Dominica Geothermal Development Company Limited
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Project Name

NZ Ministry of Foreign Affairs & Trade

ESIA: Volume 4 – ESMP, Framework ESMS and Assessment Against WBG Standards

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Document history and status

Revision	Date	Description	By	Review	Approved
A	August 2017	First Draft of ESIA Volume 4	A Kubale P Gabriel	B Clarke	B Clarke
B	September 2017	Update following MTNP and Terrestrial Ecology Reports	P Gabriel		
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V2	July 2018	Revision following World Bank RSA Comments – Issue for Disclosure	C Duncan	B Clarke	B Clarke

Contents

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs New Zealand Limited ("Jacobs") is to describe the Environmental and Social Impact Assessment (ESIA) for the Dominica Geothermal Power Project in accordance with the scope of services set out in the contract between Jacobs and the New Zealand Ministry of Foreign Affairs and Trade (the Client). That scope of services, as described in this report, was developed with the Client, the Government of the Commonwealth of Dominica (GoCD) and the Developer (Dominica Geothermal Development Company (DGDC) established and owned by the GoCD).

Jacobs has been contracted by the Client to undertake the conceptual design and overall project definition through their engineering team. In preparing this ESIA report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided. Except as otherwise stated in the ESIA report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced as noted in the ESIA volumes and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

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1. Introduction

1.1 Overview

The ESIA Volume 4: ESMP, Framework ESMS and Assessment Against WBG Standards provides the following:

- An Environmental and Social Management Plan (ESMP) – Summarises the mitigation and monitoring measures that should be employed during construction and operation for the Project. The ESMP will summarise the DGDC's commitments to address, mitigate and monitor risks and impacts identified as part of the ESIA, through avoidance, minimisation and compensation/offset.
- A Framework Environmental and Social Management System (ESMS) - The Framework ESMS provides a framework of the key elements for developing and implementing an Overarching ESMS which sets out how the mitigation and monitoring will be implemented, checked and reviewed for the life of the Project.
- Assessment Against WB Standards Assessment – The assessment provides a summary of how the Project conforms to the requirements of World Bank Performance Standards for Private Sector Activities, OP 4.03 (2013).

The findings of the ESIA (ESIA Volume 1: Introduction, ESIA Volume 2: EIA and ESIA Volume 3: SIA) are used to develop associated documentation, such as the ESMP and Framework ESMS, as shown below in Figure 1.1.

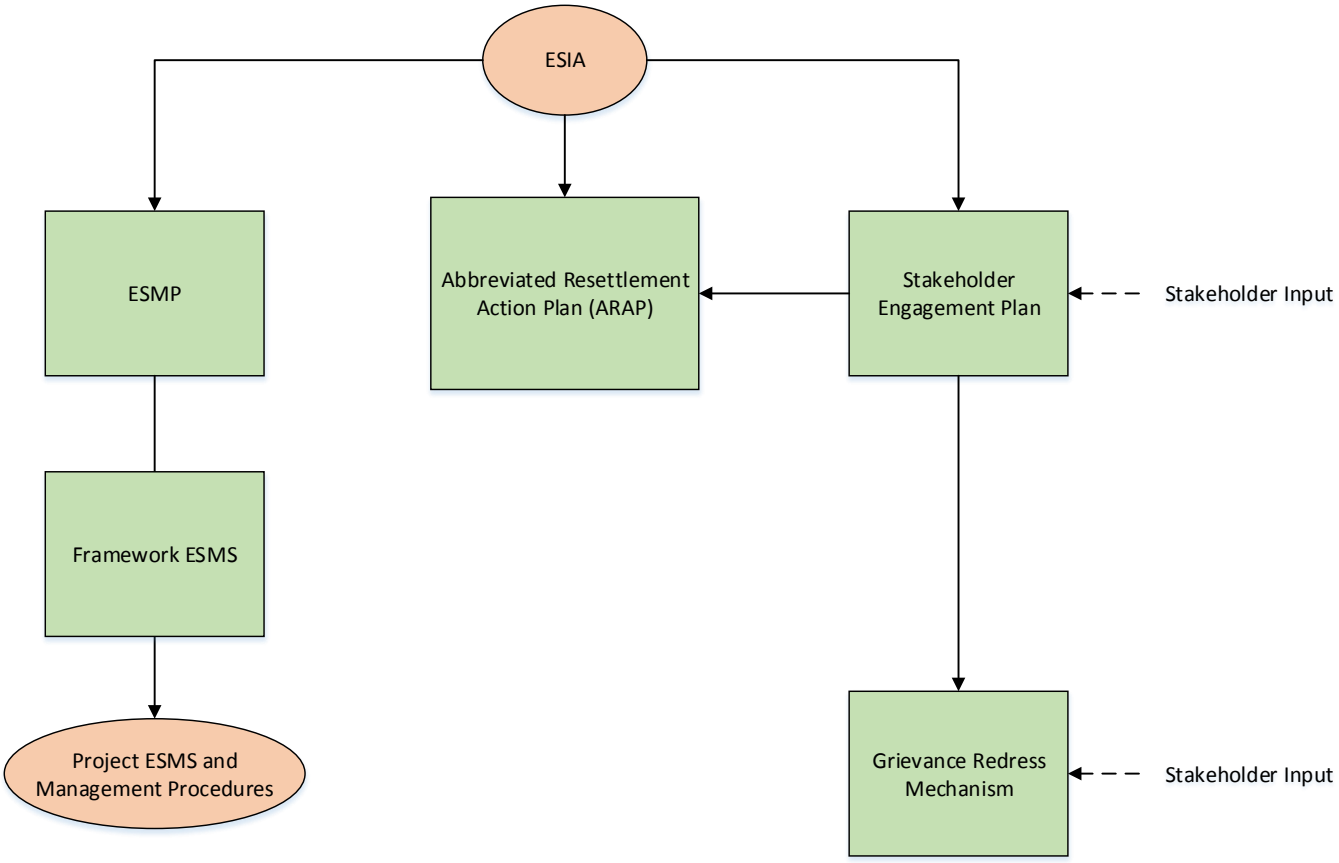

Figure 1.1 : Flow diagram showing how ESMS is developed from the ESIA and how the documents are interrelated

1.2 Structure of Volume 4

Volume 4 of the ESIA is structured as follows:

- Section 2 – Environmental and Social Management Plan (ESMP)
- Section 3 – Framework Environmental and Social Management System (ESMS)
- Section 4 – Assessment Against WB Standards

2. Environmental and Social Management Plan

2.1 Introduction

The ESMP describes and prioritises the actions needed to implement mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified in this ESIA related to the Project. Implementation of the ESMP will take place under the broader framework of the ESMS and will be implemented and managed by Dominica Geothermal Development Company (DGDC). The EPC Contractor and operation maintenance contractor will also adhere to the procedures and requirements as set out in the ESMS.

The mitigation measures and action plans covered in this section therefore relate only to pre-construction, construction and operation stages for the Project. Where necessary, mitigation measures have been proposed to meet the requirements of the World Bank Safeguard, World Bank Performance Standards, World Bank Group (WBG) EHS Guidelines and to comply with Government of Commonwealth of Dominica (GoCD) law and regulations.

