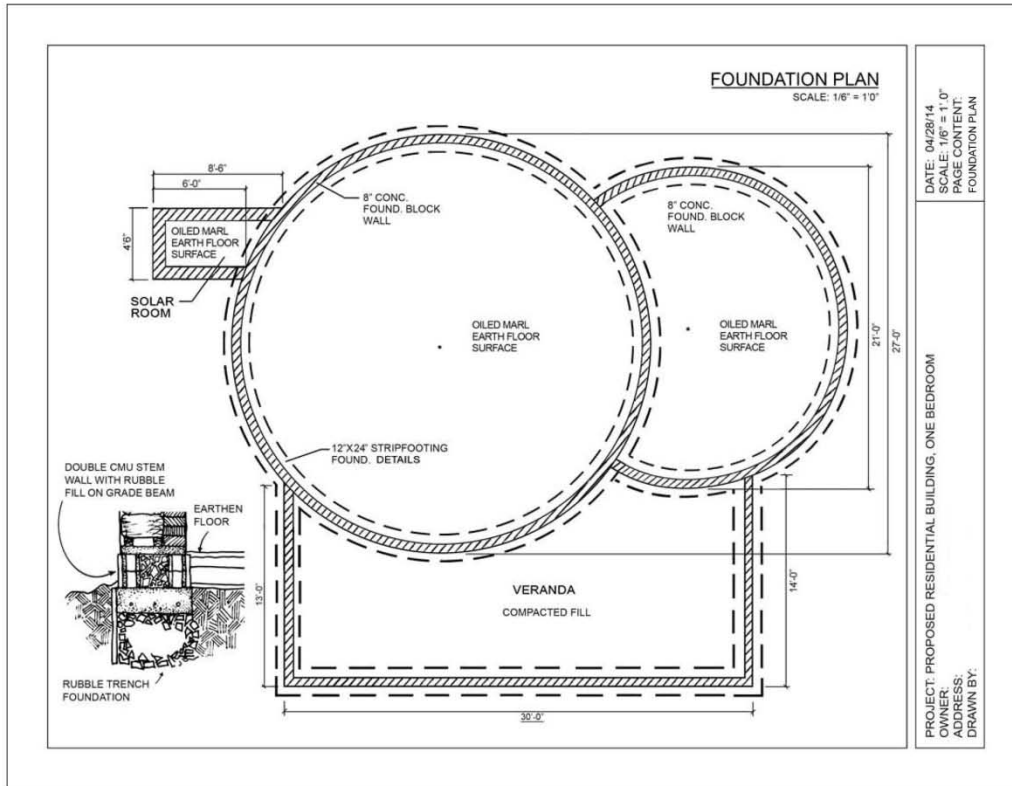
Alternative septic system designs are used on difficult sites where soil conditions (such as a rocky site, limited soil percolation rate, or high ground water level), or other terrain conditions (such as limited space for a septic system or steeply sloped sites) do not permit the installation of a conventional septic tank and drain field system. To be feasible, any system adopted would need to produce little or no additional waste products in dealing with the septic waste. As well, BIB workers or professionals available in the area would be needed to supervise and manage more complicated systems.

APPENDIX A – Complete Set of Plans for a Small Earth Bag House

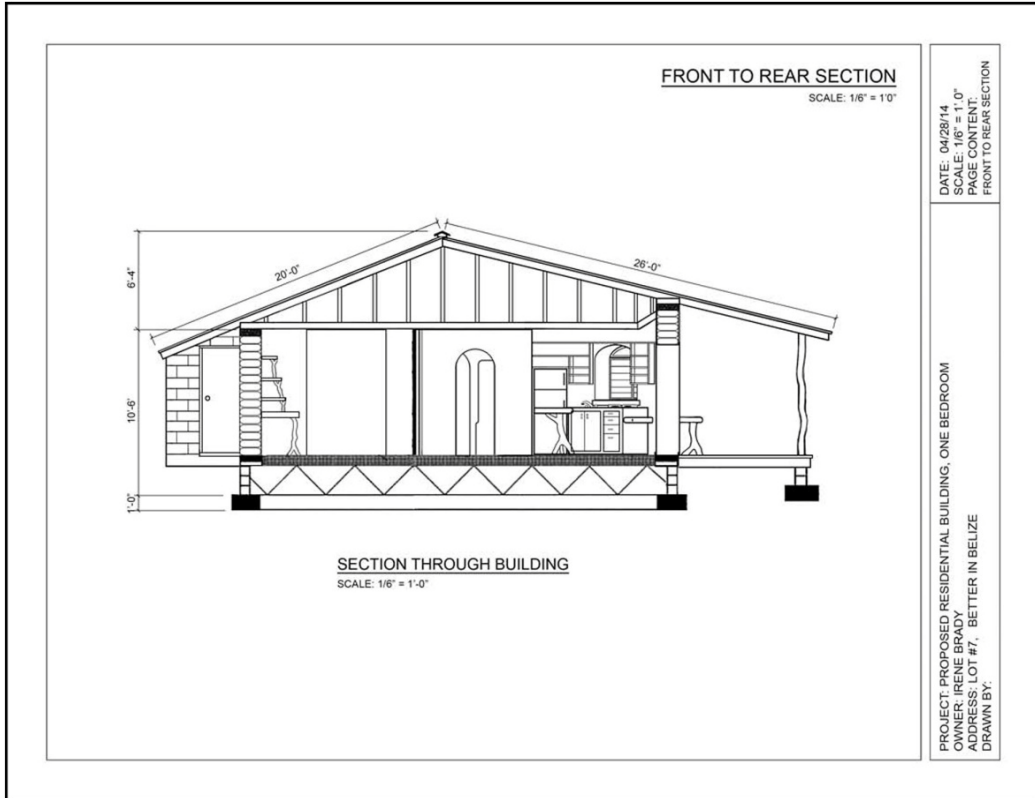
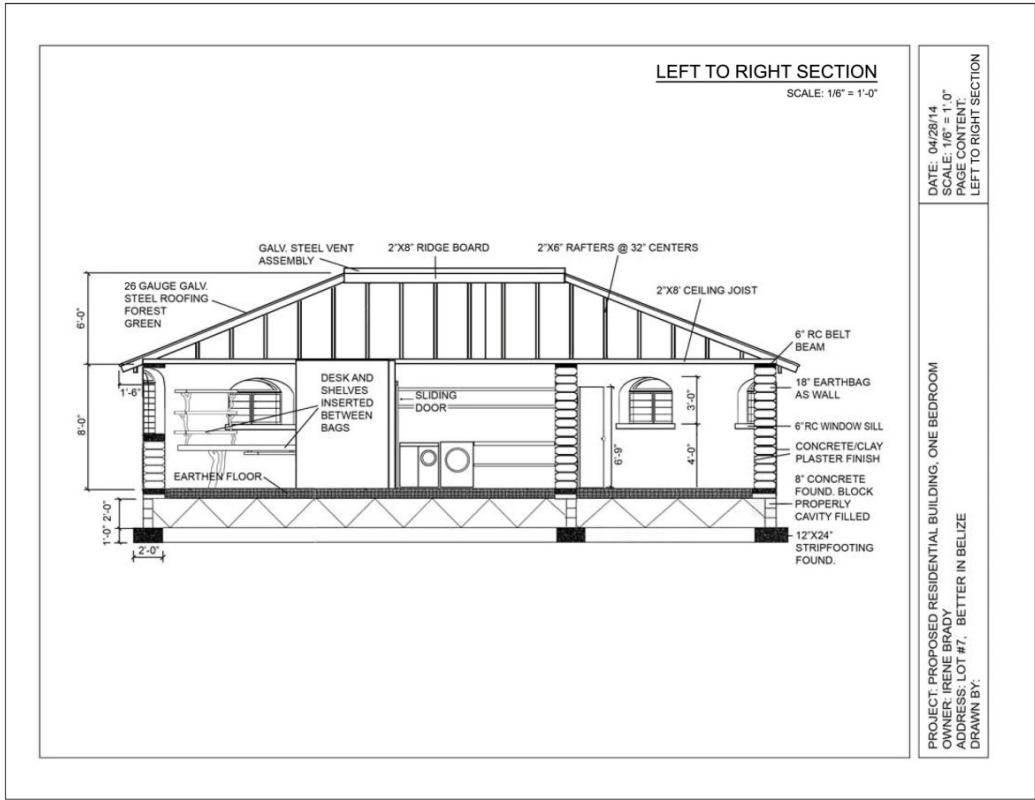
Site Plan & Dimension Plan



