

**ENVIRONMENTAL AND SOCIAL MANAGEMENT
PLAN, ESMP**

FOR

**ARUNDO DONAX RENEWABLE BIOMASS PROJECT
FOR BELIZE**

FINAL DRAFT

Caribbean Community Climate Change Center - CCCCC

**Belmopan
April 2020**

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Published by Caribbean Community Climate Change Centre, Belmopan, Belize

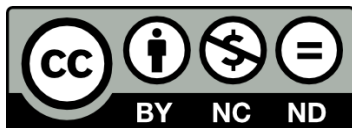
Digital Edition (October 2020)
Printed Edition (October 2020)

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ISBN-13 978-976-8269-57-7 (paperback)
ISBN-13 978-976-8269-58-4 (pdf)



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DELIVERABLE III: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

1.0. SUMMARY IMPACT ASSESSMENT AND PROPOSED CONTROL AND MITIGATION MEASURES

1.1Introduction

The Caribbean Community Climate Change Centre (CCCCC) with support from the Green Climate Fund (GCF) has embarked on the project “Arundo Donax Renewable Bio-Mass Fuel for Belize”. Several documents in connection with this project have been prepared, including a feasibility study, a stakeholder analysis, and a risk management plan and other relevant documentation. The Centre has also embarked to supervise the preparation of the “Environmental and Social Impact Assessment (ESIA) and Preparation of an Environmental and Social Management Plan (ESMP).

This ESMP is being prepared to outline key potential impacts and changes to the environment; and to propose actions to mitigate and address these issues utilizing practical and concrete approaches that can be verified with measurable indicators and a realistic time scale by participating partners of the project.

The ESMP is structured to address a description of all proposed environmental and social control, mitigation and compensation measures; and will address risks identified. Social components include community engagement, worker’s health and safety and community redress. It also includes the socio-cultural environment, with proposals to address the mitigation of issues arising from components such as the economy, employment, community, and cultural resources. This is addressed during the planning, construction and implementation phases. The ESMP will also make provisions for compensation through a redress mechanism for any grievances that may arise. It will provide the project management with guiding footprint to foster community health and safety and worker health and safety, while promoting sustainable development and a healthy working environment.

Environmental components include the terrestrial, aquatic and air quality of the area of influence. For each component, the mitigation and management activity, measurable indicators and responsible party, time frame, budgetary allocations required and frequency (for monitoring and reporting etc.). These measures are also divided into the planning, construction and implementation phases. A brief decommissioning phase is also included.

The ESMP also includes a summary of proposed mitigation and compensation actions, with a summary of the requirements of the Performance Standards (PS) of the GCF process.

The ESMP includes planned environmental and social monitoring plans for all phases. It is followed by the It also includes a component addressing Health and Safety of the community, and employees. The plan also includes monitoring protocols and standards.

Important components also include emergency evacuation plans, and a disaster management plan.

The entire operations include: (1) Cultivation and Rapid surveys – (land preparation, planting, and fertilization (with locally composted soil), harvesting, transportation); (2) Processing, (biomass handling, preparation by grinding, drying, and storage; (3) Co-generation (at the Belcogen Plant) using steam turbines from bagasse burning (bagasse storage and transportation to boilers using conveyors, steam from boilers to move turbines for electricity generation, and use of heat exchanger to recover heat from flue gases); (4) Treatment systems (sewage from domestic waste, water treatment of intake water from creek for domestic use and washing of equipment, and treatment of all mill waste using anaerobic decomposition). Throughout the process, best practices, which will include water management, will be implemented to reduce demands for water intake. Similarly, waste from filter cake and vinasse (from sugar processing) may be used to ferti-irrigate the *Arundo donax* farm. This will require the reduction of fertilizer input. All processes will be mechanized, ensuring that no burning of fields will be necessary, thus minimizing environmental impacts.

The ash from the boilers is the black solid residue left after burning bagasse in the boilers. The normal practice of disposing this by-product is to mix this with filter cake and use as soil conditioner.

1.2 Proposed Environmental and Social Control and Mitigation Measures - Summary

1.2.1 Purpose

The basic objective of the impact assessment is to provide a means to integrate environmental factors that would enhance project planning and execution. The assessment will measure the environmental impacts through an approach using criteria-based factors and with a view of preventing adverse environmental impacts while promoting the beneficial effects of the project. The assessment also intends to identify those impacts which are likely to be generated by the implementation and operation of the project and to evaluate, as far as possible, the causes and effects of these impacts and their consequences on the environmental and social structure. It also sets a benchmark for those parameters that would be impacted so that their subsequent monitoring would give out indicators on their status, whether there is a decline in quality or there are no changes. Standards, guidelines and other regulatory policies and framework are also identified with the objective of fulfilling the requirements towards mitigation and avoidance of impacts following such standards, guidelines and regulatory framework.

The impact assessment will follow the standards of the GFC, AE and ESS as stipulated in Task 3 of the TOR. These standards have been set to assess the project's impact on the construction, operation and maintenance activities. The standard format is to rank and prioritize all potential impacts and their associated hazards and associated risks. The key components to impact assessment include:

- Supply chain to keep the project on going.
- Development of an Assessment Criteria to be used as a ranking scheme for the activities and its related impact.
- Identification of all the impacts related to land clearing, biodiversity, water resources, and socio-cultural changes, community and employee health and safety; among others.
- Identify social impacts to communities and workers; and to establish environmental health and safety guidelines and redress mechanisms.

1.2.2 The Likely Impacts of Undertaking the Project

Any development irrespective of the nature of the undertaking would generate impacts. There can thus be either direct or indirect impacts both qualitatively and in terms of quantity on the physical aspects of the environment, namely land use, soil and geology, flora, fauna, air quality, water quality, noise and the landscape. The impacts could also be reversible or avoidable or a combination of both depending on the nature and complexity of the project. Apart from the impact on the physical environment this undertaking will have a positive significant impact in the energy sector as well as the socio-economic aspect which include employment, reduction of carbon emission among others. An assessment of the likely impact of the project on these environmental components has been carried and elaborated in greater detail.

Chapter 4.0 of the ESIA evaluates the level that the A. Donax Project complies with the interim GCF Environmental and Social Performance Standards. These measures will be included in the ESMP. They are described in greater detail in Chapter 4.0 of the ESIA, and summarized here together with a cost estimate and implementation arrangements, in chapter 2.

1.3 PS1: Assessment and management of environmental and social risks and Impacts

Objectives

The objectives of the GCF PS 1 are to:

- (a) Identify funding proposal's environmental and social risks and impacts;
- (b) Adopt mitigation hierarchy: anticipate, avoid; minimize; compensate or offset;
- (c) Improve performance through an environmental and social management system;
- (d) Engagement with affected communities or other stakeholders throughout funding proposal cycle. This includes communications and grievance mechanisms.

According to the IFC Guidelines (IFC, 2012), PS 1 *underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders*

The following paragraphs summarizes the extent of project compliance with the requirements of PS1, and identifies gaps, and measures that will need to be applied.

1.3.1 Identification of Environmental and Social Risks and Impacts

The potential impact assessment (Chapter 4 of ESIA, and at the end of each environmental and social Diagnostic), has identified the areas where detailed impact assessment is required. The detailed impacts will be assessed in the sections devoted to each PS; and outlined in tables and matrices.

1.3.2 Mitigation Hierarchy

The GCF requires that as described in the ESS standards, "Mitigation hierarchy", are *standards that set prioritized steps for limiting adverse impacts through avoidance, minimization, restoration and compensation as well as opportunities for culturally appropriate and sustainable development benefits*. The mitigation hierarchy aims to:

- (i) Anticipate and avoid adverse risks and impacts on people and the environment;

- (ii) Where avoidance is not possible, adverse risks and impacts are minimized through abatement measures;
- (iii) Mitigate any residual risks and impacts; and
- (iv) Where avoidance, minimization or mitigation measures are not available or sufficient, provide remedy and restoration before adequate and equitable compensation of any residual risks and impacts; (GCF, Environmental and Social Policy 2018).

An example of the mitigation hierarchy was implemented during the site selection process, whereby a site with vulnerability such as flooding and accessibility challenges was eliminated, thus using the avoidance technique. The reduction of proliferation of the species being cultivated is to be minimized through various management regimes to be tested as a separate project; but which will serve to ensure community trust in that the species will not become a nuisance to nearby agro-productive lands.

1.3.3 Assessment of Alternatives

Land Acquisition, Location and Species selection

Within a national and regional context, the use of the 400-acre area for production will therefore have minimal impact on biodiversity for a number of reasons. It is not located near a Key Biodiversity Area or Protected Area, it utilizes marginal land that would otherwise not be utilized as it is not suitable for agriculture, consists of an ecosystem that is abundantly available in Belize, and identified as an area of limited biodiversity value. While the biodiversity impacts are small, the proposed *Biomass Pilot* will lead to a positive impact in addressing climate change as it will contribute to the process of carbon sequestration and possibly the reduction of Greenhouse Gases since the biomass can burn cleaner than bagasse itself.

With respect to project planning and choice of cultivation species are fundamental decisions that undergo planning alternative considerations in order to increase the possibility of project success. Other socio-economic factors taken into account during project planning included haul distance of the crop, the availability of existing access roads and the avoidance of roads that are visibly more populated.

Integration of Ecosystem

Overall, the project's planning includes the various ecosystem components through integrated land management of its physical resources, biological resources, community setting and its biological components. Alternative crop cultivation was considered but eliminated as a result of the technical capacity of the incineration of a/ donax as the cleaner crop from those considered to supplement the bagasse.

Transportation Alternatives

Alternative transportation routes were considered based on the existing community setting with the objective of using the least populated route, which would reduce the social and environmental impacts of transportation to and from the site. These sites were pre-determined by the location of the Belcogen power generating plant at Tower Hill.

1.3.4 Environmental and Social Management System

The project aims to contribute to the reduction in vulnerability to climate change through the contribution to carbon sequestration, and the reduction of burning of bagasse that does not burn as clean as the *Arundodonax* plant. In this respect, even at the community level, the reduction of particulate matter and other noxious substances will be realized since the combustion of *A. donax* would lead to a cumulative reduction of substances emitted into the atmosphere.

While the biodiversity impacts are small, the proposed *Biomass Pilot* will lead to a positive impact in addressing climate change as it will contribute to the process of carbon sequestration and possibly the reduction of Greenhouse Gases since the biomass can burn cleaner than bagasse itself.

Since the project will be beneficial in terms of contribution to carbon sequestration, technology transfer, and the creation of employment and other positive economic outcomes; the community will share net benefits, while the project management will be able to apply the Environmental, Health, and Safety Management Systems. This includes a comprehensive OHSP that is incorporated in greater detail in the ESMP.

1.3.5 Emergency Response

After a risk analysis, the Arundo donax project has incorporated various emergency response mechanisms including: 1) Emergency Medical Evacuation, 2) Natural Disaster Management Plan, (including a hurricane plan, fire plan, and flood contingency plan), 3) Emergency Evacuation Plan of the Premises, and 4) Collection, Storage, and Transportation and Disposal of Substances, including fuel and oils. These management systems are prepared in draft format so that project management can update and which follows local regulatory framework, including guidelines and standards.

1.3.6 Stakeholder Engagement and Grievance Mechanism

Although the project is being planned within an existing agro-productive ecosystem setting, it does consider stakeholder engagement and a grievance mechanism. Stakeholder engagement has involved other stakeholders in the energy sector (BEL), among which are assisting financially to facilitate trial plots to complement the project, and the technical preparation of such trial plots is also being done through regional institutions such as CARDI and SIRDI.

At the community level, a small committee is being formed that includes a representative of the

A. Donax project, village council members of the three nearest villages, a representative of the Agriculture high school in the village nearest to the project, and representatives of the Ministry of Agriculture. This advisory committee is being structured to facilitate community communication, participation, and will also serve as the redress committee through which any grievances will be addressed. This group will also serve to supervise pilot projects in solid waste management (including separation at source, recycling and re-use, and transportation to the designated transfer station, which is also being planned through the Solid Waste Management Authority.

Further community participation will be identified and led by this advisory group.

1.3.7 Summary of Stakeholder Engagement Activity

This engagement activity was commenced at project planning through the preparation of stakeholder Management and Engagement Plan, and Stakeholder Gender Analysis and Action Plan. Stakeholders identified through this process were contacted; and the stakeholder group expanded and updated as the consultation process progressed. Primary stakeholders such as those from the energy and co-generation sectors, the research institutions, government policy makers and other organizations with technical expertise were kept informed and updated of the advancement of the various stages of the project and of the ESIA. One on one consultation meetings were carried out with this sector, as well as with community leaders of villages nearest to the project. Community engagement also included from schools and from local regulatory institutions.

1.3.8 Consultation Meeting

A consultation meeting was held at the local high school named “Belize High School of Agriculture”. Staff from this institution is keenly interested in the project, and will serve in the capacity of a member of the technical advisory group, discussed above. This stakeholder was involved in communicating with the local communities with respect to the details of the consultation meeting.

The consultation meeting was well attended. There were in excess of eighty (80) participants from nearby communities, in addition to other stakeholders. Most of the concerns were at a technical level, and their local knowledge of the site has contributed to the advancement of the research teams.

1.3.9 Social Impacts of Project

There are various potential negative social impacts that were identified during preliminary investigations, and during the course of the ESIA preparations, which were elaborated and summarized herein. Positive impacts from the project such as carbon sequestration, economic benefits from direct or indirect energy benefits, technology transfer etc. were not elaborated in this section.

During the scoping exercise several key issues were identified based literature research, and

validated through the consultation process. These were primarily described in the Gender Analysis and Action Plan as well as the Stakeholder Management and Engagement Plan and the risk analysis. Some issues identified and being areas of focus during the ESMP elaboration are as follows:

1.3.9.1 Agriculture and Food Security

From the perspective of the stakeholders the main concerns relate to the following:

- 1) The potential for the conversion of land currently under cultivation for food crop to be used for the production of A. donax. In this regard the Ministry has indicated that it could not be supportive of an industry that would see large-scale land conversion as it would undermine food security.
- 2) The perceived need to understand and guard against potential negative impacts of having A. donax cultivation in close proximity with sugar cane crop, with specific questions and assertions being- a. Whether there is a possibility that pests that are harmful to sugarcane and being effectively controlled will find safe haven among the A. donax plants, thereby undermining control measures.
- 3) Whether there is a possibility of cross-pollination.

These potential impacts are being addressed through engagement of the Ministry of Agriculture as the lead policy making body for the Agriculture sector in Belize; along with the Ministry of Natural Resources that is responsible for allocating land resources. Through piloting research projects, and community engagement and communication and reporting, the techniques relating to prevention of the proliferation of the A. Donax crop as well as means of integrated pest management shall be elaborated.

1.3.9.2 Resource and Risk Management

Once again, the issues raised by the sector with respect to resource and risk management highlights the importance of the focus on an ecosystem approach is the aim of project implementation and management. The most critical resource use issues that arose relate to land and to potential ecological impact of A. donax, as described below.

a) Land Use

- 1) To utilize only marginal lands for A. Donax plant propagation.
- 2) Interest in the location and tenure status of the plot.
- 3) Definition of marginal lands.

b) Environmental and Ecosystem Health

Stakeholders are acutely aware of the need for careful management of the A. donax crop to avoid unintentional propagation. Some specific issues and recommendations related to risk

management are set out below.

- 1) Respondents from the Ministry of Agriculture, the Forest Department, SIRD, cane farmers association and the community focus group meetings have all flagged a need for a clear exit strategy, should the A. donax cultivation not prove viable. Based on the various questions and recommendations in these discussions, the strategy should clearly outline the measure to be taken to remove any A. donax completely.
- 2) The view that although the plant is hardy, the fact that it tends to propagate in riparian and low-lying areas may be an indicator that its water consumption may be high.
- 3) Use of harvesting technique that would involve burning as this would result in emissions.
- 4) Question of measures to be taken to ensure the protection of sugarcane crop, as they have experienced that the root system threatens the survival of the sugar-cane.

The mitigative actions for the land use issues as well as ecosystem management issues are expected to be led through a series of pilot test plots that will focus on plant propagation techniques with the aim at identifying resource conservation (water, soil, fertilizer etc.); crop management, integrated pest management and control as well as methods of extermination of the plant if and when the life of the project comes to an end. This will be an on-going research, which is being partly funded by the Belize Electricity Limited, and which is considered complementary to the project but should not depend on potential budgetary allocations from GCF. Nonetheless, due to issues raised, these complementary research activities are considered critical in the support of community confidence, community involvement and participation and stakeholder participation and ownership of the project.

1.3.9.3 Gender and Resource Control

Assigned gender roles within the communities of the North are transitioning, yet control of resources continue to reflect the traditional arrangements. The following are identified key components of the gender roles and relationships that have bearing on the economic life of the communities.

- 1) There are virtually no women on the board of the cane farmers associations despite the data on registered cane farmers drawn from the Sugar Industry Management Information System (SIMIS) show female cane farmers make up 40% of the total number registered.
- 2) Where women are actively engaged in managing or working their own farms, they are recognized as being highly effective, mainly because they are disciplined about following good agricultural practices and are seen as good financial managers.
- 3) Women are heavily involved in managing the finances of the cane farming businesses and are observed as being the main ones who do banking for the families' farming business.

While the project itself may be too small in terms of its economic and job creation potential, gender equality will be a standard policy during the selection process for employment and during the community and stakeholder participation of the project. Indirect activities that may arise from project implementation and management will also consider the issue of gender equality, and should also be the focus of training and participatory activities associated directly or indirectly from the project.

1.3.9.4 Youth and Aging

It has been found that no persons under 25 years of age hold any position on the boards of any of the three cane farmers' associations, and neither do they form part of the village councils in the Yo Creek and San Lazaro communities, the two communities near the project. SIMIS data shows less than 5% of cane farmers under the age of 25, and those between 25 and 30 years of age account for less than an additional 3% of the total. Cane farmers aged 50 years and more make up 62.5% of the total number of registered farmers, indicating an aging industry and no clear succession planning.

Perspectives on the role of youth and contributors to their low involvement in cane farming include the education of children to move away from the cane industry, the prevention of new members of the cane farm industry from becoming members of the association (this was challenged by the association and now new farmers producing cane can join the association); the preference of youths to find office jobs, and the lack of technology that attracts young people in the industry.

1.4 PS2: Labour and Working Conditions

According to the IFC (IFC, 2012) PS 2 among other things, *recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.*

Objectives of PS 2

- a. To promote the fair treatment, non-discrimination, and equal opportunity of workers.
- b. To establish, maintain, and improve the worker-management relationship.
- c. To promote compliance with national employment and labor laws.
- d. To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain.
- e. To promote safe and healthy working conditions, and the health of workers.
- f. To avoid the use of forced labor.

Based on the findings, the following key issues as it pertains to Labor and working conditions in relation to the proposed Arundo donax project are as follows:

- The working environment and the need to support equal opportunity
- Occupational Health and Safety (OHS) risks and impacts of construction works

1.4.1 The Working Environment

Occupational risk and impacts associated with the project will be dependent on all phases of the production process. This includes the land clearing activities, planting, harvesting and processing, storage and delivery. In all phases, safety will be of fundamental importance in protecting the employees from the associated risks and as such the necessary engineering controls coupled with the safety tailgate meetings will be instituted. Personal protective equipment and other safety means will be portrayed to the employees via a sensitization and education campaign.

Potential Impacts

The potential impacts associated with human health and safety could include:

- Exposure to increase levels of noise
- Effects from application of and exposure to agrochemicals
- Increase dust and particulate matter
- Exposure to high levels of fuel vapors

1.4.2 Occupational Health and Safety Risks

These issues require both planning, documentation, training and on-going rehearsals and further training. During the day to day operations of employees the occupational health and safety guidelines with training is required but also other main activities presenting hazard risks identified include:

Chemical Application

Chemical application will include fertilizers and liming only since no pesticide will be used on site. Application will be done with a sprayer in the case of the fertilizers. When these activities are occurring, all other employees will be restricted from entering the affected area for the required period of time. Employees doing the application will be required to wear the appropriate personal protective equipment which includes rubber gloves, dust mask and goggles to name a few.

Shredding Process

The shredding of the dried biomass material will expose the employees to suspended particulate matter or dust created from the shredding process. This will be an ongoing activity and therefore the employees will be required to use dust mask to avoid inhaling the dust particles. If the situation needs further corrective measures, then vacuums will be installed to remove this dust from the workplace.

Fuel Dispensing

It is anticipated that the project will have small fuel storage containers onsite due to the project location which may call for the use of generators from time to time. Therefore, the dispensing area will be in an open area so to avoid vapor build-up, spill cleaning and easy access.

Noise

Impacts associated with noise emissions on the health of employees are unlikely to occur given the small number of vehicles and equipment being used. Occurrences will be extremely localized and will have minor consequences. If required (such as during harvesting) then ear protection devised will be required to be used.

Intense Labour

Agriculture production often requires strenuous labor that includes physical activity under hot and humid conditions. Workers' health becomes a priority during strenuous activity and during the peak of hot and humid days.

In addition to ensuring safe working conditions, the Occupational Health and Safety Plan (OHSP) has been drafted as a guide for which the project will continue ensuring that adequate

health and safety takes place and that health risks are reduced on the work site and off the work site.

1.5PS 3 Resource Efficiency and Pollution Prevention

According to the GCF and IFC, PS 3 *recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.* It also recognizes the growing global trend *that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations (IFC, 20112).*

The objectives of PS 3 are:

- a) To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities.
- b) To promote more sustainable use of resources, including energy and water.
- c) To reduce project-related GHG emissions.

1.5.1 Avoid Minimize or Reduce Project – Related Pollution

1.5.1.1 Waste Impacts

This type of potential impacts will include both the generation of **wastewater** as well as the generation of **solid waste** due to human occupancy at the project site.

The generation of solid waste on site can include discarded food waste, general garbage and refuse, equipment waste, and cleaning waste. These can attract wildlife animals to the area and cause a shift in the ecological balance in a way not induced by nature. The waste can also become a habitat for mosquitoes and other insect pests as well as become unsightly. This is especially so in the case of discarded used tires, containers and other waste materials.

Wastewater generation can cause nutrient enrichment from the injection of macro nutrients into the environment. This is as a result of the untreated wastewater stimulating plant growth on the land. If the untreated wastewater reaches a body of water, then the cumulative impacts could include increased BOD and nutrients in the water. This may also include the subsequent decrease dissolved oxygen in the Blue Creek. Therefore, there is a possibility of the wastewater entering the water body via the intended drainage network. Another wastewater source will be from the washing of the transportation equipment as a preventative measure. The trucks, equipment, harvesters will be washed prior to use thereby generating wastewater.

Potential impacts of waste impacts associated with the cultivation and harvesting project include:

- Pollution of water bodies

- Soil Pollution

Water Pollution

Water pollution can be derived from the generation of wastewater from the sanitary facilities as well as from the maintenance of the equipments. Wastewater generation can cause nutrient enrichment within a body of water making it unsuitable for recreation or domestic use.

The project will call for proper sanitary facilities to be constructed for the workers and administrative staff.

Soil Contamination and Health Risks

Soil contamination will be derived from the generation of solid waste materials as a result of human activities. These include food waste, wrappings, paper, boxes, etc. Collectively these are classified as domestic garbage. The unwanted accumulation and mismanagement of solid waste is what can lead to the soil contamination aspect in the form of hazardous leachates. Furthermore, vector diseases such as malaria can be propagated from discarded waste such as used tires and containers that can hold water.

1.5.5.2 Air Quality Impacts

Air quality impacts will range from the cultivation of the biomass material, its processing (drying and shredding) and transportation to the BELCOGEN facility as well as the actual burning of the biomass material to generate energy. Suspended particulate matter or dust pollution will be generated as a part of the cultivation, processing and transportation of the biomass material. Added to this will be generation of vehicular emissions in transporting the material. The suspended particulate matter will become more problematic as the shredding process occurs in the storage area. Fine particulate matter can cause respiratory illnesses as this process takes place.

One positive outcome is that the burning of the biomass material will result in cumulative cleaner emissions than the combustion of bagasse alone that is the current practice. Notwithstanding, the burning of the biomass material to produce energy will generate CO_x, NO_x and some SO_x as part of the combustion process in addition to particulate matter such as ash.

Potential Impacts

Impacts associated with the air quality include the following:

- Suspended Particulate Matter or Dust
- Wildfires and Waste Burning
- Exhaust emissions

- Combustion Emissions

Suspended Particulate Matter

This issue has been covered before and includes dust particles generated during the land clearing activities as well as the harvesting of the biomass material. Fine dust particles are generated when the harvester is cutting the biomass material and dumping it into the trailer. Similarly, during the shredding of the biomass material after it has been dried. Dust is also generated during vehicular movement in and around the area because of road conditions.

Exhaust Emissions

Emissions will be produced from the movement of heavy equipment, transportation of personnel and of the biomass material. Uncontrolled vehicular exhaust and potential fugitive emissions will impact the localized air quality. The quality of fuel and the condition of the equipment all play a key role in the generation of exhaust emissions.

Wildfires and Waste Burning

Wild fires and the inadvertent burning of the solid waste materials will generate air pollution that can impact the air quality. This will most likely be in the form of smoke. Furthermore, there is the potential for respiratory illnesses if exposed too much of the smoke. Wild fires are a natural occurrence; however, it will be contained within the buffer zone by the fire pass barrier.

Increase Emission due to burning of the Biomass Material

Contamination and the uneven drying of the biomass material can impact the combustion process resulting in an increased ash and slag content. Contamination can result from the over fertilization and liming process thereby increasing the mineral composition of the biomass material resulting in higher ash contents (Si, K, Ca, N). Contamination can also result from the handling of the biomass material. A higher water content due to uneven drying will definitely impact the combustion process.

1.5.2 Sustainable use of Resources, Including Energy and Water

The project layout does not call for the use of extensive energy demanding appliances. Energy is needed primarily in the form of electricity for lighting the compound and for powering small appliances. Small amounts of energy are also required from liquid petroleum gas for cooking and lighting of warm beverages mostly to be needed for the comfort of on-site personnel. Electricity generation produces emissions that albeit in small demands do contribute cumulatively to the national emissions of greenhouse gases. Some of Belize's electricity demand is produced by diesel powered generators, considered to be among the highest pollutants. Although the project's demands for electricity will be small as explained earlier, cumulative impacts can be reduced through energy efficiency that includes the design of the worker's quarters and drying buildings, and the use of solar powered electricity for the compounds. The

drying sheds should be constructed with energy efficient open areas that allow drying to be facilitated by winds as much as possible, and possibly using sunlight to reduce electricity demands of drying by using large fans.

Most of the energy will be required from fossil fuels that will power vehicles and large equipment. Using energy efficient equipment will be important, but also the limit of the use of these types of equipment will be important in reducing greenhouse gases and the emission of noxious substances into the atmosphere.

1.5.3 Reduction of Project Related GHGs

As outlined above, the project does not call for significant processes that result in important increase of ghgs. However, the use of equipment that uses non-renewable carbon emitting fuels and oils will be inevitable, but should include management practices reducing the time of equipment use and the use of efficient and functioning equipment.

One such equipment that will be needed will a stand - by generator which uses petroleum – based fuels and oils. This generator will only be used during power failure and if energy is needed. Other equipment that will use this type of energy is small weed eaters, land mowers or riding mowers. Compressors and domestic appliances due use electricity or LPG. LPG power generated equipment is preferential over those that use carbon emitting fuel sources.

1.5.3.1 Water Resources Impacts

The 400-acre project site designated for cultivation is not adjacent to a water source that does not allow water use such as irrigation from freshwater sources without prior collection, transportation and storage.

The water that will be utilized for cultivating the crop will be natural rain water that will be retained within the project area and prevented from drainage outside the construction of a buffer zone road access barrier. No water will be utilized from the nearby Blue Creek, nor will any water from the project be drained into the creek. This creek has characteristics of salinity intrusion, which although the A. Donax crop is somewhat salt tolerant, other native species are not. However, drainage will be constructed to adequately distribute water and also clear used water from washing machinery and equipment. The water will drain and remain within the 400-acre project area contained by the buffer zone. The Buffer Zone will also serve to minimize potential flooding of the fields during the rainy season and as a fire break to prevent any external wild fires to impact the project area. The project will dig a single small well for supplying water for washing machinery and equipment as well as other uses. A water storage tank will also be installed to capture rain water, and to minimize the use of well water for washing the machinery and equipment and for the use of project personnel. Should the tank or the well run out of water during the dry season, water will be transported from the nearest village, San Lazaro, about 7 miles away.

All transportation equipment will be washed before, moving off site. Washing will be done

within the premises of the project area at the smaller plot at the designated central work location, which will be supplied with water from a well/tank on the premises. The used wash water will drain but will be contained due to the elevated buffer zone and drainage design.

Surface Water

The Rio Hondo is the biggest water body closest to the project site. The Blue Creek is the nearest creek that is about 830 meters away from the project as previously mentioned, but which borders part of the property towards the northern end. Water runoffs from the project will be controlled however, the potential surface water impacts due to project related activities are limited to the following:

Sedimentation of retention ponds and drainage areas

The project will construct a buffer zone to minimize potential flooding of the fields. This same buffer zone will serve to prevent outside drainage. Pollution through increased sedimentation of the natural flow and drainage paths in the vicinity of the project area could result in the lack of fresh water available for native fauna. Without appropriate control measures, sedimentation from erosion caused by surface water run-off from project- related infrastructure may occur (prepared soil and roads).

There is also the possibility of processed water percolating through to the groundwater body. A retaining system of ponds will be installed to reduce this risk, and a leach field with a constructed wetland will be installed for re-use of domestic gray water. One area that slopes towards the creek becomes partially inundated during the peak of the rainy season, but the majority of the property is not prone to flooding. The area, including the access road is not within the flood risk zone of this part of Orange Walk.

- Contamination of water bodies and drainage paths

Chemical contamination from project-related activities to existing surface water bodies and drainage paths by the project can result in contamination of fresh water stocks available for native fauna. Contamination could occur from fuels and hydrocarbons stored and dispensed onsite necessary for land preparation, harvesting, and transportation. Runoff from fertilizer and pesticide application can also contaminate these surface waters.

- Sedimentation of buffer zone (barrier) and drainage paths

There will be a constructed buffer zone within the project area. The buffer zone will be sited so as to collect all surface runoff from the property. This water will then be used for irrigation purposes.

- Contamination of retention ponds and drainage paths

The use of agrochemicals can lead to the accumulation of residues in surface water. The project

intends on applying natural fertilizers as a means of compensating for the poor agricultural soil quality. The project will use lime to balance the soil acidity. Fertilization will be applied as required and needed by the project. There will be no pesticide application.

Groundwater

The primary objective is to ensure there is no impact on existing users due to a reduction in access to or quality of groundwater resources as a result of the proposed operation. Potential environmental impacts as a result of groundwater abstraction could include:

- Contamination of groundwater from fuel leaks and spills or contaminated surface water run-off from Project infrastructure or wash down areas.
 - Contamination of groundwater from the vertical seepage of irrigation water containing agrochemical residues.
- *Reduction of available groundwater quality and quantity*

There are no active groundwater supply wells within project area itself. Within the project area, therefore, there are no ground water users that will be affected. However, within the village boundaries, the use of well water is an important source for domestic use, primarily for washing. While the project site slopes away from populated areas, care must be taken to monitor the risk of introducing contaminants into the aquifer and not to impact its quantity beyond sustainable levels.

Contamination of groundwater from fuel spills/leaks and contaminated surface water run-off

Potential oil leaks/spills may travel vertically through the soil. The well will be sealed and protected. However, if contaminants do enter the local aquifer, they would be of a small quantity and any environmental effects due to this contamination would be insignificant, it must be monitored.

Contamination of Groundwater from processed water

Contamination of groundwater by washing water has low possibility but requires monitoring.