2.2 Mitigation Measures – Pre-Construction

There are a range of potential environmental and social impacts associated with the pre-construction phase of the Project. The key mitigation measures are summarised below:

- An Abbreviated Resettlement Action Plan (ARAP) has been developed prior to construction commencing. The ARAP contains the procedures that will be implemented to restore the livelihoods of people who have been resettled as a result of the Project. The ARAP has been prepared to complement the legal process of land acquisition and to comply with the principles and objectives of the Performance Standard (PS) 5 Land Acquisition and Involuntary Resettlement. The ARAP is contained in ESIA Volume 5: Technical Appendices.
- The resettlement action measures will be defined in a participatory manner with the affected people.
- The land acquisition process will be completed prior to construction commencing.
- DGDC will require the EPC Contractor and Subcontractor to actively employ locals in the construction phase.
- The Grievance Mechanism defined in the Stakeholder Engagement Plan has been disclosed to the neighbouring communities and implemented, and grievances registered will be addressed on a case by case basis.
- DGDC will undertake vocational training to assist local people in obtaining jobs with the Project.
- The Project will adapt the final design to avoid as much as possible destruction of houses and/or buildings. In particular, inhabited houses will be avoided as much as possible to minimise any potential physical displacement.
- Regular direct meetings with the local communities will be undertaken to update them on the progress of the work and to give them the opportunity to voice their concerns.
- Following Hurricane Maria in September 2017, the likelihood of landslides has increased. It is therefore recommended that further studies be undertaken to establish the risk of landslide prior to construction. It is recommended that a geotechnical study is carried out for all areas where major construction activities are taking place for the Project. This will be organised by DGDC.
- Rerouting options should be examined as a primary mitigation measure to avoid areas with large scale and active landslides, since they present a threat to the reinjection line integrity. International good practice is to identify landslide features and avoid by routing along ridge crests and spurs, and minimising the exposure to large and active geo-hazard landslides, potentially unstable and steep side slopes (Marinos et al., 2016).

2.3 Mitigation Measures – Construction and Operation

There are a range of potential environmental and social impacts associated with the construction phase of the Project (Refer to ESIA Volume 2: EIA and ESIA Volume 3: SIA). During construction of the geothermal power plant, reinjection line and access roads, the following mitigation measures are proposed in Table 2.1 for construction and Table 2.2 for operation. It should also be noted that it is anticipated that construction mitigation measures will also be implemented by DOMLEC during the construction and upgrading of Associated Infrastructure (see ESIA Volume 2: EIA, Section 18).

Table 2.1 : Summary of proposed mitigation during construction

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
Air quality	All Project construction works – emissions and dust control	The EPC Contractor will develop an Air Quality Management Procedure that they and all Subcontractors will implement during all Project construction works. DGDC will be responsible for checking and reviewing the document. The Air Quality Management Procedure will include the following measures: • Construction vehicles will be periodically checked to ensure that they are not emitting excessive pollutants. • Construction dust will be suppressed with water applied by water sprinklers and/or water carts. For access tracks, it is recommended that water is sprayed on roads at least twice a day during the dry periods. • Dust on the wheels of vehicles will be removed through wheel washing prior to leaving the site. • Vehicle speed on the construction site will be set to a maximum of 15 mph to reduce dust release from road surfaces. • In the event of high winds during dry periods, it may be necessary to cease some construction activities until the wind subsides. • When transporting material that is prone to wind blow, vehicles will be equipped with a tarpaulin cover when passing through residential areas. • Windblown material from stockpiles of soil, aggregate, sand etc. will be held in bins or other enclosures, and stockpiles of material including soil, and where practicable covered with a tarpaulin. • To reduce windblown material, the EPC Contractor will sow grass seed on soil stockpiles that will remain dormant for more than three months.
Cultural Heritage	All Project construction works	• The EPC Contractor will implement a Chance Find Procedure as set out in Volume 3: SIA during all Project construction works. DGDC will be responsible for checking and reviewing the document. The Chance Find Procedure outlines the measures taken during construction if an artefact of cultural heritage significance is found (i.e. documentation of the artefact, informing local museum). • The EPC Contractor's Worker's Code of Conduct will include a section on Cultural Heritage and respect of local beliefs and traditions in the local communities. All workers will be made aware of the EPC Contractor's Worker's Code of Conduct and awareness sessions will be organised for all new recruits. DGDC will be responsible for checking and reviewing the document.
Environmental and Social Management Systems (ESMS)	All Project construction works	• Management of environmental and social risks and impacts during construction will primarily be the responsibility of the EPC Contractor through the EPC Contract. • During the construction phase, DGDC will review and monitor EPC Contractor's performance in accordance with their Health, Safety and Environment (HSE) Plans and related management plans/procedures to ensure alignment with the overarching Project ESMS. Management of environmental and social aspects associated with the Project will be carried out in accordance with the ESMS. The ESMS will consist of a set of sub-ordinate plans and procedures, which may include, but are not limited to, the following topics: - Construction environmental management; - Pest and weed management;

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		- Biodiversity restoration; - Waste management; - Hazardous substance management; - Soil and erosion management; - Air quality/dust management; - Environmental and social monitoring; - Stakeholder engagement; - Grievance mechanism (community and workers); - Emergency preparedness and response; - Noise and vibration management; - Recycling plan; - Landscape management; - Chance find procedure; - Subsidence risk management; - Landslide stabilisation risk management; - Occupational safety and health management; and - Traffic management. • Key personnel will be responsible for ensuring good environmental practice on site during construction. These will include the DGDC Project Manager and the EPC Contractor Site Manager. • Staff will be trained in environmental management, auditing and monitoring procedures as per the framework that has been outlined in the Framework Environmental and Social Management System (see Section 3). • Reporting of mitigation activities will be issued by DGDC to the Lenders every 6 months in the Biannual Environmental and Social Report.
Existing Infrastructure	All Project construction works	Construction activities will be operated in a way that will not encroach into the existing infrastructure facilities (e.g. electricity lines, information system, water supply system, offices, etc.).
	All Project construction works –	• The EPC Contractor will develop a Waste Management Procedure that they and all Subcontractors will implement during all Project construction works. DGDC will be responsible for checking and reviewing the document. Particular attention should be given to the use and re-use of materials to minimise