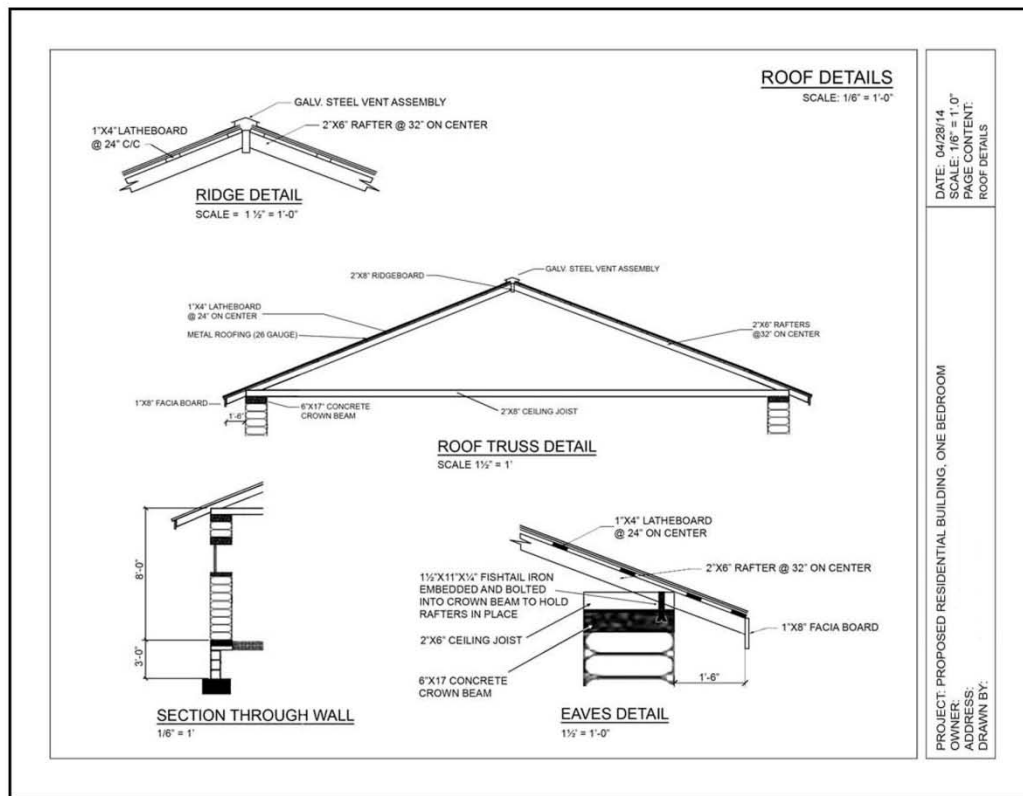
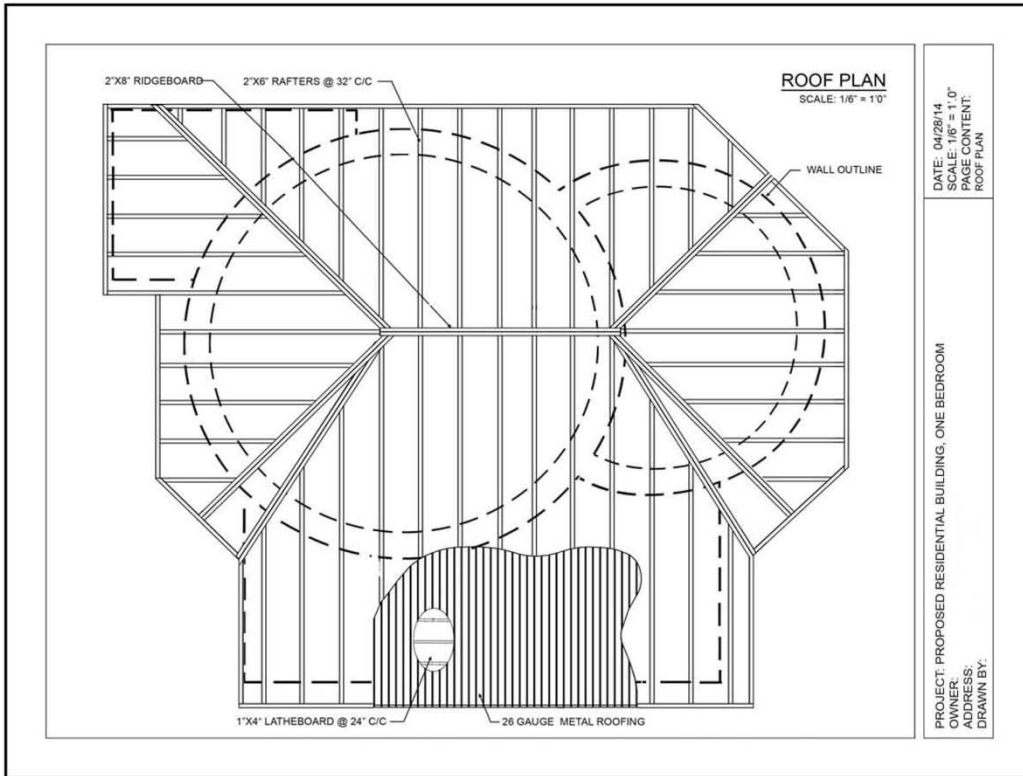
Foundation, Deck, Veranda, Cistern