1.5.4 Waste Management

Liquid Waste Management

Waste water management will be done by a septic system with a leach field and a constructed wetland. This system will treat domestic sources of wastewater and will also treat the gray water from washing of floors and equipment.

Solid Waste Management

Solid waste management will include a written management protocol that will include the separation at source of solid wastes, temporary storage and transportation to the transfer station. This solid waste management system will eventually become part of the solid waste pilot project that will be overseen as a community initiative at the local high school. It will serve both to increase waste management and increase separation of waste destined for recycling from non-recycling waste, and will serve to promote behavioral changes in the community aimed at the promoting of environmentally friendly practices that will lead to net benefits including the reduction of greenhouse gases from inadequate waste disposal. Similarly, a compost pilot project will also be initiated at the high school which will also aim to reduce biologically degradable waste volumes from entering the waste stream; thereby also contributing to a reduction in the production of greenhouse gases by introducing compost systems that are proven to be more efficient in the emission of such ozone depleting gases.

1.6PS 4 Community Health, Safety and Security

The GCF/IFC Performance Standard 4 *recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.*

Objectives:

- a) To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances.
- b) To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.

Potential project Impacts to the health and safety of the communities were identified as two main concerns:

- 1) The possibility of escape of the A donax species being cultivated and as a result for it to threaten crops and degrade lands.
- 2) The risk of pest infestation (including weeds) from the propagation area.
- 3) The possible fire hazards that may result from uncontrolled or accidental fires during harvesting or other operations.
- 4) The risk of spills from the transportation of substances, materials and equipment during project implementation/

Introduction of Pests and New Weed Species

Vegetation clearing, land disturbance and vehicle movement has the potential to increase weed populations or create conditions that are favorable for the establishment of weed species within the Project area. Vehicle and equipment movement also has the potential to introduce weed species, usually these are resistant strains that get accustomed to dust conditions and often line the roadways. There is also the possibility that the cultivation zone may form habitats for pests that may form nuisances to the communities.

Risk of fire hazards

Uncontrolled burning of weeds or excess plants may result in fire escapes. These may impact properties owned by members of the community or may also pose other health risks from smoke inhalation, and even physical harm from fires.

1.6.1 Transportation Impacts

The transportation can be described in two stages and includes the transportation of the Arundo Donax from the fields to the storage area and from the storage area to the BELCOGEN Plant for processing. It also includes the movement of vehicles to and from the worksite including heavy equipment. The impacts include the unwanted proliferation of the biomass material due to spillage along the transportation routes, traffic accidents, dust proliferation and potential for 'road kills. The first stage considers open end tractor trailers that are subjected to unpaved roads and the potential for pieces of the material to fall on the ground.

There is also a potential impact for the chipped and shredded biomass material to spill on the road when heading to the Plant. The project calls for locked containers and the impact can be forgetting to lock the container, purchasing faulty locks and faulty container doors. Other minor generalized impacts associated with transportation include dust proliferation, noise generation and potential air pollution. Improperly planned routes can also pose a problem, especially when transporting in sensitive areas such as creeks or streams.

- **Traffic**

Potential environmental impacts as a result of traffic and transport could include:

- Traffic accidents
- Accelerated degradation of road surfaces
- Increase in native fauna deaths

- *Traffic Accidents*

Appropriate signs will be placed around the access site. Additionally, the access road will be constructed so that there is visibility to traffic from both sides.

- *Accelerated Degradation of Road Surfaces and dust proliferation*

The access roads will almost certainly suffer from wear and tear; however, this is a natural consequence of its use and the project will implement a road maintenance plan. Wear and tear is expected to cause minor damage to roads and tracks; which will be easily remediated with appropriate road maintenance procedures.

- *Risk of collision with domestic or other animals*

Increased vehicular movement always increases the risk of collision with animals, either domestic or other. This may pose hazards to drivers and motorists, but may also result in the loss of pets or agriculture value animals. This situation can best be addressed through controlled worker health and safety practices, and in unavoidable situations, through the redress mechanism.

1.7PS 5 Land Acquisition and Involuntary Resettlement

This PS *recognizes that that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land.*

The objectives are as follows:

- To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs.
- To avoid forced eviction.
- To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost⁴ and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.
- To improve, or restore, the livelihoods and standards of living of displaced persons.
- To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure⁵ at resettlement sites.

This PS has been fully addressed during project planning. Land acquisition concerns have been raised but have been addressed as follows:

- 1) The land is not considered productive agriculture lands; being classified as marginal and requiring significant investment for crop success. In this respect it fulfills the Government's policy of not using productive agriculture lands for the propagation of *A. donax* species since this can threaten food security.
- 2) The land was previously held by the Government, which assisted in identifying its

location based on characteristics not only suitable for A donax cultivation but also that was free of any citizen ownership, and which had only marginal use since trees with timber value had long been harvested through the informal market.

- 3) No citizen was residing nor using the lands for any purpose other than hunting, and the occasional harvesting of firewood.
- 4) The land does not have any immediate residential homes within any of its boundaries, and the nearest residences at adjacent farms are several kilometers away, and such the communities are several kilometers away.

Therefore, there was no need for compensation, or relocation of any citizen, and the development of the project will enhance the community well-being by increased economic activity, technology transfer, and waste management practices, and community involvement and participation in pilot projects. Nonetheless, this PS was still approached from the need to establish and maintain good working relations with the community and in building partnership in sustainable development initiatives within the zone of influence of the project.

1.8PS 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources

The GCF guidelines state that *Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard have been guided by the Convention on Biological Diversity.* It also considers the value of the ecosystem in providing services and sustaining livelihoods.

Objectives of PS 6

- a) To protect and conserve biodiversity.
- b) To maintain the benefits from ecosystem services.
- c) To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.

1.8.1 Potential Impacts to Flora and Fauna

Potential biodiversity impact related to flora and fauna are described below and are based on the description of the vegetation types present including those proposed quantities to be cleared.

Impacts to Threatened Species

Vegetation clearing may reduce the abundance of threatened flora species with consequent impacts to populations of threatened species at the local level.

Reduced Species Abundance

Clearing vegetation will be necessary during implementation of the Project. The clearing process will remove plants from the broader species populations in and around the area which may have adverse effects on plant species abundance on a local level.

Reduced Conditions Favorable for Plant Growth

Vegetation clearing, vehicle movements and day-to-day operational activities will generate dust. This has the potential to reduce conditions favorable for plant growth (e.g., reduction in photosynthesis and transpiration due to an accumulation of dust on plant surfaces or damage to plants from reactive dust particles) with subsequent reduced plant health.

Introduction of New Weed Species and Weed Infestations

Vegetation clearing, land disturbance and vehicle movement has the potential to increase weed populations or create conditions that are conducive to the establishment of weed species within the Project area. Vehicle and equipment movement also has the potential to introduce weed species, usually these are resistant strains that get accustomed to dust conditions and often line the roadways.

1.8.2 Residual Impact Assessment - Flora and Fauna

Residual impacts to flora and fauna as a result of the Project-related activities are as follows:

Impacts to Threatened Species

No species that are listed as threatened were found during the flora survey. This may be due to the fact that an area has been previously cleared coupled with the remaining marginal land does not contain any significant threatened species. Since these species are not present the probability of the project impacting on these species is insignificant.

Reduced Species Abundance due to clearing

Approximately 400 acres of vegetation will be cleared or impacted by the project that will be used for cultivating and harvesting. It is almost certain that species abundance due to clearing will be reduced. However, the consequence of reduced non-threatened species abundance is insignificant given their widespread occurrence in the region. The area is described as lowland broadleaf swamp and lowland savannah.

Introduction of new weeds species and increased weed density reduced Species Abundance due to clearing

New weeds will be suppressed by regular land preparation which will destroy these weeds. Where they are a problem during the growing season they will be removed by disking or by

spraying with an herbicide. There should not be an increased in weed infestation given the active planting taking place.

Reduced Conditions Favorable to Plant Growth Due to Dust

Given the nature of activities proposed, it is almost certain that some damage to flora could occur as a result of dust. This damage will be localized and temporary and generally having an impact on the grass buffers beside roads and drains. Therefore, the impacts of reduced conditions favorable to plant growth as a result of dust are likely to be minor. It is expected that vegetation affected by dust will recover quickly either from a rainfall episode or during irrigation.

1.8.3 Other Impacts Identified

Other potential biodiversity impact related to fauna is described below and is based on the wildlife surveys conducted as part of the investigations. Potential impacts are mostly to non-threatened native fauna species or communities as well as the potential for increase to introduced fauna species density and distribution within the project area. Only one species of conservation significance was identified within the project site, and this species is not considered threatened or endangered.

Reduced Species Abundance on Site

There is potential for species abundance to be reduced as a result of:

- Native fauna habitat destruction during clearance activities.
- Death of animals during construction activities.
- “Road Kill” deaths as a result of collision with project vehicles.
- Noise and traffic movement disturbing resident populations of native fauna (birds) within the Project area.
- Death of animals due to contaminated surface water.

Impacts to Threatened Species

During the site transects no species listed under the Critically Endangered List were reported in the project area.

Increased Abundance of Introduced Species

Project related activities have the potential to create conditions that may result in introduced species. This is unlikely to happen with the cultivation and harvesting of the *Arundo donax* as it is widely documented that these types of grass are inhabited by few animals including birds.

Impacts to Threatened Species

The likelihood for significant impacts to threatened or endangered species is unlikely, due to their absence in the project area. However, on a larger scale, the consequence of a reduction in numbers of threatened species in the region is unknown but could be potentially of some risk to the species and may result in changes to the known distribution of species on a local level.

Reduced Species Abundance due to clearing

It is almost certain that faunal species abundance due to clearing, traffic movements and land preparation work may be impacted since they are dependent upon the vegetation groups to be cleared for food or shelter. The consequence of reduced species abundance through loss of habitat is insignificant, however, given the high probability that fauna will be able to relocate to adjacent areas with suitable habitat as an avoidance measure, thereby being largely unaffected by operations.

Reduced Species Abundance due to contaminated surface water

Surface runoff will be contained within the project buffer areas as much as possible. However, there will be a drainage system to alleviate any flooding. Given the small amount of water to be used by local fauna it is unlikely that this will cause any adverse effect.

- *Increased abundance of introduced species.*

There will be no species introduced as a result of this project. Opportunistic pioneers who may find an adequate habitat may multiply rapidly. However, this would be short lived as these habitats would be regularly destroyed during harvesting.

1.8.4 Potential Impacts of Land Clearing

Potential impacts of land clearing on the current and future land uses without appropriate control measures include:

Removal of Topsoil

Land clearing activities will lead to the removal of over 80% of the vegetation. The land will be cleared using heavy duty equipment and the cleared vegetation will be shredded and returned to the land. If left too long, this topsoil can be blown away by the wind.

Increased Erosion

Removal of vegetation during the rainy season can result in an increase in erosion which can impact surface water within the project area.

Changes to surface water flow

Land clearing may result in changes to water flow as well as stream morphology due to stream

alteration from changes in topography.

Land Clearing Impact due to soil erosion

Impacts to land clearing caused by soil erosion are considered to be likely. When impacts occur, they will be localized and able to be remediated through re-forestation techniques to be determined based on monitoring.

1.9PS 7 Indigenous Peoples

The GCF/ IFC description of Performance Standard 7 states *that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population.*

In the country of Belize, particularly in this region, the communities may or may not fit the technical definition of indigenous groups. Although these communities have co-existed for generations in the area, they are integrated into the mainstream society and are not considered marginalized and are not displaced from their traditional lands. These communities form part of Belize's land holding citizens and trade lands and property on the free market as opposed to other indigenous communities elsewhere. Therefore, PS 7 has been described briefly as undertaking measures to prevent the exclusion of the communities from the project participation and plans seek to involve the communities indirectly through pilot projects and communication participation.

1.10 PS 8 Cultural Heritage

As per the GCF/IFC description of Performance Standard 8; *it recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.*

Objectives

- a) To protect cultural heritage from the adverse impacts of project activities and support its preservation.
- b) To promote the equitable sharing of benefits from the use of cultural heritage.

A preliminary archaeological and cultural assessment of a portion of the project site has been done. The report did uncover any findings of archaeological or cultural significance. Nonetheless, prior to land preparation and as part of land preparation, it is recommended that a

rapid ecological survey be conducted so as to ensure that there are no resources of archaeological or cultural significance.

2.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

2.1 Objectives

The EMP outlines the proposed mitigation and compensation measures identified as a result of the impact assessment, including the risk assessment. The objectives of the *Arundo donax* ESMP are to:

- Ensure conformity of the project with the GCF's environmental and social safeguards;
- Reduce and mitigate project-related adverse risks and impacts;
- Improve environmental and social management at the project site to guarantee that the CCCCC and partners implement the project as an alternative energy generation raw material source without generating adverse risks and impacts to the surrounding communities and ecosystems.

The outlined activities are brief but holistic to facilitate adoption and monitoring of the plan.

2.2 Overview of measures and costs

Table 1 provides an overview of the measures included in the *Arundo donax* ESMP. The ESMP budget is estimated as follows:

- Construction equipment \$30,000
- Rapid Archaeological assessment \$10,000
- Air and water quality equipment \$50,000
- Employee environmental training \$30,000
- Cultivation, air, water and noise monitoring \$80,000
- Cultivation mitigation \$30,000
- Management of social and cultural resources \$20,000
- Management of transport, handling and storage \$30,000
- Decommission monitoring \$40,000
- Land preparation \$100,000
- Land restoration \$200,000

Total cost is \$630,000.

The *Arundo donax* Project will identify synergies with other ongoing national cultivation efforts to secure best agricultural practices and showcase the project as an alternative source of energy generation for the region.

2.3 Detailed presentation of ESMP activities

The following pages provided detailed presentation of the activities.

Table 2.1 Summary of A donax Environmental and Social Management Plan.

Reference	PS	Activity	Responsible	Funding	Counterpart
2.3.1	PS1	Planning, Implementation, Enforcement and Reporting	Project Team Leader/Engineer/Staff/Permitting agencies/consultants		
2.3.2.1	PS8	Archaeological Assessment and Preparation for Construction	Project Team Leader/Archaeologist		
2.3.2.2	PS1	Land Preparation for Cultivation and Construction	Project Team Leader/engineer/workers/partners		
2.3.2.3	PS3	Basic Guidelines Established for Mitigation Against Air Quality Changes and Noise Pollution	Project Team Leader/consultant/workers/partners		
2.3.2.4	PS2	Establish Acceptable Working Environment for Employees and Community	Project Team Leader/project staff/social worker		
3.1.1.1	PS6	The Cultivation of <i>A. donax</i> with subsequent land use change	Project Team Leader/agriculture expert/workers/partners		
3.1.2.1	PS3	The Protection of Water Resources Against Pollution and Hydrological Changes	Project Team Leader/workers/partners		
3.1.3.1	PS3	Guidelines Established for Mitigation Against Air Quality Changes	Project Team Leader/workers/partners		
4.1	PS6	Long Term Cultivation Will Impact Biological Species	Project Team Leader/workers/partners		
4.2.1	PS4	Develop Social and Community Engagement Plan, Redress Mechanism and Reporting Mechanism	Project Team Leader/workers/partners		
4.3.1	PS4	Develop Plan, for Handling, Transportation and Storage of <i>A. donax</i> and Substances/Materials for Project and Solid Waste Produced	Project Team Leader/workers/partners		
4.4.1	PS6	Decommissioning and Closure of Cultivation Site and Supporting Infrastructure	Project Team Leader/engineer/workers/partners/authorities		

2.3.1 Planning, Implementation, Enforcement and Reporting

ESMP Activity 2.3.1 – PS1

Planning, Implementation, Enforcement and Reporting

Objectives: To ensure that documentation and permits are in place prior to construction; the project is responsibly implemented; guidelines are enforced and there is proper reporting

Responsible entities: Project Team Leader/Engineer/Staff/Permitting agencies/consultants

Activities:

- Comply with relevant legislations and building plans
- Properly supervise project implementation
- Enforce the ESMP throughout the project
- Deliver reports in a timely manner

Timeframe:

Before construction/during construction/project operation

Cost:

As per staffing requirements

Monitoring and Reporting

As per measurable indicators

Target

Reports throughout all phases are submitted as required in ESMP

2.3.2 Construction Phase

During the construction phase, including land preparation and resource mobilization, potential impacts may arise that require management regimes. This section outlines the objectives and potential impacts of the main activities, performance goals, followed by monitoring and management regimes and means of verification.

The activities outlined in the construction phase include:

- Preparation for construction (of small buildings and storage structure);
- Preparation for cultivation;
- Acquisition of construction equipment;
- Hiring of personnel; and
- Establishment of management protocols, procedures and safety guidelines.

ESMP Activity 2.3.2.1 – PS8

Rapid Archaeological Assessment and Preparation for Construction

Objective: To ensure that documentation and permits are in place prior to construction

Responsible entities: Project Team Leader/Archeologist

Activities:

- Compliance with relevant archaeological legislation
- Acquire and test construction equipment
- Identify and mark any area of archaeological value
- Train personnel to recognize and preserve areas of archaeological value

Timeframe:

Before construction

Cost:

As per staffing requirements

Equipment: \$40,000.00

Archaeological Assessment \$10,000.00

Monitoring and Reporting

As per measurable indicators

Target

The Monitoring Reports submitted as required in ESMP

ESMP Activity 2.3.2.2 – PS1

Land Preparation for Cultivation and Construction

Objective: To prepare the land for construction of associated infrastructure and cultivation of Arundo donax

Responsible entities: Project Team Leader/engineer/workers/partners

Activities:

- Ensure that soil erosion does not occur as a result of the daily activities on the plant, farms, and other areas
- Ensure that the soil is not compacted needing additional tilling
- Prevent water logging of soil through general irrigation/water management
- Ensure that nutrient value is recycled as much as possible
- Enhance soil resources through a buffer zone and local landscaping using native plant species

Timeframe:

Before construction

Cost:

As per staffing requirements

Land preparation \$100,000.00

Monitoring and Reporting

As per measurable indicators

Target

The Monitoring Reports submitted as required in ESMP

ESMP Activity 2.3.2.3– PS3

Basic Guidelines Established for Mitigation Against Air Quality Changes and Noise Pollution

Objective: To adopt practices to reduce air and noise pollution

Responsible entities: Project Team Leader/consultant/workers/partners

Activities:

- Properly maintain all equipment and monitor all emissions
- Ensure that ambient noise levels are kept to acceptable levels
- Ensure the minimization of visual clutter and the degrading of the visual quality of the immediate vicinity

Timeframe:

Before and during construction

Cost:

As per staffing requirements

Monitoring equipment \$40,000.00

Monitoring and Reporting

As per measurable indicators

Target

The Monitoring Reports submitted as required in ESMP

ESMP Activity 2.3.2.4– PS2

Establish Acceptable Working Environment for Employees and Community

Objective: To adopt practices leading to good working conditions for employees and foster good working relationship with the community

Responsible entities: Project Team Leader/project staff/social worker

Activities:

- Identify potentially hazardous working conditions
- Ensure that all waste generation is minimized and managed in an environmentally sensitive manner to avoid human exposure
- Foster communities working relations

Timeframe:

Before and during construction/planting and harvesting

Cost:

As per staffing requirements

Material printing, community visits and social monitoring \$30,000.00

Monitoring and Reporting

As per measurable indicators

Target

The Monitoring Reports submitted as required in ESMP

3.0 ENVIRONMENTAL MANAGEMENT FOR IMPLEMENTATION PHASE

During the project implementation phase, potential impacts may arise that require management regimes, particularly since these will be more long-term impacts. This section outlines the objectives and potential impacts of the main activities, performance goals, followed by monitoring and management regimes and means of verification.

Potential Negative and Positive Impacts

The proposed development is expected to lead to a number of positive and negative impacts to the physical, biological and socio-cultural environment. Direct and immediate impacts (positive and negative) should occur in the immediate physical location and immediate adjacent properties, and the Zone 1 area of influence. Potential impacts beyond zone 1, will be mostly cumulative, particularly those that add to the existing impacts from biomass combustion at the Belcogen plant.

The potential negative impacts will be as follows:

The Physical Environment

Land and Soil alterations, including soil loss and soil erosion, soil compaction, alteration of normal hydrological regime, and; alteration of the existing chemical composition of soil and lands.

Water resources, such as ground and surface water may become altered, and their chemical composition may also be altered.

Air Quality may also be impacted due to the increase in dust, from vehicular transportation and the increase in particulate and noxious gases at the processing plant.

The Biological Environment

The biological environment includes the water resources, the ecology, flora and fauna. Some activities posing environmental change will include vegetation removal, water quality changes due to possible erosion.

Social and Cultural Environment

The **Socio-cultural environment** and related issues require mitigation and management. For example, the potential risk of the *A. donax* becoming a nuisance due to propagation beyond the project site. The risk of fires may also pose a risk to communities in terms of risk of the burning of fence posts, pasture, and the risk of smoke and particulate matter inhalation due to wildfires.

Another social issue is the **health and well-being** of employees and the community.

The investigations have not yielded any cultural assets of historic or other value, and during

project implementation, care and further research must be done to ensure that there are no cultural or historic artifacts at risk.

The ESMP aims to provide the basic guidelines to ensure that management, mitigation and positive action is taken to ensure the protection of the environment, cultural resources, and to foster community and employee health and safety. As a result, the ESMP has the following positive social aims:

- 1) To contribute to long term net Climate Change Mitigation through the reduction of greenhouse gases benefits through biomass burning for energy;
- 2) To contribute to the national economy, particularly in the energy and agriculture sector;
- 3) To create direct and indirect employment through direct job creation and economic spin offs;
- 4) To foster Community relations and partnership through initiatives that will benefit the project as well as the communities;
- 5) To monitor potential negative impacts to the social and cultural environment so as to reduce potential impacts to the lowest possible; and
- 6) To comply with the regulatory structure required for the project implementation and management.

3.1 Physical Environment

3.1.1 Terrestrial Resources (Land and Soil)

ESMP Activity 3.1.1.1 – PS6

The Cultivation of *A. donax* with subsequent land use change

Objective: To plant and cultivate the *A. donax* as a source of biomass for electricity generation

Responsible entities: Project Team Leader/agriculture expert/workers/partners

Activities:

- Mitigate the impact of long-term land use change through aesthetic landscaping activities
- Ensure that the soil is not degraded through compaction and earth movement
- Prevent water logging of soil through general irrigation/water management
- Ensure that nutrient value is recycled as much as possible
- Enhance soil resources through buffer zone and local landscaping using native plant species

Timeframe:

After infrastructure construction

Cost:

As per staffing requirements

Planting, surveillance and harvesting supervision \$30,000.00

Monitoring and Reporting

As per measurable indicators

Target

The Planting, Harvesting and Monitoring Reports submitted as required in ESMP

3.1.2 Water

ESMP Activity 3.1.2.1 – PS3

The Protection of Water Resources Against Pollution and Hydrological Changes

Objective: To establish a water quality monitoring plan and to inspect the hydrological regime of water bodies

Responsible entities: Project Team Leader/workers/partners

Activities:

- A water quality monitoring plan is to be finalized as drafted in Annex C
- Minimize the potential for surface and ground water hydrological alterations
- To ensure that species abundance and vigor are not significantly altered in the water source creek

Timeframe:

During project implementation

Cost:

As per staffing requirements

Monitoring \$30,000.00

Monitoring and Reporting

As per measurable indicators

Target

Environmental protection. Monitoring Reports submitted as required in ESMP

3.1.3 Air and Noise

ESMP Activity 3.1.3.1 – PS3

Guidelines Established for Mitigation Against Air Quality Changes

Objective: To adopt practices to reduce air pollution

Responsible entities: Project Team Leader/workers/partners

Activities:

- Harvesting of biomass, transportation and combustion at the BELCOGEN Cogeneration plant
- Ensure that ambient noise levels are kept to acceptable levels
- Reduce Risks of Cumulative Impact from Gases and Particulate Matter
- Enhance soil resources through buffer zone and local landscaping using native plant species

Timeframe:

After infrastructure construction

Cost:

As per staffing requirements

Planting, surveillance and harvesting supervision \$20,000.00

Monitoring and Reporting

As per measurable indicators

Target

Air quality protection. Reports submitted as required in ESMP

4.0 MITIGATION AND MANAGEMENT FOR BIOLOGICAL ENVIRONMENT

4.1 Cultivation

ESMP Activity 4.1 – PS6

Long Term Cultivation Will Impact Biological Species

Objective: To plant and cultivate the A. donax as a source of biomass for electricity generation

Responsible entities: Project Team Leader/workers/partners

Activities:

- Removal of Existing Habitat and part of the ecosystem for cultivation of A. donax
- Create artificial or enhanced nesting sites for birds
- Monitor Expansion of A. donax cultivation frontier and halt its expansion
- Identify possible areas that may attract pests and eliminate by mechanical means

Timeframe:

During planting and harvesting

Cost:

As per staffing requirements

Planting, surveillance and harvesting supervision \$30,000.00

Monitoring and Reporting

As per measurable indicators

Target

Environmental Protection. Reports submitted as required in ESMP

4.2 Mitigation and Management for Social and Cultural Resources

ESMP Activity 4.2.1 – PS4

Develop Social and Community Engagement Plan, Redress Mechanism and Reporting Mechanism

Objective: To establish a working-relations between communities and the Project and address any regress that may be necessary

Responsible entities: Project Team Leader/workers/partners

Activities:

- Established small team to find solution for the waste management practices
- Establish a redress mechanism for any grievances that may arise
- Establish guidelines for identification of artifacts of cultural importance and reporting mechanism
- Train Employees in Communication Skills and Method of Communication

Timeframe:

During planting and harvesting

Cost:

As per staffing requirements

Cost of plan and mechanism \$20,000.00

Monitoring and Reporting

As per measurable indicators

Target

Social Communities involvement. Reports submitted as required in ESMP

4.3 Mitigation and Management for Transport Handling and Storage

ESMP Activity 4.3.1 – PS4

Develop Plan, for Handling, Transportation and Storage of A. donax and Substances/Materials for Project and Solid Waste Produced

Objective: To establish working Protocol for Handling Storage and Transportation of A. donax, as well as Materials and Substances

Responsible entities: Project Team Leader/workers/partners

Activities:

- Establish and adopt a Spill Contingency Plan (that includes Handling, Storage, Transportation and Disposal)
- Establish Contingency and Clean Up Mechanism
- Adopt Contingency Practices and Secure Licenses; Adopt List of Prohibited Substances
- Train Employees on Community Relations and Communications

Timeframe:

During project implementation

Cost:

As per staffing requirements

Cost of plan, mechanism and training \$30,000.00

Monitoring and Reporting

As per measurable indicators

Target

Best practices used for handling A. donax and chemicals used. Reports submitted as required in ESMP

4.4 Mitigation and Management for Decommissioning Phase

ESMP Activity 4.4.1 – PS6

Decommissioning and Closure of Cultivation Site and Supporting Infrastructure

Objective: To Establish a Decommissioning Work Plan for the closure of all operations with respect to the project

Responsible entities: Project Team Leader/engineer/workers/partners/authorities

Activities:

- Review, update and execute Decommissioning Plan
- Work during daylight hours
- Conduct Health and Safety Review Training
- Review Environmental Safety Procedures

Timeframe:

After project implementation

Cost:

As per staffing requirements

Cost decommissioning exercise monitoring \$40,000.00

Project area restoration \$200,000

Monitoring and Reporting

As per measurable indicators

Target

Execute decommission plan and restore project area. Reports submitted as required in ESMP

5.0 DISASTER RISK MANAGEMENT PLAN

Disaster Risk Assessment and Disaster Risk Management Plan

The phenomenon of climate change is already believed to be increasing the vulnerability to natural disaster risks. For example, during the 2019 year, Belize and the region experienced an extended drought. This drought resulted in effects such as reduction in crop yields and other impacts to the agriculture sector. At the time of writing, (April 2020); the dry season in Belize was being plagued by numerous fires, and Channel 5 Belize news reported that as many as 186 fires burning throughout the country (<https://edition.channel5belize.com/archives/201590>). As a result, the air quality was reported as being very poor for human health.

Also, the on-going pandemic had had major implications at the global and national scale, and Belize's economy as a result of drastic quarantine and emergency declaration measures adopted by the government was having significant financial tolls. The measures to contain the pandemic had resulted in major loss of productivity of the agriculture, tourism and all other sectors.

Table 5.1 below (also from Section 5 of the ESIA), is hereby reproduced to illustrate the following risks that were evaluated.

A) Risks from Natural Disasters. These include risks from:

- ✓ Increased risk and vulnerability to Hurricanes and Tropical Storms
- ✓ Flood Risks
- ✓ Forest Fire Risks
- ✓ Seismicity and Seismic Hazard
- ✓ Risk of Diseases and Pandemics

b) Man - made risks include:

- ✓ Fires
- ✓ Chemical and Hazardous material Spills
- ✓ Accidents
- ✓ Phytosanitary and Plant Risks

Table 5.1: Ranking of Risks and Severity of the Consequences.

RISK	LOW(1)	MEDIUM (2)	HIGH (3)	SEVERITY
				Minor,
				Moderate
				Major
Hurricanes			√	Major
Tropical Storms		√		Major
Floods			√	Moderate
Fires		√		Moderate
Earthquakes	√			Low
Crop Diseases		√		Low
Diseases/Pandemics		√		Major
Chemical Spills		√		Low
Accidents		√		Moderate
Phytosanitary & Crop Failure	√			Major

As a result, the Disaster Risk Management Plan has been developed.

The Disaster Risk Management Plan (DRMP) includes the following sections:

Emergency Evacuation Plan

Hurricane Plan,

Fire Guidelines,

Flooding Guidelines,

Fuel Spill Contingency Plan

Medical Emergency Plan;

Plan for Handling Storing and Transportation of Substances

Phytosanitary Control Plan

Decommissioning Plan

5.1 EMERGENCY EVACUATION PLAN OF PREMISES

5.1.1 Purpose

This Emergency Evacuation Plan will provide standard guidance to manager and staff of the Arundo donax Project Located near San Lazaro, Orange Walk District, Belize. The Plan considers the nature of operations conducted at the Cultivation Site and associated Facilities, primarily Worker's Quarters and Compound. Its primary Aim is to Safeguard Life and Property; and to Prevent Loss or Damage to Life and Property. The objective is to adopt and implement evacuation measures to be taken in the event of an emergency, whether man-made or natural.

Current Date: October 28, 2019

Arundo donax Cultivation Project Site

CARIBBEAN COMMUNITY CLIMATE CHANGE CENTRE

PLAN LAST UPDATED: April 20th, 2020 (Change Date Here Upon Updating of Plan)

UPDATED BY: Name and signature:

(N.B. Plan to be updated Every Two Weeks for the first three months of operation, then quarterly thereafter)

Table 5.2: Emergency Services Numbers

Institution	Contact Number	Other Contacts
Western Regional Hospital Bmp.	822-2263, 822-2264	Fax: 822-2518
San Ignacio Hospital	824-2761, 824-3129, 824-2122	Fax: 824-4894
La Loma Luz Hospital	824-2087	
Karl Heusner Memorial Hospital	223-1548, 5686, 5689, 5691	Fax: 223-3081
Belize Medical Associates	223-0303 or 223-0304	Fax: 223-1261
Universal Health Partners	2237-7870, 7873	Fax: 223-7865, 7866
Belize Police Head Quarters Bmp	911 or 822-2222	Fax: 502-3090
Orange Walk Police	322-2022	
Belize National Fire Service	90 or 227-2579	Fax: 223-4212
Orange Walk Fire Service	302-2090; 824-2095/824-4208	
Medical Emergencies	322-2072; 824-2066, 824-2761	
Astrum Helicopters	222-5100	
NEMO Headquarters - Belmopan	936 or 822-2054/822-0995	Fax: 822-2861
DEMO Orange Walk	302-2525; 824-2054; 936	
Spanish Lookout Ambulance Service	600-0911	
Department of the Environment	822-2816 or 822-2542	Fax: 822-2862

5.1.2 Emergency Evacuation Plan

Introduction

The following is a plan to prepare the managers and staff of the A. Donax project and compound for emergencies that are likely to occur within the work area and associated facilities. For this emergency plan, the facilities include primarily the cultivation site, and the workers' compound. Therefore, the plan includes all facilities within the compound. This plan is being prepared in consequence of the Environmental and Social Impact Assessment (ESIA) being conducted, and the Environmental and Social Management Plan (ESMP) and is subject to change prior to commencement of operations. This plan is included as Annex A in the ESIA/ESMP but is a standalone document and intended for management of the project to make adjustments and modifications as they deem fit.