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
Hazardous Substances and Waste	general measures for waste	waste and, whenever practicable, using materials and products from sustainable sources. The Waste Management Procedure will be prepared in accordance with the waste hierarchy and include the following steps: • Consideration will be given to recycling to minimise waste disposal; and • Waste will be stored in closed containers away from direct sunlight, wind and rain. Waste packaging will be in good condition, undamaged, corrosion and leak free. • Waste will be stored so as to prevent or control accidental releases to air, soil, and water resources. • Waste signs will be put on all waste containers and collection areas. Each sign will be highly visible and easily seen by the person using the waste container or area. Each container or waste area sign will be labelled as Domestic Waste, Non-Hazardous Waste or Hazardous Waste and include the responsible person with contact information and how to handle the waste. • Waste will be stored in a manner that prevents the commingling or contact between incompatible wastes. Sufficient space is needed between incompatibles or physical separation such as walls or containment curbs. • Solid waste produced during construction will be disposed of in compliance with the regulations and will be outlined in the Waste Management Procedure. • When entrusting wastes for disposal, the Site Manager or Environmental Manager shall: - Select proper waste disposal companies certified by GoCD for the type of waste being disposed of; - Prepare all required documentation and permits if required by Dominican law for the type of waste being disposed of; and - Ensure the waste is disposed of by the third party waste contractor to the agreed disposal facility.
	All Project construction works - hazardous substances use and disposal of hazardous waste	• The EPC Contractor will develop a Hazardous Substances Management Procedure that they and all Subcontractors will implement during all Project construction works. DGDC will be responsible for checking and reviewing the document. • Under the Hazardous Substances Management Procedure, the EPC Contractor will induct the workforce to be made aware of hazardous substances, with reference to the applicable Safety Data Sheets (SDS). They will also attend mandatory safety training in the correct way to use and handle the hazardous substances. Training must be adjusted to be compliant with the laws of Dominica and any other relevant regulations prescribed by the competent authorities. • Workers will be provided with the appropriate Personal Protective Equipment (PPE) for the handling and use of hazardous substances. • Emergency facilities, first aid points, clinics, eye wash fountains, emergency showers will be identified/provided where required. • Other facilities that will be available include fire extinguishers, first aid, communication equipment, emergency doors and alarms. • Smoking will be restricted to designated areas and all flammable liquids will be kept away from hot work areas. • Oil, fuel and lubricants storage and dispensing stations will be restricted to established locations. Dispensing area should be located on an impervious surface and under shelter where possible.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		• Storage areas will be identified and unauthorised entry will be controlled by use of barriers warning signs and close supervision. All hazardous substances will be stored away from construction activities under covered stores. 'No Smoking' signs will be placed at these locations and all storage areas shall have minimum one dry powder type fire extinguisher. • Hazardous and toxic wastes stored on site will be minimised by increasing the frequency of pick-ups where necessary. The producer of hazardous waste may store hazardous and toxic waste on-site for a maximum of 90 days. This period may be extended if the amount that is produced is less than 50 kg/day. • Adequate ventilation will be provided where volatile wastes are stored. • Secondary containment should be included wherever liquid wastes and hazardous substance are stored in volumes greater than 220 litres. The available volume of secondary containment should be at least 110% of the largest storage container, or 25% of the total storage capacity (whichever is greater), in that specific location. • Triple rinsing must be undertaken before empty chemical containers can be treated as non-hazardous solid wastes. • Hazardous waste will be collected by a licensed contractor and treated, reclaimed or disposed offshore. • Wherever possible, less hazardous substances will be obtained as substitutes.
	All Project construction works - spill management	• The EPC Contractor will develop an Emergency Response Plan that they and all Subcontractors will implement during all Project construction works. DGDC will be responsible for checking and reviewing the document. The EPC Contractor, alongside DGDC will communicate the plan with the local community. Further details of the outline of an Emergency Response Plan are located in ESIA Volume 5: Technical Appendices, Technical Report - Occupational Health and Safety and Working Conditions. • Vehicles will only be fuelled in designated locations where the area is hard paved and the collection sump is connected to the wastewater treatment system. • In the event of a spill during construction, spill containment and clean up equipment will be located onsite. This will include equipment for: - Containing and cleaning any spill such as a shovel, broom, drain covers, sandbags, booms and absorbent material. All spills will be handled with compatible materials. - Storing and disposing of spilled material such as safe containers, bags, and drums. - Protecting the safety of staff through PPE. - Any spills will be contained and cleaned up immediately and disposed of at an approved facility. Incidents will be recorded and reported following the accident reporting system as detailed in the HSE Plan. This includes the preparation of an Accident/Incident Report.
Landscape	All Project construction works	• The EPC Contractor will develop a Pest and Weed Management Procedure that they and all Subcontractors will implement during all Project construction works. DGDC will be responsible for checking and reviewing the document. • Plants used in any landscape planted will be nursery grown and will be sound, healthy, and vigorous and free from insect infestations. Trees and shrubs will be chosen to tolerate weather conditions and other such site characteristics.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		• Any lighting requirements will be designed to ensure light spill is directed into the construction site. • Where possible the selection of neutral/muted cladding and external finishing would aid in limiting the extent of adverse visual impacts. • After construction works are completed, it is proposed that the power plant site will be landscaped in order to improve visual amenity. • The soil removed during earthworks for construction will be reinstated and used as topsoil for the proposed landscaping bunds (piles of earth mounted at the Project site boundary that are planted with trees to provide screening and natural noise attenuation for local residents). • For visual appearance and to limit erosion from surface water during heavy rains, stockpiled topsoil will be used for landscaping and to create 'green zone' areas on the power plant site as soon as practicable. • Site fencing has the potential to aid in mitigating adverse visual effects of the power plant by partially screening and softening the visual impact of the site and ensuring light spill from the site is minimised.
Hydrology	Power plant construction	A Stormwater Management Procedure (SMP) (embedded within the Erosion and Sediment Control Procedure) will be developed by the EPC Contractor before the construction phase. DGDC will be responsible for checking and reviewing the document. • Following surveying of the boundary of the construction pad, diversion drains should be excavated around the perimeter of the site to convey overland flow to appropriate locations downstream. During construction these could be temporary excavations, rock or geotextile lined to reduce erosion. • Direct site runoff should be captured via interceptor ditches and sumps/sediment ponds. In localised areas, sediment runoff could be managed through silt fences. Grading the construction site to ensure runoff is captured and detained in these locations is essential, as its highly likely surface water will be sediment laden and will need some settling before discharge to the nearby Titou Gorge Stream (likely through a decant structure or overflow spillway in a sediment pond). • Any discharges of concentrated flow should be to watercourses that have adequate erosion protection in place to prevent gullying of channels, bank collapse and increased sedimentation downstream. This may require installation of reno mattresses or rock rip rap (adequately sized to convey flows and velocities) at the discharge point. The remaining channel (if it exists) may require further excavation to convey the increased flows, and subsequently the installation of a permanent channel draining from the construction pad settling ponds to the Titou Gorge Stream would be recommended (a distance of ~250 m). • Should local water sources be required for meeting some construction demands including vehicle and equipment washdown, the use of a temporary portable storage tank is advised. A 25,000 L plastic tank (3.6 m x 2.8 m) could provide storage for firefighting and water supply, and be topped up from Titou Gorge Stream at low abstraction rates (<2 L/s) to minimise environmental impact. A full assessment of construction water demands will be needed to verify the infrastructure required.
	Reinjection pipeline construction	• Near stream works will require local sediment controls such as silt fences or downstream sediment traps to reduce the effects of disturbance. Water supply for concrete mixing will be minimal and infrequent, primarily used for support foundations.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
Noise and Vibration	All Project construction works	The EPC Contractor will be responsible for the following mitigation measures during construction: • A Construction Noise Management Plan (CNMP) should be formulated to provide a framework for addressing construction noise levels. Noise control options including site mitigation and the investigation of low noise plant should be detailed and direction provided for the delivery of best practice noise management on site. • Construction works should adopt Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) practices. BMP includes factors discussed within this report and encouragement of a project objective to reduce noise emissions. BATEA practices involve incorporating the most advanced and affordable technology to minimise noise emissions. • Limit construction works to daytime hours where reasonable and feasible. • Locating haul routes as far as possible from residential receivers. • Using equipment that has been well maintained so that noise emissions are minimised. • Provide localised noise screening where works are to be conducted within 200 metres (the compliance distance) of any sensitive receivers. • Where possible, static construction plant such as generators should be located adjacent to on-site structures to impede noise propagation. • Engines shall not be started and on-site activities shall not be undertaken outside of the daytime construction hours. Non noise generating works can be undertaken at staging areas where works are not adjacent to residential receivers. • Construction activities should be undertaken in accordance with BS 5228, Code of Practice for Noise Control on Construction and Demolition Sites. All equipment used on site would be required to demonstrate compliance with the noise levels recommended within BS 5228. • Appropriate use of all plant and equipment, with reasonable work practices applied, including no extended periods of 'revving', idling or 'warming up' in proximity to existing residential receivers. Any excessively loud activities should be scheduled during periods of the day when general ambient noise levels are greatest. This would reduce the potential for cumulative noise impacts (relating to worst-case elevated operations) and extended periods of off-site annoyance. • Minimising reversing alarm noise emissions from mobile plant and transport truck operations should be considered, provided occupational health and safety requirements are satisfied. Where practicable, site entry and exit points should be managed to limit the need for reversing. • Construction plant source noise levels should be confirmed prior to the commencement of works to verify construction noise impacts and noise management measures. • Provide a summary of required construction noise management practices to all staff and contractors and be included during site inductions. The summary should include, as a minimum, the permitted hours of construction work, work site locations and site ingress/egress. • Local residents and land owners are to be notified a minimum of 2 weeks prior to the commencement of construction works. The notification would detail proposed construction works, permitted hours of work and potential noise impacts.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
Landslides	All Project construction works	• It is also recommended that the EPC Contractor develop an Erosion and Sediment Control Procedure that will incorporate a Landslide Management Procedure, which will contain measures to reduce potential impacts of landslides (slope stabilisation, planting, sandbags etc.). DGDC will be responsible for checking and reviewing the document.
Social / Economic	All Project construction works	*General* • The EPC Contractor and all Subcontractors will respect and apply industrial good practices as highlighted in WBG EHS Guidelines. This includes among others: no operation during night time near inhabited settlements, implementation of noise and dust control measures, low speed limits for the Project's vehicles in inhabited areas. DGDC will ensure that this is being completed through regular site visits and auditing of reports. *Grievance* • DGDC will implement regular consultations with PAPs, their grievances will be lodged, treated and addressed. • The Grievance Mechanism defined in the Stakeholder Engagement Plan will be disclosed by DGDC to the neighbouring communities and implemented, and grievances registered and addressed on a case by case basis. Note: The Grievance Mechanism was disclosed to Laudat, Trafalgar and Wotten Waven communities in July 2017. It will be disclosed again to these communities at least six months before the start of construction. *Jobs / Employment* • DGDC, the EPC Contractor and all Subcontractors will ensure a transparent hiring process is conducted to help the community to understand strategic staffing decisions for the Project. • DGDC will establish a local employment brokerage that will publicise job vacancies and put in place initiatives to ensure employment opportunities for hard to reach groups. • DGDC will make efforts to facilitate the growth and development of new entrepreneurs, both individuals and groups originating from affected communities. • DGDC will provide opportunities for women and women's groups to participate in the work force to the extent safe and practical, and assist them in having good quality work standards so they can train others and are able to work with other companies in the future. • DGDC will define targets for women employment (at all levels and skills). It will be disclosed that recruitment is also open to women in the local communities. Specific recruitment strategies targeting women will be defined. *Skills and Training* • DGDC will develop a Workforce Development Strategy – a commitment to maximize employment and skills opportunities for local people which the EPC Contractor will follow. *Community Development* • DGDC will develop a Community Development Fund to undertake a range of community development initiatives.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		• DGDC will develop Corporate Social Responsibility (CSR) programmes implemented in partnership with local governments to create business opportunities for the local workforce that is no longer involved in the construction of the Project. CSR programmes will also seek to improve levels of education and skills for people affected by the Project. *Health and Social Initiatives* • To prevent social tensions between the workforce and the local population, the EPC Contractor will develop a Worker's Code of Conduct, which will be checked and verified by DGDC. The Worker's Code of Conduct will address issues such as anti-social behaviour, drug and alcohol consumption, banning weapons, and including respect for women. • The EPC Contractor will provide free and anonymous health surveillance and active screening and treatment of workers including sexually transmitted diseases. Onsite health care shall be provided to ensure prompt medical attention. • The EPC Contractor will prevent illness among workers in local communities by undertaking health awareness and education amongst the workforce and in the neighbouring communities. An important aspect of minimising the spread of communicable diseases within the community is worker health screening, particularly as many workers are anticipated to be sourced from outside of Dominica. A worker health screening programme shall be developed and implemented during the peak construction period. • The EPC Contractor will prepare and implement a Sexually Transmitted Disease (STD) Management Plan. DGDC will be responsible for checking and reviewing the document. • DGDC and the EPC Contractor will collaborate with local authorities to enhance access to public health services and promote immunisation. • DGDC will define vector-borne diseases prevention measures (such as avoidance of stagnant water, measures to avoid mosquito development) which the EPC Contractor will implement. • The EPC Contractor will provide adequate and sufficient sanitation facilities for both female and male workers. *Access and Security* • The EPC Contractor will control access to all construction sites with no unauthorised access from local communities permitted. • The EPC Contractor will train the security guards on human rights issues. The security guards will not be armed. They will coordinate with local government security forces in case of need and will ensure that security and human rights of local communities' members are respected. • For the reinjection line, access restriction and safety measures of the general public will be defined implemented along the Right of Way (RoW) during pipeline construction.
Soils, Geology and Groundwater	All Project construction works - soil erosion	• The EPC Contractor will develop an Erosion and Sediment Control Procedure and Hazardous Substances Management Procedure that they and all Subcontractors will implement during all Project construction works. DGDC will be responsible for checking and reviewing the documents. • The EPC Contractor and Subcontractors will ensure that they undertake the following mitigation activities:

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		- Excavated earth should be strongly compacted and cut-off ditches should be dug in erosion prone areas to divert water away for the earthworks and to settling ponds before discharge to nearby water courses. - Along the reinjection pipeline route catchment areas will be kept to small sizes with their own temporary drains and specific treatment devices. - Silt curtains, fibrous mats etc. will be placed across as temporary stormwater drains to reduce the efflux velocity of the water and to aid settling of suspended sediment from the water.
	All Project construction works - soil and groundwater pollution	The EPC Contractor and Subcontractors will ensure that they undertake the following mitigation activities: • Spill kits should be located on the construction site to manage and contain any fuel or hazardous substance spillage. If an accident does occur, then contaminated soil should be excavated and replaced with clean fill to minimise (or prevent) groundwater contamination with treatment of any stormwater runoff or process water prior to disposal. • All wastewater should be collected prior to discharge. • Oily and/or hazardous waste will be separately collected and disposed of by an appropriately licensed operator. • All vehicle maintenance should be done in garages. • The laying of overland flow diversion drains and preload fill should be completed preferable during the dry season and prior to the power plant construction earthworks commencing. • Drainage water collection and treatment systems should be installed as a priority to prevent discharge to the adjacent rivers and streams.
	All Project construction works - excavated material	The EPC Contractor and Subcontractors will ensure that they undertake the following mitigation activities: • Excavated topsoil will be transported to, and stockpiled in, designated topsoil storage areas. • Prior to filling, sub-grade surfaces of depressions will be free of standing water and unsatisfactory soil materials will be removed. • All unnecessary excavated materials will be transported and deposited outside of the site at an approved facility. • Where excavated material is suitable to be used for fill and backfill, the material will be segregated and transported to a stockpile location at the construction site.
Terrestrial Ecology	All Project construction works	The EPC Contractor and Subcontractors will ensure that they undertake the following mitigation activities: • Implement dust-suppression measures such as covering vehicles transporting materials, ensuring vehicles use wheel wash facilities at site, and use of water spray dust suppression systems. • Highly noisy activities will be undertaken during daylight hours where possible. • Inductions/tool-box talks for staff will include reference to measures required to protect biodiversity. • Appropriate provision will for be made for waste disposal.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		• Vegetation clearance activities should commence outside the breeding season for five key threatened species identified, to minimise impacts on breeding animals. The breeding seasons of the three bird species are overlapping, between January and August[1]. The amphibian species are thought to breed year-round, but primarily between May and July. • Habitat cleared will be the minimum possible, with any way-leave area required of the minimum width necessary. • Use temporary fencing to prevent inadvertent damage outside designated construction areas. • Avoid piling of clear-felled vegetation on standing live vegetation which would hinder movement of wildlife. • Any replanting / landscaping will use native or endemic species to prevent the incursion of opportunistic invasive species. • Machinery and vehicles should be cleaned upon entry/exit, and any soil brought on or off site screened for invasive species or plant pathogens. • Minimise potential for sedimentation impacts by ensuring good construction site practices are implemented. • Appropriate disposal of solid and liquid wastes, in line with recommendations in international and national standards, and using designated facilities as required. • Any effluent discharged to surface watercourses must meet the more stringent of international water quality discharge standards prior to release to remove pollutants. • Minimise potential for pollutants and surface water run-off to migrate off-site by ensuring standard good construction site practices are implemented. • Ensure all standard safe storage measures for n-pentane are implemented, as detailed in ESIA Volume 2: EIA, Chapter 15. • The 6-7m of the construction corridor of the reinjection line that is not required permanently will be replanted with native species as soon as possible after construction. • A Habitat Management Plan (HMP) will be developed that sets out the establishment and maintenance required for a biodiversity offset, to be created with minimum extent 1.7 ha (equivalent to the Natural habitat lost under the Project Area). This will be developed with input from local specialists and stakeholders as appropriate and will incorporate measures identified in *Post-Hurricane Maria Specific Actions* below, as appropriate. • It is expected that the pipeline will be designed such that smaller animals can pass under it. In addition, the pipeline will have under/overpasses installed at intervals along its length to minimise fragmentation effects and allow passage of animals across the corridor.
	All Project construction works - Post-Hurricane Maria Specific Actions	DGDC will develop a Habitat Management Procedure (HMP) that will be adhered to be the EPC Contractor and all Subcontractors during all Project construction works. The HMP will aim to provide enhancement measures for post-Maria terrestrial biodiversity of the area: • Stabilise bare slopes or improve resilience on slopes where trees have fallen – promote tree and shrub planting to stabilise lose soil and rock, prevent further erosion and slips. This could also include supporting local nurseries to grow more trees which in turn could be used by local communities.