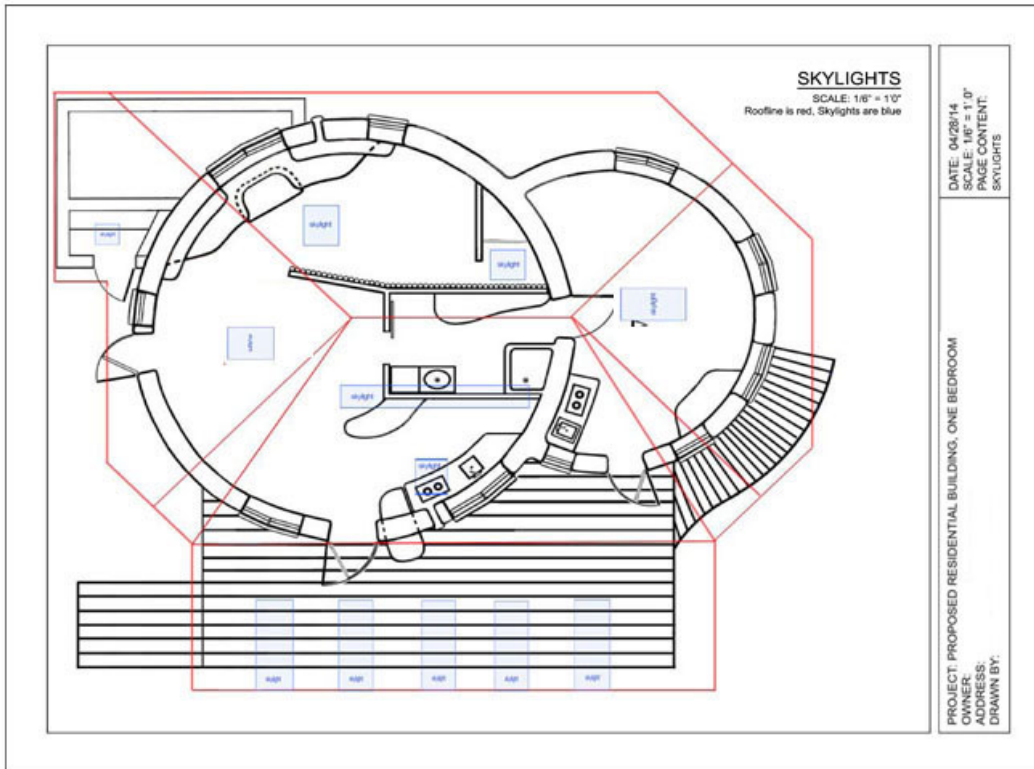
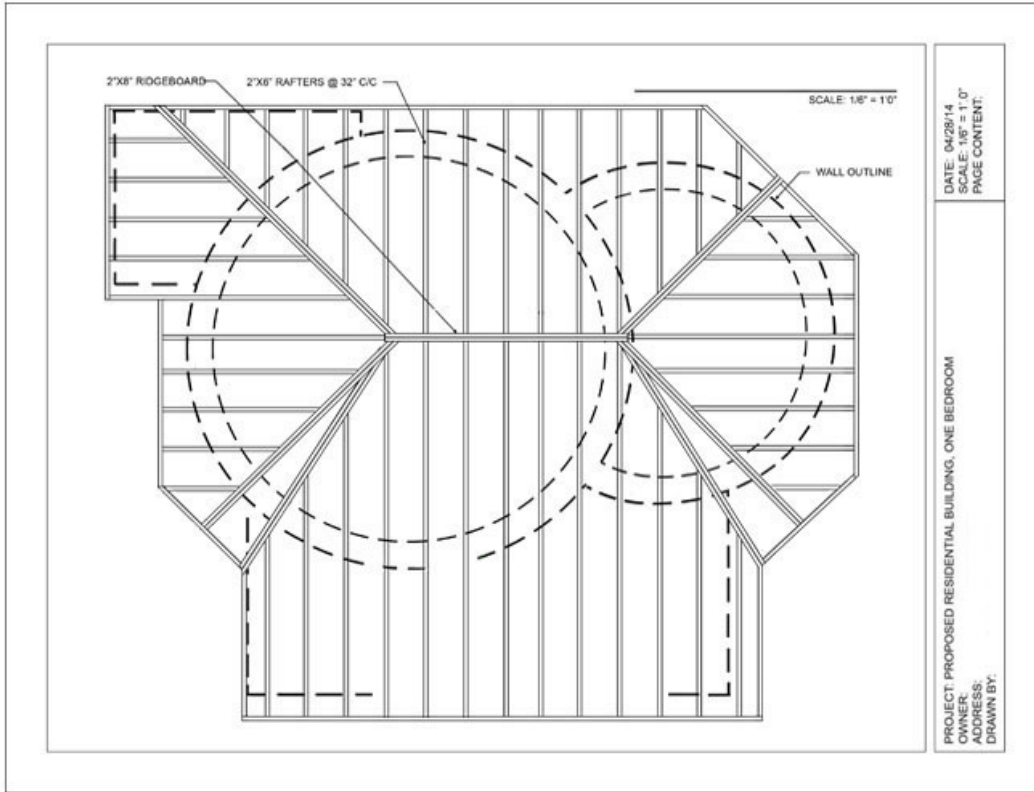
Left-to-Right, Front-to-Rear Sections