Objective of the plan: To ensure the health and safety of all personnel within the compound and in close proximity to the compound, including visitors, and to preserve human life of all employees and personnel through training of the employees, to procure and maintain the necessary equipment, along with assigning responsibilities and to prepare for the various emergencies that are likely to occur.

The intent of the plan is to ensure that all employees and clients have a safe and healthy working environment. Those employee(s) assigned emergency duties under the plan will be provided with the necessary training and protective equipment to ensure their safety.

SCOPE OF THE PLAN

The plan applies to emergencies that could reasonably be expected within the Work Site and Facilities at the Compound.

PLAN COORDINATORS

The Emergency Plan, Building Wardens and Fire Protection Coordinator(s) will be designated as follows:

Facility/site/structure	Name & Position	Telephone/radio
Camp site/Office	Security	
Compound	Manager	
Farm Site	Team Leader/Manager	

Key Emergency Agents	Name & Position	Telephone/radio
Miguel Angel Cabanas	San Lazaro Village Chairman	667 7982
Ariani Carmina Alfaro	Chairlady Trinidad Village	655-1993
Juan Leiva	Nemo Orange Walk	
	Officer in Charge OW Police Department	322-2022
Lisbeth Delgado	Principal – Belize High School	604-4885

	of Agriculture	
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The Security Officer or a maintenance manager will be responsible for maintenance of equipment. The Manager may be contacted for further information on or explanation of the Plan.

5.13 Element of the Plan

Preferred Means of Reporting Fire and Other Emergencies

All Fires and emergencies will be reported by one of the following means:

- a. Verbally to the Manager if during standard working hours.
- b. By Radio or telephone if after standard working hours
- c. By the alarm system 24 hours a day

The following numbers will be posted at all the phones having outside lines:

MANAGER: _The Manager is to prepare a monthly report under the Reporting Guidelines providing information detailing accidents, their causes, potential hazards and recommendations to prevent future accidents and submit the report to the CCCCC. Within 15 days after receiving the Inspector's or supervisor's inspection report, a report outlining remedial steps is to also be submitted to the Inspector/supervisor.

PROJECT MANAGER:

AIR AMBULANCE/HELICOPTER SERVICE: _____

POLICE:

NORTHERN REGIONAL HOSPITAL – EMERGENCY SECTION: _____

DEPARTMENT OF THE ENVIRONMENT:

BELIZE DEFENCE FORCE: _____

Alarm system requirements

Alarm system requirement for notifying all employees in an emergency are the following:

- a. Provides warning for safe escape or evacuation
- b. Can be perceived by all employees
- c. Alarm is distinctive and recognizable
- d. Employees are properly trained
- e. Emergency telephone number will be posted
- f. Emergency alarm will be given all priority
- g. Alarm is maintained properly serviced by the trained personnel.

Sounding the Alarm

The signal for immediate evacuation for the Facility is:

Continuous blast by the alarm, accompanied by flashing of lights. The alternative means of notification of immediate evacuation is employees shouting continuously the nature of emergency, i.e. Fire, Fire, Fire; etc.

Evacuation Plans

Emergency evacuation escape routes are attached and are posted in each building and labeled: EMERGENCY EXIT. All employees have been trained concerning these plans and routes and should also be familiar with the evacuation plan for the other building and facilities within the compound.

Employee Accountability Procedures after Evacuation

In the event of an actual emergency the employee who sees or is informed of the incident(s) having confirmed that such is the case is to raise the alarm by activating the electronic/mechanical alarms and/or shout the nature of the incident. That employee is to respond appropriately and remain on the scene until regularly relieved. Alarms will be installed strategically by selecting the area near the present operations; in such a way that they become clearly visible and audible. The relocation of these alarms to new areas under operations may be required as the project progresses.

All occupants will orderly and promptly exit their respective building/area by heading to the nearest and safest exit. Once clear of the building/area, they will go to the designated "Muster Point" and immediately report to their Supervisor and/or Building warden. The Building/Area Warden is to account for every employee within that building/area and will subsequently direct the movement to the Primary Assembly Area at the Muster Point.

At the Muster Point/Assembly Area each supervisor or Building Warden is responsible for accounting for each employee assigned to that supervisor and/or that building by mustering at the Building/Area Muster Point and conducting a head count. Each employee will be accounted for

by name. All Supervisors or Building/Area Warden are required to report their head count to the Manager or Supervisor of the Mine Facility and the Security Officer.

The Manager, if the order was not given by the Supervisor, is to be made aware of the situation so that the necessary trans-mediation arrangement is made to evacuate the respective employees from the unsafe area(s).

N.B. The designated route of traffic flow will be highlighted with signs and will be towards the nearest path to the camp grounds.

Designated Muster Points

The Building and Area Muster Point are as follows:

Main Office/ Camp Site

Primary Location _At the parking lot_____

Rescue or Medical Emergency Procedures

Those people who are certified in First Aid care will be required to render first aid to those need that service until the trained medics arrive to taken over the person. In any case the medical response effort will be initiated by the Employee, Manager or his nominated Representative. As much staff as possible will be given first aid training, with the aim of having trained everyone as soon as possible.

First Aid Services

First Aid is the provision of limited medical care for sudden illness or injury, which is provided, usually by a certified person, to a sick or injured patient until appropriate medical treatment can be accessed. Applying First Aid to a patient consists of a series of simple, sometimes lifesaving, medical techniques, that an individual, either with or without formal medical training, can be trained to perform with minimal equipment. The project proprietors will ensure that there are at least two certified first aiders at the work site at all times. Training will be sought through the Belize Red Cross. First aid kits will be available at the establishment headquarters at all times. This should include the basic first aid supplies.

Protection against Snake Bites

Belize is a known country to have at least 11 species of venomous snakes, and the Northern regions are known to have snakes due to the sugar cane crops that attract rodents which then attract snakes.

The first rule is to be careful where one steps, and not outdoor work should be done without an assistant nearby, or within calling range in the event of a snake attack. The worker must always use a machete and be vigilant.

Therefore, management should ensure that they are aware of what snakes are present in the area. If a Snake Bite kit is provided, ensure First Aiders know how to use it. However, snake bite kits are available at the Northern Regional Hospital, and the priority in the event of an attack, would be to stabilize the patient and transport him immediately to the Hospital.

Transportation (Evacuation) of Patient

When a patient must be transported to a recognized health institution for further treatment as quickly as possible, the act of preparing the patient and notifying the institution is a very important and critical issue. Time is of the essence and therefore important in a life and death situation. The Operations Manager will be required to make transportation arrangements to the health institution in the event of a medical emergency. The remoteness of the operation sites may warrant the use of a helicopter to evacuate the sick under certain emergency situation. Such a mode of evacuation cannot be ruled out.

Re-entry

Once the site or building is evacuated, no one is to re-enter the site or area for any reason. Rescue Personnel are excluded from this rule. When the trained personnel or other responsible Agency has notified that the site is safe for re-entry and the “All Clear” is given by the Manager, then and only then will personnel return to their workstations.

5.1.4 Training for Employee Who Assist in Evacuation

The personnel; listed below have been trained to assist in the safe and orderly emergency evacuation of employees. Employee training is provided to employee when:

- a. The Plan is executed (Exercise or real response)
- b. When employee's require actions and responsibility change
- c. There are any changes to the plan.

Task	Facility/Area	Persons
Fire Extinguisher	All extinguishers to be strategically located in front of each building. Clearly visible sketch maps of the aboveground and underground sites be provided, specifying the exits, muster points, and the location of the alarms and	Security Officer

	fire extinguishers throughout the workplace. Ventilation and electrical plans should also be mapped	
Evacuation Assistant		
Emergency Shut-down		

Training for Employees

Employee training is continuous and will be provided when:

- Employee's require actions responsibility change
- The Plan is initiated
- There are any change(s) to the plan
- Initially to new employees
- Refresher training, to be conducted every three months, or immediately after an incident.

Items Reviewed during training includes but are not limited to:

- Emergency Escape Procedures
- Fire Extinguisher Operation
- Procedures for accounting for Employees
- Fire Prevention Practices
- Alarm Systems
- Closing Doors behind you
- Location of Emergency medical kits

EMPLOYEE EMERGENCY ACTION TRAINING

NAME	TYPE OF TRAINING	DATE	INSTRUCTOR

PROPOSED SITE PLAN FOR A. DONAX (100 ACRE LOT)

PLAN VIEW OF DETAIL A

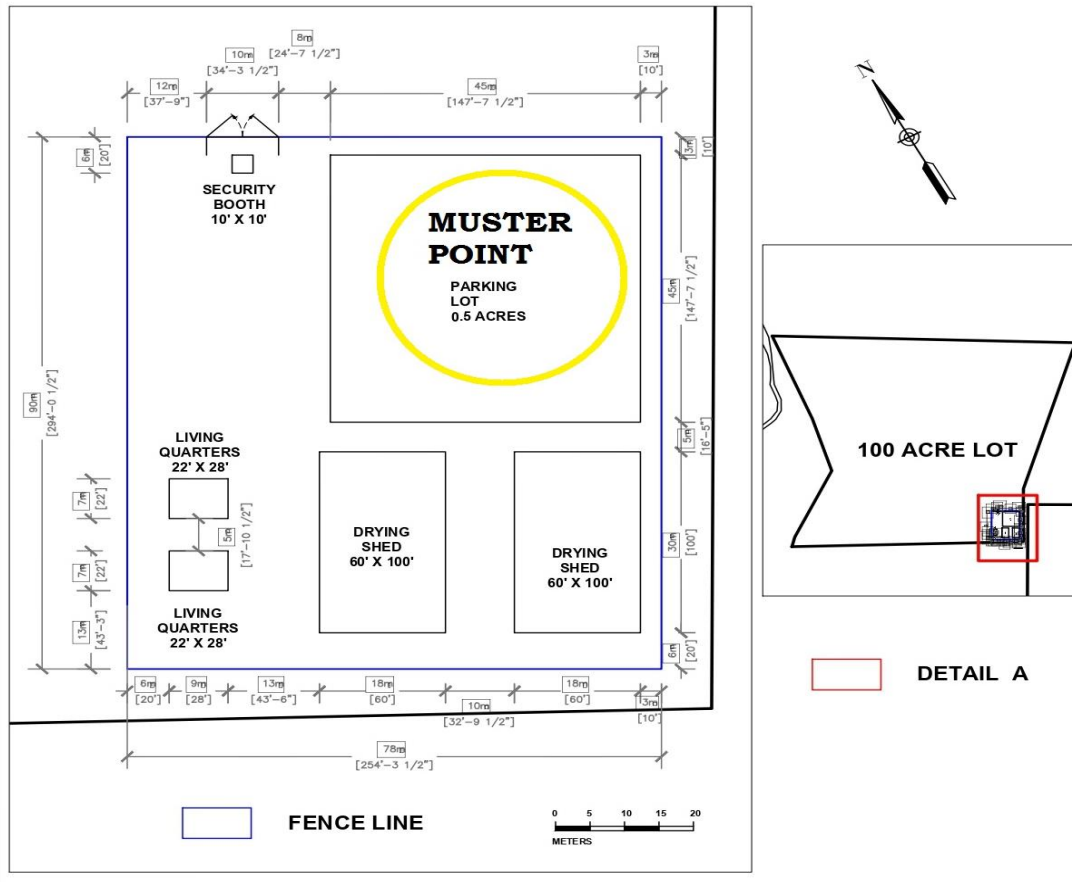


Figure 5.1: Muster point at Main Compound.

5.2 Hurricane Plan for Arundo Donax Facilities

5.2.1 Purpose

This Disaster Management Plan includes a Hurricane Plan, a Fire Guidelines, and Guidelines to use during Flooding, fuel spill contingency guidelines; medical emergency plan; Plan for Handling Storing and Transportation of Substances; and a Decommissioning Plan.

The main purpose of the Plan is to adopt preparation activities that will contribute to the Safeguarding against risks to employees and property during a natural or man-made disaster.

Table 5.3: Emergency Services Numbers.

Institution	Contact Number	Other Contacts
Western Regional Hospital Bmp.	822-2263, 822-2264	Fax: 822-2518
San Ignacio Hospital	824-2761, 824-3129, 824-2122	Fax: 824-4894
La Loma Luz Hospital	824-2087	
Karl Heusner Memorial Hospital	223-1548, 5686, 5689, 5691	Fax: 223-3081
Belize Medical Associates	223-0303 or 223-0304	Fax: 223-1261
Universal Health Partners	2237-7870, 7873	Fax: 223-7865, 7866
Belize Police Head Quarters Bmp	911 or 822-2222	Fax: 502-3090
Orange Walk Police	322-2022	
Belize National Fire Service	90 or 227-2579	Fax: 223-4212
Orange Walk Fire Service	302-2090; 824-2095/824-4208	
Medical Emergencies	322-2072; 824-2066, 824-2761	
Astrum Helicopters	222-5100	
NEMO Headquarters - Belmopan	936 or 822-2054/822-0995	Fax: 822-2861
DEMO Orange Walk	302-2525; 824-2054; 936	
Spanish Lookout Ambulance Service	600-0911	
Department of the Environment	822-2816 or 822-2542	Fax: 822-2862

5.2.2 Introduction

Tropical storms and hurricanes are the most common natural phenomenon affecting Belize and one most likely to impact the site.

Potential Impacts of Hurricanes and Mitigation Measures

Damages resulting from hurricanes will be those primarily associated with strong wind and flooding. Strong wind and flooding on the farming site can have several negative effects, the destruction of crops and forest as well as structural damages (due to wind and falling trees or debris) and water damage to feeder roads, culverts, and farm equipment.

To mitigate against flooding, the natural flow of any creeks or drains will not be obstructed as far as possible and where there is damming, the area will be cleared for easy flow of water. Wherever possible the placement of any equipment will be done at the highest elevation point

possible.

The Arundo Donax project proprietor's hurricane preparedness plan will involve planning, alert, response, damage assessment, and recovery stage to deal with any natural disaster involving hurricanes, storms, or tropical depressions. The hurricane preparedness plan will focus in protecting the lives of its employees and in protecting the assets of the company. The plan will focus in securing the existing facilities and evacuating all employees. An important element of the plan is its recovery program to ensure that the farming site is safe and operational at its earliest time possible.

This draft hurricane plan shall be updated and adjusted, wherever necessary, prior to full project implementation; i.e., prior to completion of construction of all facilities.

The hurricane season in Belize commences officially on June 1st and ends on November 30th. This hurricane preparedness plan will be updated every year if there is no emergency event, and on a case by case basis after each and every storm or hurricane event. This revision will ensure constant improvement in the preparedness plans and actions.

The preparedness plan needs to confirm to the Hurricane Orders for each where the facility is located as produced by the NEMO District Committees.



Figure 5.2: Generalized Hurricane Alerting Mechanism.

The relationship between the alerting mechanism used by NEMO/DEMO and the Contractor and CCCCC is shown in Figure 6.1. The Manager is directly responsible for implementing actions resulting from the hurricane plan.

Purpose of Plan

The purpose of this hurricane preparedness plan is to:

- (i) Increase awareness to management, employees and visitors of the need for hurricane and tropical storm preparedness;
- (ii) To establish the coordinating mechanisms necessary for Management to prepare and implement measures to safeguard property and lives of all concerned during the threat of a storm or hurricane.

The basic responsibilities of management are to ensure that the coordinating mechanism that will ensure maximum safety of property and lives during an incoming storm, is put in place, and to make sure that employees and visitors are familiar with the mechanism. Management shall be responsible for updating, and implementing this plan in order to ensure its effectiveness.

Hurricane Warning System

The contractor or relevant party responsible for each site will follow the official alert system currently in place by the National Emergency Management Organization (NEMO). It will follow the District Emergency Committee's (DEMO) orders and alerting system.

Hurricane Categories and Wind Speeds

- *Tropical Depression 38 mph*
- *Tropical Storm 39-73 mph*
- *Hurricane Category 1 74-95 mph*
- *Hurricane Category 2 96-110 mph*
- *Hurricane Category 3 111-130 mph*
- *Hurricane Category 4 131-155 mph*
- *Hurricane Category 5 above 155 mph*

Hurricane Warnings FLAG COLORS

Warning Flags

The following warning system is adopted from the official hurricane warning system as follows:

- *One Red Flag -Preliminary Alert First Phase (storm or hurricane watch)*
- *One Red Flag with Black Center -Red I Phase (storm or hurricane watch)*
- *Two Red Flags with Black Centers -Red II (Warning Phase)*
- *One Green Flag – Green Phase (all clear)*

Pre-season Preparations

At the beginning of May of each year the Manager will ensure that the disaster management plan is reviewed, and updated, if necessary. Any important or critical updates should be communicated to the owners/principals of the company.

Pre-season Actions to be taken:

Manager: (i) Communicate the results of the emergency plan updating activities by verbal or written communication to the company who relays to DEMO AND CCCCC, (ii) Ensure that actions required as follow up are done and, (iii) Take actions to ensure the effective implementation of this hurricane preparedness plan.

The Manager will ensure that all relevant equipment and items required for the hurricane season is available. This includes updates of this document, the identification of the sources of hurricane tracking charts etc.

Furthermore, management will ensure that the compound is free of debris by inspecting and removing garbage and litter from drains, as well as securing loose equipment that may be spread by wind and water movement. All drains will be cleared of blockage and debris that may impede the flow of water, and become hazardous.

All substances such as agrochemicals, fuels and oils will be adequately stored in drums and containers and secured above ground to prevent escape during rainfall and possible flooding of the area.

As such, photographs of the compound will be taken to assist in post hurricane assessment.

Implementation Plan during Threats

Preliminary Alert - Hurricane Watch

This is the First Phase, and means that a storm or hurricane may threaten within 72 hours. A storm or hurricane is within 21° N 80° W of Belize. At the issue of the Preliminary Phase, the Manager will ensure that post the tracking map and start plotting the course of the hurricane.

He/She will also ensure that all personnel are familiar with the hurricane response plan, and their roles and responsibilities under the plan, and are indeed able to carry them out.

Actions to be taken:

- i. Management will ensure that an updated list of employed persons, telephone numbers, and telephone numbers of next of kin are kept in the office.*
- ii. The management should be prepared to convene and take action if the National Meteorological Service issues a warning, and upon advice of the committee. Stay informed by radio and television of the storm progress, and on all local advisories.*
- iii. Obtain hurricane tracking chart for management and administration members and relevant personnel,*

- iv. *Ensure that contact is made with all drivers of company vehicles, whether by direct or indirect means to alert them of the phase and to make initial contact.*
- v. *Prepare a checklist (electronically) of items required in the event of an emergency for each head of household.*
- vi. *The Management will identify and categorize items or equipment to be removed as follows: list of equipment to stay, and list of those to be removed to a site on the advice of the CCCCC.*

Hurricane Warning – Red 1 Phase (Watch)

During this phase, a hurricane may threaten within 36 hours. A hurricane or storm is located within 20° N 85° W.

Actions to be taken:

Transfer Stations and Facilities:

These actions to be taken apply to tropical storms and category one hurricanes only:

- (i) *Prepare for storm and if visitors are scheduled or present, they should leave immediately.*
- (iv) *Inform all personnel to secure all personal property and be prepared to leave upon recommendations of the committee chairperson, in the event that mandatory evacuations are ordered.*
- (vi) *The management will identify employees to report to work after the hurricane or after the Green Phase all clear is given.*
- (vii) *Remain in contact via telephone and radio, and Update CCCC on all actions taken.*

Hurricane Warning – RED 2 Phase

Whenever Phase 2 (Red) is given, this means that a hurricane is likely to strike Belize within 24 hours.

Actions to be taken:

- (i) *Management will advise all employees to secure property and to leave the project site immediately, (if possible),*
- (ii) *All employees to be dismissed from active duty at this stage and only required staff will remain at this stage.*
- (iv) *The list of employed persons will be printed and provided to management for their perusal,*
- (v) *Shelter will be sought (outside of the project site) for employed persons requiring shelter, and as soon as steps 1 and 2 are completed, and wherever, possible, will advise Nemo or Demo.*

Fourth Phase – Green (All Clear)

This is the ALL CLEAR, which will be declared by NEMO after the hurricane has passed and it is safe to return to review the effects of the hurricane.

Actions to be taken:

- (i) *Management will ensure that a survey of the project site and all properties is done as soon as possible,*
- (ii) *The Manager along with other expertise will immediately make a brief report on all damages (supported with photographs), and prepare an estimate of damages, and submit the same to District Committees for their perusal.*
- (iii) *Employees will report as previously advised.*
- (iv) *Clean-up phase will commence with the assistance of project employees, and others, where possible.*

5.3 Fire Management Plan for Arundo Donax Project Site

Introduction

The construction of all buildings should be done to meet the standards of the Belize Building Authority. In lieu of this, buildings will need to be evacuated as soon as Red one flag is issued for an impending storm or hurricane.

At least each building will have a fire emergency evacuation plan and fire management plan in place in case there is a fire. Therefore, all buildings are to be equipped with fire extinguishers, and an area outside the buildings be designated as a safe area (muster point); preferably the parking area. Each building should be equipped with an alarm system to be used in the event of any emergency including fire.

Guidelines for Fire Prevention and Control

It is important to note that almost all fires are preventable, and control measures can limit the losses if a fire does occur. Fire prevention and control principles include the following:

1. Buildings should be constructed using sprinklers to serve as fire alarms and to prevent fire from expanding.
2. Prevent a fire from starting by using fire-proof construction materials, wherever possible, designing facilities to isolate hazardous areas, controlling operations, using preventive maintenance, and eliminating unsafe practices.
3. Do not overload electrical circuits or use frayed or defective electrical cords.
4. Do not allow any electrical repairs to be made by an unqualified person.
5. Do not use fuels for anything except to run an engine.

6. Use and store gasoline and other fuels only in a safety can, and in a safe area.
7. Provide instruction in the prevention of fires to employees.
8. Mark all exits clearly and ensure that they remain clear.
9. Provide periodic instruction in the location and proper use of fire extinguishers and other fire-fighting equipment.
10. Require all employees to be able to explain how and where to locate fire extinguishers and choose the correct type of fire extinguisher for the type of fire.
11. Properly mount and mark all fire extinguishers, and fire-fighting equipment.
12. Have all the extinguishers inspected regularly, and records kept of the inspection. Regular check should include inspection of hoses, nozzles, seals, gauge pressure, corrosion and dents.
13. Promptly extinguish the fire before it grows out of control. Most fires start small and can initially be extinguished by a hand-held fire extinguisher or water.
14. Limit the spread of fire. Provide suitable fire barriers and keep the amount of combustibles stored to minimum.

All buildings will be equipped with a fire extinguisher that is to be strategically located. All permanent staff will be trained in basic firefighting and emergency response skills.

Individuals have certain responsibilities for fire protection. Loss of employees' lives, and property, as well as permanent injuries, may be averted through the understanding of fire protection. Therefore, the primary purpose of this fire protection plan is to provide guidelines and procedures to be used in case of a fire, so that all personnel will be fully aware of their responsibilities.

Procedures to be used in Case of a Fire

1. Sound the alarm.
2. Evacuate building or area immediately.
3. Block all entrances to building.
4. If an attempt is made to put out the fire, always use appropriate equipment with care.
5. Secure all fuel sources such as vehicles within the compound.
6. After the fire, prepare a detailed report, intended to investigate sources or cause of the fire; route and general incendiary characteristics, procedure and steps used for fire

suppression, general safety and health issues (if any), conclusions and recommendations for improvement.

5.4 Hydrocarbons Spills and Leaks Contingency Plan

Purpose of the Plan

Hydrocarbons such as diesel, gasoline and lubricants will be either stored or used during farming operations, hence requiring that all efforts be made to protect the area from any spills or leaks of hydrocarbons into the environment. The Oil Spill Contingency Plan (OSCP) is intended to guide the biofuel production workers through the processes required to manage an oil spill or fuel leak in the farm/grain storage area or surrounding waters.

This plan focuses on the possible spillage of refined petroleum product, primarily diesel, gasoline and engine lubricants.

The proposed plan will not only focus on the prevention of leaks and spills but will also provide employees with the appropriate training, materials and equipment, and guidelines to be able to contain these and respond appropriately.

Contingency plans describe information and processes for containing and cleaning up a spill that occurs in a defined area. Because the approach and methods for responding to oil spills are constantly evolving, and each spill provides an opportunity to learn how to better prepare for future incidents, contingency plans are also constantly improving and providing increased protection to human health and the environment from these accidents.

The plan's three main objectives can be summarized as follows:

1. Increase employees' awareness on spill response procedures taking into consideration the different governmental tier response levels.
2. Define the coordinating mechanisms necessary for employees to utilize their resources in response procedures.
3. Establish and define clearly the roles and responsibility of Operations Manager and other related personnel in spill contingency and response procedures.

This plan identifies the need for a timely and effective response to incidents involving leaks and spills. In order to respond rapidly and successfully to a leak or spill, workers responsible for containing and cleaning up the spill must know the steps that are required to be followed during and after the spill.

National Oils Spill or Chemical Spill Response Policy

The Environmental Protection Act makes it mandatory that any person using or exploiting the environment take all effort to protect the environment against unnecessary damage or pollution by harmful substances. In addition, the pollution regulations make it mandatory that all spills and leaks are immediately contained and reported to the Department of the Environment. The

Department of the Environment in close collaboration with NEMO has prepared a National Oil Spill Contingency Plan in which it outlines the response procedures, roles, and responsibilities of those involved.

Table 6.2 shows DOE's Inland Spill level as described by the National Emergency Preparedness Plan for Oil Spills (NEPPoS).

Table 5.4: Inland Spill Level.

Level	Quantity	Location	Response
A	<1,000 Gallons	On land or Inland	To be managed by polluter
B	>1,000 Gallons or poses significant health hazard and requires evacuation	On land or Inland	Responsible party requires GOB assistance to manage the discharge.

Level B is most applicable to the size and types of spills that could be associated with the proposed farm operations envisage.

Fuel Management

The Arundo Donax project management will focus on the prevention of leaks and spill through the implementation of a stringent fuel management plan which also addresses issues associated with spent or unusable oils and fuels. The fuel management plan will address issues with its transportation, transfer, and storage. Contaminated fuel and oils will be stored in drums for later storage at designated sites determined in consultation with the DOE. Fuel will be managed to prevent spills and leaks via the following:

A. Transportation:

- During transportation the container (single metal tank or 45-gallon steel drum) will be check for leakages and sealed properly.
- During transfer of fuel from containers to storage facility all lines will be properly connected before pumping and strictly supervised.

B. Storage:

- All fuel will be stored in above ground storage tanks which shall be place within a reinforced concrete containment wall.
- The containment walls will be designed to contain 110% of the maximum tanks volume.
- To protect against any accidental fire all fuel storage tanks will be sited away from all

electrical installations and sources of exposed flames.

- Highly visible “No Smoking “and “Danger! Highly Flammable” signs will be posted on the site.
- Any fuel dispensed will be done within the containment area, and any spill will be immediately and appropriately dealt with through the use of absorbent pads which shall be stored in sealed containers within the fuel storage area.
- Soiled absorbent pads will be placed in specially lined plastic containers with covers and disposed of properly.

C. Documentation: All fuel received and consumed will be properly recorded in a fuel ledger book.

D. Maintenance: The Arundo Donax proprietors shall ensure the implementation of a strict maintenance program which will require regular inspection of all storage tanks, containment walls, fire extinguishers, pipes, valves, and generators for spills and/or leaks.

E. Waste Oil Management:

Although waste oil will be produced in very small quantities primarily from the servicing of the earth moving equipment and plowing, waste oil, if not appropriately managed, could pose a risk to the environment and surrounding water bodies. Oil containers for engines are another potential source. However, it is important to understand that a very small amount of waste oil can contaminate a large amount of water. Waste oil will be managed according to the following:

- *Storage:* All waste oil will be stored in properly sealed containers and inside a roofed containment area until transported outside the farm area for proper disposal.
- *Handling:* The use of waste oil will be strictly prohibited and all volumes generated will be properly recorded on a ledger which will also record the dates these are generated.
- *Disposal:* No waste oil shall be disposed of without the written permission of the DOE. All waste oil will be properly stored and disposed with in accordance with DOE’s waste oil disposal program and guidelines.

5.5 Medical Emergencies

Introduction

Responding to medical emergencies in the Arundo Donax project site will be challenging. There is no resident Doctor or Nurse in nearby Trinidad Village at the time of writing.

First Aid Services

First Aid is the provision of limited medical care for sudden illness or injury, which is provided, usually by a certified person, to a sick or injured patient until appropriate medical treatment can be accessed. Applying First Aid to a patient consists of a series of simple, sometimes lifesaving, medical techniques, that an individual, either with or without formal medical training, can be trained to perform with minimal equipment. The project proprietors will ensure that there are at least two certified first aiders at the work site at all times. Training will be sought through the Belize Red Cross. First aid kits will be available at the establishment headquarters at all times. This should include the basic first aid supplies.

Protection against Snake Bites

Belize is a known country to have at least 11 species of venomous snakes, and the Northern regions are known to have snakes due to the sugar cane crops that attract rodents which then attract snakes.

The first rule is to be careful where one steps, and not outdoor work should be done without an assistant nearby, or within calling range in the event of a snake attack. The worker must always use a machete and be vigilant.

There are different schools of thought about snake bite kit contents. Therefore, management should ensure that they are aware of what snakes are present in the area. If a Snake Bite kit is provided, ensure First Aiders know how to use it. However, snake bite kits are available at the Northern Regional Hospital, and the priority in the event of an attack, would be to stabilize the patient and transport him immediately to the Hospital.

Transportation (Evacuation) of Patient)

When a patient must be transported to a recognized health institution for further treatment as quickly as possible, the act of preparing the patient and notifying the institution is a very important and critical issue. Time is of the essence and therefore important in a life and death situation. The Operations Manager will be required to make transportation arrangements to the health institution in the event of a medical emergency. The remoteness of the operation sites may warrant the use of a helicopter to evacuate the sick under certain emergency situation. Such a mode of evacuation cannot be ruled out.

Measures during Pandemic or Disease Outbreaks

This section is written primarily for the SARS-Cov-2 pandemic and the measures being taken by the Government of Belize at the time of writing. These and future guidelines require updating or amendments, as the need arises. In the interim, it appears that the pandemic is unpredictable in nature, and, therefore, the present guidelines that are the official Government guidelines are summarized.

On Tuesday, March 31st, Prime Minister of Belize took measures to address the on-going pandemic caused by the SARS-Cov-2 virus or Coronavirus. He announced a planned National State of Emergency. The nationwide state of emergency, began at midnight on Wednesday, April 1st, was as a result of the country registering its third confirmed case on Sunday, March 29th, 2020.

On Monday 6th April, the Prime Minister declared enhanced quarantine for the Cayo District since two more persons tested positive for the SARS-2-Cove virus. Movement was further restricted; including the movement of personnel from the construction industry. Personnel involved in the agriculture sector were considered as part of the essential services sector, and were allowed to continue their activities.