[1] http://www.iucnredlist.org/ (Accessed September 2017)

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		• Areas of fallen trees surrounding well pads and other infrastructure – plant native tree species to stabilise ground conditions, improve ecological resilience and reduce rainwater run-off which in turn could pollute water courses and cause soil erosion. • Restore river courses – remove bulky items where possible such as fallen trees, logs and other detritus and large rocks which could block river flow and cause flooding; destabilise slopes or cause soil erosion to surrounding terrestrial areas. • Removal of habitat cover – provide hibernacula of log piles, stone/rock piles for amphibians and other animals which might have been lost along with tree canopy cover. • Exposed ground - plant native grass seed with fertilizer where exposed ground is still visible or where slopes are too steep or where soil has been washed away.
Morne Trois Piton National Park World Heritage Site	All Project construction works	Alongside the HMP described above, the EPC Contractor and Subcontractors will ensure that they undertake the following mitigation activities: • Implement dust-suppression measures such as covering vehicles transporting materials, ensuring vehicles use wheel wash facilities at site, and use of water spray dust suppression systems. • Highly noisy activities will be undertaken during daylight hours where possible. • Inductions/tool-box talks for staff will include reference to measures required to protect biodiversity. • Proposals for the MTPNP buffer zone should be progressed, and this area maintained as a development-free zone. Activities that would facilitate access to the MTPNP should not be encouraged. • Any replanting / landscaping will use native or endemic species to prevent the incursion of opportunistic invasive species. • Machinery and vehicles should be cleaned upon entry/exit, and any soil brought on or off site screened for invasive species or plant pathogens. • Minimise potential for sedimentation impacts by ensuring good construction site practices are implemented. • Appropriate disposal of solid and liquid wastes, in line with recommendations in international and national standards, and using designated facilities as required. • Vegetation clearance activities will commence outside the breeding season for five key threatened species identified, to minimise impacts on breeding animals. The breeding seasons of the three bird species are overlapping, between January and August[2]. The amphibian species are thought to breed year-round, but primarily between May and July[3]. • Habitat cleared will be the minimum possible, with any way-leave area required of the minimum width necessary. • Use temporary fencing to prevent inadvertent damage outside designated construction areas.

[2] http://www.iucnredlist.org/ (Accessed September 2017)
[3] http://www.amphibianark.org/pdf/Husbandry/Leptodactylus%20fallax%20-%20Management%20Guidelines.pdf (Accessed September 2017)

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		• Avoid piling of clear-felled vegetation on standing live vegetation which would hinder movement of wildlife. • Minimise potential for sedimentation impacts by ensuring good construction site practices are implemented. • Appropriate disposal of solid and liquid wastes, in line with recommendations in international and national standards, and using designated facilities as required. • Minimise potential for pollutants and surface water run-off to migrate off-site by ensuring standard good construction site practices are implemented. • Detailed measures to minimise the likelihood and magnitude of a BLEVE occurring is provided in ESIA Volume 2: EIA, Chapter 15, including: - Induction and training; - Standard Operating Procedures; - routine inspections; - good record keeping; and - suitable firefighting equipment.
Traffic Management and Access	All Project construction works	The EPC Contractor will develop a Traffic Management Procedure (TMP) that they and all Subcontractors will implement during all Project construction works. DGDC will be responsible for checking and reviewing the documents. The TMP will: • Identify routes within the site and from Roseau and the port to the site; • Identify weight/height restrictions and alternative routes; • Develop a signing strategy for the routes; • Ensure controls to mitigate for any obstruction to walkers using the Waitukubi National Trail route: and • Formulate mechanisms for vehicle control. The EPC Contractor and Subcontractors will ensure that they undertake the following mitigation activities: • All routes must be clearly signed from the main highway, and through to the catchment areas. The signing strategy must allow unique identification of each route, along with speed and other restrictions. All drivers should have access to a schedule of the routes and a delivery control mechanism put in place to ensure all goods and material deliveries are clearly routed. • The strategy may also include further restrictions such as a restriction upon the time during which vehicles may operate and the use of hazard warnings. • Signs must clearly indicate that they relate to vehicles serving the power plant construction so that they are not misunderstood by other road users. • Work at night should be avoided for safety reasons.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		• The EPC Contractor will provide safe access for pedestrians and cyclists throughout the duration of construction phase of the Project. • Consideration will be given to the speed at which the vehicles are advised to travel on the public road network and especially in rural areas. • A vehicle awareness program could be conducted with the villagers most likely to be impacted, which will warn them of increased vehicle movements and the hazards posed due to the Project. • Construction traffic drivers will be asked to reduce speeds in built up areas and ensure that braking distances are acceptable. • Operators of the vehicles should regularly maintain vehicles to reduce excessive emissions. • Drivers of all vehicles leaving the site should wash their wheels at the facility before entering the main road (refer to Air Quality mitigation strategies above) • Other procedures to prevent the deposition of slurry, clay or other materials on roads by vehicles leaving the site will include: - use of asphalt millings to surface the internal site haul road; - provision of cleaning facilities including hoses, brooms and shovels; - twice daily monitoring, and education of all construction staff/drivers to monitor for any material which may be accidently spilt onto public roads from construction traffic; and - maintaining a contingency of sweeper equipment on call at all times to clean up material which may be accidently spilt onto public roads. • Adherence to the TMP will be included within site induction and weekly toolbox meetings as required to ensure all site staff are aware and practice the required clean roads protocols. The TMP should outline methods for controlling noise and vibration associated with construction traffic. • It is recommended that a Travel Plan is written and distributed to staff to inform them of the best ways to travel to the sites of the Project. Staff should be encouraged to take public transport, car pool or that the contractor provides transport for them.
Working Conditions, Occupational Health and Safety	All Project construction works	• DGDC will be required to develop an Occupational Health Safety (OHS) Plans for the construction activities at the Project site, which will apply to all personnel involved in the Project, including EPC Contractors, Subcontractors and part-time workers. The primary health and safety objectives will be to ensure effective measures and management of occupational health and safety to minimise workplace accidents and injuries. The health and safety procedures within the OHS Plans will comprise a comprehensive Health and Safety Management System HSMS. They will meet the requirements specified in the WBG EHS Environmental, Health and Safety Guidelines pertaining to occupational safety and health. In addition, any Subcontractors appointed by the EPC Contractors will be required to submit their own OHS Plans/Health and Safety Management System. Further details for the requirements of OHS Plans are presented in ESIA Volume 5: Technical Appendices, Technical Report – OHS and Working Conditions. • The EPC Contractor will develop an Occupational Health Safety Management System which covers their staff and sets out the safety performance standards which the EPC Contractor and its subcontractors will meet. The EPC Contractor will actively monitor and audit the safety performance of its subcontractors.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures