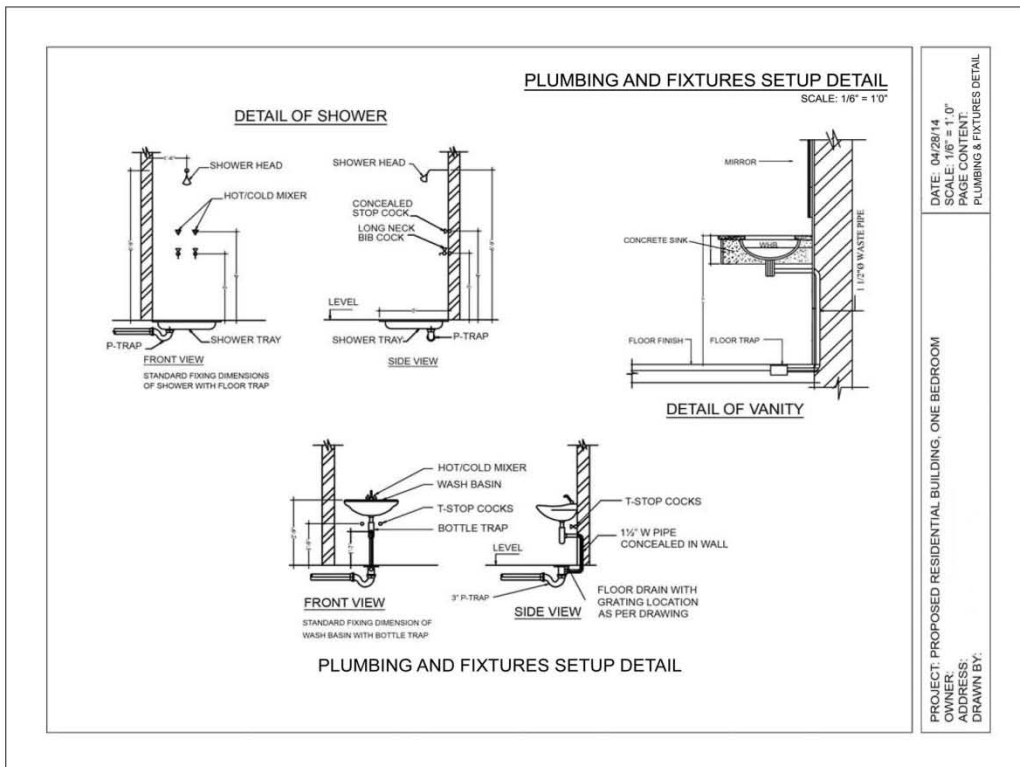
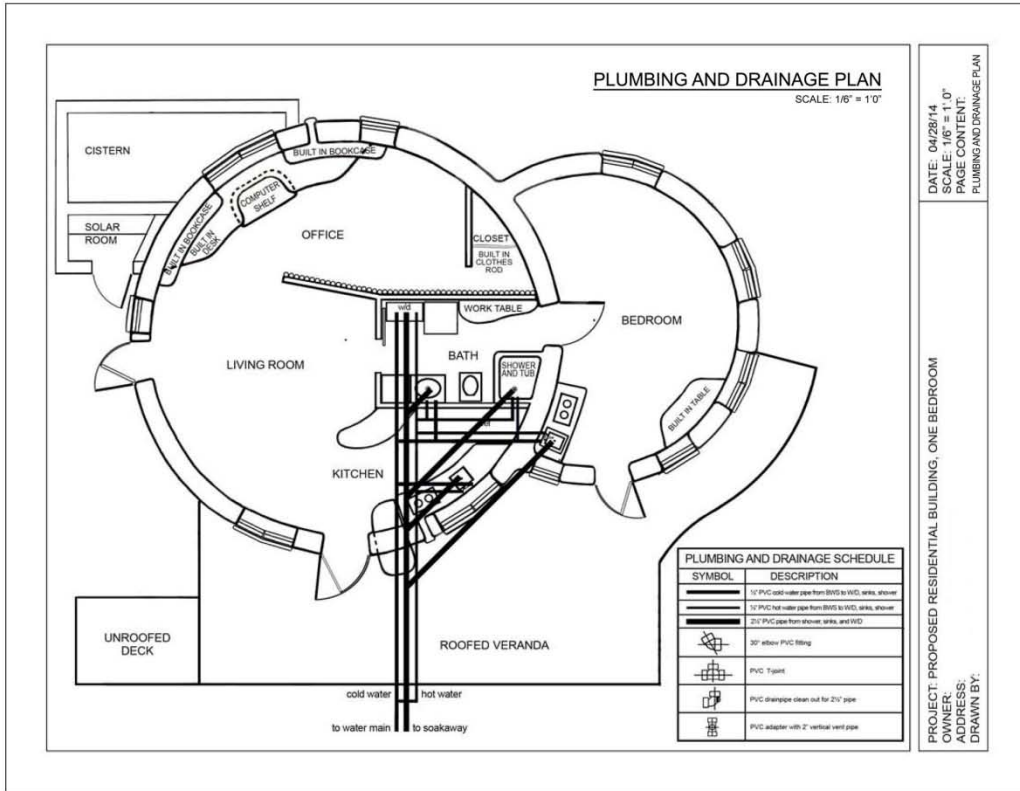
Roof Plan & Details