In the interim contractors are advised to ensure official Government guidelines are followed. Furthermore, sanitation at work places should be adequate and employees should also follow official government guidelines and to report flu like symptoms and do not show up to work if any such symptoms develop.

The curfew was extended for the entire country. During the National State of Emergency, a curfew was put into effect from 8 PM to 5 AM. No loitering is allowed and wandering and assembling at any public place will not be permitted. Persons are allowed during the day (5AM-8PM) to purchase essential needs (including medication). Essential workers include security guards, agriculture or factory workers, bakeries, tortilla factories, sanitation workers, public transportation, fuel stations, port operators, along with governmental institutions that may need to remain open.

These guidelines are to be continually updated as per official government instructions, and the project is required to update and amend these guidelines as they become needed based on the developing circumstances.

5.6 Arundo donax Chemical Compounds Management Plan

Introduction

The benefits derived from the use of pesticides and fertilizers in agriculture have been tremendous in the Belizean economy. The use of pesticides reduces losses from weeds, insect pests and diseases on harvestable crops. Productivity has also increased due to the use of fertilizer along with best agricultural practices.

Severe weed infestations especially in the early stages of crop development, can account for large yield reductions. The use of herbicides provides labor and economic benefits. Severe insect infestations can also lead to crop yield reductions. Insecticides are used to combat insect infestations in order to increase productivity by eliminating insects that eat the plants and carry disease.

Even though the benefits of herbicides, insecticides, fungicides and fertilizer has been proven, if these compounds are not handled properly, they can result in serious human health and environmental implications. In Belize, like any developing country, there are high risk groups which are exposed to these compounds. These groups include general farm and production workers, formulators, mixers, sprayers and loaders.

Management Plan for the Handling of Agricultural Chemical Compounds

Agricultural chemicals are defined as chemicals such as pesticides, herbicides, fungicides, insecticides, and fertilizers used in agriculture to control pests and disease or control and promote growth. The *Arundo donax* Project which will be considered a monocrop will have an agricultural chemical compounds management plan covering the transport, handling, storage and disposal, with associate management and reporting practices including preventive and contingency measures, in consultations with workers and communities. The plan is necessary in order to address the following:

Environmental Impact

When pesticides are applied, they can contaminate the soil, water and other neighbouring vegetation. Pesticides can be toxic to other organisms including birds, fish and beneficial insects.

Soil contamination can occur due to the persistency, water solubility, soil absorption constant and the half-life of the compounds. Pesticides can also bio accumulate and bind to the soil. Excess fertilizers can also be absorbed by the soil.

Surface water contamination can be caused by pesticide and fertilizer runoff from the field and treatment holding areas.

Ground water contamination can be caused by pesticide and fertilizer seeping from the field or holding areas.

Air contamination can happen when spraying drifts from the targeted areas. Drift can account to a large percentage of the chemicals applied and can travel over large distances.

The plan will address the following:

Transportation – Drivers transporting pesticides, fertilizers or other hazardous materials will have to obtain special licenses and will require special training in handling and record keeping from the Pesticide Control Board (PCB). The vehicles will need to have secure containers, emergency kits, and fire extinguishers, cleaning supplies and special clothing such as gloves, eye goggles and overalls for the driver (s).

Storage–In order to maximize safety, only amounts and types of the pesticides and fertilizers used in the project will be stored. The storage facility will be locked at all times with access only

to those workers who are properly trained in the usage of these compounds. The storage facility will be erected in a suitable area on the project site to avoid direct public access, away from surface water sources, areas prone to flooding and away from direct sunlight and extreme heat. The storage facility should be properly and boldly marked.

Handling –Special guidelines will be followed for handling pesticides and fertilizers. Mixing will be conducted faraway from water supplies. No application equipment will be filled directly from any natural water source or surfaces that can allow spills. Protective gear will be worn by workers before opening especially pesticide containers. The transfer of pesticides between containers, mixing, loading and equipment cleaning should be conducted in a designated containment area in order to retain, recover any leakage or wash water.

Disposal – Pesticide and fertilizer containers and expired compounds will be disposed as per PCB guidelines.

Emergency response – The storage facility should include documentations with the following information: owner and employees names, addresses and telephone numbers; names and quantities of pesticides and fertilizers and location of emergency equipment. This information should also be provided to the Belize Pesticide Control Board.

Conclusion

The *Arundo donax* Project will work closely with the Pesticide Control Board which is the regulatory body for these compounds. The PCB has its authority under the Pesticide Control Act, Chapter 216, Revised Edition 2003 and its regulations under Statutory Instruments No.8 of 1989, No. 77 of 1995, No. 30 of 1996, No. 112 of 1996, No. 71 of 1998 and No. 18 of 2003. Not many compounds or large quantities will be used as the project is small with only one crop. Usage of this compound will also depend on the cost benefit analysis to maximize profits and safety. Appendix 1 lists the pesticides that the project will not use as they are banned in Belize. The executors of the project will convey prevention measures in order to offset the adverse health effects of pesticide and fertilizer usage to employees and members of the surrounding villages of Trinidad, San Lazaro, San Antonio Rio Hondo and Yo Creek. Health education packages will be developed and disseminated within the communities to minimize human exposure to these chemical compounds.

Literature Cited:

[Http://agropedia.litk.ac.in](http://agropedia.litk.ac.in) [Pesticides Control Board Belize](#)



5.7 Phytosanitary and Crop Risk Mitigation and Management

5.7.1 Principles of Risk Management

This section is summarized from the Caribbean Community Climate Change Center's publication *Environmental and Risk Management Plan for Piloting the Cultivation of Arundo donax in Northern Belize*. Belmopan, February, 2016.

The Risk Management Guidelines proposes the methodology summarized in the table below, in order to identify various potential risks throughout the production chain for cultivating and supplying a biomass crop for energy use. For more information and the complete document, please refer to Appendix x of Environmental and Risk Management Plan: Voluntary Best Management Practices for Energy Crops: Minimizing the Risk of Invasiveness prepared by the North Carolina Department of Agriculture and Consumer Services, North Carolina Cooperative Extension, and the Biofuels Center of North Carolina in 2012.

The first step is to explore risks of the crop prior to its selection, which the 5Cs have already carried out, and is described in detail in the previous sections of this document. The goal is to ensure that the crop is not prohibited or restricted; and ensure that the cultivation is appropriate to the circumstances and potential risks are identified.

	Identify ways in which propagates escape from the production field, which could result in intended propagation beyond the design of the Biomass Pilot; and for the risks identified, specify measures and steps that will be taken to reduce the likelihood of propagates dispersal and establishment.
	The harvesting methods that are utilized should eliminate or reduce viable propagules in order to minimize the likelihood of untended propagation beyond the design of the Biomass Pilot.
	Storage sites are analogous to production fields in serving as a stationary source of propagules; and therefore, should be designed, constructed, and managed in a manner that minimizes the likelihood of untended propagation beyond the design of the Biomass Pilot
	Land along the route from harvested fields to the bioenergy facility could also be susceptible to inadvertent escapes. As such, the transporting of feedstock material should be done in a manner that reduces unintentional propagates loss in order to minimize the likelihood of untended propagation beyond the design of the Biomass Pilot.

It is important to note that the above are guidance principles only, and that each project should be

screened against these principles to determine the risks that are specific to the said project; and implement mitigation measures only to those that apply. In this spirit, the following sections screen the proposed Biomass Pilot against the guidance principles to, first, determine the risks that are applicable in this instance, and then indicate the measures and steps that the 5Cs will take during implementation to eliminate or minimize the likelihood of unintended propagation. The measures that will be taken by the 5Cs to manage these risks during the implementation of the Biomass Pilot are detailed in the remainder of Sections below; and summarized in Table 5.5, (found as 5 Cs Risk Management Plan Appendix 1).

5.7.2 Risk Management for Pilot Cultivation of *Arundo Donax*

Approaches to Risk Mitigation for the Biomass Pilot

The identification and selection of *Arundo* as a potentially promising biomass crop that can grow on uninhabited, marginal land that is not suitable for agriculture in Belize was determined on the basis of the research and analysis that was carried out by the 5Cs with the assistance of CCI. The research was also validated by BSI, the owners of the BELCOGEN power plant and the recipient of the processed biomass from the Biomass Pilot; and permits were granted by the Ministry of Natural Resources and Agriculture, and the Department of Environment complying with the policy and regulatory framework in Belize; which provided the basis for the decision to move forward with a pilot to demonstrate the feasibility of cultivating *Arundo donax* and testing it in the existing BELCOGEN power plant during its idle months.

The Biomass Pilot, which will be carried out in a total of 400 acres of land designated as marginal and not suitable for agriculture, will be guided by the risk management framework detailed in this document; in order to ensure that it follows good environmental practices commensurate with the risks. At the conclusion of the pilot, on the basis of its results, observations and lessons learned, an industry-standard Environmental and Social Impact Assessment (ESIA) will be prepared and submitted to the World Bank for its approval. This ESIA will be for any follow-on activity that may result post Biomass Pilot prove that *Arundo* can be cultivated in a technically and commercially viable manner; and also confirm by the ESIA that the crop can be sustainably cultivated successfully and risks adequately managed, then it is likely that cultivation would expand to part of the larger 1,800 acre area for commercial operation. The post-Biomass Pilot commercial operation, which would provide processed biomass to the existing power plant at BELCOGEN on an ongoing basis, will comply with the Environmental and Social Management Plan in the ESIA to continue to manage potential safeguard related risks that could arise with the cultivation of *Arundo*. Should the results of the Biomass Pilot lead to the conclusion that further cultivation should not proceed, either for technical, commercial, or environmental and social related reasons, then the existing 400 acres cultivated through the proposed Biomass Pilot will be orderly wound down according to accepted industry practice as described in the following sections of this document. Once the Biomass Pilot is successfully concluded, then there will be no additional risk of unintended propagation of the crop.

5.7.3 Characteristics of *Arundo donax* and the Risk of Propagation

As previously noted the *Arundo donax*, also known as Wild Cane in Belize, is a large, robust plant known for its fast growth and resilience. As a result, it can be harvested about three times a year, which is one of the reasons as to why it was selected for the proposed Biomass Pilot. However, this fast-growing nature can also present an environmental challenge should the plant propagate beyond its intended design. It is important to clarify that *Arundo* does not propagate through seeds as these are sterile in the plant (Will be verified during the research phase). Therefore, there is no risk of propagation through airborne and other means where the *Arundo* seeds could be dispersed beyond intended areas. *Arundo* propagates only through rhizomes and cuttings of the stem/stalk. Typically, stalks of the plant are planted manually and then covered with soil in order to cultivate *Arundo*. Therefore, propagation is only feasible through the transplanting and transfers of live rhizomes and stem cuttings. The method chosen for the initial planting in the Biomass Pilot will be through the freshly harvested pieces of the stem. The primary environmental concern posed by *Arundo* is its aggressive annual growth and ability to spread laterally by rhizomes in the event it is not properly managed. The practices that will be put in place by the 5Cs, at each of the stages of producing the biomass, to manage this risk and to eliminate or substantially reduce the likelihood of unintended propagation through the spread of rhizomes are further detailed in the sections below.

5.7.4 Planting and Management of the Field

Land Preparation. The land area where the 5Cs obtained permission from the Ministry of Natural Resources and Immigration is located in an uninhabited area within the Orange Walk District, about a 20-mile distance from the existing BELCOGEN power plant. The permit grants the 5Cs a lease for 500 acres within a larger area of 1800 acres of marginal land not suitable for agriculture, of which 400 acres will be utilized for the Biomass Pilot. The area was selected specifically because the land is publicly owned and not occupied by any private citizens, and has limited use or biodiversity value since it is not suitable for agriculture or other uses. The land area is flat preventing the runoff of water, which makes it suitable for cultivating *Arundo*, the exact extent which will be determined based on the results of the Research Phase (sub-component 1) of cultivating the test plots. The lack of drainage (as well as the elevated Buffer Zone) also prevents rhizomes from potentially escaping into nearby waterways, preventing a key risk from being realized. The closest waterway, which is a small waterway named Blue Creek, is also at an adequate distance (at least 830 meters) from the nearest point of the 400-acre land area approved by GoB for the Biomass Pilot.

Constructing Buffer Zone around Planting Areas. The land area, once cleared, will be set-up into the plots where the *Arundo donax* will be planted and cultivated. These designated cultivation areas will be completely surrounded and protected by at least 20 feet wide access road that will function as a buffer zone. A two-foot-wide ditch will be dug and maintained clean along the entire inner perimeter of the buffer zone/access road. This access road will be built by experienced contractors. The road alignment will be demarcated and gravel material will be trucked in to cover the existing base material. Imported material will be dumped up, and graded to produce a camber on both sides, which allows water to run off the carriage way but remain within the larger 400-acre area.

The at least 20 feet wide buffer zone that will be constructed will have multiple important purposes:

- Additional barrier to prevent unintended propagation. As previously noted, the *Arundo* plant propagates through the underground rhizome since its seeds are considered sterile. The Biomass Pilot, during its implementation, will only harvest the above ground material of the plant and will not extract the rhizome. However, as an added barrier following Environment and Risk Management guidelines, the buffer zone will further prevent any unintended shift of rhizomes laterally underground that could lead to the risk of propagation beyond the planned plot areas of the Biomass Pilot
- As a road providing access to the plantation area. The buffer zone will also serve as a road that will provide access into the plantation area for planting equipment and harvesting machinery to be transported as well as for security personnel from the project who will closely monitor the project area.
- As a means of preventing water run-off. The buffer zones, which are elevated to 12 to 18 inches above the plantation area, will also contain water utilized for cultivating the *Arundo* during the Biomass Pilot, and prevent any runoff outside the 400-acre project area. This is ideal for the cultivation of the crop, but equally important, since it will further reduce any opportunity for movement of rhizomes and pieces of stems as a result of any drainage into nearby land or water resources. As previously noted, the nearest water source, the creek known as the Blue Creek, is at least 830 meters away from the proposed location of the Biomass Pilot. Given that the proposed land area is flat and not tilted/sloped more than 5% and there is little opportunity for rhizomes to escape, additional barriers such as silt-fences or berms are not deemed to be necessary for the proposed Biomass Pilot. It is important to note that the proposed Biomass Pilot will not plant any new rhizomes in the project area, only freshly cut stalks at the inception of the project when establishing the research plots. Thereafter, it is the stalks that will be cut and replanted. Therefore, any rhizomes that naturally occur in the project area will be underground and will not be extracted due to any project activities. As such, it is very unlikely that there would be rhizomes at the surface that could get moved due to drainage. Nevertheless, the elevated buffer zone that prevents drainage adds another barrier to prevent potential propagation and further reduced such risk.

It is important to note that, the various safeguards that follow good-practice guidelines will provide a number of barriers against the unintended propagation of *Arundo* during the implementation of the Biomass Pilot. Even in the very unlikely circumstance where each of these barriers is breached, then the additional propagation will also be within the larger 1,800 acres of marginal land that is not suitable for agriculture. Should such encroachment occur, for which there would be regular monitoring to identify; quick action would be taken to eradicate and prevent the further propagation beyond the design area.

Human Access to the Field. Human access to the field will be limited by its location and nature of design. The proposed location for the 400 acres for the Biomass Pilot is at a minimum five

miles from the nearest households, and not within proximity to large population centers (nearest village of San Lazaro is 7 miles away and has a population of less than 2,000). In addition, the crop itself, once planted, will serve as a barrier providing limited space that would not enable easy encroachment without machinery. Finally, the Biomass Pilot area will also be regularly monitored by project personnel, in line with the Inspection/Monitoring Plan detailed below in this document. Project personnel would disperse any people if they were to encroach into the Biomass Pilot area.

Inspection/Monitoring Plan. The Biomass Pilot area including buffer zones and area surrounding the 400-acre zones will be regularly monitored by project personnel. This will include a supervisor plus two field workers, equipped with an All-Terrain Vehicle (ATV) for mobility:

- ✓ A security company will be contracted to provide security of the area, and at least one person will be on duty in the Biomass Pilot project area at all times.
- ✓ The security personnel's main duties will be to patrol the perimeter and interior access roads of the Biomass Pilot project area at regular intervals using ATV to enable complete coverage of the entire area on each circuit, and will have the following general qualifications: be a non-resident of the immediate area; have at least five years of service with the security company; and have a history of duty in remote locations under difficult conditions. Personnel will conduct inspection at eight-hour intervals each day, inspecting the plantation areas of the Biomass Pilot for signs of entrance into the fields on foot or vehicle. The 5Cs Project Manager will familiarize the security personnel with the Environment and Risk Management Plan and train them in inspection and monitoring (including reporting forms). These personnel will report any findings during each day of duty to the Supervisor. Anything out of the ordinary will be followed-up by the Supervisor.

Handling of Excess Plant Material. The cultivated *Arundo* plant material will be handled as follows:

- i. The stalks of the crop are the primary source of biomass once it is processed. Therefore, it will be harvested and processed, as per steps described in the next section of this document to maximize the quantity and quality of fuel produced.
- ii. The rhizomes through which *Arundo* naturally propagates, will remain underground throughout the Biomass Pilot, and will not be extracted, as per procedures described in the next section. The rhizomes will only be extracted when it is being eradicated, as per the procedures described later in this section.
- iii. The excess leaves of the crop are not promulgating, and therefore, will biodegrade.

Water Usage. *Arundo* will be cultivated utilizing rain water, which given the poor drainage in the selected 400 acres of marginal land as well as the elevated buffer zone, will contain the water within the Biomass Pilot project area, making it ideal for the cultivation of the crop. The ability of *Arundo* to grow in such an environment is its attractive quality, which will be further tested and confirmed through the Biomass Pilot.

Fire Prevention. In Belize, especially during the dry season, there is a risk of wild fires that can often ignite in areas such as sugar plantations where crops begin to dry. Hot embers from such external fires can potentially be blown for various distances, and if it were to reach the location of the proposed Biomass Pilot, it could pose a problem due to surrounding vegetation. However, *Arundo Donax* itself, while the crop is planted, has a natural resilience of fires due to its high moisture content (about 60%). ***Typically, the crop is combustible before it has been dried.*** Therefore, a potential wild fire that may arise from other sources is likely to impact the Biomass Pilot due to this natural hazard. Furthermore, the 20-foot-wide buffers/access road infrastructure will also serve as a fire break since there is no living or dried biomass in the buffer zone that would fuel wildfires to cross over to the Biomass Pilot project area or out of the area. Forest or wildfires in the north of the country are generally ground fires because the forest structure and composition will not support crown fires (forest fires which burn in the canopy or leafy part of the trees). The fire which does ignite or is set will run on the ground consuming fuel as it spreads.

Eradication Plan. The eradication plan is designed to address two particular risks:

- 1) to eliminate unintended propagation should any lateral shifts in rhizomes occur
- 2) to wind down the Biomass Pilot and clear the land area should the decision arise not to continue at either the conclusion of the research phase (end of or during first three years) or the managed cultivation phase post-pilot (end of fourth year).

During the implementation of the Biomass Pilot, the following steps will be taken:

- The constant monitoring of the designated and surrounding area of the Biomass Pilot and other ad-hoc supervision visits by Project Personnel will identify if, despite the various barriers that are already in-place, any rhizomes have shifted/are shifting laterally, which would be confirmed by young shoots emerging in the buffer zone through the road material. It is important to note that this likelihood is very limited given the project sale, design, and preventive risk management measures that are taken.
- If any lateral shifting does occur unintentionally, it would only be on the edges of the outer perimeter of the plots (the density and the compacted nature of the planted plots will provide little room for rhizomes from the plants in the middle of the plots to shift; and will be shaded by existing plants limiting sunlight that is necessary to sprout/grow).
- Will request BAHA to do a semi-annual inspection and evaluation.

At the conclusion of each of the phases, the Research Phase and the Cultivation Phase, of the proposed Biomass Pilot, there will be an evaluation of results from that phase to determine whether to proceed further. In the case of the Research Phase, the 5Cs will discuss with the World Bank the results of the testing including outcome of the pilot eradication of one or two plots.

The process through which it would lead to the permanent eradication of the research plots or the cultivated crop from the Biomass Pilot would include the following steps:

- ✓ The 5Cs, on the basis of the results following the Research Phase or the final feasibility study and ESIA prepared by industry specialists, will make a determination whether the crops cultivated up to that point (either up to 50 acres or 400 acres) in the Biomass Pilot should be permanently eradicated.
- ✓ In the case following the Research Phase, this decision will be based on the results from the three years of testing for yields, cultivation techniques, and eradication approaches. The eradication approach described below would be adjusted based on test results, if necessary, and will be applied for up to 50 acres of one-acre plots, as indicated below.
- ✓ In the case of the managed cultivation of the 400 acres, the consultants preparing the ESIA document will further review the proposed eradication plan and provide input into further improving the eradication approach, which will be incorporated in the steps ultimately taken. This will have the benefit of the results from the one or two test plots that were eradicated and monitored during the three-year Research Phase, which would ensure that the eradication method that is implemented will be effective.
- ✓ Whether the eradication takes place following the first three-year Research Phase or at the end of the fourth year following the Managed Cultivation Phase, the overall approach proposed for eradication would be as follows:
 - The first step in eradication would be to dig-up all of the rhizomes in the area where the *Arundo donax* is cultivated. This will be done through the raking of the field using the same equipment used for site preparation. This will be followed by field crews using regular rakes and spades to dig up the rhizomes for extraction and disposal. The uprooted rhizomes will then be processed through a biomass chipper which will chop the biomass into small pieces of a size less than half an inch shown below in Figure 6.5. The material will then be left to dry subsequent to destruction by burning under controlled conditions.
 - Once the rhizomes are cropped, and collected, they will be placed on the drying slab, dried, and then set on fire under controlled conditions prescribed by the Agriculture Department or BAHA.
 - The above ground stalks and sterile seeds of the crop, which are not needed, but promulgates, will biodegrade once the field is plowed. This process will take about two weeks.
 - The inspections to ensure that the rhizomes and stems of the plant are completely eradicated will be conducted 1 to 3 times per year for two years following eradication activities.

Harvesting and Processing

It is noted that during harvesting the crop for *Arundo donax* for utilization as a biomass fuel, the rhizomes, which promulgate in *Arundo donax*, will not be extracted, and will remain in the ground. Additionally, as previously noted, the *Arundo donax* seeds are considered sterile and therefore, is not expected to propagate either. And, as will be further detailed in this section, the *Arundo donax* stalks, which will be utilized for biomass energy use, will be cropped, chipped, dried and shredded in a manner such that it will be converted to a fibrous material similar to bagasse; which is also is expected not capable of propagation in such a form. In other words, the design of the harvesting approach is such that the extracted and processed material is incapable of further propagation.

5.7.5 Storage

Construction of Storage Area. A storage area of about 19,000 square meters will be specially constructed to hold the cropped and chipped *Arundo donax*. The storage area, which will be located within the 400-acre area designated for the Biomass Pilot, will be a combination of elevated area covered by marl and stone and concrete flooring. The area with marl and flooring will be for parking and washing of equipment entering and leaving, and location of the temporary building for housing project personnel and supplies.

Drying the Processed Biomass. One of the primary purposes of the storage area within the premises of the Biomass Pilot is for drying the harvested and processed plant material that is chipped to ½ to 1 inch in size.

Shredding/Final Processing

The biomass material, which at this point is chopped and processed into ½ inch sized pieces and dried to a level where its water content is 15-20%, will be further processed while at the storage facilities. The final processing step is to shred the biomass material from the ½ inch pieces to fibers similar in size and texture to the bagasse material. The shredding process consists of removing the dried pieces from storage, which are then fed into a chipper/shredder machine that reduces the material into fibers similar in size and texture to bagasse, as well as simultaneously load the material directly into lockable container trucks on the Biomass Pilot premises for delivery to the BELCOGEN facility. The result is of the shredding process is that the biomass material is transformed into a fibrous substance comparable to bagasse. This process will prepare the biomass materials to a format that can be easily blended with sugarcane bagasse and utilized as a fuel in the existing BELCOGEN power plant. This step of final processing will also have the benefit of making it virtually impossible for any of the biomass crop to be capable of propagating leaving the Biomass Pilot Area.

Fire Prevention and Control. Threats of fire will come from the following sources:

- Preparation of meal - any cooking will utilize bottled gas stoves so precautions will be necessary to avoid household fire through use of smoke detectors and having fire extinguishers readily available.
- Fuel spillage fire – there will be significant use of diesel and gasoline to power heavy equipment and hand operated equipment such as bush cutters. Workers will receive training of how to safely handle fuels as well as safety requirement.
- Wildfires – ignited by smokers, farmers, weather, principal threat here is the fire coming onto the Biomass Pilot area or starting in the pilot area. As mentioned earlier the establishment of a Buffer zone around the Biomass Pilot area would act as major fire break to protect the research. There is very little possibility that a ground fire could make it across the buffer zone even in the presence of very high winds and dried biomass fuel on the ground, in such a case the fire prevention protocols described previously in this Environmental and Risk Management Plan will be initiated. Additionally, the buffer zone consists not only of the elevated and surfaced roadway but also an interior drainage ditch which represents yet another barrier to fires getting into or going out from the Biomass Pilot Area.
- Ignition of the harvested biomass – the harvested biomass in ½ inch sizes stored in the cone shape will only ignite if fire at high temperature is introduced, an ember from a farmer burning sugarcane field will not have enough energy to ignite the storage piles. If ignition does occur the smoke alarms located at the site would alert staff to take the necessary measures of fire extinguisher, water or call the fire department (following fire prevention protocols described). This material does not ignite spontaneously as would be the case with wood residue in sawdust piles.

Transportation

Since the processing (chipping, drying, and shredding) and storage of the biomass crop is carried out on the premises of the Biomass Pilot, the transportation of the material is the final step of the production chain of the proposed project. Unlike in many biomass cultivations that transport live biomass material, the proposed Biomass Pilot will only transport inert (unviable) biomass material that is not capable of propagation.

The transportation of the cropped, chipped, dried and shredded biomass material to the existing BELCOGEN power plant facility premises will be carried out by a number of locked container trucks.

The first activity would be to prepare the container trucks, shown in Figure 6.4 for transportation, which would include the following steps:

- ✓ Communication between management of the BELCOGEN facility and the 5Cs will determine the volume and timing for the transportation of the biofuel to the existing BELCOGEN power plant facilities.
- ✓ Once the “order” has been placed, the 5Cs will determine the number of container trucks that would be requirement, and make arrangement for the rental of the vehicles.
- ✓ The container trucks would be loaded as outlined above, directly from the discharge of the chipper shredder machine. Any required labour for managing the load in the container truck will be a requirement of and the responsibility of the transportation contractor. It is anticipated that the transportation contractors will come primarily from the sugar cane areas and are well accustomed to this type of activity. Sugarcane is mechanically harvested and loaded.
- ✓ The container trucks would then be fully locked to prevent accidental spillage during transportation. While the material that is being transported will not be capable of propagation, the locked container trucks will serve as an additional barrier that mitigates the risk of spillage of biomass material on the way to the BELCOGEN power plant facility further preventing possible unintended germination of the crop outside the designated premises of the Biomass Pilot.
- ✓ The container trucks would traverse a distance of less than 20 miles from the Biomass Pilot location to the BELCOGEN power plant premises. The two routes that the container trucks will utilize are existing feeder (access) roads, other than the public roads, that do not include any large population centers or sensitive areas in particular of biodiversity consequence. Feeder roads in Belize are unpaved roads built to enable farmers to travel shorter distances between the fields and the sugar factory thus minimizing the use of the paved roads and residential areas.

Table 5.5: Summary of Risk Management Plan.