		• As well as the main OHS Plans, specific Safety Management System procedures shall be developed for each element of the Project, including the following:
		  - safety management organisation / reporting chain;
		  - construction methodology;
		  - hazard / risk assessment and proposed mitigation measures; and
		  - safety checklists.
		• The Safety Management System will have a procedure for identifying all hazards associated with the activity in question. A hazard in this context is defined as any aspect of the Project activities which could result in harm to onsite personnel.
		• The EPC Contractors and Subcontractors will be made aware of their role in ensuring the Project meets international standards related to labour and working conditions, and will be contractually obliged to do so. The EPC Contractor will establish a hierarchy of responsibility with regards for the provision of health and safety.
		• DGDC and the EPC Contractors will establish a hierarchy of responsibility with regards for the provision of health and safety. The precise titles and roles of each member will be determined by DGDC and the EPC Contractors prior to work on the site.
		• A DGDC and the EPC Contractor Health and Safety Management Committee will be appointed to evaluate health and safety at the site and to assess and recommend changes to equipment, policy and/or procedures where required by health and safety issues.
		• Staff will be trained in safety procedures and provided with Personal Protective Equipment (PPE). Working conditions and occupational safety and health procedures framework has been outlined in ESIA Volume 5: Appendices, Technical Report – Working Conditions and Occupational Health.
		• The EPC Contractors will issue all Project staff with an individual contract of employment detailing their rights and conditions in accordance with the national law and WBG requirements related to hours of work, wages, overtime, compensation and benefits such as maternity or annual leave, and update the contract when material changes occur.
		• Generic rules shall be provided within employment contracts and task specific procedures will be communicated during tool box talks and displayed on machinery or within hazardous work areas.
		• All hazardous work shall require the completion of a permit-to-work form and approval by the OHS Manager prior to commencement.
		• A security procedure shall be included within the OHS Plan covering areas of security control, working hours etc.
		• Emergency Response Procedures will form an integral part of the OHS Plans/HSMS. As part of these, an Emergency Response Plan shall be prepared to address emergencies of all scales. Further details of the outline of an Emergency Response Plan are located in ESIA Volume 5: Technical Appendices, Technical Report - Occupational Health and Safety and Working Conditions.
		• A worker's grievance mechanism will be established. In compliance with World Bank Group Standards, this grievance mechanism will be designed to receive and facilitate resolution of concerns and grievances about the Project's working conditions and safety performance.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
	Worker's Accommodation Camp	• The Worker's Accommodation Camp on site will be kept clean, tidy and pest-free. • The EPC Contractor will ensure that standards are kept in accordance with the guidance document 'Workers' accommodation: processes and standards' (IFC and EBRD, 2009). • Provide a cultural education programme for workers from outside the area to help reduce community conflict. • Work camp regulations shall be developed to minimise local nuisance. •
Water Quality and Freshwater Ecology	Power Plant - earthworks during construction	The EPC Contractor will develop an Erosion and Sediment Control Procedure (ESCP) that they and all Subcontractors will implement during all Project construction works. DGDC will be responsible for checking and reviewing the documents. The ESCP will aim to manage and mitigate suspended solid discharges to the Roseau River to an acceptable level. This will be managed in accordance with the EHS general Guidelines. The ESCP will include the following mitigation: • Clean water diversions – An overland flow path crosses the proposed power plant location. This should be diverted around the site area first to minimise clean water ingress to bare earth areas. • Access road sealing – the access road should be gravelled or sealed as a first stage in construction to minimise erosion. • Staging – the works should progress in stages where possible to minimise the amount of bare earth. This is likely to include clearing the laydown area first, then providing erosion and sediment control to it before then moving onto the power plant area. • Reducing catchment sizes – work areas should be created that involve small sub catchments in which flows can be reduced, channelized concentration or water minimised to reduce erosion. • Installation of temporary stormwater drains through each of the catchment areas to collect and direct stormwater to sedimentation ponds. • Erosion protection – when flows have been concentrated into channelized flows these should be within protected channels. These could be either temporary protection using geotextiles or more permanent hard protection. • Sediment retention - Silt fences should be used around all the downstream site earthwork boundaries and within the site around each subcatchment. These will work to slow water flow and retain sediments. Silt fences should also be provided on the downstream side of the access road where earthworks are proposed. • Sediment settlement – prior to discharge, all collected stormwater shall be directed by temporary drains through sedimentation ponds. • To minimise any potential adverse environmental effects from flooding or erosion (inclusive of land or watercourses) from the stormwater discharge from the operation of the steamfield and plant.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
	Power Plant – Worker's Camp	A package plant will be used by the EPC Contractor that will treat sewage and wastewater during the construction phase.
	Reinjection pipeline construction activities - earthworks during construction	The ESCP recommendations for the power plant location will also apply with the following additional mitigation to manage specific risk activities for the reinjection pipeline: • Staging – The works should progress in stages where possible to minimise the amount of bare earth. This is likely to include clearing the route in sections with installation of settlement retention features for each section before pipeline construction in that section. The next sections should not be cleared till works are ready to progress. • Clean water diversions – overland flow paths going through work areas should be directed directly through the pipeline corridor and not allowed to travel down the cleared pipeline route to minimise erosion. • Sediment retention - Silt fences should be used around all the downstream pipeline route boundaries. These will work to slow water flow and retain sediments. Silt fences should also be provided on the downstream side of the access road where earthworks are proposed. • Temporary stream crossings – where streams will be regularly crossed temporary protection should be installed (culverts) to minimise direct disturbance and sediment generation. These should be removed after works are complete.
	Reinjection pipeline construction activities - discharge of sewage and site amenity wastewater	• Portable toilets will be installed and used by workers to prevent contamination of waterways.