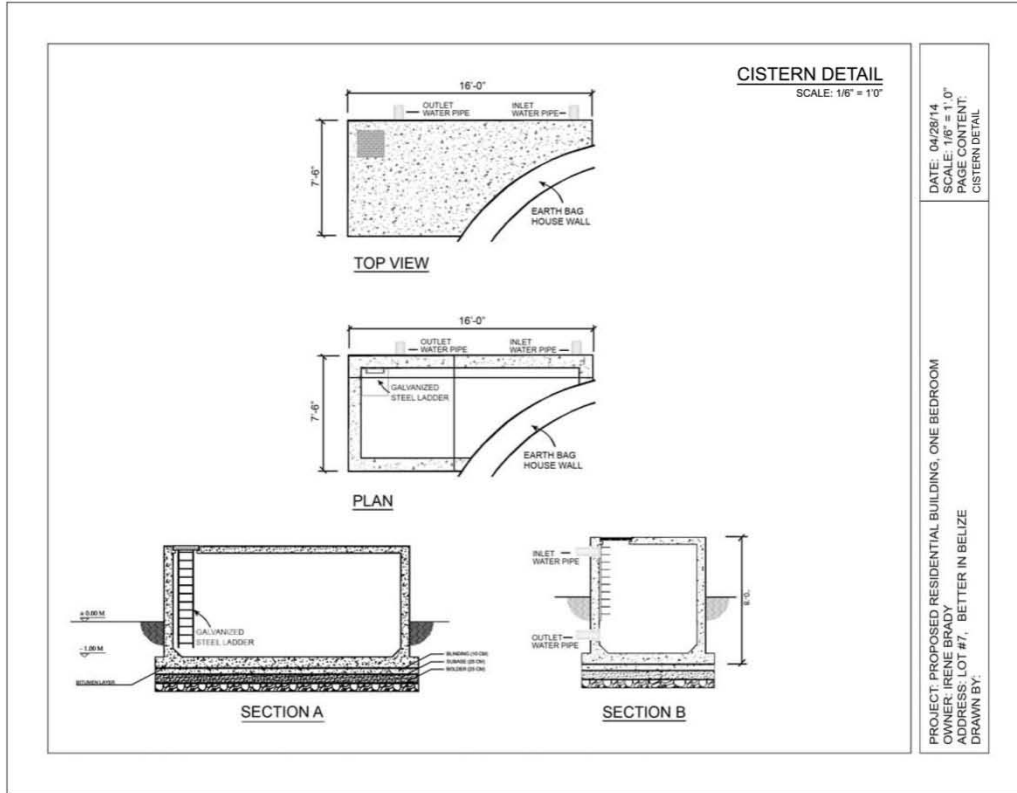
Skylights On Frame & Over Interior



Plumbing, Drainage & Detail

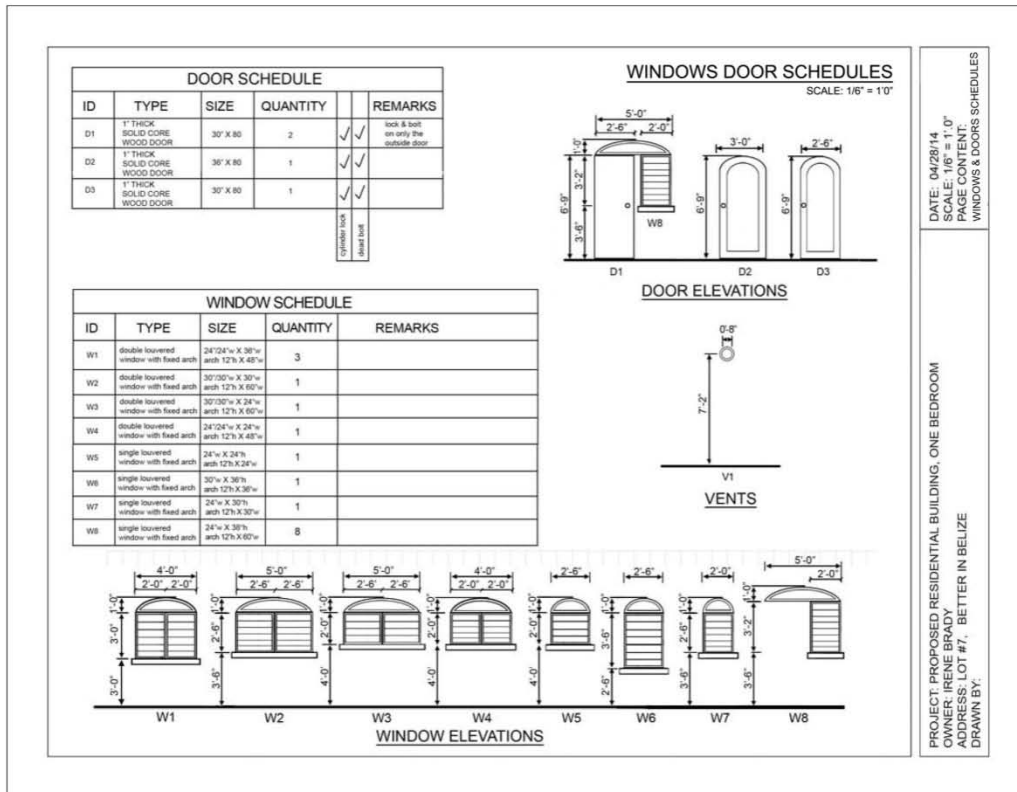


Cistern Detail, Window & Door Schedules



DATE: 04/28/14
 SCALE: 1/8" = 1'-0"
 PAGE CONTENT: CISTERN DETAIL

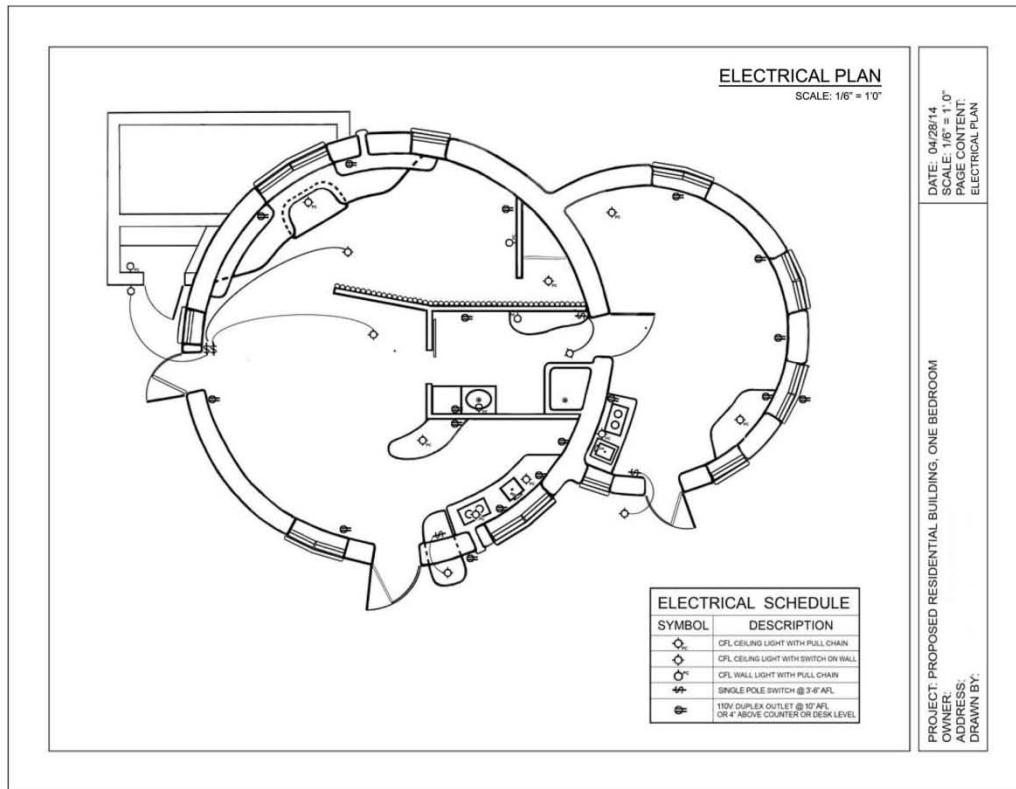
PROJECT: PROPOSED RESIDENTIAL BUILDING, ONE BEDROOM
 OWNER: IRENE BRADY
 ADDRESS: LOT #7, BETTER IN BELIZE
 DRAWN BY:



DATE: 04/28/14
 SCALE: 1/8" = 1'-0"
 PAGE CONTENT: WINDOWS & DOORS SCHEDULES

PROJECT: PROPOSED RESIDENTIAL BUILDING, ONE BEDROOM
 OWNER: IRENE BRADY
 ADDRESS: LOT #7, BETTER IN BELIZE
 DRAWN BY:

Electrical Plan



This set of plans should give you a general idea of what is required for a successful build; both in terms of detail and the number of drawings you will need (there were seventeen for this house). More complex houses will have more drawings and more detail.

If your proposed home is larger than 1000 square feet, you must employ a professional architect. The CBA (Belizean Central Building Authority) will not approve plans from non-Belizean architects. This has the advantage of ensuring that your architect will have experience with materials and practices common and available in Belize. It will also probably be considerably less expensive than having them drawn up in your country of origin. To find a Belizean architect, go online to the Association of Professional Architects of Belize (APAB), <https://www.architectsofbelize.com/>.

If asked, many BIBers would tell you that if they had to do it over again they would build smaller houses with larger verandas. Our shady, airy verandas are where we have potlucks, parties, meetings, and get-togethers with friends and neighbors. With an average annual maximum temperature of 86° Fahrenheit (30.0° Celsius) and an average annual minimum temperature of 71.6° Fahrenheit (22.0° Celsius) and a beautiful jungle and wildlife all around us, many people spend more time on the veranda than inside the house.

APPENDIX B (1)

Environmental Advisory Board (EAB) Plan Review Checklist

Details for complying with this checklist are in the CCRs which you received with your lot deed.

April 2020

- Allowable building footprint: 10% of gross parcel footage, up to 2000sq ft including porches, decks, patios and balconies
- 10' setback NO disturbance zone on all sides, except for one driveway and one walkway on each side
- Max 3 accessory structures not to exceed 3% of total single lot sq footage or 750sq ft, whichever is smaller, including garages
- 2 stories plus basement max. A basement = 30% of walls below grade
- Roof must be designed for rainwater catchment, no asphalt or gravel, or composition shingles
- Rooftop solar collector for power must be low profile; generator is to be contained for noise abatement. Wind power only in special circumstances.
- Cistern or water catchment, hidden from public view where possible (NOTE: this rooftop surface can be used for rain catchment in case of spring drying up with addition of cistern.)
- Septic system for waste with grey water holding tank/leach field
- Aesthetic exterior in harmony with surroundings (paint color, etc)
- Approved tree removal plan only
- Shielded outdoor lighting, if any, should be non-intrusive of neighbors or wildlife, down-lighting.
- Passive cooling, no window AC
- Pools (optional)

If we need more information, we'll let you know ASAP. Once we've confirmed everything is in compliance, and have approved any needed tree removal or site preparation, you'll be sent a formal response and you are ready to build!