Source: Environmental and Risk Management Plan, ERCAP, Caribbean Community Climate Change Center’s publication *Environmental and Risk Management Plan for Piloting the Cultivation of Arundo donax in Northern Belize*. Belmopan, February, 2016. **Appendix 1: Summary of Risk Management Plan.**

<p>Objective of Biomass Pilot: The proposal is for the managed/controlled cultivation of <i>Arundo donax</i> (AD) in specifically identified and contained areas, for testing its suitability as a biomass fuel.</p>	<p>Land for Biomass Pilot: Land area for pilot is a total of 500 acres within a larger area of 1,800 acres identified by the Government of Belize for the activity. It is identified by the Ministry of Natural Resources and Agriculture as marginal, non-agricultural land. The testing of the AD will take place on 400 of the 500 acres designated by the Government.</p>	<p>Viability of Seeds: No viable seeds will be produced as a part of the Biomass Pilot, since seeds for AD are sterile. The plant will not propagate through its seeds, eliminating any prospect for unwanted propagation through airborne or other similar means.</p>	<p>Storage: The pilot will construct 19,000 square feet storage with concrete flooring at the pilot area, where the harvested AD material will be transported immediately following harvesting (i.e. cropping and chipping).</p>	<p>Transportation: Container trucks used for transportation of dried and shredded AD will be locked during transportation. The primary reason for the use of lockable container trucks is to prevent spillage that may cause disruption en-route and loss, rather than any risks since the dried and shredded biomass material can no longer propagate. Nevertheless, it is an additional barrier that will eliminate any risk of unwanted propagation.</p>
<p>Biomass Pilot Results: The approach to The Biomass Pilot operation is designed to help test/confirm whether it is feasible to cultivate and utilize the crop as a biomass feedstock from technical, commercial, financial, and environmental and social perspectives</p>	<p>Buffer Zone: The 400 acre designated Biomass Pilot area that will be used for AD growing will be surrounded by a buffer area of at least 20 foot width that is elevated 12-18 inches, which will have multiple purposes:</p> <ul style="list-style-type: none"> • It will primarily provide containment against the lateral shift of rhizomes, minimizing the likelihood of unintended propagation beyond the designed cultivation area. • Prevent drainage beyond the 400 acre cultivation area keeping all water within Biomass Pilot 	<p>Harvesting: The AD will be mechanically harvested using rotary head cutters, where the machinery will also simultaneously chip the material to approximately ½ inch sized pieces. The chipped material will be discharged directly into a tractor drawn trailer before it is transported to a specially constructed storage area on the premises of the</p>	<p>Drying: The cropped and chipped biomass material will be air-dried in the on-premise storage facility, which reduces the water content of the biomass material to about 15-20 percent in about 2-3 weeks. The biomass material, at this point, can no longer propagate even if planted beneath the soil, according to a number of agronomist specialists.</p>	<p>Transport Route: The transport route, which is less than 20 miles, does not traverse through any major population centers or sensitive areas; in particular of biodiversity consequence or any surface water sources. It will pass by some sugar cane fields.</p>

	<p>area. This will prevent any plant material from being drained beyond the Biomass Pilot area.</p> <p>Serve as an access road to the area where crop is cultivated</p> <ul style="list-style-type: none"> • Act as a fire break should outside fires threaten the pilot project area 	<p>Biomass Pilot.</p> <p>According to several agronomist specialists, the ½ inch chipped material does not have the capability to propagate, and never leave the pilot area as freshly cut plant material, further reducing any chance of propagation outside the pilot area.</p>		
<p>Utilization of Land:</p> <p>The pilot will only utilize a land area that is publicly owned and identified as marginal by the Ministry of Natural Resources and Agriculture. Marginal land is non-agricultural land where the soils are poorly drained, shallow and droughty and cannot be utilized even with skilled management and high inputs. A number of failed attempts at commercial agriculture on these marginal lands. The crop will not be introduced to any areas outside of the designated land area. Therefore, the pilot will not utilize land that will have any alternate agricultural use</p>	<p>Planting AD: The initial 50 acres of test plots (within the 400 acres designated for the Biomass Pilot) will be established from fresh cut stalks from AD growing in the South of the country. The AD stalks collected will be transported in fully enclosed, locked, and inspected container trucks to the Biomass Pilot area. No rhizomes will be removed, uprooted, or transported during the proposed Biomass Pilot. The AD stalks for planting the additional 350 acres (i.e. the remaining 400 acres designated for the Biomass Pilot) during the managed cultivation sub-component, will be supplied from AD stalks cut from the 50 acres of research plots within the Biomass Pilot area. There will be no transport of any live plant material outside the Biomass Pilot area or the removal of any rhizomes within the project area. The rhizomes from the AD will remain underground in the Biomass Pilot area and not being removed at any stage of the Biomass Pilot activity will greatly limit the risk of unwanted propagation.</p>	<p>Cleaning Machinery and Equipment: All machinery that is utilized for harvesting will be washed before they leave pilot facilities. Washing will be done within the location of the Biomass Pilot at a designated central work location, which will also have a water supply in the form of a well. The water used to wash equipment will be drained within the premises as per the design of plots and Buffer Zone; and will not drain beyond the project area as it will be contained by the Buffer Zone.</p>	<p>Shredding: Prior to delivering the stored biomass material to the existing BELCOGEN biomass co-generation power plant, it will be further shredded and directly loaded into container trucks for transport. The shredding, converts the biomass material to a fibrous content that is ready for utilization in the power plant boilers. The dried and shredded biomass material cannot propagate, since it does not have any properties of a live plant material.</p>	<p>Transport Route Inspection: The route will be inspected daily during the transfer of the biomass, even if a spillage of the processed and shredded AD will be rare due to the locked container trucks, if it were to spill, the biomass material does not have any properties that can propagate. The inspector contractor will be equipped with portable vacuum and broom and trash bags to immediately clean-up if any spillage from the container trucks are detected. Contractor will be asked to report on any sign of spills after each trip. If necessary, motorized street sweepers will be utilized to clear debris from road if there is processed and shredded biomass material that is encountered. The collected debris will be brought back to the biomass pilot</p>

				site and returned to the cultivation areas. The daily route inspection planned for risk management will ensure that any fallen material will not remain on the ground for any extended period of time.
The seeds of crop are sterile so it cannot propagate through airborne and other means via the seeds. The only means of natural propagation of crop is through the spread of rhizomes that are underground. Managed propagation requires the harvesting and planting of AD stalks in a manner similar to any sugarcane.	<p>Water Resources: The area 400 acre designated for cultivation of AD in the Biomass Pilot is sufficiently far from the nearest water source (at least 830 meter distance from nearest stream), preventing any AD plant material from the Biomass Pilot from being introduced to water sources. It will prevent waterborne transportation and propagation of the crop due to the proposed Biomass Pilot.</p> <p>The designated land area/fields are flat lands and do not naturally drain water. While this aspect makes the area suitable for cultivating the crop, it also limits run off of water reducing the likelihood of any plant material spreading.</p>	<p>Cleaning Transport Equipment: All transportation equipment will be washed before, moving off site. Washing will be done within the premises of the 400 acre Biomass Pilot at the designated central work location, which will be supplied with water from a well on the premises. The used wash water will drain but will be contained within the 400 acre Biomass Pilot premises due to the elevated buffer zone and drainage design./</p>	The seeds of crop are sterile so it cannot propagate through airborne and other means via the seeds. The only means of natural propagation of crop is through the spread of rhizomes that are underground. Managed propagation requires the harvesting and planting of AD stalks in a manner similar to any sugarcane.	<p>Water Resources: The area 400 acre designated for cultivation of AD in the Biomass Pilot is sufficiently far from the nearest water source (at least 830 meter distance from nearest stream), preventing any AD plant material from the Biomass Pilot from being introduced to water sources. It will prevent waterborne transportation and propagation of the crop due to the proposed Biomass Pilot.</p> <p>The designated land area/fields are flat lands and do not naturally drain water. While this aspect makes the area suitable for cultivating the crop, it also limits run off of water reducing the likelihood of any plant material spreading.</p>
Risk Management Framework to Prevent Unwanted Propagation: Since the risk of propagation of the crop is only if the cultivation is not adequately managed, it is good practice to prepare a framework	<p>Handling/Utilization of Plant Material: Plant material will be handled/utilized as follows:</p> <ul style="list-style-type: none"> • The excess leaves are biodegradable and do not propagate • The stalks are cropped, processed (chipped, dried, and shredded) as 			

for managing any residual risks. This document represents such a Risk Management Framework that will further minimize any residual risk of uncontrolled propagation.	<p>biomass feedstock. This biomass material cannot propagate.</p> <ul style="list-style-type: none"> • The rhizomes through which AD propagates remain underground throughout project and are not extracted; and further protected by a buffer zone. This will prevent propagation outside the 400 acre Biomass Pilot area through the spread of rhizomes. 			
<p>Post-Pilot Assessment: At the conclusion of the pilot, a complete environmental and social impact assessment (ESIA) will be commissioned to ascertain potential impacts and mitigation measures that may be required for expansion of AD cultivation beyond pilot. The Biomass Pilot itself will provide valuable information on refining the practices for the managed cultivation of AD, which can be incorporated into the ESIA. The post-Biomass Pilot ESIA will comply with World Bank and Government of Belize environmental and social safeguard requirements</p>	<p>Access to Biomass Pilot Area: There are no residents living in the proposed project area, and it is all publicly owned land. The nearest household is at least 5 miles from the Biomass Pilot area, and even then, it is a limited population that resides in these distant communities. These factors make it unlikely that there would be unauthorized/unprepared access by outsiders to the Biomass pilot area. In addition, the nature of the plants will make unplanned access difficult. Moreover, there will be posted signs restricting access as well as regular monitoring by project security to ensure that there is no unauthorized access to the Biomass pilot area by outsiders/non-project personnel. Only authorized project personnel will be provided access to the 400 acre Biomass Pilot area</p>			
	<p>Monitoring and Inspection: There will be an inspection plan under implementation with regular monitoring for propagules in the cultivated fields and</p>			

	<p>buffer zones, including sight inspection of the plots and surrounding buffer and surrounding areas to determine if there is any unwanted growth. If any such cases are observed outside the cultivated area, it will be immediately removed and replanted within the 400 acre area designated for the Biomass Pilot that is surrounded by the buffer zone.</p> <p>Monitoring will also be undertaken to ensure that there is no unwanted encroachment into the Biomass Pilot area by unauthorized personnel.</p>			
	<p>Eradication Plan: In the event that the pilot is unsuccessful or termination of the project is necessary, then the field will be ploughed repeatedly to uproot the rhizomes, and raked to remove rhizomes. This industry practice is being applied instead of chemical eradication of the crop. As the AD rhizomes do not grow to more than 50 centimetres in length, to cross an area of 20 feet would require that plant to have shoots about every two feet.</p>			

Annex 1: Register of Restricted Use Pesticides in Belize				
No.	Registration Holder	Trade Name	Active Ingredients	Restricted on the basis of Criterion:
1	Pilarquim(Shanghai)Co.Ltd.	2,4-Damine60SL	2,4-D	4
2	Westrade GuatemalaS.A.	Agromina60SL	2,4-D	4
3	AGROQUIMICA INDUSTRIAL RIMACS.A.	Bullgrass30.4SL	2,4-D+picloram	4
4	Shandong Binnong Technology Co.,Ltd	Capture60SL	2,4-D	4
5	ADAMA Crop Solutions ACC,S.A.	Deferon60SL	2,4-D	4
6	Dow Agrosciences GuatemalaS.A.	DMA68,3SL	2,4-D	4
7	AgrocentroS.A.	Elimina60SL	2,4-D	4
8	AgrocentroS.A.	Elimina72SL	2,4-D	4
9	Tikal Agrosolutions	Espuela30,4SL	2,4-D+picloram	4
10	Dow Agrosciences GuatemalaS.A.	Flash7.5SL	2,4-D+picloram	4
11	Tikal Agrosolutions	Foram16,5SL	2,4-D+picloram	4
12	Dow Agrosciences GuatemalaS.A.	Fullmina60SL	2,4-D	4
13	Dow Agrosciences GuatemalaS.A.	Kuron16SL	2,4-D+picloram	4
14	Dow Agrosciences GuatemalaS.A.	Matamina60SL	2,4-D	4
15	ADAMA Crop Solutions ACC,S.A.	PasoD30,4SL	2,4-D+picloram	4
16	AGROQUIMICA INDUSTRIAL RIMACS.A.	Rimaxil60SL	2,4-D	4
17	Dow Agrosciences GuatemalaS.A.	Tordon30,4SL	2,4-D+picloram	4
18	Químicos y Lubricantes,S.A.	Totem60SL	2,4-D	4
19	Químicos y Lubricantes,S.A.	Totem72SL	2,4-D	4
20	AgroInsumosS.A.	Weedmaster46.5SL	2,4-D+dicamba	4
21	Biesterfeld U.S.,Inc.	2,4-Damine72SL(Biesterfeld)	2,4-Damine salt	4
22	UPL Costa RicaS.A.	Quickphos56GE	Aluminium phosphide	1
23	FMCLatino AmericaS.A.	Rugby10GR	cadusofos	1
24	Koppers Performance Chemicals	K-33(60%) Wood Preservative	Chromated copper arsenic	1
25	Drexel Chemical Company	Diazinon60EC(Drexel)	diazinon	8
26	ADAMA Crop Solutions ACC,S.A.	Diazol50EW	diazinon	8
27	ADAMA Crop Solutions ACC,S.A.	Diazol60EC	diazinon	8
28	ADAMA Crop Solutions ACC,S.A.	Diazolution60EW	diazinon	8
29	AGROQUIMICA INDUSTRIAL RIMACS.A.	Rimazinon60EC	diazinon	8
30	Químicos y LubricantesS.A.	Agente36SL	glyphosate	9

31	AgrocentroS.A.	GlifosatoAleman35,6SL	glyphosate	9
32	ADAMACropSolutionsACC,S.A.	Glyphogan35,6SL	glyphosate	9
33	JiangsuGoodHarvest-WeienAgrochemicalCo.Ltd.	Glyphosate35,4SL(Jiangsu)	glyphosate	9
34	JiangsuGoodHarvest-WeienAgrochemicalCo.Ltd.	Glyphosate69,8GR(Jiangsu)	glyphosate	9
35	Pilarquim(Shanghai)Co.Ltd.	Helosate35,6SL	glyphosate	9
36	AgrocentroS.A.	Jaripeo68SG	glyphosate	9
37	AGROQUIMICAINDUSTRIALRIMACS.A.	Kila44,9WP	Glyphosate+ Metsulfuron-methyl	9
38	DrexelChemicalCompany	Nock-Out35,6SL	glyphosate	9
39	QuímicosyLubricantes,S.A.	Pantek36SL	glyphosate	9
40	AgrocentroS.A.	Ranchero24SL	glyphosate	9
41	AGROQUIMICAINDUSTRIALRIMACS.A.	Rimaxato35,6SL	glyphosate	9
42	QuímicosyLubricantes,S.A.	RootOut36SL	glyphosate	9
43	Monsanto	Roundup35,6SL	glyphosate	9
44	Agroinsumos,S.A.	Touchdown Forte50SL	glyphosate	9
45	RainbowAgrosciencesLimited	Wipeout35,6SL	glyphosate	9
46	ElClonoAgropecuário	Banazeb60SC	mancozeb	4
47	E.I.DuPontdeNemoursandCo.	CurzateM72WP	Mancozeb+cymoxanil	4
48	ROTAMAgrochemicalCo.	Diligent72WP	Mancozeb+metalaxyl	4
49	DowAgrosciencesGuatemalaS.A.	Dithane60SC	mancozeb	4
50	UPLCostaRicaS.A.	Glory75WP	Mancozeb+azoxystrobin	4
51	Pilarquim(Shanghai)Co.Ltd.	Helcozeb80WP	mancozeb	4
52	SulphurMillsLtd.	Manco80WP	mancozeb	4
53	QuímicosyLubricantes,S.A.	Mancozeb42SC (QUILUBRISA)	mancozeb	4
54	QuímicosyLubricantes,S.A.	Mancozeb0SC(QUILUB RISA)	mancozeb	4
55	AGROQUIMICAINDUSTRIALRIMACS.A.	Mancozeb80WP(RIMAC)	mancozeb	4
56	WestradeGuatemalaS.A.	Manzate43SC	mancozeb	4
57	UPLCostaRicaS.A.	Manzate75WG	mancozeb	4
58	UPLCostaRicaS.A.	Manzate80WP	mancozeb	4
59	AgroInsumos,S.A.	RidomilGoldMZ68WG	mancozeb	4
60	AgroInsumos,S.A.	RidomilGoldMZ68WP	Mancozeb+metalaxyl	4
61	UPLCostaRicaS.A.	SAAF75WP	Mancozeb+carbendazim	4
62	WestradeGuatemalaS.A.	Tenaz60SC	mancozeb	4

63	UPLCostaRicaS.A.	Tridium70WG	Mancozeb+azoxystrobin	4
64	ParijatIndustriesPvt.Ltd.	Victor80WP	mancozeb	4
65	UPLCostaRicaS.A.	Vondozeb42SC	mancozeb	4
66	UPLCostaRicaS.A.	Vondozeb62SC	mancozeb	4
67	UPLCostaRicaS.A.	Vondozeb75WG	mancozeb	4
68	UPLCostaRicaS.A.	Vondozeb80WP	mancozeb	4
69	WestradeGuatemalaS.A.	Lannate21,6SL	methomyl	1
70	E.I.DuPontdeNemoursandCo.	Lannate40SP	methomyl	1
71	E.I.DuPontdeNemoursandCo.	Lannate90SP	methomyl	1
72	ROTAMAgrochemicalCo.	Lash21,6SL	methomyl	1
73	ROTAMAgrochemicalCo.	Lash90SP	methomyl	1
74	E.I.DuPontdeNemoursandCo.	Vydate24SL	oxamyl	1
75	AgrocentroS.A.	Angloxone20SL	paraquat	8
76	AgroInsumosS.A.	Doblette20SL-	Paraquat+diquat	8
77	Agroinsumos,S.A.	GramoxoneSuper20SL	paraquat	8
78	Agroinsumos,S.A.	GramuronX30SC-	Paraquat+diuron	8
79	ShandongLubaChemicalsCo.Ltd.	Lubaquat20SL	paraquat	8
80	Pilarquim(Shanghai)Co.Ltd.	Paraquat42TC	paraquat	8
81	AgroInsumosS.A.	ParaquatFull20SL	paraquat	8
82	AgroInsumos,S.A.	Preglone20SL	Paraquat+diquat	8
83	QuímicosyLubricantes,S.A.	Rafaga20SL	paraquat	8
84	AGROQUIMICAINDUSTRIALRIMACS.A.	Rimaxone20SL	paraquat	8
85	AgroInsumosS.A.	Curyom55EC	Profenofos+lufenuron	1
86	AMVACdeCostaRicaS.A.	Counter10GR	terbufos	1
87	AMVACdeCostaRicaS.A.	Counter15GR	terbufos	1
88	TikalAgrosolutions	Forater15GR	terbufos	1

Source: Pesticide Control Board Website

6.0 OCCUPATIONAL HEALTH AND SAFETY PLAN (OHSP)

6.1 Preamble

This OHSP is in draft format, to be completed during the approval process and prior to commencement of construction. The plan applies to all employees, including those with contractual obligations.

OCCUPATIONAL HEALTH AND SAFETY PLAN – OHSP

Last update: April 20 2020

KEY RULES OF THE OCCUPATIONAL HEALTH AND SAFETY PLAN (OHSP)

1. Never pass over or interfere with any security provision; or allow others to do so, regardless of their hierarchical level.
2. The rules on the use of the corresponding Personal Protective Equipment (PPE) at the end of a given task must be met at all times.
3. The isolation and locking procedures must be met at all times.
4. It is forbidden to work under the influence of alcohol or drugs.
5. You must inform, analyze, and communicate in a timely manner, all injuries and incidents.

Description of OSHP

Entrenching a culture of health and occupational safety is to involve all staff, to achieve zero injury and damage to the company's resources.

Directors, managers, administrators, coordinators, heads and Area supervisors, are responsible for establishing and maintaining the highest standards of Occupational Health and Safety (OHS).

Each partner is responsible for his or her safety and must stop to anyone who commits an unsafe action.

The issue of occupational health and safety is not an attempt to look for guilty parties; but saving lives and minimizing risks.

We must all work within the procedures and rules of OHS, enabling us, identifying, correcting and reporting incidents, hazards, conditions and unsafe

actions.

As part of our passion for safety, the Arundo donax Project Team has developed this guide with a series of rules which must be strictly followed.

Infractions

Offences are as follows:

- Failure to follow the occupational health and safety guidelines OHSP.
- Playing in a manner that disregards his/her security and that of his/her companions.
- Failure to comply with the present normal way of operating (Modus operandi).
- Enter or consume alcoholic beverages or drugs of abuse within the premises.
- Introduce yourself to work under influence of psychoactive substances.
- Attitudes denoting negligence in occupational safety and health.
- Being caught destroying signals, equipment and any warning signs on the ground.
- Damage or vandalism of the team's personal protection, combat first aid and fire equipment.

6.2 Contents of the OHSP

Health and safety policy

Vision and mission of occupational health and safety

Process of investigation of incidents

Hazard identification and risk assessment

Isolation and lock

Personal protection

Signaling

Control of hazards at work

Annex I

Annex II

Annex III

Offences and penalties

6.3 Occupational Health and Safety Policy and Guidelines – Arundo donax Project.

Occupational safety and health are an essential part of our value system. As a result, the occupational health and safety, is incorporated in all our businesses and activities.

Health and safety are a first priority; no other objective or priority may be above the preservation of the integrity and health of the people with whom we work. This includes our employees, contractors, customers, visitors and communities with which we interact.

Senior management is responsible for the prevention of accidents and occupational diseases. Each employee has an obligation to ensure compliance with standards of occupational health and safety, and especially in his or her area of responsibility.

As an organization, we are responsible for providing media, training and resources needed to implement standards and good practices in health and safety in all our activities. We aim to continuously ensure a commitment to provide safe and healthy environments in order to preserve the well-being of all people with whom we work.

Health and safety objectives are integrated into our systems and management processes at all levels of the Organization, which we modeled with active and visible behavior at all levels, working on continuous improvement to achieve our goal of '0' injuries, occupational diseases or other losses.

6.4 Vision and Mission

Our Vision on OH&S: *Workers return home safe and sound.*

Our mission on OH&S: *To achieve zero injuries and not to tolerate employees working with risks.*

Our mission will be achieved with the continuous monitoring, information on health and occupational safety and implementation of preventive actions to the identified risks.

RISK CONTROL AT THE WORK PLACE

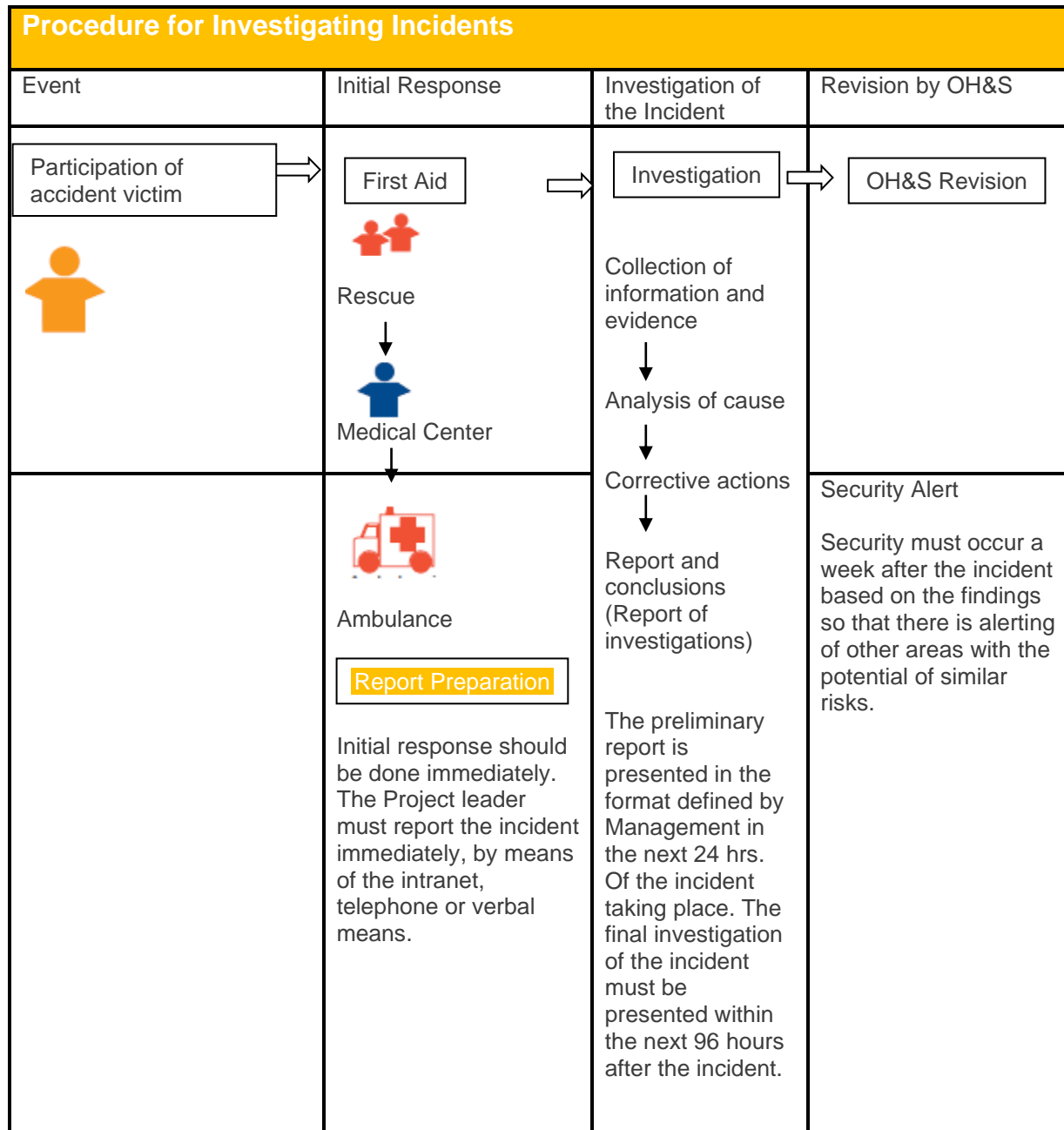
Prevent the entry of strangers, delimiting with caution tape to identify the danger area, illuminate the area and marked to avoid incidents.

- Debris must be removed promptly.
- Must be done systematically: in buildings floor by floor and without removing the brackets of the upper floors until the end of the work.
- The walls will be demolished by sections.

- Shut up the area with temporary barriers (fences or tables) at an appropriate height to prevent incidents from waste debris.

6.5 Procedures for the Investigation of Incidents

All incidents must be reported to look for their causes and corrective actions, which should be implemented as soon as possible to avoid further injuries and recurrences.



The temporary measures should be replaced by permanent solutions. The solutions developed to save lives, prevent injuries and losses in any business unit of the group, must be integrated to our worldwide standards.

6.6 Identification of Dangers and Risk Evaluation

Take Two (2) minutes to analyze a task in order to identify, assess and mitigate risks in the work we do.

You must take the time to do it right.
What must you do before each Task?

Stop and think.
Note the area of work and surroundings.
Discuss what is going to make?
Observe and analyze what is happening in nearby areas?
Identify what could go wrong?
All risks should be controlled before starting work.

What must you do during each task?

- Stay alert.
- To perform a routine task, it is possible to do it automatically, and can result in an incident.
- Take short and regular breaks to concentrate again on its environment and related hazards.
- When finishing thinking: what does, to complete their task safely?

What should you do when the work is finished?

- Note the work area.
- Check any hazards that might result from the work.
- Think of the work:
 - All went well?
 - Planned it properly?
 - He felt safe working?
 - Were there others working nearby and did the work safely?
 - Are there any improvements for a next time?

The success of the identification of hazards and risk assessment depends on you.
If risks that cannot be controlled are identified, communicate them to his boss and OH&S Department.

6.7 Isolation and Blocking

You may suffer serious injury when exposed to sources of energy (kinetic, mechanical, electrical, etc.). To avoid this, it is necessary to follow the seven golden rules that pertain to isolation and blockage.

The 7 Rules for Isolation and Blocking

1. Coordinate

Before commencing contact a fellow employee (where applicable) to ensure the correct insulation of equipment.

2. Isolate

The involved equipment must be isolated from a power source to avoid explosions or electrocution, possible sources of energy accumulated in springs, pneumaticsystems, transformers, etc. should be inspected

The use of emergency stops should not be considered as isolation.

3. Secure and Block

- Equipment used to isolate should be secured in place by a padlock, removing the connecting or installing a physical barrier.
- Hazardous energy sources must be disconnected.
- Protective equipment will be selected by a qualified person and shall meet the requirements of the related task. Protection may include respirators, clothing and protective gloves, glasses, clothing, chemicals, helmet, toe, ear protector.

4. Test

- Before you begin perform a visual inspection or attempt to start the computer.
- Mechanically verify the absence of energy: tension, movement.
- Check absence of voltage between the conductors.
- Check the process: lack of pressure, flow; accompanied by the required, specific control and continuous (O2 oxygen, carbon monoxide, CO, etc.)

5. Label

All locking device must be tagged with the data of the person who performs the task. Note all locks in the work permit, signed by the staff and who authorizes.

6. Immobilize

Immobilize parties that can release energy for work.

Note: Be sure that the locking devices used resist the force that can be.

7. Mark Out

Work areas should be marked and prohibit the passage through them.

6.8 Personal Protection

6.8.1 Procedure for the use and abuse of psychoactive substances:

The CCCCC recognizes the value of each collaborator in different levels of the Organization and the importance that has your well-being.

Therefore:

- The CCCCC is not indifferent and takes an active role in the different situations that promote or require the use of psychoactive substances, to prevent serious risks or problems that can be generated by the consumption of these substances.
- Employees are subject to random testing that may be carried out while carrying out activities of the company.
- If you take prescription medications that affect your concentration or reaction time, discuss this with your supervisor. For this we implemented a program of orientation, awareness, prevention and assistance to employees.

Psychoactive substances: They are substances that stimulate or depress the central nervous system, disrupt behavior and motor function, can be drugs, alcohol, or drugs of abuse.

General hygiene:

- Use SOAP, water or the cleaning materials that is provided.
- Never use solvents or flammable materials to clean their hands, dissolve protective oils from the skin and may cause injury.
- If you suffer from any infectious disease, consult your doctor before work and report to your supervisor.
- Keep the dining rooms and dressing rooms clean, label refrigerators and storage for "Chemicals only" or "Food only" shelves.



Do not use air compressed to clean clothes or work areas, may cause injury or trauma to the eyes.

6.8.2 Personal Protection Equipment (PPE)

The Organization will give the necessary equipment for their personal health and safety. It is your duty to keep it clean and in good condition. It is forbidden to make modifications to the personal protective equipment. The following basic requirements apply: is obligatory the use of the helmet, goggles, hearing protection and safety boots and if necessary, dust mask. Elements of protection must be adequate to each task. The main ones are:

- Safety harness
 - Safety goggles
 - Leather/rubber gloves
 - Goggles (Disposable masks)
 - Harness
 - Hearing protection
 - Mask for sanding
 - Welding mask
 - Welding torch goggles
-
- It is required to wear gloves when working with sharp materials, for chiseling or cut welded, rivet, handle Rails, sleepers and materials that have sharp edges.
 - When used for welding or cutting with a welder, special care must be taken to ensure that welders do not contain oil or grease which could react with oxygen.
 - When working with batteries, acidic electrolytes or live circuits, rubber gloves should be used that are in good condition.
 - Special glasses or masks should be used in the following operations:
 - ✓ Hammer chisels on metal.
 - ✓ Whenever you use grinding wheels.
 - ✓ Welding and cut with acetylene.
 - ✓ Applying or removing of chemical paint.
 - ✓ Blowing with compressed air (not be used for personal hygiene).
 - ✓ Grinding, cutting or caulking metal, stone or concrete.
 - ✓ Cut screws or rivets, split or split nuts.

- ✓ Metallic engines or if one performs tasks such as turning, milling, brushing, drilling, and cutting.
- ✓ Transferring or handling acids or caustics.
- ✓ Placement and pumping concrete.

Visiting a plant or office remember to take all your Personal protective equipment and use it according to the existing signage

Modifications to personal protection clothing are prohibited.

6.9 Warning Signage

These are some of the most common signs within our offices and facilities:

	Warning/Hazard
	Keep Out
	Mandatory
	Fire Extinguisher
	First Aid
	Emergency Exit

6.10 Control of Work Hazards

Terms and conditions of order and cleanliness

- Staff should cooperate to keep their area as well as the entire work areas clean and tidy.
- Access roads must be kept free from materials and obstacles.
- Storable materials are placed preventing slipping or falling.

- Recyclable waste, including metals must deposit in the containers labeled for recycling.
- Remaining stems of welding electrodes and the cutting waste, must deposit in vessels assigned for this purpose.
- The storage of waste should be done according to its classification and in properly labeled containers.

<p>We are all responsible for the order and cleanliness of the workplace.</p>
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Work at Office and Work Shop(s)

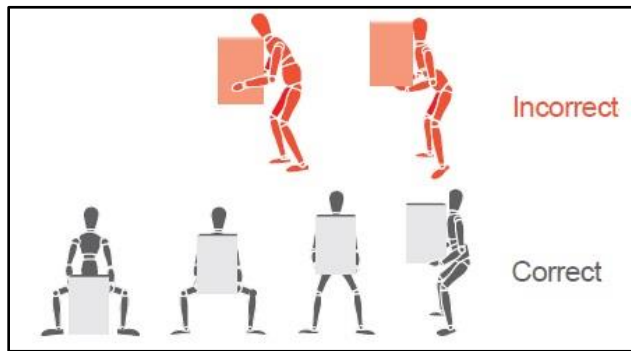
- Make sure that your position when sitting is correct and your Chair meets the recommendations of OH&S.
- Cables phone or extension cords not cross the soil to avoid unsafe conditions that may cause injury.
- Do not leave doors, drawers or open cabinets.
- Air conditioning systems should be kept within a range of 20 ° C and 24 ° C. 3.

Lighting

- If your work area is insufficiently lighted, refer to your supervisor to make corrections.
- Poor lighting can cause accidents, injuries or illnesses. If you are working with welding and flame cutting, equipment should not be placed on the scaffolding and their cables and machine must be secure.
- Skirting boards must be installed on all scaffolds to stop falling objects and tools.
- All scaffolding must be able to withstand, without failure, its own weight and at least 4 times the maximum load applied or transmitted to the team.
- All scaffolding must be approved and identified for use.
- The disarming of the scaffolding will be done only after verifying that there are no objects that can serve as hindrance.

Load Handling Manual

- Lifting loads improperly may cause serious injury.
- Warm up your body before handling loads, while making an effort, put your feet around the load and keep your back straight. Be sure to choose the safer route and that the way is free of obstacles.
- Observe and analyze the load before lifting a load: do not over estimate your strength, if the load is too heavy, is very large or very difficult to maneuver, get help or use machinery.



To rotate the body with the load it is necessary to first move your legs. Tasks that involve lifting with repetitive motions should be subjected to a specific analysis.

Storing

- The shelves should not carry one weight greater than that indicated in each and must be anchored to the wall or floor.
- The heavier objects will be stored in the lighter in the top and bottom shelves; in addition, all rack should have systems of protection from falling objects.
- To determine the safe of the loading height must take into account the mechanical resistance efforts, shape, size and composition of the materials, and in your case, containers or packaging, as well as its placement and arrangements for stacking them or recommended by the manufacturer.
- All materials palletized and stored in the upper parts of the racks must be packaged.
- Storage floor-level should be on a firm, level surface; the stowage should be stable, uniform, according to the type of material and be ensured of way in to avoid its collapse.