2.4 Operational Mitigation

Table 2.2 : Summary of proposed mitigation during operation

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
Air quality	All power plant operation activities related to emissions and dust control	The O&M Contractor will ensure the following: • Routine maintenance checks will be undertaken on wellheads and blowout prevention equipment to check it is in operable condition. • If a wet cooling tower system is to be used for the Project, drift eliminators will be incorporated into the final design to minimise particulate emissions. • Impacts from the operational station will be dependent on the geothermal fluid chemistry and the plant design. Given the predicted level of effects is predicted to be at an acceptable level, additional measures such as total or partial re-injection of gases with geothermal fluids; and abatement systems to remove hydrogen sulphide emissions from NCGs (e.g. wet/dry scrubbers), are not required.
Cultural Heritage	All Project operation activities	The O&M Contractor will ensure the following: • The mitigation measures employed during operation will be the same as those described above for construction (Table 2.1), namely the implementation of the Chance Find Procedure if an asset of cultural heritage value is discovered as part of the operational activities of the power plant or transmission line • The Worker's Code of Conduct used during operation will also include a section on the importance of cultural heritage preservation and understanding.
Environmental and Social Management Systems (ESMS)	All Project operation activities	• The O&M Contractor will operate the power plant and will be responsible for recordkeeping and reporting, maintenance inspections, execution of routine maintenance, periodical maintenance and major overhaul in accordance with the Project ESMS, and emergency stop of operation and incident reporting. The O&M Contractor will prepare separate operation management plans and procedures that align with the Project ESMS. The O&M Contractor will also develop an overall organisational structure for environmental responsibilities on site. DGDC will have responsibility for reviewing and auditing the O&M Contractor's documents. • The O&M Contractor, in collaboration with DGDC, will establish, maintain, and strengthen as necessary an organisational structure that defines roles, responsibilities and authority to implement the ESMS and ESMP. Specific personnel with clear lines of responsibility and authority are designated in this section. Key ESMS responsibilities are defined and will be communicated to the relevant personnel and to the rest of the O&M Contractor workforce as well as DGDC and any Subcontractors. Sufficient management sponsorship and human and financial resources will be provided on an ongoing basis to achieve effective and continuous ESMS performance. • Reporting of mitigation activities will be issued by DGDC to the Lenders every 6 months in the Biannual Environmental and Social Report.
Geothermal Resource	All Project operation works	The O&M Contractor will ensure that the Reservoir Management Procedure will be implemented during operation that considers all possible change that may occur to the deep reservoir and the surface thermal activity.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
Hydrology	Power plant operation activities	The O&M Contractor will ensure the following: • Power plant site and laydown area will have a stormwater system designed to capture and treat any runoff. • The power plant's stormwater system will drain through a sump or settling pond. This would capture any runoff from the pad and settle out rubbish and sediment, while reducing flow velocities. • Diversion drains will be installed around the site, the capacity of these drains needs to convey adequate flood events to reduce the likelihood of this occurring. • Sourcing a water supply for firefighting will be infrequent, however would require >500 m^3 stored in a tank.
Hazardous Substances and Waste	All Project operation activities	The O&M Contractor will ensure the following: • Heat and pentane sensors will be fitted around the storage tank and the plant to detect any leaks and heat changes. • A deluge fire extinguishment system is suppled which when activated will quickly extinguish any fire.
Natural Hazards	All Project activities – subsidence	The O&M Contractor will ensure a Subsidence Management Plan will be prepared and implemented.
Noise and Vibration	Power plant operation activities	The O&M Contractor will ensure the following: • Commissioning testing should be conducted during daytime periods only. • Erect temporary localised screening during commissioning testing. Potential noise impact reduction of up to 6 dB(A) is achievable where acoustic screens are located within 5 m of the construction works, be at least 300 mm above the height of the noise source and provide a solid façade impeding line of sight to nearest receivers – any gaps negate noise reduction performance. • Notify local residents and landowners prior to any commissioning testing.
Landscape and Visual	All Project operation works	During operation it is proposed that the power plant site will be landscaped in order to improve visual amenity. Additionally, this will aid in limiting soil erosion at the site during heavy rainfall events. The soil removed during earthworks for construction will be reinstated and used as topsoil for the proposed landscaping. Plants used for landscaping will be nursery grown and will be healthy and free from insect infestations. Trees and shrubs will be chosen in keeping with prevailing weather conditions and other such site characteristics. Maintenance operations will begin immediately after planting by mulching, watering, pruning, spraying, weeding and other necessary operations of maintenance. Planting beds will be kept free of weed, grass and other undesired vegetation growth. It is anticipated that vegetation will grow up around the power plant site quickly, given the climate and high rainfall in the valley. See Section 13 – Terrestrial Ecology and ESIA Volume 5: Appendices – Terrestrial Ecology Impact Assessment, for more recommendation regarding planting regimes and the use of a Habitat Management Plan. The following recommendations are proposed for consideration for the buildings and power plant site: • Any planted beds will be kept free of weeds and other undesired vegetation growth, as per the measures proposed in the Pest and Weed Management Plan.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
		• Site fencing has the potential to aid in mitigating adverse visual effects of the power plant by partially screening and softening the visual impact of the site and ensuring light spill from the site is minimised. • Any lighting requirements should be designed to ensure light spill is directed into the construction and operation site. • Where possible the selection of neutral/muted cladding and external finishing's would aid in limiting the extent of adverse visual impacts. • Installation of drift elimination, if wet cooling towers options is selected to reduce particulate emissions and plume visibility. The reinjection pipeline should be coloured so that it is conspicuous with the surrounding environment. An overall recommendation is to make the public aware that potentially affected parties can use the public grievance mechanism. This will be monitored in accordance with the measures set out in ESIA Volume 3: Social Impact Assessment.
Social / Economic	All Project operation works	The mitigation for social and economic issues will be the same as that stated above during the construction phase, under the management of the O&M Contractor.
Soils, Geology and Groundwater	Power plant operation activities	The mitigation for soils, geology and groundwater issues will be the same as that stated above during the construction phase, under the management of the O&M Contractor.
Terrestrial Ecology	All operation activities	The O&M Contractor will ensure the following: • Appropriate disposal of solid and liquid wastes, in line with recommendations in international and national standards, and using designated facilities as required. • Any effluent discharged to surface watercourses must meet the more stringent of international water quality discharge standards prior to release to remove pollutants. • Machinery and vehicles should be cleaned upon entry/exit, and any soil brought on or off site screened for invasive species or plant pathogens. • Ensure all standard safe storage measures for n-pentane are implemented, as detailed in ESIA Volume 2: EIA, Chapter 15.
	All Project operation works - Post-Hurricane Maria Specific Actions	DGDC will implement a Habitat Management Procedure for the Project that will aim to provide enhancement measures for post-Maria terrestrial biodiversity. The Habitat Management Procedure will be the same as that set out above in Table 2.1. The O&M Contractor will assist in the facilitation of this Habitat Management Procedure.
MTPNP World Heritage Site	All operation activities	Mitigation measures are the same as those outlined above during construction, with the exception of the following (the O&M Contractor will be responsible for this): • Standard safe storage for n-pentane includes storage under a nitrogen blanket; incorporation of a Pressure Relief Valve; appropriate bunding; and a deluge fire extinguishment system. Heat and pentane sensors are also fitted around the storage tank and the plant to detect any leaks and heat changes.

Issue	Location of Mitigation Measures	Proposed Mitigation Measures
Traffic Management	Power plant operation activities	• The O&M Contractor will implement a Traffic Management Plan will be distributed to staff to inform them of the best ways to travel to the sites of the Project. Staff should be encouraged to take public transport, car pool or that the contractor provides transport for them.
Working Conditions, Occupations and Safety	All operation activities	• The O&M Contractor will be required to develop an Occupational Health and Safety (OHS) Plans for the operation and maintenance of the Project, which will apply to all personnel involved in the Project, including subcontractors and part-time workers. The primary health and safety objectives will be to ensure effective measures and management of occupational health and safety to minimise workplace accidents and injuries. The health and safety procedures within the OSH Plans will comprise a comprehensive Health and Safety Management System. They will meet the requirements specified in the WBG Environmental, Health and Safety Guidelines pertaining to occupational safety and health. DGDC will be responsible for auditing and reviewing the document. Further details for the requirements of OHS Plans are presented in ESIA Volume 5: Technical Appendices, Technical Report – OHS and Working Conditions. • As well as the main OHS Plans, specific Safety Management Systems shall be developed for each element of the Project, including the following: - safety management organisation / reporting chain; - construction methodology; - hazard / risk assessment and proposed mitigation measures; and - safety checklists. • Each Safety Management System will have a procedure for identifying all hazards associated with the activity in question. A hazard in this context is defined as any aspect of the Project activities which could result in harm to onsite personnel. • The O&M Contractor will establish a hierarchy of responsibility with regards for the provision of health and safety. • Health and Safety Management Committee will be appointed by the O&M Contractor to evaluate health and safety at the site and to assess and recommend changes to equipment, policy and/or procedures where required by health and safety issues. • O&M Contractor staff will be trained in safety procedures and provided with Personal Protective Equipment. Working conditions and occupational safety and health procedures framework has been outlined in the ESIA Volume 5: Appendices, Technical Report - Working Conditions, Occupational Safety and Health. • The O&M Contractor's Worker's Grievance Mechanism and Worker's Code of Conduct will continue to run throughout operational period.
Water Quality and Aquatic Ecology	Power plant operation activities – discharge of treated wastewater	• During operation wastewater will be treated initially in a package plant. The package plant would be to a sand filter or similar medium that allows the treated effluent to infiltrate to ground below the soil surface and receive further treatment. This infiltration system should be located close to the edge of the power plant area to maximise distances to watercourses. • The power plant's stormwater system should ideally drain through a sump or settling pond. This would capture any runoff from the pad and settle out rubbish and sediment, while reducing flow velocities. Areas of the plant that are at risk of having contaminant discharges (such as oil leaks from vehicles or fluid spills) should be isolated, with their flows first draining through an oil water separator. The outflows from this separator could then drain to the sump/settling pond for further treatment.

2.4.1 Monitoring

A recommended monitoring program is set out in the ESMP which is designed to conduct sufficient monitoring in order to demonstrate compliance with GoCD regulatory discharge limits and ambient standards and the applicable WBG EHS Guidelines standards specified for the receiving environments (air, water, soil, etc.) and to assess the performance of containment and treatment systems at the power plant during construction and operation and for the construction of the reinjection line.

The Monitoring Procedures will set out the location of the sampling points, sampling methodology to be used (grab samples, automated etc.), number of samples to be collected each round, frequency of sampling, sample handling and preservation, parameters to be analysed for and analytical methods, and reporting requirements. This monitoring will include, but will not be limited to:

- Wastewater effluent-quality monitoring to ensure that effluent continues to meet the relevant WBG EHS Guidelines;
- Regular monitoring of water quality of stormwater discharged into the environment from the stormwater sumps, during all seasons;
- Biodiversity monitoring along reinjection route, wellpads and power plant;
- Slope stability and subsidence monitoring;
- Monitoring of geothermal features linked to the reservoir supplying the power plant;
- Noise and ambient air quality; and
- Social surveys and changes monitoring.