APPENDIX B (2)

EAB Eco Construction Site Checklist						
		Lot type	Lot #	Lot Size	% footprint allowed	Dwelling Max Footprint
		Residential			10%	
		Commercial			50%	
		Multi-unit			20%	
		With pool			5%	
		accessory building			3% or >750 sq ft	

			Comments
From The Road	1	will there be a driveway?	
	2	Will a culvert be needed?	
	3	take a picture from road.	
	4	Who did I meet with? Owner, architect, builder?	
	5	where will trash go? Garbage can? Back of car?	
Paper-work	6	Did I see the plans?	
	7	Did I review the plans?	
	8	Copy of CCR's delivered?	
	9	Is footprint calculated? Write it down in box	
	10	How many stories? 2 max + 70% basement aboveground	
	11	Roof design(rainwater collection)	
	12	Roof material?	
	13	Solar system location	
	14	Wind power? **Special exemption**	
	15	Solar panel location? Roof, ancilliary building?	
	16	Generator housing?	
	17	Color of house?	
	18	Cistern location?	
	19	Gravity feed cistern location?	
	20	Septic system - type, location	
	21	Gray water system	
	22	humanure system	
	Property	23	Is footprint outlined?
24		Is there 10 feet on front, right and left side?	
25		trees over 6" diameter to be removed?	
26		Pics of trees?	
27		walkways outlined?	
28		Large or rare trees?	
29		Giant boulders?	
30		Lighting? Paths,verandas,security?	
31		animal areas?	
32		Number of vehicles and types? Car, ATV, go cart, golf cart	

APPENDIX C

The following materials are the same as those attached to your Deed of Conveyance, to which you signed and agreed when you bought your property. Be advised that there are additional by-Laws that pertain to your requirements and conditions. They should be accessible on the official BIB Website.

COVENANTS, CONDITIONS, AND RESTRICTIONS

Covenants Run with the Land. These covenants shall run with the land and shall inure and be binding on the property and upon each person acquiring ownership thereof.

Covenants are Accumulative. Each of these Covenants is cumulative and independent and is to be construed without reference to any other provisions dealing with the same subject matter or imposing similar or dissimilar restrictions. The provision shall be fully enforceable although it may prohibit an act or omission sanctioned or permitted by another provision.

Covenants May Not Be Waived. Except as these Covenants may be amended or terminated in the manner hereinafter set forth, they may not be waived, modified or terminated and a failure to enforce shall not constitute a waiver or impair the effectiveness or enforceability of these Covenants. Every person bound by these Covenants is deemed to recognize and agree that it is not the intent of these Covenants to require constant, harsh, or literal enforcement of them as requisite of their continuing vitality and that leniency or neglect in their enforcement shall not in any way invalidate these Covenants or any part of them, nor operate as impediment to their subsequent enforcement and each such person agrees not to defend against enforcement of these Covenants on the ground of waiver.

Enforcement. These Covenants are for the benefit of the Purchasers jointly and severally and "Better In Belize Ltd." a company duly incorporated under the Laws of Belize (BIB) and may be enforced by action for damages, suits for injunction, mandatory and prohibitive, and other relief, and by any other appropriate legal remedy instituted by BIB, or its successors. All costs incurred by anyone in connection with any successful enforcement proceeding shall be paid by the party determined to have violated these covenants.

1. INTRODUCTION

1.1. Purpose

The covenants set forth herein have been enacted and will be amended from time to time to accomplish the highest standard of self-sustainability that can be reached for the environment and healthy continuance of "Better In Belize" hereinafter known as "BIB". The goal is to create practices for sustainable development and dwellings that minimally affect the environment. It is expected that parcel owners will commit to protecting and maintaining these important

natural habitats by adhering to the letter and spirit of these covenants. These covenants establish policies and procedures so we can co-exist with and within the natural habitats with minimal impact. The enactment and ongoing enforcement of these covenants will serve to maintain the natural condition and value of “Better In Belize” properties and make the community harmonious and aesthetically pleasing.

2. ESTABLISHMENT OF THE “ECOLOGICAL ADVISORY BOARD” (“EAB”)

In order to administer and supervise the enforcement of all these covenants and in order to provide a systematic and uniform review of all proposed construction of any type and nature in BIB, the Board of Directors of “Better In Belize” have created and enacted the covenants herein set forth and do hereby establish the EAB which shall be composed of three to five community appointed members by annual election. The purpose of EAB is to provide for a systematic and uniform review and approval process of all proposed construction of any type or nature whatsoever within BIB and to establish and maintain design criteria regarding such proposed plans for building, utilities, construction, landscaping, and maintenance. The EAB will ensure that such plans and maintenance of the aforementioned are consistent with the quality of environmental standards specified by these covenants. The EAB will also implement the structure for the Home Ownership Association.

3. EAB LEGAL AUTHORITY

All owners of BIB properties must agree in writing to submit to the rules and abide by the decisions of the EAB. In order for a purchaser to build upon BIB property, the EAB will first:

- 3.1. Review all plan, design and construction applications;
- 3.2. Approve utility and waste disposal methods;
- 3.3. Approve or deny items submitted;
- 3.4. Distribute and enforce construction-related rules and regulations;
- 3.5. Determine and review policies, procedures and criteria;
- 3.6. Revise and amend EAB rules, regulations, policies, procedures, criteria, covenants, conditions and restrictions of the “Better In Belize” project from time to time or as required;
- 3.7. Enforce waste and contamination policies;
- 3.8. Approve water supply sources and methods;
- 3.9. Approve energy supply sources and methods.

Once construction is underway, BIB shall have the power to halt any construction process on site that is in violation and to levy fines and enforce development guidelines, bylaws and rules.

4. LOT USE RESTRICTIONS

4.1. Construction Restrictions

No construction, demolition or alteration may be started in any manner until Final Approval is received in writing by the Applicant from EAB. No other category of work may be commenced without Final Approval being received by the Applicant, except for surveying and staking of structures within the existing lot borders. Lot borders will be marked by BIB and are not to be altered by lot owners. "Construction" includes demolition of an existing dwelling, and also includes the alteration or renovation of an existing dwelling where 50% or more of the building footprint (For example, a 2-story, 20 x 40 structure has 800 square feet of building footprint but 1600 square feet of floor) of the existing dwelling is to be altered, renovated or added. On failure of the Parcel Owner to observe requirements as to commencement and completion of construction, EAB shall, in its discretion, impose fines against the Parcel Owner as provided herein.