Environmental Conditions

In adverse weather conditions (rain, cold, wind, Sun, etc.) appropriate clothing should be used. Area managers are in charge of coordinating the breaks and rotation of staff working exposed to high temperatures. Remember to stay hydrated.

Noise

The noise can damage hearing and the nervous system. Hearing protection must be used in required areas and replaced if damaged.

Dust

In areas with dust concentration, respiratory protection must be used. Identify the source of the dust to ensure protection and change their PPE when it is defective.

Equipment and Hand Tools

- The collaborator should keep your tools in good condition.
- It is forbidden to use modified or improvised tools.
- The tools should only be used for what they were designed. Do not use tools in poor condition, replace them.
- Tools with cutting edges or sharp points are fitted with guards.
- All site work will have a designated place to save every tool, they must be inventoried. During transportation avoid endangering people.
- Drive cutting tools or polished only must be operated with the guard installed and appropriate personal protective equipment.
- Jacks and similar tools must be used with a weight within their rated capacity and placed on a solid and level basis.
- Hand tools will not temporarily abandon in stairs and elevated places from where it could fall.
- Power tools when not in use must remain unplugged from power sources.

Safety Guards and Devices

Guards and safety devices must not be removed or become inoperable and will be placed where there is possibility of entering into direct contact with equipment in motion.

Use of Ladders

- The portable ladders must rest at an angle in which the horizontal distance from top to the support of the ladder it is 1/4 of it. The ladders will be used by one person at the same time.
- Personnel must do not use metal stairs in welding or near lines or energized electrical services.
- Avoid the support points to move, if not possible, a person shall be at the foot to avoid displacement
- Identify the work area before starting.
- Do not use ladders that have some steps defective or missing.
- Ladders should remain in good condition and be inspected by competent persons each month.

Note: The portable ladders are not to be tied to each other for support during use. Remember to use the 3 points of support to move up or down.

- The portable ladders must be equipped with non-slip bases. Portable ladders must not be placed in front of doors that open towards them, unless they are blocking to remain open or be guarding.

Dangerous Substances

- Material Safety Data Sheets (MSDS) should be available to staff who handle dangerous substances. The MSDS listed chemicals in use, the correct way of handling them and emergency procedures.
- Get to know where these records are and how to use them. You must use suitable PPE when handling dangerous substances.

Fire Protection – Flammable Materials

Flammable materials storage:

- Flammable material will be stored isolated from sources of ignition and sufficient ventilation.
- Flammable waste (paper trash, rags with oil or FAT) should be removed regularly.

Handling:

- Handle flammable liquids carefully, avoid spills, and do not use cell phones orelectrical appliances near substances with a low ignition point.
- Never use gasoline or other flammable liquids such as cleaning agents.

Fire Prevention

- Personnel must know the location and operation of fire extinguishers.
- Follow instructions on the emergency of the area plan.
- Never use water to put out electrical fires.

Be alert for the signs: NO smoking / flammable

- Use CO2 fire extinguishers and dry chemicals in the presence of electric current.
- Any outbreak of fire must be reported and remember: do not take unnecessary risks.

Whenever you use an extinguisher immediately send it to refill or replace and notify Management.

Hoisting of Loads

- The use of equipment for lifting loads is the responsibility of the supervisor of the area or the mounting.
- The team will only be used to raise and mobilize cargo; no worker should be mounted on the load or travel next to it.
- Loads must not be resting on workers.
- All Slings or Cable operators (persons with ability and training to place cables, slings, etc.) should safeguard the operating safety of the equipment for the lifting. You must examine gears and compare their methods of operation with other approved and accepted. The slinger should check that the load is securely clamped and that the sling is safe before giving the signal of the uprising.
- Never use open hooks when material is passed about even when passed over people.
- If you must use hooks, these must be provided insurance to prevent scope out the hook.

Transport of Personnel and Materials

- Personnel will be mobilized exclusively inside the cabin of each vehicle and vehicles adapted for this purpose, without exceeding its capacity.

- Use the safety belt while the vehicle is in motion.
- The driver must check that the load is secured and that no person on it there before starting the vehicle.
- Vehicles must park in the assigned area, into starting position and without obstructing traffic, pedestrian areas, emergency equipment and spaces for use by people with different abilities.
- Must respect the speed limit set for the headquarters.
- Any vehicle entering / out of the plant will be reviewed by the security guard on duty in the control booth.
- The taking out of equipment, tools and materials should be backed by an order signed by the authorized representative of the company, and it must be presented to the security officer in turn.
- **Only authorized personnel can drive vehicles of the organization. Any partner that enter or exit the facilities will cooperate with review of vehicle at security posts along.**
- All collaborator who enters or leaves the facilities will cooperate with the revision of the vehicle in security posts along the

System of Work Authorization (for hazardous work activities)

Permits or authorization (verbal or written) are required as follows:

- a. Permits are required to work at heights.
- b. Electrical work.
- c. Jobs in hot environments.
- d. Work in confined spaces.
- e. Excavations and trenches.
- f. Work with equipment or vehicles.

During all hazardous work the area must be cordoned off.

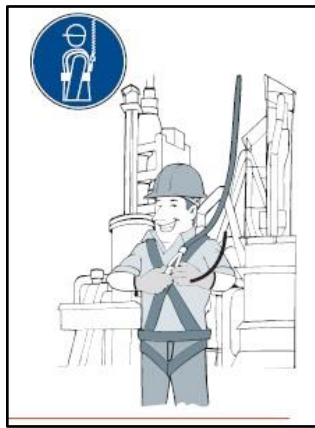
Requirements for the Use of Work Permits. Work permits should:

- ✚ Be carried out by a competent person.
- ✚ The competent person will make an explanation prior to working with those involved.
- ✚ Placement of the license in a conspicuous place.
- ✚ Are valid for a day's work.
- ✚ It must be signed by the persons defined by management.

Description of the activities covered by the system of work

Work in High or Elevated Conditions

- Working at elevated areas is defined at working at elevations higher than 1.8 m from the surface without any control measure in the event of a fall.
- It is forbidden to climb defective stairs or stack material.
- If you should carry out work at heights and feel dizziness or other indisposition inform the supervisor immediately.
- Perform an inspection before putting on a harness, lifeline and straps.
- To raise and lower materials or tools it must be done by means of ropes and confirm the absence of people below. In case someone is present, notify staff that are at floor level and wait until there is no more risk.
- Before leaving the work site in elevated areas verify the absence of materials that could fall.
- The number of loose items should be reduced to facilitate the mobilization of personnel and move them away from the edge to prevent their collapse.



The anchor point must be higher than the level of the head

- If you need to interrupt a task related to assembly or disassembly, do not leave loose parts. Tie and secure them to prevent their collapse.
- If an item falls you must call out to warn operators below.

Scaffolding

- Must be installed on a level surface and crossbars must be secured. If the height of the scaffolding is equal to or greater than 1.8 m height; work permit and mandatory PPE is required.
- The surface of the scaffold should be completely covered by platforms that fit securely into the frame of scaffolding and are in good condition (no holes, cracks, corrosion).
- When they are two bodies or more it must be secured to a firm and resistant structure and all sections of the scaffold should tie.
- The provision of planks or floor of the scaffolding must prevent sliding and tilting.

For Works in heights it Is Mandatory that during the Use of a Harness it should be Anchored at all Times, and such is the use of Helmet And harnesses and straps.

Electrical Work

ELECTRICAL RISK			
Type of Electricity	Control No. 1 Electrical Discharge	Control No. 2 Isolation and Signaling	Control No. 3 Available Safety Distance
Low Tension	Voltage Distribution (120/220V)	Request Isolation by Company	Energy Distribution
Medium Tension	Voltage Distribution (1.0/22 kv)	Company Authorizes Isolation	Request Isolation by Company
High Tension	Voltage Distribution (69 kv or higher)		

- Inputs and high voltage controls must be suitably protected sites and only authorized personnel will enter.
- Fuses and distribution boxes should be always covered, labeled and in perfect condition.
- Generators and transformers will be labeled and identified and isolated with barrier or protective devices.
- All barrels, tanks and fuel containers must be landed on the surface prior to loading, unloading, and transfer operations.
- During Pre-operational tests, energized circuit breakers must have a process of locking and labeling for dangerous power (padlock and card).

Works in Hot Environments

Electrical welding
Welding and brazing
Gas and compressed air cylinders

All work must have safeguards for fixed or portable screens of no less than 2.15 m tall; painted dark grey or opaque black.

Electric Welding and Cutting of Metals

Always and at all times you should use PPE (masks, welding mask, dielectric shoes, leather gloves, leggings, leather sleeves, and apron).

You must not work in clothes that are contaminated with fuel or oil.

- Always and at all times you should use PPE (face mask, welding mask, safety shoes, leather gloves, leather, apron and vapors respiratory protection)

- You should not work with clothes contaminated with fuel or oil.
- Works on the premises with combustible materials, dusts or flammable vapors, will only be authorized by a Supervisor of the respective area.
- The use of Personal protective equipment is mandatory for welders and helpers. You are responsible for the activity daily review and replace if necessary, the connecting cables, holder electrodes and ground clamp. In welding of metals with toxic fumes, welders use protective equipment for respiratory tract.
- On the work premises avoid that toxic fumes that may affect other people who must stand near the place, (removing or respiratory protection).
- The connection and disconnection of welding machines and packaging should be exclusively done by electrical maintenance personnel.

Adequate holders and clamps for chargers and ground wire will be used, improvisations will not be accepted.

Gas and Compressed air Cylinders

- Only if you are trained you can use oxy-acetylene equipment.
- Do not touch the valves on cylinders of compressed gas unless you have the necessary training.
- Only compressed air will be used for its original purpose (not to be used for personal hygiene).
- Gas and compressed air cylinders must have a check valve and joints in the hoses will not be accepted.

Cylinders of oxygen and fuel gas (acetylene) must be stored with a wall of separation between them or with a minimum distance of 6 m.

- Compressed gas cylinders must be in good physical condition and remain upright and secured with string, strips or wire rope at all times, capped when not in use and properly identified.
- Do not store cylinders near electrical circuits, equipment that generates heat or sparks.
- Liquefied gas containers should be protected from solar radiation by means of reflective paint or roof when they are outdoors.
- Compressed gas cylinders should be covered when not in use, or when they are being transported or stored.
- Empty and filled cylinders should always be stored separately.
- Pressure Indicators and adjusting valves must operate correctly and avoid damage.

Confined Spaces

- A confined space is that of difficult access that has no natural ventilation and where they can accumulate pollutants toxic or flammable, or have a poor atmosphere into oxygen.
- Before entering any confined space, you must have the respective permission and you must inform everyone involved in the task.
- Take precautions before going and keep a person at the entrance which monitor (visual or auditory contact) your work. Personnel must be trained, have rescue team and support staff trained in rescue in confined spaces.
- You should determine that the work atmosphere does not have explosive mixtures, vapors or gases harmful to health or oxygen deficiency.
- No work in any well will be allowed without following these guidelines for confined spaces and for in order to ensure emergency evacuation there must be emergency evacuation personnel present.

Excavations

- A preliminary study of the area should be done to determine if there are any impeding barriers such as water lines, phone, etc., or trees, stones and objects that create a hazard, should be removed or corrected before you begin excavation.
- If the excavations require the entry of people, there should be a distance of at least 1.5 m from the edge and the excavated material, tools and equipment used.
- Install appropriate barriers and cross people or equipment on them, and ensure that corridors or bridge with railings are also installed.
- In trenches more than 1.20 m depth, a ladder should be provided which should be tied up and exceed one-meter distance from the edge and positioned at a distance of less than 7 m from side-scrolling.
- Excavations having more than 5 m in depth must be staggered with maximum of 3/4:1 pitch and reinforce the walls with guard to prevent material slippage.

Working with Heavy Equipment

- Prior to any equipment entering the facilities. It must be reviewed by a qualified person.
- The machinery will not be operated until it does not meet the minimum-security requirements.
- Equipment operator must be a competent person that ensures the safe operation of the equipment. Only skilled operators can manipulate machinery.
- Machinery operator must submit his license that also bears a certification written with stamp and signature of the provider that formalize with assigned machinery operator skills.
- You must use a monitor where the operator does not have total visibility, whether due to dimensions of the load, by the operations to be carried out, or for handling of loads over long distances.

Work Involving Ionizing Radiation

- For this activity it is mandatory to comply with the procedure described in the work permit.
- This work must be performed only by qualified personnel.

Procedures that are Particularly Risky

a) Equipment tires and engines

- Always use the labeled and established procedure.
- Does not use shovels; pick axe, tubes, brooms, hoes, to clean the material from moving equipment.
- Do not use a conveyor belt to walk on even if it is locked or tagged.
- Do not use loose clothing, jewelry, watches and hair loose close to equipment or vehicles.

b) Demolition and Waste Movement

- Before a demolition job, make an evaluation of the structure and its surroundings, developing a project and work plan.
- Start the demolition by disconnecting all the service lines (electricity, water, phone and similar).
- For Demolitions of structures of any kind use trained, directed by qualified personnel.

c) Explosives Management - Firearms

- Only personnel qualified to operate explosives such as firearms in the process of charging, loading, transportation and handling of such explosives and devices can perform work under the supervision of qualified experts.
- Work supervisor is responsible for the evacuation and protection of persons and property involved in the blasting.
- The supervisor is the first to return to the place where they were blasting until it has been verified that there is no danger.
- Transport bullets separately from ignition and avoid hitting them.
- Keep all firearms in a safe place and with safety latch on.
- The area is a no hunting zone and unless the safety of personnel is at risk, firearm use is prohibited.
- Secure licenses for firearms and carry them at all times on your person.

Safe Driving of Vehicles

It is forbidden to use mobile phones and radio transmitter while driving.

Traffic incidents are one of the major causes of death; minimize the risk of an accident with the following guidelines:

- That the vehicle be the appropriate one and is in good working condition, with seat belts in perfect condition.
- That the number of passengers does not exceed the specified quantity allowed.
- It must not transport unauthorized personnel.
- The load must not exceed specifications of the manufacturer, nor the legal limits.
- That the drivers are trained licensed and have the health conditions necessary to operate the vehicle.
- Drivers should not be under the influence of alcohol, drugs or any substance or medication that affects his/her ability to drive.
- All crew members must use the seat belts.
- Motorcyclists should wear safety equipment as appropriate.

Guide during an Emergency

In case of emergency keep calm and do not panic.

Evaluate:

Evacuation routes and meeting points are specific to each host; you must know where they are located, from any location.

The emergency and its magnitude: what? Where? Howmany?What's so serious?Has the danger passed?

Notify

Immediately contact your supervisor, and the police if necessary. Describe the situation; give all the details that can. The notice may be by radio or by telephone.

Assist/Vacate

Stay on the scene if your safety and health are not at risk, and if you are trained. Secure the place of the event and provide assistance as needed; assist with emergency services and report the situation. If your personal safety is at risk, evacuate immediately and go to the respective muster point.

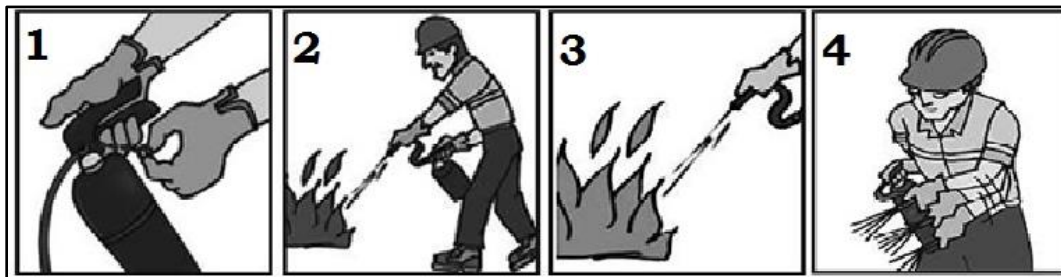
Evacuation routes and meeting points are specific to each site, you must know where they are located, from any location where you are.

ANNEX I TO OSHP

Use of Fire Extinguishers

Learn about fire-fighting equipment and its operations:

1. Ensure that fire extinguishers are of appropriate size for personnel to handle. Extinguishers that are too heavy may prohibit the user from operating them.
2. Check the equipment before using it. Pull the pin this will enable you to download the fire extinguisher.
3. Check the position of the wind and start from a safe distance and then approaching slowly.
4. Point to the base of the fire and shoot at the base of the fuel. If it shoots flames fire extinguishing agent will pass through them without any effect. Press the upper hand releasing the extinguishing agent under pressure.
5. Sway from side to side, until the fire is out.



Once the fire is out be attentive because it can reignite. Never turn your back.

ANNEX II TO OHSP

FIRST AID

Immediately notify your manager or supervisor, coordination and Emergency team.

You must know the location of the kits and the identity of the persons trained to provide first aid.

Assist in Rescue only if you are qualified to do so.

IMPORTANT: Report all injury as minimum as is may be, so that its root causes can be identified and controlled.

ANNEX III TO OHSP

Employee and Contractor's Obligations

According to the training and the instructions given by his or her employer, Partners must:

- Take care of yourself and people who may be affected by your actions.
- Make correct use of machinery, apparatus, tools, dangerous substances, transportation equipment and means of production.
- Make correct use of supplied PPE.
- Do not disconnect, move, or remove safety devices. Report any condition or act representing a serious or immediate risk.
- Cooperate according to rules, laws and practices adopted, with those responsible for health and safety to perform tasks that protect people and create a safe work environment.

Employees should refer to their Supervisor, Project Manager or other senior staff on any questions about OHSP.

7.0 MONITORING PLANS AND STANDARDS

ARUNDO DONAX

ENVIRONMENTAL MONITORING PLANS

7.1 Introduction

The management of the Arundo donax Project is committed to responsible stewardship of the environment. BML's goal is to minimize environmental impact, conduct efficient use of the resources, and conserve natural resources for present and future generations. As stated in the EIA, BML commitment is to:

- Manage our operations to minimize or eliminate impacts on the environment through use of best management practices and appropriate application of technology;
- Adopt and promote policies specific to protecting the environment;
- Implement measures to ensure the efficient use of resources, energy and materials to minimize environmental impacts through all phases of the operation;
- Ensure compliance with all relevant legislation and regulations; including social and environmental guidelines
- Set objectives and put processes in place to continually improve its environmental performance; and
- Manage operation to prevent or resolve environmental non-compliance conditions.

This section provides a framework for components to be included within the environmental monitoring program. Further monitoring details will be developed through on-going stakeholder consultation during the ESIA process, in consultation with the ESIA expert team and through conditions placed on regulatory instrument such as permits, authorizations and approvals issued by the regulatory agencies.

Management will be responsible to carry out the environmental monitoring program and that the agencies and authorities will be responsible for ensuring implementation of the environmental monitoring program, with input from public stakeholders. The environmental monitoring program will be reviewed to determine its effectiveness and if changes are required.

Environmental monitoring programs are created to ensure the Project is being carried out in compliance with existing legislation, best practices, and compliance with guidelines. In addition, the environmental monitoring program is to ensure that the Project complies with the CCCCC's core environmental policy. The environmental

monitoring program will ensure that the measures implemented to mitigate environmental and social effects are successful and that benefits from the Project are enhanced.

Environmental monitoring program implementation will occur over all phases of the Project (site preparation, construction, operations, closure, and post-closure). Enactment of the environmental monitoring program will allow for compliance of all development phases with permit and approval requirements, while providing information of the effectiveness of mitigation strategies and measures. Environmental monitoring programs will provide for progressive or adaptive management should affects vary from that predicted, mitigation methods are less effective than anticipated, or new information becomes available.

7.2 Reporting

All monitoring programs associated with the Project will be under the supervision of the CCCCC management and the site or operations manager. All reporting will be subject to applicable conditions as set within permits, approvals, and guidelines and mechanisms. All reporting results will be provided to the relevant agencies and authorities.

7.3 Monitoring Plans

The CCCCC will design the environmental monitoring program to monitor the implementation of any mitigation measures resulting from the ESIA process, including:

- *Verifying predictions of environmental effects with respect to the natural environment, as well as residual impacts that could not be addressed within the context of the EIA;*
- *Determining the effectiveness of mitigation measures as they relate to environmental effects with respect to the natural environment in order to modify or implement new measures where required;*
- *Supporting the implementation of adaptive management measures to address previously unanticipated adverse environmental effects or unanticipated adverse impacts to the natural environment and peoples;*
- *Verifying measures identified to prevent and mitigate potential adverse effects on the environment and natural resources:*

Finalization of the detailed environmental monitoring program will occur through consultation with communities, public stakeholders and government agencies. Industry standards, regulations, current legislation and legislative guides will be used to develop

and finalize the components of the detailed environmental monitoring program. Frequency and timelines for monitoring will be finalized through this phase. Information presented within the detailed environmental monitoring program will be consistent with information presented within this section.

Wherever possible, this monitoring program shall establish links between impacts identified in the report and studies, measurement indicators, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions.

The monitoring plan shall include the monitoring of the physical aspects of the operations, and the monitoring of habitat enhancement and recovery efforts, including the re-vegetation of areas where removal was a temporary activity; the monitoring of workers health and safety; and, the monitoring of the physical characteristics of the soil and water resources.

The responsibility to enact this monitoring plan as well as the mitigation plan will rest on the Management, who designates trained personnel to conduct the monitoring and reporting.

7.4 Resources Required for Monitoring

Equipment

Resources for a Monitoring Plan

Health and safety equipment to be acquired are outlined in the OHSP.

Implementing a monitoring program requires access to resources including an equipped laboratory, office space, and equipment for fieldwork, transport and trained personnel in all areas of the monitoring program. In the initial stages of the monitoring program the company may proceed as follows:

- Train staff to ensure that proper procedures are followed
- Impose quality assurance on all procedures from the beginning
- Take samples in places where the selected parameters are of relevance to the monitoring program
- Prepare reports that are acceptable to DOE and other Agencies
- Increase the number of variables, the number of sampling stations and the frequency of sampling as the capacities of the sampling and analysis teams increase
- Obtain services of professionals in the field to do training or sampling, if possible.

Laboratory facilities

A number of options are available for conducting analysis of various types of water and soil samples. For water and soil samples, the proponent may have his own in situ equipment but ex-

situ analysis should be submitted to a laboratory or the facilities of another agency or of a government ministry may be available, or some of the analytical work may be done under contract by a private laboratory. The option to hire trained professionals to do monitoring, or the services of NGOs with professional expertise can also be requested.

Equipment should be acquired prior to construction of the processing facilities, and adequately trained staff must handle these, and establish existing baseline data; or it may be sourced from other sources.

Transportation

The type of transport needed depends on ease of access to various sampling stations. It is envisaged that the following type of transport will be needed for the proposed monitoring program: four-wheel drive vehicles, motor-cycles (for one person and a portable kit) and a manual sample of creeks will be necessary.

Staff

Staff on a monitoring program as a minimum should include a technical person accompanied by a minimum of one assistant for the efficient handling of sampling equipment and samples taken.

7.5 Parameters for Monitoring and Standards

Table 7.1: Monitoring Parameters for Water Quality.

PARAMETERS	FREQUENCY	CRITICAL LEVELS	AREA LOCATION
IN-Situ: Temperature, Dissolved Oxygen, pH, Salinity, Turbidity, Total Dissolved Solids, Specific Conductance	Every three (3) months – (Quarterly)	20% above existing levels (see ESIA); or to be determined by Effluent License	See attached map of proposed sampling points
Laboratory 1 Calcium, Magnesium, free Chlorine, total Nitrogen, Sulphates, Alkalinity, Hardness (as calcium carbonate), Ammonia, Nitrite, Nitrate, Phosphate, Sulphate, Fluoride,	Quarterly	30% above existing levels or as per Effluent Licenses	

Laboratory 2 Chemical Oxygen Demand (COD), 5 Day BOD,	Quarterly during Year 1, twice per year during Year 2; Once per year at Year 3	As per DOE/WHO Standards
Laboratory 3 E.coli and Enterococci bacteria.	Quarterly during Year 1, twice per year during Year 2; Once per year at Year 3	Above 10 colonies, or as per DOE/WHO standards

Table 7.2: Parameters for Air Quality Testing

PARAMETERS	FREQUENCY	CRITICAL LEVELS	AREA LOCATION
Total suspended particles (monitored by Professional equipment)	standards/baseline established		See Map attached. Sampling points may vary and are not set at these precise locations
Nox/SO2, CO	OSHA Standards/ baseline to be established		

Table 7.3: Monitoring of Biological Environment.

PARAMETERS	FREQUENCY	CRITICAL LEVELS	AREA/LOCATION
Vegetation & Landscaping plants (seedlings harvested) and trees planted	Annually	Stunted growth or no growth. Wind damage, infections	buffer zones and green zones
Pests and Diseases	Seasonally	na	
Subsurface	Seasonally	Turbidity, sedimentation, erosion	Around and near over the water structures
Mammals and birds	On going	Make notes of any important sightings of endangered animals	

8.0 RELEVANCE

8.1 Background

The CCCCC has indicated that the project goal is to investigate and demonstrate the efficacy of *Arundo donax* as a renewable energy source, as part of its Energy Resilience for Climate Adaptation Project (ERCAP), using Belize as a pilot site. The project intends to utilize a fast-growing perennial rhizomatous grass (*A. donax* or Wild Cane) for cultivation on marginal lands in Belize. Most Caribbean states depend on fossil fuel as the main source of energy resulting in a larger carbon footprint in the world today, at the same time increasing the cost of energy as the price for fossil fuel increases. Carbon dioxide emissions from electricity generation are a major contributor of anthropogenic climate change.

8.2 Relevance

Energy costs in Belize are among the highest in Central America. In 2011, Belize led the Central American region with the highest gasoline prices and had among the highest electricity tariffs for the residential, commercial, and industrial sectors (US\$0.223/kWh, US\$0.2278/kWh, and US\$0.169/kWh, respectively). For 2015 the electricity tariffs for the residential, commercial, and industrial sectors was lower (US\$0.14/kWh, US\$0.15/kWh, and US\$0.20/kWh, respectively).

8.2.1 Status of Belize's Energy Sector

Belize is the smallest country in Central America by population (408,487) and the second smallest by surface area (20,418 km²). In 2010, the main consumer of energy was the transport sector (46.80% of total energy consumption) followed by the industrial sector (27.43% of total energy consumption). The residential, commercial, and service sectors were responsible for the remaining 25.77% of total energy consumption in 2010.

Belize has local fossil fuel resources, 63% of the country's energy supply was imported in 2010, mostly in the form of secondary energy either as refined petroleum products or as electricity. Crude oil equivalent to 68% of the country's energy supply was exported in 2010, as Belize has no domestic refining capacity. Domestically, 37% of energy supplied was obtained from local resources such as biomass (firewood and sugar cane bagasse), hydropower, and local fossil fuel resources. Petroleum products such as liquefied petroleum gas (LPG), gasoline, kerosene, and diesel oil accounted for 93% of the total energy imported in 2010, whereas electricity accounted for 7%. All refined oil products (gasoline, diesel, kerosene, and aviation fuel) were previously imported from Venezuela under the Petro-Caribe Agreement. Gasoline and diesel are also "imported" into Belize by local vehicles that travel across to border towns. Belize is an oil producer, with a production of around 2,000 barrels a day of which most oil is exported, though some crude oil is used directly by the industrial sector.

Belize's electricity is supplied mainly through a 115 kV transmission line that covers the entire northern and western sections of the country, and is interconnected with Mexico, currently the most reliable source of energy. The southern areas of the country are partly covered by a 69 kV transmission line. Belize Electricity Limited (BEL), which was nationalized in 2011, is the

primary distributor of electricity in Belize, serving a customer base of approximately 97,714 accounts. In 2012, 45% of the electricity generation output was purchased on the spot market from Mexico's Comisión Federal de Energía (CFE). Previously, CFE supplied BEL up to 15 MW of firm capacity and up to 40 MW on an economic basis, but CFE cancelled its firm power agreement with BEL in 2009. In 2012, the remaining 55% of electricity was supplied as follows: Belize Electric Company (BECOL, 38%), Belize Co-Generation Energy Limited (BELCOGEN, 12%), Hydro Maya (2%), BEL's own diesel generation capacity (3%), and the Blair Athol Power Company Limited (BAPCOL, 1%) (BEL, 2012a). As population growth is high (2.65% per annum) (SIB, 2010), studies estimate that electricity demand will grow by about 4% per annum in the coming years (OAS, 2012) in the absence of a demand-side management program or strategy. Belize's peak energy demand reached 82 MW in 2012, and it is expected to grow despite a recent setback in the period 2011. Installed capacity was approximately 156.2 MW in 2012, and is enough to cover peak demand in the near term. Hydroelectric capacity is 54 MW, of which 21 MW come from run-of-the river or low storage capacity hydro plants. BAPCOL's generating capacity is approximately 10 MW, although it only generated power in 2010 and again in 2012. BEL owns and operates 28.3 MW of diesel-fired gas turbines. BELCOGEN generates electricity by burning bagasse and has a capacity of 13.5 MW. This capacity is only available when there is an available bagasse resource from sugar processing. BEL's supply from CFE is constrained by a 60MW maximum transfer capacity of the 115 KV transmission line linking the two national systems. Moreover, BEL is currently unable to take more than 50 MW of power from Mexico without experiencing voltage regulation problems. Figure 1 shows a more updated breakdown of energy generation and source for 2015.

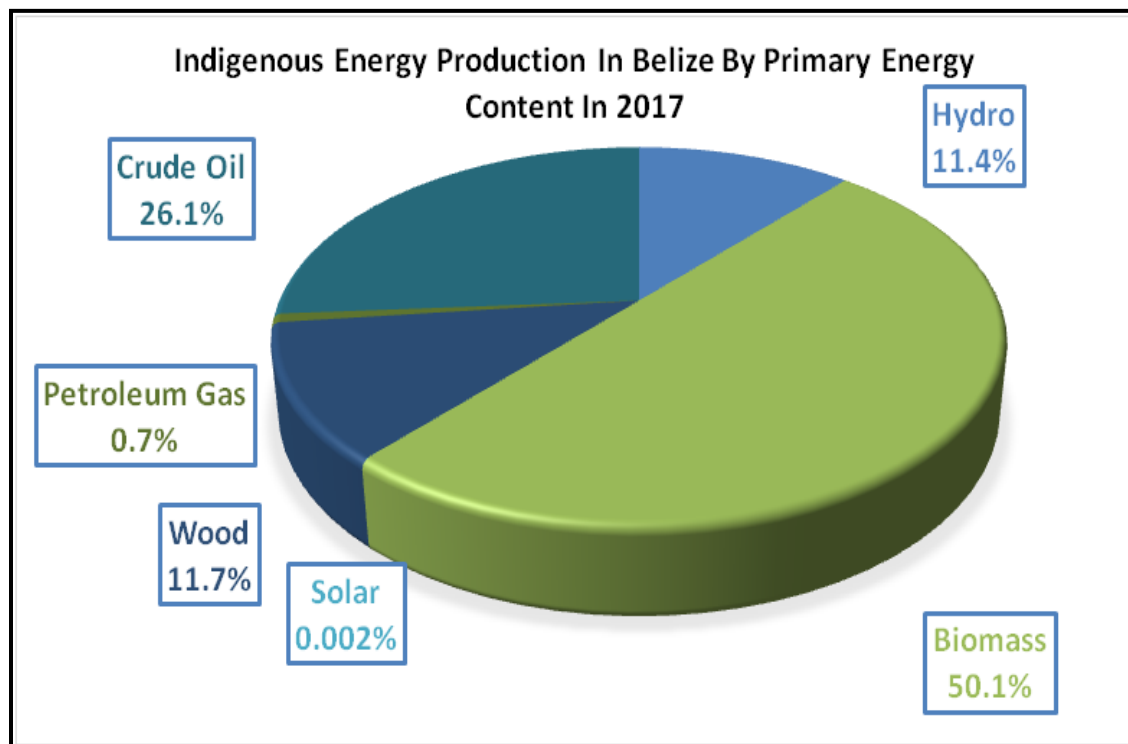


Figure 8.1: Supply by Primary Energy Content in 2017.

8.2.2 Potential of Energy Resources

In terms of availability of energy resources, Belize has unexploited potential in both renewable and fossil fuel sources. According to the CIA World Factbook, in 2018 oil reserves were estimated at 6.7 million barrels, although other studies indicate reserves in the order of 20 million. The country has some wind resource potential, both offshore and onshore. The National Renewable Energy Laboratory (NREL) of the United States estimated in 2008 that the country had 737 km² of moderate to excellent wind resource potential (class 3–7 wind) at 50 m (NREL, 2008a). A study carried out for the government estimated the undeveloped hydroelectric potential of the country to be approximately 75 to 100 MW. Belize has 54 MW of hydro capacity installed. In terms of biomass, the country has additional biomass resources that could be used for energy generation purposes.

8.2.3 Policy Framework

The government of Belize in 2011 developed a National Energy Policy Framework, which was approved in 2012, it identifies the goals for the sector, which are to: (i) foster the sustainable production, distribution, and end use of energy; (ii) minimize the cost of energy in the local economy; (iii) mitigate the impacts of external shocks; and (iv) create a culture of energy efficiency. In 2012 the Ministry of Energy, Science, Technology, and Public Utilities (MESTPU) published the National Sustainable Energy Strategy (2012–2033) as part of its Strategic Plan for 2012–2017.

The National Sustainable Energy Strategy includes a number of programs and activities to support the development of the country's non-renewable and renewable energy resources and improve energy efficiency and conservation in order to transform to a low carbon economy by 2033. The Inter-American Development Bank (IDB) provided technical assistance to MESTPU which focused on identifying the energy efficiency and renewable energy potential of Belize and assessing the barriers that prevent that potential from being realized, which resulted in recommendations for interventions to overcome the barriers and an action plan to implement said recommendations. It should be noted that moving forward with this ambitious agenda will be a challenge for the government, as it requires resources and technical expertise and given the government's limited resources, it is important to prioritize the interventions in the sector to have significant impact.

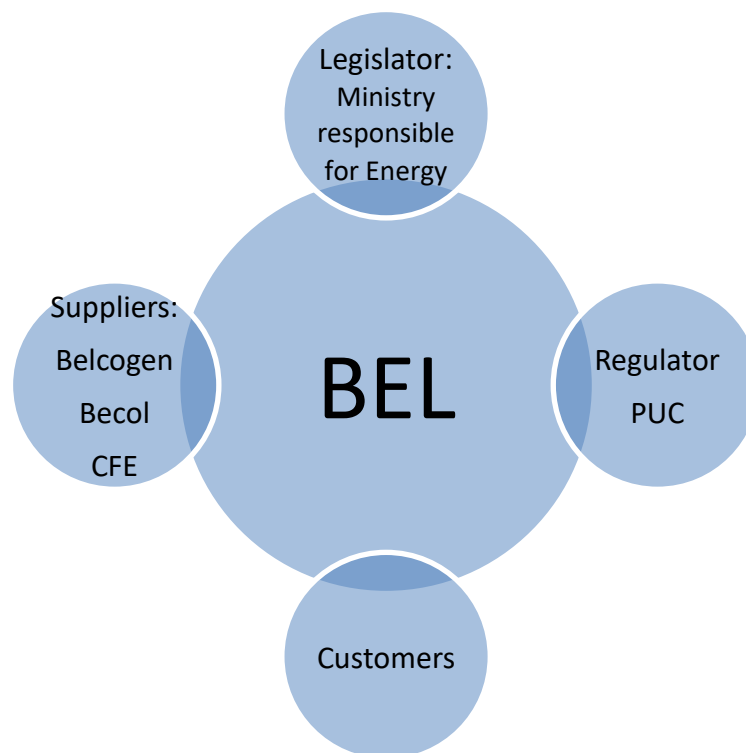
8.2.4 Institutional Framework

In 2012, the government created the Ministry of Energy, Science, Technology, and Public Utilities. Among the main responsibilities of its energy portfolio, the Ministry is envisioned to be in charge of the electricity and gas and petroleum (hydrocarbons) subsectors. Previously, the Ministry of Public Utilities, Transport, Communications, and National Emergency Management regulated the electricity subsector. The Ministry of Natural Resources and the Environment governed the renewable resources (i.e., bio fuels). Oil exploration was also under the Ministry of Natural Resources and the Environment, but the Ministry of Finance regulated oil products. The

Ministry of Natural Resources and the Environment was responsible for integrating environmental safeguards into the development of energy projects.

Belize Electricity Limited (BEL) has a monopoly on transmission and distribution. The national grid connects all the districts and is interconnected with Mexico and has a 92.1% coverage. The national grid does not reach all parts of the districts: in some remote locations, such as in the more remote cayes, electricity consumers self-generate. Until recently, Belize's electricity market was liberalized and the government limited itself to regulating it. BEL served the distribution/transmission market. In 2011, the government nationalized BEL; presently GoB owns 32.6% shares, while SSB owns 31.2%, while Fortis Cayman Inc. 33.3% and over 1500 small shareholders own 2.9% interest. Currently, BEL is the sole buyer of electricity from public and private generators and the only supplier of electricity to final users.

The Public Utilities Commission (PUC), created in 1999, regulates tariffs and the quality of the electricity service and grants licenses for generation, transmission, and distribution. According to the Electricity Act, the primary duty of the PUC is to ensure that utilities provide satisfactory service at a reasonable price. The PUC has the power to issue bylaws for the electricity sector relating to the methodology and process for the determination of tariffs, charges, and fees for the transmission or supply of electricity. It also has the power to determine and prescribe the standards that must be maintained in relation to these services. In addition, the PUC is responsible for the awarding of licenses and for monitoring and enforcement. In 2012, the PUC reduced electricity prices by 7%. However, a rate increase of 16.87% was imposed in early 2013.



8.2.5 Regulatory Framework

The Electricity Act (1992), its amendments (1999 and 2007), and the Electricity Bylaws (2005) are the main pieces of legislation that provide the legal framework for the PUC to carry out its duties and functions in the electricity subsector. The bylaws govern the tariffs, rates, charges, and fees for the transmission and supply of electricity and for existing and new services to be charged by a licensee to consumers in Belize. In addition, the bylaws establish the mechanisms, formulas, and procedures for calculating and determining these tariffs, rates, charges, and fees, as well as the methodology for periodic review proceedings. Further, the bylaws govern the quality of service (service reliability standards).

The Electricity Act requires the PUC to ensure that all reasonable electricity needs are met, ensure that license holders are able to finance the business for which they are licensed, and protect the interests of consumers in general and, in particular, in rural areas. The PUC is responsible for the economic regulation, quality and continuity of service, and security and safety of the electricity sector. It is mandated to enforce the Electricity Act and any related regulations. The Electricity Act allows the PUC to establish regulations and bylaws on any matters in the industry, including the methodologies that license holders may use to charge their customers. The Act does not define any such methodology. The PUC has, however, established a tariff and rate-setting methodology in Statutory Instrument 60 of 2001. The services for which fees can be charged are transmission, distribution and supply, installations, rentals, and removals. The PUC can also facilitate the resolution of disputes between participants in the electricity industry. The Electricity Act allows auto-generation, but it does not allow interconnection of auto-generation systems. The supply of electricity is exempted from the sales tax, as it is considered an input for the production of goods and services.

8.3 The Biomass Project

Belize's dependency on imported energy sources poses a concern regarding the country's security of energy supply. Measures have been taken to reduce the country's dependence on imported electricity, by enhancing the country's hydropower capacity and other renewable energy sources.

8.3.1 Project purpose

The proposed concept is consistent with the GoB goal of expanding the utilization of biomass to meet some of the country's energy needs and achieve the dual aim of reducing the country's carbon footprint and adapting to climate change impacts. In pursuit of that overarching objective the project aims to initially introduce a new high energy crop as a supplementary fuel for generation of electricity in Belize. Based on the outcome of the preliminary exercises, large-scale cultivation on a commercial basis for ongoing use and for expanded use elsewhere could be pursued.

A successful fossil fuel substitution project, although partial in scope, will represent significant progress towards Belize achieving its goals of becoming energy self-sufficient. Developing a commercial renewable enterprise based on the use of *A. donax* can bring significant benefits to Belize. The immediate benefits would be to stabilize power production from BELCOGEN,

provide clean sustainable power throughout the year, create new jobs in the cultivation of *A. donax*, save foreign exchange by displacing imported Mexican power, increase energy security, reduce Belize's greenhouse gas emissions and reduce BEL's cost of power.

A successful Project will represent significant progress towards realizing Belize's goals of:

- i. reducing its carbon footprint by 2022
- ii. having 80% of its energy for household and industrial uses generated from renewable energy sources, while
- iii. Simultaneously leverage existing infrastructure to provide immediate and direct benefits in response to the national energy challenges.

Fully developing the potential of *A. donax* to provide a renewable source of fuel to drive the national economy could bring significant benefits to Belize. The benefits of investing would be to:

- i. increase power production from ASR/BSI BELCOGEN
- ii. provide clean sustainable and reliable power throughout the year at affordable rates,
- iii. create new jobs in cultivating *A. donax*,
- iv. Allow for agricultural activities by farmers being displaced out of sugar production and utilize marginal lands.
- v. replace imported Mexican power,
- vi. increase energy security, and
- vii. Reduce Belize's greenhouse gas emissions and the country's cost of power.

Through this project it is estimated that the total tons of CO² equivalent emissions avoided annually would be over 19309 (tCO₂). The number of direct beneficiaries is estimated at over 5,000 or approximately 2% of the total population. The indirect beneficiaries would be the entire country through lower cost per KWh of electricity.

8.3.2 Stakeholder by Groups and Influence

The key stakeholders by respective groups are shown in the table 9.1 below, along with indicators of levels of influence on, and engagement or interest in the projects. The assessment was done using expert judgment to analyze information gathered through stakeholder consultations and literature review.

Table 8.1: Stakeholders by Group

Stakeholder	Role	Comments
Caribbean Community Climate Change Centre	Proponent	Advisor/sponsor
Belize Electricity Limited	Proponent	Sponsor/advisor
BELCOGEN	Proponent	Sponsor/advisor
ASR/BSI	Proponent	Sponsor/advisor
PUC	Regulator	Regulator/oversight
SIRDI	Research	Support
BAHA	Research/Permits	Support
Energy Unit, Ministry of Public Service	Proponents/Legislators/Policy	Oversight/advisor
National Climate Change Office	Proponents/Policy	Oversight
Ministry of Economic Development	Proponents/Policy	Oversight/coordination
Ministry of Agriculture	Policy	oversight
Department of the Environment	Policy/Regulator	oversight
Forest Department	Policy/Regulator	oversight
Cane farmers Associations	Beneficiary	Participation
Belize High School of Agriculture	Beneficiary	Participation
Farmers	Beneficiary	Participation
Community members	Beneficiary	Participation

8.3.3 Social co-benefits

8.3.3.1 National Impact

It is well known that Energy Intensity is a measure of the energy efficiency of a nation's economy. High energy intensities indicate a high price or cost of converting energy into GDP. Low energy intensity indicates a lower price or cost of converting energy into GDP. In 2011 the energy intensity of Belize was 400 which are above the global average of 298 and much higher than neighboring countries in Central America with an average of 153. A successful project will

provide the enabling environment for reducing the energy intensity and making it comparable to the other countries in Central America. This would contribute to a significant improvement in the overall level of competitiveness of the economy and enable Belize to better attract foreign investment and to improve the competitiveness of its products in export markets. This could lead to: Increase in job opportunities; increase in disposable income from reduced cost of electricity; development of new skills sets in the country.

Other social benefits could also be derived through the reduction in the cost of electricity which would enable the extension of the current grid network to rural communities not currently on the grid. Such extension would lead to an: Improved health and safety in rural communities through increase availability of potable water made possible through the availability of electrical energy, and reduction in poverty as persons who are now connected to the grid would now be in a position to acquire consumer durable goods, such as a refrigerator, thus leading to more food being stored, rather than disposed of.

8.3.3.2 Gender-sensitive development impact

As with other agro-related industries in Belize, opportunities would be equally distributed between male and female. Given that women are an integral part of the agricultural sector in the country, benefit sharing is expected to be equality distributed as the project would be an equal opportunity employer, as well as employing a certain percentage of young persons.

8.3.3.4 Economic Co-Benefits

Using the sugar cane industry as a guide, the economic co-benefits from a full scale up programme in the form of jobs and reduction in foreign currency leakage is estimated to be of the order of:

- ✓ At least 1,000 new jobs initially increasing to nearly 5,000 once projects are fully commercialized
- ✓ Annual foreign exchange savings would approximate US\$24 million. This is calculated using an average US\$0.10/KWh under the PPA between BEL and CFE of Mexico for approximately 233,150 MWh provided annually.
- ✓ Government's budget deficits reduced by about 1% point during the pilot phase.

The project has significant potential to be replicated and scaled-up, given the multiple benefits of an environmental and socio-economic nature that are expected to accrue such as reduced cost of power, increased competitiveness of manufactured output, greater energy security and reduced poverty and improved quality of life. The following additional factors that can contribute to the success of the undertaking must also be taken into consideration moving forward: The Potential for scaling-up depends on the availability of marginal land. In Belize marginal land is estimated at 467,000 hectares. Replication in other CARICOM Countries such as Guyana and Suriname would also be possible. The potential for the transfer of knowledge and learning to other regions

should pose no challenge given the 5Cs network of partners and the planned knowledge sharing mechanisms identified earlier. Potential for knowledge and learning the knowledge and experience gained through the process of developing the investment thus far has/will provide ample knowledge, familiarity and the justification for scaling-up and replication, and also contribute to the development of an appropriate regulatory framework and policies that are essential to support this transformation

8.3.4 Contribution to the creation of an enabling environment

Contribution to the regulatory framework and policies A successful project would supply concrete evidence in support of the MESTPU strategic plan which among other things calls for a significant use of different forms renewable energy in the energy matrix by 2030. Lessons learned in the commercialization process may help guide or refine the regulatory policy framework to systematically drive investment in low-emission technologies.

8.3.5 Project Activities

The project comprises of two components:

Component 1: The Funding Proposal Preparation will assess the merit and fundability of the concept through the conduct of the following: -

1. A feasibility study that will focus on the technical, financial and economic feasibility of the initiative and identify operational and funding modalities to enable long-term sustainability.
2. A stakeholder analysis with a corresponding management and engagement plan that will identify stakeholders and set out actions for their participation and inclusion, with a view to enabling the successful implementation of the initiative. In addition to government, non-profit, civil society and private sector stakeholders, the plan should take account of women, children, youth and the disabled.
3. A gender study and gender action plan that will facilitate the mainstreaming of gender considerations into the funding proposal and implementation of the project and ensure that activities result in short term and long-term benefits of men, women and children.
4. An Environmental and Social Impact Assessment (ESIA) and development of an Environmental and Social Management Plan (ESMP), which will:
 - a) identify all potential environmental and social impacts of the project and measures to prevent, minimize, mitigate or compensate for adverse environmental and/or social impacts;
 - b) assess the legislative and regulatory environment;
 - c) identify appropriate institutional/organizational arrangements for this renewable energy initiative on a sustainable basis;
 - d) survey of the commercial interest from the sugar industry and other pertinent third parties
 - e) investigate and present findings for PPP investment options in the underlying project and for the long-term sustainability of the investment

- f) describe the nature and number of beneficiaries potentially affected by the proposed project;
- g) Opportunities, risk and concerns/issues related to the proposed project.

Component 2 addresses the conduct of Compatibility Test to assess the viability and compatibility of the biomass produced from *Arundo donax* with the co-generation plant owned and operated by BELCOGEN in Orange Walk, Belize. The technical compatibility of the fuel with BELCOGEN's co-generating equipment is to be determined through the actual use of the desiccated and shredded grass in the facility's feeder systems and furnace over a period of time, while monitoring the facility's performance. The intention is to facilitate sufficient burning to determine the calorific value or efficiency of *A. donax*. The trials will involve testing different proportions of *A. donax* with bagasse in order to observe their relative performance. This is an indispensable requirement for verifying the feasibility of the project.

8.3.6 Other Preparatory Initiatives

The pilot initiative to be financed by the BEL consists of the test cultivation of wild cane of some 400 acres of leased lands near the San Lazaro, Trinidad and Yo Creek villages. The pilot cultivation activities will consist of two phases, the first being a testing phase during which 50 one-acre yield plots will be established, and the final being expanded cultivation of *A. donax* within the 400-acre property. The intention of the initial phase (yield plots) is to test the performance of *A. donax* plants under various conditions, as well as to identify the best approach to eradication. The aggressiveness of the plant will be mitigated during this phase by measures that will include the following: 1) Construction of a 20-foot wide buffer which will also function as an access road that will completely enclose the 400-acre site and site. It has been assessed that *A. donax* rhizomes cannot bridge this distance so that crop beyond the buffer would be protected. 2) Use of water from wells within the 400-acre property, and disposal within the buffer only; avoidance of any runoff or use of nearby waterways.

8.3.7 Additional Uses of *A. donax*

Arundo donax is a very versatile plant that has multiple uses besides being grown for biomass energy with around 25-40 dry tons of biomass yields per acre every year. Harvested plants have a 9-12 % moisture content after leaving the field for a couple of days, ash content of 4-6 % is slightly higher than wood's, but has a high melting point of 900-1000 Celsius which is safe for all power plants and it can be stored in 300-400 lbs. bales which reduces logistic costs. Electricity production per ton of *Arundo* is 275 kWh. One of the most important environmental arguments for its use is that *Arundo* is CO₂ neutral and it is the most efficient alternative to food crops.

It can be used as feedstock for biogas generation; biogas and bio-methane gas production is 1.5 times higher compared to corn whilst the cost of production is 50% lower, methane content of biogas produced from Arundo is over 60%, biogas yield from A. donax is 413 m³/ton.

Ethanol can also be obtained from *A. donax* as well as it can be used for furniture once particle boards are manufactured. Arundo is also a good source of fibrous raw material for making quality paper. It can also be used as livestock feed directly or in silage. Last but not least, it can be utilized for bioremediation of polluted soils.

9.0 SUSTAINABILITY

9.1 Introduction

The assessment of the sustainability for this initiative is done within the context of energy supply through the use of biomass. According to the World Economic Council (WEC), energy sustainability means “the provision of energy in such a way that it meets the needs of the present without compromising the ability of future generations to meet their needs”.

To assess the environmental, social and economic sustainability of *Arundo donax* biomass project, the starting point is the most widely recognized and agreed set of 24 indicators for the assessment and monitoring of bioenergy sustainability developed by the Global Bio-energy Partnership (GBEP).

The GBEP indicators cover each of the three pillars of sustainability:

Environmental

Social

Economic

However, we will add two more pillars:

Technical

Political

Sustainability according to GBEP has three key dimensions: A process or supply chain for a particular energy form (biomass) is considered economically sustainable if the benefits of the energy it helps to produce, and other spin-off benefits from its constituent activities that accrue to the economy as a whole, outweigh the costs incurred over the long run. It is environmentally sustainable if it causes minimal harm or damage to people and the environment over the long run. And, it is socially sustainable if it improves the living conditions of the poor and others living on the margins of society, either by providing them with greater accessibility to and affordability of modern energy forms or by generating economic activity within their communities.

It should be noted that from our experience the other two pillars were added. It is technically sustainable if the technical skills capacity and technology exists to ensure clean development along the supply chain and energy generation to minimize any negative impacts. The last pillar of politically sustainable refers to the political commitment/will to the initiative to survive changes in administrations of governments.

From a holistic point of view of the energy of ecosystem, the way we use energy, the forms and amounts of energy use, also has equally important implications for its sustainability. Incorporating fewer polluting forms of energy lowers GHG emissions, and so reduces harm done to people and the environment. The less energy we use, the less we need to supply it, and the lower are the corresponding costs, losses and environmental impacts.

9.2 Sustainable Energy and Climate Change – The Link

Most of the world's energy is sourced from fossil-fuels: coal, oil and natural gas. The burning of fossil fuels in generators to produce electricity; in vehicles, marine vessels and airplanes for transport; and in industrial motors emits a variety of gases into the earth's atmosphere: among them are carbon dioxide (CO₂), methane and nitrous oxide. The concentration of CO₂ in the atmosphere continues to increase as we continue to burn fossil fuels. In fact, it has been estimated that the CO₂ content of the atmosphere has risen from 285 ppm to some 390 ppm or as much as 430-450 ppm CO₂ equivalent, if other greenhouse gases are included as a result of human activity, mainly the combustion of fossil fuels, deforestation, agricultural practices and emissions of particular gases by industry.

Higher-than-normal concentrations of CO₂ in the atmosphere will result in Global Warming. CO₂ and the other greenhouse gases present in the earth's atmosphere absorb thermal radiation coming from the earth and re-radiate a part of it back to the earth's surface. The higher the concentration of greenhouse gases in the atmosphere, the more is the radiation that is reflected back to earth. This causes an increase in the temperature on the earth's surface. In the 20th century alone, for example, the mean temperature of the earth's surface rose between 0.56°C to 0.92°C. Scientists predict that, if we continue burning fossil fuels unabated, this temperature will increase by 3-5°C above pre-industrial revolution levels.

As a consequence of global warming, Belize's future climate will be characterized by warmer temperatures, declining levels of precipitation, increasing concentrations of CO₂ in its coastal waters and more frequent extreme weather events, resulting in heat stress, water stress, loss of important ecosystems including our coral reefs, changes in agricultural productivity particularly lower yields from maize, physical damage from storms and hurricanes, and greater incidence of infectious diseases. These scenarios have significant implications for energy demand patterns and supply infrastructure in the future: demand for air-conditioning and cooling will increase with hotter days and nights and more frequent heat waves. The output of hydro-electric sources will be curtailed as rainfall levels decrease; and transmission and distribution lines and other structures, such as wind turbines and roof-top mounted solar panels, will need to be built to more stringent structural standards to withstand the more intense weather events.

Given the current stage of development in modern energy technologies that we have at hand, it is much more cost-effective to direct our efforts to cutting back on our use of fossil fuels and so cut back on the rate of GHG pollution rather than trying to sequester the emissions we produce as we burn them or after we burn them.

9.3 Demand and economic sustainability

The Sustainable Development Goals clarifies the need to restructure the bioenergy sector with creating a more sustainable sourcing of plant-based energy. Growing population, increased average income and political initiatives will all lead to an average growth in demand for biomass. The International Renewable Energy Agency (IRENA), projects that global biomass demand for energy supply could double from 53 EJ per year in 2010 to 108 EJ per year in 2040. Bioenergy has a key role in mitigating climate change, but the large-scale application of its current practices

could be problematic. These include potential negative trade-offs, such as threatening food security, land use changes, and deforestation. However, the use of energy crops could be a possible solution to create affordable, clean and modern energy that supports Goal 7.

Unlike Wind and Solar, there are significant environmental risks associated with biomass combustion and gasification; principally it can use large amounts of water and cause air pollution (impact habitats and ecosystems). The technology and conversion process used to produce secondary energy from biomass must therefore be carefully selected and monitored in order to mitigate the harmful effects of its production.

For Belize to meet the electricity demand associated with an average 9% annual growth rate (Launchpad Consulting, 2003), and the increasing demand for fuel in the transportation sector, energy sector planning should be established as a priority, but it must be done carefully. Biomass supplies 8.9% of Belize's energy needs, but demand currently exceeds supply of biomass. Implementing additional renewable energy and energy efficiency measures will help lower electricity costs, improve environmental quality and ensure energy security for Belize. Any biomass to energy project succeeds or fails to a greater degree on its ability to source and maintain a regular and consistent supply of high-quality feedstock.

Biomass power stations generate electricity from biomass in all three states - solid, liquid and gas. 'Biomass' refers to cellulosic material of organic origin such as energy crops like *A. donax* similar to sugarcane "bagasse". Most modern biomass-based plants are built as cogeneration facilities, where the biomass is burnt to produce high-pressure steam that drives turbines to produce electricity; the exhaust low pressure steam is then used in one or more heating applications. Recent advances in technology have also created a new opportunity for converting biomass into cellulosic ethanol that can then be used as transport fuel replacement. Of course, the conversion of biomass to electricity and/or cellulosic ethanol has the added benefit of getting rid of the waste at the same time.

In an economic feasibility study evaluating *A. donax* production as energy crop in Sicily, (Testa et al). reported that woodchip and silage production with this crop shows the highest profitability (up to 617 €/ha), especially with respect to annual crops such as melon (310 €/ha) and tomato (280 €/ha). Testa and colleagues performed a financial analysis through a discounted cash flow method, collecting techno-economic data from interviews with farmers, biomass markets, and literature. In contrast to other crops, the highest profitability was attributable both to the current market prices (up to 50 €/Mg dry matter for woodchip production) and lower production costs. Similarly, the economic performance of *A. donax* as silage biomass feedstock for biogas plants in Sicily was undertaken by Sgroi et al (Sgroi et al)., who concluded that this perennial plant is an effective alternative energy crop in Mediterranean areas respect to other crops (i.e. maize and sorghum), given the current market conditions.

Table 9.1: Electricity Sector Overview.

Total Installed Capacity	24 megawatts (MW) (BEL) 80 MW (IPPs) 50 MW (Mexico)
Peak Demand	84.3 MW
Total Generation	483.9 gigawatt-hours
Renewable Share	65%
Transmission & Distribution Losses	12.3%
Electrification Rate	92.1%
Average Electricity Tariffs (USD/kWh)	\$0.22 (mean electricity rate)

Table 9.2: Belize 2017 Economic Energy Indicators.

Electric Sector Contribution to Primary Intensity GDP USD 2011 PPA ([kgoe / USD 2011 PPA])	0.02
Energy Intensity GDP USD 2010 ([boe/10 ³ USD 2010])	1.68
External Balance	-0.48
Final Energy Consumption per capita ([toe/10 ³ inhab.])	972.01
Firewood Consumption per capita ([t/inhab])	0.09
Industrial Energy Intensity GDP USD 2010 ([boe/10 ³ USD 2010])	8.03
Intensity of Final Energy GDP USD 2011 PPA ([kgoe / USD 2011 PPA])	0.13
Primary Energy Intensity GDP USD 2011 PPA ([kgoe / USD 2011 PPA])	0.13
Renewable Energy Supply per capita ([toe/10 ³ inhab.)	424.53
Renewable Energy Supply per Unit of GDP USD 2011 PPP ([10 ³ toe/10 ⁶ USD 2011 PPP])	56.17
Residential Consumption per capita ([toe/10 ³ inhab.])	183.59
Residential Electricity Consumption per capita ([toe/10 ³ inhab.])	75.58
Total Electricity Consumption per capita ([GWh/10 ³ inhab.])	1.96
Total Supply of Electricity per unit of GDP USD 2011 PPP ([kgoe / USD 2011 PPP])	0.03
Total Supply of Electricity per capita ([toe / inhab.])	0.19
Total Supply of Primary Energy per capita ([toe / inhab.])	1.00

Source: SIELAC-OLADE

Table 9.3: Supply and Demand Series- Belize 2017

Production

OIL (10 ³ bbl)	NATURAL GAS (10 ⁶ m ³)	HYDROEN ERGY (GWh)	FIREW OOD (10 ³ t)	SUGA RCAN E AND PROD UCTS (10 ³ boe)	ELECTRICI TY (GWh)	LPG (10 ³ bbl)	CHARCOA L (10 ³ t)
360.23	1.64	270.58	55.48	698.47	635.95	11.75	3.16

Import

ELECT RICIT Y (GWh)	LPG (10 ³ bbl)	GASOLINE/ ALCOHOL (10 ³ bbl)	KEROS ENE/JE T FUEL (10 ³ bbl)	DIESE L OIL (10 ³ bbl)	FUEL OIL (10 ³ bbl)
230.14	296.76	598.55	110.25	542.63	16.96

Export

OIL (10 ³ bbl)
267.07

Stock Change

OIL (10 ³ bbl)
23.18

Total supply

OIL (10 ³ bbl)	NATURAL GAS (10 ⁶ m ³)	HYDRO- ENERGY (GWh)	FIREW OOD (10 ³ t)	SUGA RCAN E AND PROD UCTS (10 ³ boe)	ELECTRICI TY (GWh)	LPG (10 ³ bbl)	GASOLINE/ ALCOHOL (10 ³ bbl)	KEROS ENE/JE T FUEL (10 ³ bbl)	DIE SEL OIL (10 ³ bbl)	FU EL OIL (10 ³ bbl)	CHAR COAL (10 ³ t)
116.34	1.64	270.58	55.48	698.47	866.09	308.51	598.55	110.25	542.63	16.96	3.16

Power plants

OIL (10 ³ bbl)	NATURAL GAS (10 ⁶ m ³)	HYDROEN ERGY (GWh)	ELECT RICITY (GWh)	DIESE L OIL (10 ³ bbl)	FUEL OIL (10 ³ bbl)
-18.43	-0.99	-270.58	527.66	-1.26	-16.96

Self-producers

SUGA RCAN E AND PROD UCTS (10 ³ boe)	ELECTRICI TY (GWh)
-154.13	108.29

Gas plants

NATURAL GAS (10 ⁶ m ³)	LPG (10 ³ bbl)
-0.81	11.75

Charcoal Plants

FIREWOOD (10 ³ t)	CHARCOAL (10 ³ t)
-20.29	3.16

Total transformation

OIL (10 ³ bbl)	NATURAL GAS (10 ⁶ m ³)	HYDROENERGY (GWh)	FIREWOOD (10 ³ t)	SUGARCANE AND PRODUCTS (10 ³ boe)	DIESEL OIL (10 ³ bbl)	FUEL OIL (10 ³ bbl)
-18.43	-1.80	-270.58	-20.29	-154.13	-1.26	-16.96

Own consumption

OIL (10 ³ bbl)
5.03

Losses

ELECTRICITY (GWh)
104.61

Adjustment

OIL (10 ³ bbl)	NATURAL GAS (10 ⁶ m ³)	HYDROENERGY (GWh)	ELECTRICITY (GWh)	LPG (10 ³ bbl)
0.00	-0.16	0.00	0.00	0.00

Transport

OIL (10 ³ bbl)	GASOLINE/ALCOHOL (10 ³ bbl)	KEROSENE/JET FUEL (10 ³ bbl)	DIESEL OIL (10 ³ bbl)
46.44	598.55	108.97	472.88

Industrial

OIL (10 ³ bbl)	SUGARCANE AND PRODUCTS (10 ³ boe)	ELECTRICITY (GWh)	LPG (10 ³ bbl)	DIESEL OIL (10 ³ bbl)
46.44	544.34	172.36	30.85	68.50

Residential

FIREWOOD (10 ³ t)	ELECTRICITY (GWh)	LPG (10 ³ bbl)	KEROSENE/JET FUEL (10 ³ bbl)	CHARCOAL (10 ³ t)
35.18	340.69	246.81	1.28	3.16

Commercial, services, public

ELECTRICITY	LPG (10 ³ bbl)
-------------	---------------------------

RICIT Y (GWh)	bbbl)
232.36	30.85

Agriculture, fishing and mining

ELECT RICIT Y (GWh)
16.07

Energy consumption

OIL (10³ bbl)	FIREWOOD (10³ t)	SUGARCAN E AND PRODUCTS (10³ boe)	ELECT RICITY (GWh)	LPG (10³ bbl)	GASOLINE/ ALCOHOL (10³ bbl)	KEROS ENE/JE T FUEL (10³ bbl)	DIESEL OIL (10³ bbl)	CHARC OAL (10³ t)
92.88	35.18	544.34	761.47	308.51	598.55	110.25	541.38	3.16

Final consumption

OIL (10³ bbl)	FIREWOOD (10³ t)	SUGARCAN E AND PRODUCTS (10³ boe)	ELECT RICITY (GWh)	LPG (10³ bbl)	GASOLINE/ ALCOHOL (10³ bbl)	KEROS ENE/JE T FUEL (10³ bbl)	DIESEL OIL (10³ bbl)	CHARC OAL (10³ t)
92.88	35.18	544.34	761.47	308.51	598.55	110.25	541.38	3.16

Source: SIELAC-OLADE

9.4 Financial Sustainability

Biomass production on unfavorable areas is a crucial aspect of the economics of *A. donax*. A comprehensive research focusing on the sustainability features of energy crops also synthesized the results of several EU-funded projects and stressed that *A. donax* is one of the most suitable feedstocks to produce biomass on marginal agricultural areas of Europe.