All construction plans shall be submitted from a professionally licensed architecture or design firm and should bear official seal or stamp of the said firm. The plans should include all architectural, landscape design, electrical, utility, and mechanical drawings with complete specifications in order that EAB can clearly identify location, layout, materials, power source, water source, sewage disposal, and other design features of proposed structure, ancillary buildings and landscaping. BIB has established an "Eco Construction Workbook" document that should be used by all planners in preparation of submissions to the EAB. This document is available, upon request, to owners only, and will provide a valuable reference tool to help those prepare their plans to meet EAB requirements and to maintain a high degree of ecological compatibility with the tenets of BIB. All building plans shall first be vetted by the EAB before they are submitted to the Central Building Authority. Two sets of Site Plan, Floor Plan, and the Elevations of Front, Back and Sides view shall be submitted to EAB for approval before construction can start.

4.2. Allowable Building Footprint on lots

- 4.2.1. On a residential parcel, the building footprint of any dwelling may not exceed Ten Percent (10%) of the gross parcel square footage (e.g. parcel size is 200' X 100' = 20,000 square feet which is .45 acre, dwelling may not exceed 2,000 square feet for the building footprint). Square footage measurements shall include the exterior walls. All square footage measurements shall be inclusive of porches, decks, patios or balconies. Maximum building footprint of 2000 sq. ft. on any lot is allowed.

- 4.2.2. On a multi unit parcel, the building footprint of the total dwellings may not exceed twenty percent (20%) of the gross parcel square footage (e.g. parcel size is .93 acres 135' X 300' = 40,500 square feet, dwellings may not exceed 8,100 square feet for the total buildings footprint). Square footage measurements shall include the exterior walls. All square footage measurements shall be inclusive of porches, decks, patios or balconies.
- 4.2.3. Parcel Owners having multiple parcels, each contiguous, may construct a dwelling using the same calculation as above; however, multiple parcel square footage may be combined in the calculation of a single dwelling's total square footage.
- 4.2.4. Pools may not exceed 5% of the total parcel size. This 5% calculation shall be considered in addition to the 10% residential dwelling or 50% commercial building calculations.
- 4.2.5. One dwelling unit per residential lot. Maximum of 6 units on a Multi-Unit Lot.
- 4.2.6. A maximum of three accessory structures not exceeding a total building footprint of either 3% of the total square footage of the parcel or 750 sq. ft. whichever is smaller, including garages

4.3. Basic Construction Design Criteria

- 4.3.1. The height of any residential or commercial dwelling is not to be more than a basement (which must have 30% of the walls below grade) and two stories;
- 4.3.2. Roofs should be designed to catch rainwater with drainage to a cistern or bladder. Roof top decks or terraces are encouraged and do not count as an extra story of a dwelling thus minimizing a building footprint. Roofs are to be constructed with overhangs to protect dwellings from mid-day sun;
- 4.3.3. Rooftop solar collectors, as approved by EAB; engineering drawings, including reference to ventilators may be used if the roof vents are low profile, blending into the roof materials;
- 4.3.4. Asphalt and gravel built up roofing on pitched surfaces and asphalt composition shingles are prohibited due to contamination and leaching;
- 4.3.5. The EAB reserves the right to review any item that may affect the exterior appearance in consideration of the aesthetic harmony of

- the design or color scheme with the surrounding area;
- 4.3.6. Any removal of trees for land preparation or any other reason MUST be done by the EAB building site preparation team at an expense to be borne by parcel owners and a schedule to be determined by the EAB according to a priority sequence. Trees will not be permitted to be cut down unless necessary in the eyes of the EAB. If additional landscape materials are needed they shall be of indigenous plants to Belize, as approved by the EAB, with said indigenous plants payable by the parcel owner. Anything other than organic landscaping materials must be approved. If a tree over 6" diameter is removed during land preparation, the owner will plant 5 native hardwood or fruit trees (at least one foot in height) somewhere on his parcel or an approved location in a BIB common area. EAB reserves the right to property inspections to verify compliance; your house location on your lot may be affected to save large or rare types of trees.
- 4.3.7. Outdoor lighting must be located so that it does not interfere with or become a nuisance to other residents or wildlife. The light source of any exterior light must be shielded from public view and must not intrude upon your neighbours and must minimize impact on nocturnal environments, Use of downlighting instead of uplighting is essential. EAB reserves the right to enforce lighting provisions from both an aesthetic and an environmental standpoint after the construction of the residence is completed. In order to reduce light pollution and to preserve the pristine night sky visible from BIB, only lighting fixtures that have received the Fixture Seal of Approval from the International Dark-Sky Association will be approved for outdoor use. A list of manufacturers and distributors of these fixtures may be found at <http://www.darksky.org/mc/page.do?sitePageId=56404&orgId=idsa> Another potentially good source of information is the Illuminating Engineering Society of North America's Recommended Practice Manual: Lighting for Exterior Environments <http://www.acrobatplanet.com/non-fictions-ebook/ebook-designinterior-and-exterior-lighting-and-controls.html>.
- 4.3.8. Above ground, on-ground or in-ground swimming pools, hot tubs, whirlpools, etc. are permitted where they do not materially disturb the natural habitats or natural water flow. Pools and hot tubs must be completely enclosed by a fence at least 60" high in order to prevent accidents and protect children and wildlife. The least harmful of chemicals should be used. Any disposed of water must be done in an appropriate manner such as purification etc Preference would be a natural water swimming pool <http://www.naturalswimmingpool.org>.

- 4.3.9. Maintenance is the responsibility of the Parcel Owner. All dwellings, accessory and related structures shall be cleaned and maintained as in original or subsequently approved condition so as to maintain the harmony and aesthetic appearance of the community. EAB reserves the right to enforce and fine owners in violation of this at their discretion.
- 4.3.10. Construction procedures shall ensure the site is kept free of all construction materials and refuse at all times during construction. Sanitary systems (e.g. portable composting toilets) and refuse containers are to be located on the Construction site. Both composting toilets and containers must be screened to provide minimum off-site view or exposure, and must be removed as soon as construction is complete. No refuse or Construction equipment shall be discarded on or in any way permitted to remain on neighbouring properties, public areas, wild areas, or on site after construction is finished. Builder is responsible for the removal of construction materials at their own cost and disposed of in an environmentally friendly manner. Any damage to adjoining properties is the responsibility of Parcel Owner.
- 4.3.11. In addition to penalties and liabilities for violating any laws of Belize, EAB may halt the construction process on a site until any code, bylaw, covenant, or environmental violation is corrected.
- 4.3.12. All setbacks shall be subject to and shall be measured from the appropriate property survey. Distances from the property line for any structural elements (e.g. structures, screened enclosures, porches, walls, equipment, accessory structure, garage, etc.) must be shown. EAB may modify, amend or waive setback requirements in accordance with this document.
1. Minimum front yard, rear yard and side yard setbacks for dwellings, patios, porches, decks, garages, buildings and screened enclosures is ten (10) feet except for exempted lots.
 2. Minimum side yard setback for equipment, trash containers and other similar utilitarian devices is ten (10) feet. Such items must be landscaped from view.
 3. The (10) foot setback will be a NO disturbance area except for pathways and one access road to the building.