Producing biomass energy does not require a heavy capital input either. The low cost of production is passed on to the customer's benefits, meaning that customer's energy bills will decrease.

The integration of *A. donax* production for supply of energetic biomass feedstock creates an additional agricultural sector activity thus boosting further economic growth while providing employment to the farming community. Many farmers have abandoned their land or are no longer able to cultivate with acceptable returns. The low cost and simplified farming methods linked to the culture of sugarcane will allow these farmers to retrieve sustainable attractive income and to again generate profits from their land. This in turn will secure long-term interest from local farmers to produce *A. donax* feedstock for Belcogen to produce its renewable energy in the form of electrical power even when the sugarcane crop is not on. Marginal or less desirable agricultural land may still be suitable for growing the naturally adaptable *A. donax* plant and can generate revenues. Such opportunity will ensure support from both the Government and its rural community.

9.5 Institutional and Management Sustainability

Four types of barriers prevent the realization of Belize's renewable energy potential:

- ✓ Information barriers - there is a lack of information about several key renewable resources, specifically biomass and waste.
- ✓ Regulatory barriers - the regulations governing how to access and develop renewable energy sites are unclear; the procurement process could also be clearer.
- ✓ Financial barriers - some financiers may demand higher returns because of perceived lack of security in the Belizean electricity sector.
- ✓ Technical/skills barriers - Belize's power sector workforce is not familiar with operating and integrating generation from intermittent sources.

MESTPU (with the support of the IDB), is engaged in the design and implementation of a National Sustainable Energy Action Plan. This plan builds on recent efforts to provide a concise, coherent guide to the tasks needed the entity responsible for each task, and the timing and sequencing of those tasks to ensure an effective critical path. The Plan's five components will guide actions coordinated among MESTPU, the PUC, BEL, and the private sector with the following objectives:

- (i) Promote large-scale renewable energy generation. Develop resource assessments for biomass for power generation.
- (ii) Prepare for distributed renewable energy generation. As prices of distributed renewable generation technologies continue to decrease, they will become viable in Belize. A regime needs to be ready in time to integrate them in a way that is beneficial for consumers, does not increase the cost of service for non-participating customers, and is viable for the utility and setting up financing mechanisms to support the purchase and installation of distributed renewable systems.
- (iii) Build a more efficient and enabling electric utility. Maximize BEL's own efficiency on the supply side.
- (iv) Help households, businesses, and the Government become more energy efficient. Belize has major unrealized potential for energy efficiency.
- (v) Increase human capabilities and skills. The human factor is key to the success of all components described above, as appropriate know-how is needed for implementation at all levels. Strengthening the capacity and capabilities of key entities (MESTPU, PUC, BEL, Bureau of Standards, and others) to allow them to play their role to its full potential.

9.6 Environmental and Socio-cultural Sustainability

A. donax is considered to be sustainable in terms of economics (biomass supply and revenue generating) and social development (neutral or negative CO₂ emissions and avoiding food-crop competition); however, in terms of environmental protection it has deficiencies, mainly in reducing freshwater resources and having negative biodiversity impacts (Nackley et al, 2015).

The only carbon released into the environment from biomass fuels is the quantity that was absorbed by plants throughout their life cycle. This aspect renders biomass cleaner than all other forms of energy production. *Arundo* is considered carbon neutral.

Table 9.4: Marginal Lands Classification by definition

Academic discipline	Definition	Context scale	Indicators of marginality
Geomorphology <i>Reference to supporting/habitat capacity</i>	Lands with physical, soil and climate limitations and restrictions, with limited capacity to sustain ecosystem services	Local, regional	Altitude, slope and relief, soil profile, erosion, stoniness, groundwater level, surface water, contaminants, pollution, climate limitations
Agronomy <i>Reference to production capacity, provisioning, input resources</i>	Lands poorly suited to cultivation due to inherent edaphic or climatic limitations or because they are in areas affected by erosion or other environmental risks when cultivated	Local	Crop productivity, soil quality, water holding capacity, evapotranspiration, organic matter, nutrients availability, drainage, salinity, soil texture, pH, compaction
Economy <i>Reference to economic capacity</i>	Land where cost-effective production, under given environmental conditions, cultivation techniques, agriculture policies as well as macro-economic and legal conditions is not possible	Local, regional	Costs of production, added value, revenues, cost/benefit analysis, net present value, discounted cash flow, gross margin, profitability, access to market
Socio-cultural <i>Reference to a combination of social and cultural condition</i>	Land with poor quality of life, or where quality of life indicators are below the reference average. Linked with deprivation and disadvantage concepts	Local, regional, national	Health, education, income, accessibility, personal motivations, leisure and social interactions, crimes, livelihoods, population density, aesthetic, recreation

Main challenges include environmental risks associated with the agronomic practices (e.g. soil management, irrigation practices, biodiversity, GHG emissions, land use competition with food), as well as uncertainty about sustainability and integration with surrounding agro-ecosystems and farmers' needs.

Regarding the agronomic management, more in situ research is especially needed to respond to the issue on water use and efficiency, with tailored applications for energy crops in terms of resilience or adaptability to future climate scenarios. It is important to note that detailed information about evapotranspiration rate, life water requirements, drought tolerance, as well as water stewardship strategies (technologies, methods, scheduling, watershed delivery) for second generation energy crops have been barely investigated and is scarce. On the other hand, the application of irrigation practices coming from traditional crops is risky (e.g. could encourage the growth and spread of unknown disease, weeds and pests) and is probably inefficient.

Using treated wastewater to irrigate energy crops is a favorable alternative for traditional irrigation, especially on marginal lands or in seasons when water is scarce.

Overview of selected case studies on *Arundo* (see table 5), related indicators, type of biomass, data sources and findings. The key insights are intended as guidance for policymakers and planners for translating the research knowledge into planning and application contexts.

Table 9.5: Case studies of *A. donax*.

Location	Indicator	Type of biomass	Data source	Findings	Key insights
Pisa, Italy	GHG emissions	<i>Arundo donax</i> L.	LCA evaluation using primary data for fertile and marginal soil; field operations (fertilizers, pesticide, water, diesel consumption)	The annualized soil carbon gain sequestration was – 6464 kg CO ₂ eq/ha in fertile soils (12th year of growth) and – 5757 kg CO ₂ eq/ha in marginal soils (5th year of growth)	The net GHG balance for both systems was negative, and confirmed that in the cultivation phase wild cane is a carbon negative crop, <i>or a net GHG sink</i>
Bologna, Italy	Soil quality	<i>Miscanthus</i> , <i>Arundo donax</i> L.	Total C, total N, ¹³ C isotopic analysis on soil samples	In the lowest soil layer, <i>Miscanthus</i> and <i>A. donax</i> stored 44 and 35 Mg C/ha, respectively, while much lower values are stored under annual crops	Perennial crops can represent a promising and sustainable solution not only for energy production but also to <i>restore soil fertility</i> and to increase the C sink potential compared to the annual crops
Lisbon, Portugal	Land restoration and phytoremediation	<i>Miscanthus</i> , <i>Arundo donax</i> L.	Metal concentration (Zn, Cr, Pb) determined by atomic absorption spectrometry	Heavy metal concentration occurs mainly in the hypogeal system, up to 34 mg Pb/kg dry weight for wild cane, 197 mg Zn/kg dry weight for	Perennial crops showed to be well suited for <i>phytostabilization of heavy metal contamination</i> as these grasses <i>prevented the leaching of heavy metal and</i>

Location	Indicator	Type of biomass	Data source	Findings	Key insights
				<i>Miscanthus</i> , and 34 mg Cr/kg dry weight for <i>Arundo</i> .	<i>groundwater contamination</i>
River Basin Districts, Spain	Land use	<i>Arundo donax</i> L.	Soil database, water electrical conductivity measurements, GIS data, Corine Land Cover 2006, geostatistical analyses	The irrigated and saline agricultural area suitable for biomass production amounted up to 34,412 ha	The <i>use of saline and saline-prone agricultural areas</i> for biomass production <i>avoids competition with agro-food land uses</i>
Sicily region, Italy	Profitability of value chain	<i>Arundo donax</i> L.	Structural data and production process (farming operations, inputs required, workload, sales price)	Woodchip production showed the highest net present value and annual gross margin respect to annual crops	Results showed the <i>highest profitability of Arundo</i> with respect to other crops with current market prices in the Mediterranean area

9.7A sustainable Source for Biomass: *Arundo donax* (Wild cane)

In light of the growing demand for biomass, the agro-energy sector is gaining more importance. Energy crops are cultivated exclusively for energy production. For instance, large perennial rhizomatous grasses are known to produce cheap lignocellulosic biomass and have good adaptability to a wide range climate condition. *A. donax* stands out for its high biomass yield, wide scope of tolerance and adaptability even to low quality marginal lands. *Arundo*'s high production potential has been proven in various environments, and in addition it had a high biomass yield, low production costs and no negative environmental effects.

9.8 Regulatory and Operational Sustainability

However, despite encouraging results of studies, the cultivation of energy crops still remains uncertain and less attractive without incentive mechanisms, tax credits and exemptions or long-term pricing schemes. Thus far, a narrow range of policies provides direct and indirect support for energy from renewable sources in Belize; essentially divided into regulatory policies, fiscal incentives and public financing. In the future support schemes and business models for mobilizing financing and attracting investors should be more aligned with GHG emissions, ecosystem services and sustainability indicators, avoiding criticism raised regarding trade-offs on land use pressure for biomass production, market distortions and environmental impacts.

The use of certification schemes, analytical tools and context-specific measurable indicators such as those developed by the GBEP can inform farmers, industry representatives and stakeholders on how to achieve sustainability goals for ex-post assessment or for ex-ante suitability evaluation. To unlock the opportunities and ambitions for bio-energy production in the marginal lands, further work needs to be carried out to resolve uncertain and controversy points for aforementioned agronomic practices and socio-economic aspects.

A quick overview of the existing policy and regulatory framework can be observed in table 10.6, where it demonstrates the gaps that exist currently.

Table 9.6: Existing Policy and Regulatory Framework

Renewable Energy	Status
Feed-in Tariff	na
Net Metering/Billing	na
Interconnection Standards	In Development
Renewables Portfolio Standard/Quota	na
Tax Credits	na
Tax Reduction/Exemption	In Place
Public Loans/Grants	na
Green Public Procurement	na
Energy Efficiency	
Energy Efficiency Standards	na
Tax Credits	na
Tax Reduction/Exemption	na
Public Demonstration	na
Restrictions on Incandescent Bulbs	na
Appliance Labeling Standards	na
Targets	
Renewable Energy	In Place
Energy Efficiency	

Bioenergy production is a long-term and relative complex technology with complexities of fragmented regulations and markets. Looking to the coming years more should be done by national institutions to reinforce and better guide the development of the bioenergy sector in Belize with clear benefits for sustainable development in rural areas. For instance, coherent agricultural, energy and environmental policies should affect the economic attractiveness of bioenergy production engaging investors on long-term energy strategies for viable markets,

connecting fiscal incentives, feedstock prices, grant programs with the compliance of environmental and social criteria, avoiding detrimental land use changes, land grabbing or intensive cultivation. For example, under the National Agriculture Policy direct support schemes could be expanded to including bioenergy under specific crops most suited on marginal lands. Under the ‘greening measures’ bioenergy crops can be inserted under agricultural practices and management commitments beneficial to the climate and the environment since it can have a significant impact on marginal land (e.g. carbon sequestration, water quality, biodiversity). In addition, under Rural Development Programs support should be provided to the value chain (i.e. farmers, processors and investors) with initiatives including technical support, business models and financial guidance for making bioenergy projects bankable, in the purpose of removing market uptake barriers.

The challenge for investors and stakeholders is to reverse the conventional approach, moving beyond biomass value chain legacy, linking sustainable bioenergy production in the framework of biorefinery systems by fully exploiting the global value of bioenergy crops and raw materials into commercially competitive and sustainable products.

9.9 Sustainability Plan to be Implemented for the Biomass project

Using the GBEP indicators (see table 10.7) for the establishment of the basis to monitor the sustainability of the project during the pilot phase a set of indicators will be developed in consultation with the stakeholders. The initial indicators selected can be observed in table 8 but it will be further refined and be made more realistic based on availability of skills, equipment and resources available.

Table 9.7: The Global Bioenergy Partnership Sustainability Indicators for Bioenergy

INDICATORS		
1. Lifecycle GHG emissions	9. Allocation and tenure of land for new bioenergy production	17. Productivity
2. Soil quality	10. Price and supply of a national food basket	18. Net energy balance
3. Harvest levels of wood resources	11. Change in income	19. Gross value added
4. Emissions of non-GHG air pollutants, including air toxics	12. Jobs in the bioenergy sector	20. Change in consumption of fossil fuels and traditional use of biomass
5. Water use and efficiency	13. Change in unpaid time spent by women and children collecting biomass	21. Training and re-qualification of the workforce
6. Water quality	14. Bioenergy used to expand access to modern energy services	22. Energy diversity
7. Biological diversity in the landscape	15. Change in mortality and burden of disease attributable	23. Infrastructure and logistics for distribution of

8. Land use and land-use change related to bioenergy feedstock production	to indoor smoke 16. Incidence of occupational injury, illness and fatalities	bioenergy 24. Capacity and flexibility of use of bioenergy
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Table 9.8: The Selected Sustainability Indicators for Bioenergy

BIOENERGY SUSTAINABILITY INDICATORS		
ENVIRONMENTAL	SOCIAL	ECONOMIC
Life-cycle GHG Soil Quality Non GHGs	Land Tenure Change in Income Jobs in Bioenergy Sectors	Productivity Net Energy Balance Gross Value Added
Water Use and Efficiency Water Quality	Modern Energy Access	Trainings
Biodiversity Land Use Change		Infrastructures and logistics for bioenergy distribution Capacity and flexibility of use of bioenergy

ANNEX A TO ESMP: REPORT ON CONSULTATION MEETING

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE ARUNDO DONAX RENEWABLE BIOMASS FUEL PROJECT PUBLICCONSULTATION REPORT

Held at

*Belize High School of Agriculture,
San Lazaro Village, OrangeWalk District, Belize*

Date: October 3rd, 2019

Time: 6:30 p.m.

Submitted to:

Caribbean Community Climate Change Centre

Prepared by:

Wilderness Consulting Group

October 3rd, 2019
6:30 p.m.

PROCEEDINGS SUMMARY

Moderator: Dr. Luciano Chi

Presenters:

Mr. Jose Garcia	WGC
Mr. Earl Green,	CCCCC
Oswaldo Sabido,	WGG
Ramon Pacheco	WGC
Evaristo Avella	WGC
Sergio Garcia	WGC

CCCCC Representative:

Mr. Earl Green, Climate Change Officer

Mr. Leroy Martinez, Representative, National Designated Authority

No. Of Participants: 85

ANNEX A: Attendance Record

ANNEX B: Public Notice

ANNEX C: Photographs

AGENDA
CONSULTATION MEETING ON THE
Environmental and Social Impact Assessment for the Arundo donax Renewable
Biomass Fuel for Belize Project
Belize High School of Agriculture
San Lazaro Village, Orange Walk District
3rd October 2019
6:00 p.m.

Moderator: Dr. Luciano Chi

Note taking/Documentation: Mr. James Azueta

- | | |
|------|---|
| 6:15 | Opening Prayer Mrs. Raquel Carillo
National Anthem
Welcome - Mr. Nolasco Teck, Vice Principal, BHSA |
| 6:20 | Introduction of Consultants and Stakeholders – Mr. Jose Garcia, Engineer |
| 6:25 | Agenda for Meeting& Consultation Process - Moderator |
| 6:30 | Presentation: The Arundo donax Project – Relevance and Status Update – Mr. Earl Green, Project Manager, CCCCC |
| 6:45 | Project Setting/Baseline Information/Flora and Fauna – Oswaldo Sabido, & Ramon Pacheco Forest Engineers |
| 7:00 | Presentation – Social & Environmental Impacts and Mitigation Measures (ESMP) - Evaristo Avella, EIA Specialist |
| 7:30 | Presentation: Risks, Challenges and Opportunities for Bioenergy Initiatives - Sergio Garcia, Agriculture Expert |
| 8:00 | Questions and Answers |
| 8:30 | Closing Remarks - Mr. Earl Green |
| 8:40 | Vote of Thanks - Village Councilor |
| 8:45 | Snacks!!! |

DETAILS OF CONSULTATION

1.0 Opening

At 6:30 p.m., the meeting was opened by Dr. Luciano Chi, who acted as the Moderator.

He introduced himself and briefly explained about the project as being one that can enhance the usage of biomass for the production of electricity. He also presented the agenda for the consultation, and explained that comments or questions will follow the presentations.

Mrs. Raquel Carillo led the opening prayer after which the National Anthem was sung by the participants.

Mr. Jose Garcia, Environmental Engineer, for the ESIA Consulting team introduced the members of the consulting team.

During the process, the attendance sheet was handed out so that participants could sign the sheet. The count indicated that 85 persons were present from the villages of San Antonio Rio Hondo, San Lazaro, and Yo Creek, and Trinidad and representatives from several stakeholder organizations.

2.0 Presentation by Mr. Earl Green

Mr. Earl Green gave a brief introduction on the usage of biomass for the production of electricity.

- *Arundo donax* has the potential to be an alternative fuel for electrical energy generation
- The project was intended to determine the feasibility of using an alternate biomass fuel at the BELCOGEN plant to complement/supplement its bagasse biomass being burnt for electricity generation which supplies the national grid
- He explained that the *A. donax* cultivation project is not expected to compete with other agricultural cultivation of any kind
- *A. donax* grows in Belize
- It has higher energy content than bagasse, and burns as a cleaner gas; as such it would complement bagasse burning and not replace it

3.0 Presentation by Mr. Oswaldo Sabido and Mr. Ramon Pacheco

Mr. Oswaldo Sabido delivered a presentation on the flora found in the project demonstration area. The following are highlights of the presentation:

- 224 acres consist of savanna type vegetation
- Cross Creek enters in a very small area of the project land
- There is a small area with logwood and broad leaf where oak makes upwards of 50%
- 11 transect lines were conducted; 20 X 200 meters in the savanna and 10 X 200 meters in the broad leaf area

- Most of the commercial high value trees has been extracted from the project site

Mr. Ramon Pacheco also delivered a presentation on the description of the wildlife in the project area; with the following highlights:

- 105 species of birds were identified in the area
- The highest species concentration was in the broad leaf area
- None of the birds found are in the national endangered species list
- One agouti and one lizard were found in the project site

4.0 Presentation by Mr. Evaristo Avella

Mr. Evaristo Avella, EIA specialist, gave a concise description of possible environmental and social impacts and possible mitigation efforts. The principal highlights of the presentation are:

- The ESIA was a team effort led by Jamaican Energy Expert Wayne Williams
- The project will be conducted in a relatively small area and it will involve monoculture of the *A. donax*
- Project Setting:
- The geology of the area is typical of the limestone karst formation of northern Belize
- The area receives about 60 inches of rain annually
- The project background also took into consideration the surrounding community structures, land ownership types and employment and education status
- Water quality was conducted on four surrounding sites; various parameters were looked at such as salinity, turbidity, chloride content etc.
- The salinity was found to be a little high for freshwater habitats and may be attributed to saline incursion due to the prolonged dry season, which in turn is related to the drought that is attributed to the climate change phenomenon
- High *E. Coli* levels were found in the water samples
- Preliminary air sampling revealed low particulate levels as the sampling was conducted during the closed BSI milling season and calm weather conditions;
- All sites had zero CO emissions as well as NOx emissions but showed elevated levels of particulate matter in most sites (total particulate matter, which included PM2.5 and PM 10)
- **Social Concerns:** usage of good agricultural land for *A donax* production; possible contamination of sugar cane plots; habitat changes; water and air quality pollution
- **Possible Mitigation:** Develop an exit strategy based on trials; lowering of water consumption and emissions when burning
- Various plans (fire, emergency evacuation, Health and safety, monitoring) will be produced for the project

5.0 Presentation by Mr. Sergio Garcia

Mr. Sergio Garcia, agriculture specialist, gave a presentation on the risks, challenges and opportunities of bioenergy.

- **Risks:** *A. donax* is a grass
- It is an invasive species

- It is a hydrophyte and native to Asia
- It multiplies asexually and can grow in various soil types
- It inhibits other plants from growing through chemicals produced by the roots
- It is highly flammable even when green and can increase bush fires
- **Opportunities:** *A. donax* can be produced into biogas, biofuel, ethanol, livestock feed, musical instruments, medicine and bioremediation of polluted soil
- High production can be used by BELCOGEN to decrease the usage of Mexican electricity

Challenges: Need to change the Energy Act since the current Energy strategy and Policy recommends increasing use of biomass even in no particular one is named.

- to accommodate the usage of biomass, including *A. donax*.
- There is the need for tax incentives and investments in bioethanol
- There is the need for capacity building for women and youths
- Need to work together to make the project successful

6.0 Questions and answers

The consultation concluded with a question and answer period where participants asked a few questions as follows:

1. Why was the 2015 land survey mentioned? Answer: It was the first study of the area; the recent study was concise and ground- truthing.
2. Why was the air quality poor when burning *A. donax* during the test trial run? Answer: The equipment used for the burning did not have exhaust scrubbers or treatment for the particulate matter.
3. How long does the plant take to be harvestable?

Response: It can take up to nine months and can be harvested through mechanical means. CARDI and SIRD I will conduct the research.

4. Who will benefit?

Response: The project is experimental but once concluded, the plant can be grown on existing marginal lands. The landowners will benefit from Belize and the Caribbean as the project outcomes can be extrapolated to other countries.

5. Are savannas and lowlands suitable for cultivation?

Response: Yes.

6. Will the plant grow in water or close to water?

Response: It is a hydrophyte so it will grow better in a wet environment but being a hydrophyte does not mean it will grow or use a lot of water.

7. What are the different methods of destroying the plant?

Response: Several methods will be tested including the use of herbicides and mechanical out-rooting, or a combination of both.

8. There were some **recommendations** made by participants as follows:

- ✓ The 66 feet of riparian forest should be left when planting;
- ✓ the project should leave a buffer zone;
- ✓ the project should record existing changes before the project starts so as not to attribute certain changes to the project; planting close to the rivers will be discouraged since the plant can propagate through root fragmentation.

7.0 Closure

Mr. Earl Green gave the closing remarks thanking the communities for their participation and that they would be kept informed as the project progressed and were asked for their close cooperation to make the project a success.

It was also mentioned that an advisory group that will enhance communication and cooperation with nearby communities will be formed. One activity already being planned in consultation with the Solid Waste Management Authority is the possibility of separation of recyclable waste, and a possible compost pilot project by the high school with technical assistance from organizations.

Participants were informed that the draft documents will be posted on the 5 C's web site and participants will be informed when this becomes available.

The meeting was closed at 10:15 pm, after which snacks produced by the personnel from the school cafeteria was served.

EVENT: / rundo donax ESIA Public Consultation, Trinidad Village

Date: 3rd October 2019

No.	NAME	ADDRESS	TELEPHONE	E-MAIL
1	Ahtzili Acosta	Santa Cruz	911	Ahtzili.29@gmail.com
2	Jillianie Castillo	Yo Creek	911	Jillianie13@gmail.com
3	Mr. Sergio Cal	T. Fain	615-6640	gracianoach@gmail.com
4	Ms. Janny Pech	Carmelita Village	620-8653	fpech1992@gmail.com
5	Mrs. Melanie Blanco	Yo Creek Village	608-0758	melanie.blanco_bz@yahoo.com
6	Mrs. Lucia Novelo	Yo Creek Village	625-4011	lucianov1@yahoo.com
7	Mariaack	Yo Creek Village		
8	Ovidio Wicab	San Felipe Village	622-4777	Thegreatwicab@hotmail.com
9	Gilberto Cabe	Douglas Village	666-22-02	
10	Dele Samayo	San Lazaro Village	669-5823	
11	Noriema Carrillo	San Lazaro Vly	661-4188	
12	Moises Lopez	San Lazaro vly	667-7478	
13	Virginia Cruz	Trinidad Village	664-0794	

Appendix A – Attendance record

EVENT: / rundo donax ESIA Public Consultation, Trinidad Village

Date: 3rd October 2019

No.	NAME	ADDRESS	TELEPHONE	E-MAIL
14	Enilda Flamenco	Trinidad Village	654-9134	
15	Brian Puy	San Lazaro		
16	Shanir Carrillo	San Lazaro Village		
17	Rafael Canul	San Lazaro		
18	Miguel Pablosa	Trinidad Village	654	
19	Juan Carlos Lugo	San Lazaro / Yacarek		
20	Kathleen Garcia	San Felipe		
21	Josie Balam	Orange Walk		
22	Gabriel Perez	Orange Walk		
23	Natasha Sanchez	San Lazaro		
24	Oscar Sanchez	San Lazaro		
25	Teodoro B. Canul	Trinidad	667-2819	teo.boncan@gmail.com.
26	Anita Blance	Yo Creek Village		anita.jorge.blance@gmail.com

EVENT: Aundo donax ESIA Public Consultation, Trinidad Village

Date: 3rd October 2019

No.	NAME	ADDRESS	TELEPHONE	E-MAIL
40	Kevin Serrano	San Lazaro	665-9850	-
41	Derek Vasquez	San Felipe	-	-
42	Eric Ardon	San Felipe	—	—
43	Creslyn Aguilar	San Lazaro	666/3951	—
44	Jorge Briceño	August Pine Ridge	—	—
45	Raquel Carrillo	San Lazaro	—	raqs14carrillo@gmail
46	Emelda Carrillo	San Lazaro	—	—
47	Jomario Sanchez	Orange Walk Town	—	—
48	Jodi Rae	Indian Church Village	—	—
49	Frank Mucut	Santa Cruz	*911	natasia@gmail
50	Dorwin Chan	August Pine Ridge	911	—
51	Annie Cortez	San Felipe	911	—
52	Henry Mojica	San Felipe	—	—

EVENT: Aundo donax ESIA Public Consultation, Trinidad Village

Date: 3rd October 2019

No.	NAME	ADDRESS	TELEPHONE	E-MAIL
27	Leroy Josiah	San Ignacio	822-2526	leroy.josiahmed@gmail.com
28	Sergio Garcia	Guinea Gram	663 8418	serghino@gmail.com
29	Jose Gonzalez	Yo Creek Village	—	—
30	Leandro Santos	San Carlos Village	—	Leo_Santos@yahoo.com
31	Andrew Henriquez	San Felipe Village	636-1850	—
32	Elvis Soliz	August Pine Ridge Village	—	elvisoliz56@gmail.com
33	Erlindo Blanco	August Pine Ridge Village	—	—
34	Darel Torres	August Pine Ridge V	663 0570	—
35	Jaslin Cordova	August Pine Ridge v.	—	—
36	Myles Novelo	San Lazaro V.	—	—
37	Jose Torres	August Pine Ridge V	632 3217	—

EVENT: Arundo donax ESIA Public Consultation, Trinidad Village

Date: 3rd October 2019

No.	NAME	ADDRESS	TELEPHONE	E-MAIL
79	Sergio Garcia	Guinea Grass Village	663-8418	
80	Karl Green	San Ignacio Town	660-3054	sgreen@caribbeanclimate.bz
81	Evanto Avella	Santa Rosa Town	661-9575	charleavella@gmail.com
82				
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EVENT: / rundo donax ESIA Public Consultation, Trinidad Village

Date: 3rd October 2019

No.	NAME	ADDRESS	TELEPHONE	E-MAIL
66	Iris Ack	YoCreekVillage	-	-
67	Flyma Lizama	San Lazaro	-	Flymalizama.09@gmail.com
68	Eric Cal	Yo Creek	668-1730	ecalbz2005@gmail.com
69	Edwin Rodriguez	San Felipe	911 -	cd. -
70	Norman Perez	San Felipe	-	-
71	Vannelle Cruz	San Felipe	-	-
72	Jose Moh	San Felipe	-	-
73	Shawn Garcia	San Felipe	???.???	☺ C
74	Julio Cal	Yo Creek	911	keysigh@icloud.com
75	Nigel Tillet	San Lazaro	911	nigeltillette12300@gmail.com
76	Luigie Gonzalez	YoCreek	911	Luigie.gonzalez10@gmail.com
77	Jonathan Vazquez	San Lazaro	-	Jonathan.vazquez12300@gmail.com
78	Jaziel wicab	San Felipe	911	Jazielwicab35@gmail.com

EVENT: / rundo donax ESIA Public Consultation, Trinidad Village

Date: 3rd October 2019

No.	NAME	ADDRESS	TELEPHONE	E-MAIL
53	Deyra Reyes	San Antonio village	605-4081	
54	Geidy Andrades	San Felipe Village	-	-
55	Aliyah Calderon	San Antonio village	604-8933	
56	Jose Henriquez	San Felipe Village	653-6815	
57	Aila Sosa	Yo Creek Village	—	—
58	Jennifer Chi	Yo Creek village	661-2617	—
59	Betuel Magaña	August Pine Ridge Village	655-4914	junior.magana80@gmail.com
60	Omaira Avila Postent	CARDI Central Farm	8242934	cardi@btL.net
61	Ramon Pacheco	Orange Walk Town	6301221	rpacheco1966@gmail.com
62	Oswaldo Sabido	Belmopan	610-1097	oswaldosabido@gmail.com
63	James Amata	Belize City	620-2353	jamesamata_bz@yahoo.com
64	Jose Garcia	BZ. CITY	610-1093	PUPPEPE@GMAIL.COM
65	Luciano Chi	SIRDI	621-5228	luciano.chi@sirdi.bz

Appendix B – Public Notice

PUBLIC NOTICE

**FROM: ESIA CONSULTING TEAM ON BEHALF OF THE CARIBBEAN
COMMUNITY CLIMATE CHANGE CENTRE (CCCCC)**

RE: INVITATION TO CONSULTATION MEETING

**THE PUBLIC IS HEREBY INVITED TO A CONSULTATION MEETING TO DISCUSS
THE MAIN FINDINGS OF THE ENVIRONMENTAL AND SOCIAL IMPACT
ASSESSMENT (ESIA) AND ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN
(ESMP)” FOR THE ARUNDO DONAX (WILD CANE) RENEWABLE BIO-MASS FUEL
FOR BELIZE.**

THE MEETING WILL BE HELD ON: THE 3RD OF OCTOBER 2019 AT 6:00 P.M,

**LOCATION: THE BELIZE HIGH SCHOOL OF AGRICULTURE, SAN LAZARO
VILLAGE, ORANGE WALK DISTRICT.**

**CONSULTANTS WILL BE PRESENTING THE PROJECT AND THE FINDINGS OF THE
DRAFT ESIA AND ESMP REPORTS.**

Appendix C - Photographs









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Nackley, L.L.; Quinn, L.D.; Matlaga, D.P.; Barney, J.N. Good Intentions vs Good Ideas: *Evaluating Bioenergy Projects that Utilize Invasive Plant Feedstocks*; Cabi Publishing-C a B Int: Wallingford, UK, 2015; Volume 5, pp. 134–153.