5. BASIC ENERGY, SUSTAINABLE AND WASTE TREATMENT DESIGN CRITERIA

5.1. Energy Plan

- 5.1.1. Solar power is permitted as a source of energy in BIB. Wind Power may only be used on special permit-by-permit basis due to tower and location requirements as well as aesthetic concerns. All wind power plans must be approved by EAB.
- 5.1.2. Low decibel (75db) butane generators may be used for emergency backup power. Diesel and gas are to be avoided, if possible.
- 5.1.3. The use of an occupancy sensor is encouraged to minimize energy use when unit is not occupied.
- 5.1.4. Passive techniques should be used as the primary source of ventilation and cooling. Fans or blowers run by a renewable power source are an acceptable secondary source of ventilation. No window mount air conditioners are permitted.
- 5.1.5. If hydro is brought in from BEL or other local public utility company all associated costs attributed to bringing in the power, delivery, transmission lines, transformers etcetera will be borne equally by ALL lot owners.

5.2. Water Supply and Collection

- 5.2.1. Units must have cisterns, bladders or water catchment and holding systems, which store rainwater collected. Systems should be hidden from public view.

5.3. Waste Treatment and Removal

- 5.3.1. Human waste must be treated with an EAB approved septic system.
- 5.3.2. Grey water holding tanks shall be used in conjunction with drip irrigation systems for the fertilization of local planting.
- 5.3.3. Compostable organic waste must be disposed of in composting bins.
- 5.3.4. All Parcel Owners must participate in the Recycling and Reclamation Program as available. They must have a composting bin for food waste, paper products and any other compostable materials, along with recycling bins for crushed metal cans, glass and plastic bottles and/or containers. Parcel Owners must take

recyclable materials to designated waste collection points on site.

- 5.3.5. All consumable goods or products, including but not limited to bathing products, cleaning solutions, cleaning products, cleaning supplies, household paper products and sunscreen must be biodegradable. NOTE: anti bacterial products can kill necessary bacteria required for your septic system.

5.4. General Guidelines

- 5.4.1 Leave nothing but footprints. Common areas are to remain undisturbed.
- 5.4.2 Domestic animals will be allowed in BIB but owner takes responsibility for all waste removal and non-interference with residents, flora and wildlife. Dog and cat Owners must provide proof of rabies vaccination. All pets (including cats) must be on leash when outside of the dwelling. Cats must be kept indoors so as not to disturb the wildlife.
- 5.4.3 The feeding of native animals and mammals in BIB is strictly prohibited.
- 5.4.4 The use of chemical fertilizers for landscaping is prohibited. Compost and natural mulches are permitted.
- 5.4.5 NO more than 3 vehicles per owner will be allowed on the site. These are all to be properly licensed, insured, and in running conditions.
- 5.4.6 4 stroke, licensed and insured ATVs and motorcycles allowed solely for transportation, not recreation. All drivers must be 16 years of age and older. Two-stroke vehicles are not permitted other than work tools.
- 5.4.7 Quiet golf carts are permitted.
- 5.4.8 Incandescent light bulbs are not permitted. Where possible LED lights should be used.
- 5.4.9 Once Construction has started, owners will have 18 months to complete their construction.
- 5.4.10 **BURNING:** No burning is allowed during dry season. All fires should be constantly supervised, and not causing inconvenience to others.
- 5.4.11 **HUNTING AND FIREARMS:** No hunting or discharge of firearms

shall be conducted within the subdivision.

- 5.4.12 **COMPLIANCE WITH LOCAL REGULATIONS:** No pier or jetty be constructed without a permit from the Physical Planning Department of the Lands Department. Construction approval must be obtained through the EAB and the Central Building Authority.
- 5.4.13 **ENFORCEMENT:** Enforcement of these restrictive covenants shall be by legal proceedings, or in equity against any person or persons violating or attempting to violate any covenant. Such enforcement may be by the owner of a lot, the Vendor, or his successor(s).
- 5.4.14 **AMENDMENTS:** These Restrictive Covenants may be amended by a majority vote of property owners, with one vote per lot owned, or by the Vendor or his successor(s). In the event that a property owner is already into construction when amendments are made, he/she shall be governed by the Restrictive Covenants in effect at the time he commenced construction. Amendments may be distributed to owners at the latest address on record. Property owners shall at all times provide a current address.
- 5.4.15 **SAVINGS CLAUSE:** Invalidation of one or more of these covenants or restrictions for any reason, shall not affect any other covenant or restriction. All other covenants and restrictions shall remain in full force and effect.
- 5.4.16 **COMMERCE:** No commercial activity shall be conducted on properties that are not officially designated as commercial lots. No signs, billboards, or other erection for the purpose of advertising or giving notice shall be erected or placed within the subdivision unless approved by the EAB or his successor(s). Please see official plan for Commercial and Multi Unit lots. No commercial activity shall be conducted without the Vendor's approval in writing. The Vendor shall have the right to refuse any commercial activity if it is offensive or a nuisance to other homeowners.
- 5.4.17 **EASEMENTS:** All "public easements" in Better in Belize are designed to give free access to the public. No structure shall be erected within the 66 feet reserve on the Macal River frontage, or on the access easements without the proper permit obtained from the Lands Department. All vegetation along the bank of the Macal River, shall be maintained in its natural state, but be kept clean and clear of synthetic debris. Bare areas may be beautified with plants that are indigenous or compatible with the natural environment for at least 66 feet from the river bank. The respective Green Space in front of the lots 114 through and including 128 at Better in

Belize to the 66 feet reserve is for the sole use of the respective lot owners.

- 5.4.18 There must be a utilities easement of five feet along the inner sides of all the property lines which front a road right-of-way.
- 5.4.19 All building plans need the prior written approval from the EAB and the Central Building Authority. 2 sets of Site Plan, Floor Plan, and the Elevations of Front, Back and Sides view shall be submitted to EAB for approval before construction can start.
- 5.4.20 **ROAD ACCESS AND MAINTENANCE of ROADS AS WELL AS OPEN SPACE:**
The forty-foot road reserve is also declared a public easement and shall therefore be kept clear and accessible. The road right-of-way is not to be used for storage of construction materials or trash. The natural drainage of the road right-of-way is not to be blocked and a proper culvert shall be installed at the owner's expense. A "Community Maintenance Fee" shall be payable by Purchaser to Better In Belize Ltd for purposes of maintaining roads, and open spaces, and providing general administrative services for the maintenance and operation of the subdivision. The details to this will be laid out in the Annual Home Owners Association report. The Community Maintenance fee is currently approximated at \$1000 USD per year per lot and shall be paid at the beginning of each year and prorated at the closing. The Purchaser agrees that a late fee of 1 % per month is due on any outstanding balance of Community Maintenance Fees. The Purchaser hereby agrees that his land shall be equitably charged in favour of the EAB as security for all outstanding amounts with respect to Community Maintenance Fees, late fees and collection or legal costs.