This environmental monitoring for the construction and operation phases is set out in Table 2.3 and Table 2.4. It should also be noted that it is anticipated that construction monitoring measures will also be implemented by DOMLEC during the construction and upgrading of Associated Infrastructure (see ESIA Volume 2: EIA, Section 18).

2.5 Construction Monitoring

Table 2.3 : Monitoring activities during construction

Issue	Location of Monitoring	Proposed Monitoring Measures
General	All construction works	• Independent third-party auditing of the implementation of the ESMP will be undertaken at regular intervals. The budget for this auditing and its frequency will be specified in the ESMP and verified by the relevant regulators.
Air quality	All construction works	• To determine the effectiveness of dust mitigation measures used during construction, the EPC Contractor will ensure that ambient air monitoring is undertaken on the site boundary. DGDC will monitor the performance of the EPC Contractor. Sampling should be conducted for: - Visual dust inspection of the site on a daily basis during the dry season to gauge the effectiveness of dust mitigation measures will occur at least 400m from construction works. - The monitoring provides a means of ensuring control systems such as dust suppression sprays are operating correctly and should be undertaken by a qualified laboratory using appropriate sampling equipment. Visual inspections of cleaning truck tyres and road watering activities will also be monitored and recorded. The results will be reported on a monthly basis and included in publicly available reports. • As part of good working practice the EPC Contractor will complete routine checks on dust generation from construction activities, and confirm that dust suppression and appropriate storage is being used where required. In addition, a mechanism for complaints regarding dust will be available to locals, and due regard given to any issues raised. • Safety monitoring systems with warning alarms for high emissions of potentially hazardous gases, including H_2S, incorporated at the well sites (e.g. the power plant and reinjection sites), as well as providing direct safety measures in the event of a blowout, will highlight potential H2S emissions issues which could arise during well commissioning and operation. All personnel and local residents will be made aware of the procedure should an alarm be activated.
Cultural Heritage	All construction works	No monitoring measures are proposed during construction, with the exception of the EPC Contractor ensuring implementation of the Chance Find Procedure.
Environmental and Social Management System (ESMS)	All construction works	• The ESMS will set out DGDC's policies and procedures for managing, mitigating and monitoring environmental and social impacts. Monitoring will be carried out in order to determine whether environmental and social outcomes are being achieved. Monitoring requirements will be specified in a monitoring plan (or plans), which identify: - The type of monitoring that is to be carried out including monitoring the performance of the EPC Contractor; - Where monitoring is to take place; - How frequently monitoring will be carried out; - The parameters that will be tested for; - The applicable objectives and performance standards; and - Staff responsible for conducting the monitoring.

Issue	Location of Monitoring	Proposed Monitoring Measures
		• DGDC will undertake reviews of the ESMS will be conducted throughout construction and operation of the Project and where necessary changes should be made to the documentation to ensure that it remains relevant. For instance, once construction has been completed, the construction related environmental and social aspects will no longer be relevant. • DGDC will be responsible for overall monitoring and reporting every six months to relevant authorities regarding the findings of the reports. • Reporting of monitoring activities will be issued by DGDC to the Lenders every 6 months in the Biannual Environmental and Social Report.
Hazardous Substances and Waste	All construction works	The EPC Contractor will ensure that: • The amount and destination of the wastes will be recorded and monitored. • A record of all spillages will be maintained. • All bund enclosures will be regularly inspected for water and sheens prior to the collected water being discharged. • Regular inspection of storage facilities to check for leaks, spills and inappropriate storage practices. • As part of the Waste Management Procedure a monitoring plan will be developed to inspect waste collection skips, to check wastes are being separated correctly and hazardous wastes are not being included with non-hazardous. The inspection should also include a check of the waste skips and bins condition to be sure waste is being held securely and not able to impact the environment through leakage or being blown away. • Regular inspections to check that wastes are being separated and deposited in the correct bins for recycling and disposal. DGDC will monitor the performance of the EPC Contractor.
Hydrology	All construction works	The EPC Contractor will ensure that visual monitoring is undertaken at stream banks and the construction of diversion channels to identify any areas that may be performing inadequately (resulting in bank collapses, localised erosion hot spots and scouring). DGDC will monitor the performance of the EPC Contractor. Prior and during construction it is recommended that monitoring of the flow rates be conducted at the small stream used for abstraction of water.
Geothermal Resource	Key geothermal sites	A Reservoir Monitoring Procedure (RMP) will be developed by DGDC and monitoring undertaken by DGDC staff. The RMP will consider all possible changes that may occur to the deep reservoir and the surface thermal activity. DGDC will ensure that a baseline monitoring programme is undertaken at selected natural geothermal features before the power plant is commissioned, to establish the natural seasonal variability of surface spring activity including flowrate, temperature and fluid chemistry. Springs can change over time so the baseline data is needed for objective assessment, post commissioning.
Natural Hazards	All construction works – risk of landslide	• The EPC Contractor will undertake monitoring during construction for identified geo-hazards of moderate or high landslide risk that have not been avoided.
Noise and Vibration	All construction works	• The EPC Contractor will undertake noise monitoring to confirm the actual construction noise levels at representative sensitive receiver locations should be undertaken, for example, adjacent to the power plant site). This monitoring should be carried out at the start of the construction of the Project and on a quarterly basis. DGDC will monitor the performance of the EPC Contractor.

Issue	Location of Monitoring	Proposed Monitoring Measures
		• Direct observation of machine maintenance should also be made to ensure that any noise-creating faults are repaired. Direct observation of machine maintenance should be made to ensure that any noise-creating faults are repaired.
Water Quality and Aquatic Ecology	All construction works	The EPC Contractor will ensure the following: • Inspection and maintenance – the ESCP shall specify who is responsible for inspecting all physical elements of the erosion and sediment control measures. These shall be inspected daily to ensure they are installed and working correctly. Any defects shall be rectified before earthworks occur in that area of the site. Accumulated sediment shall be removed from all features when it reaches 25% of the available space. Records of all inspection and maintenance shall be kept. • Visual inspection of the river - the ESCP shall specify who is responsible for inspecting the river upstream and downstream of the works on a daily basis. The inspection should identify whether any visible change in water clarity or turbidity occurs after the site discharges. If no discharge is occurring the inspection should identify if any sediment builds up is obvious within the channel downstream of the site. If visible changes are observed, then modification of site operations and/or site erosion and sediment control practises should be made to reduce the impact. Records of all inspection and response activities shall be kept. • The discharge from the sedimentation ponds should be monitored during rain events. At least once per month for total suspended solids for comparison with the discharge limit of 50 mg/l and to determine the effectiveness of the pond. • Monitoring of treated effluent from the Workers' Accommodation package sewage treatment plant on a monthly basis. • Prior and during construction it is recommended that water quality and ecological (i.e. aquatic invertebrates) monitoring will be conducted at the small stream used for abstraction of water. DGDC will monitor the performance of the EPC Contractor.
Social	All construction works	• DGDC will monitor the number of people being employed by the Project in: 1) the three key villages (Laudat, Trafalgar and Wotten Waven) and 2) the wider Roseau Valley, against predicted numbers of employees. • DGDC will undertake surveys to determine the number of new businesses generated by the development and the level of indirect employment. • A DGDC Community Liaison Officer will be responsible for updating and monitoring the implementation of the RAP and Grievance Mechanism defined in the Stakeholder Engagement Plan. • DGDC will undertake ongoing consultation and communication with the local community will be required particularly with PAPs, vulnerable groups and key stakeholder groups. The minutes of meetings and signed lists of attendees will be completed and documented. • An independent third party review is recommended of the effective implementation of the RAP, one year after civil construction works commence at the power plant and reinjection line. • The following will be monitored through on-site visits by DGDC on a quarterly basis: - effectivity of the implementation of good practices as per World Bank HSE Guidelines; - existence of access control; - number of sanitation facilities available for men and for women at each construction site; and

Issue	Location of Monitoring	Proposed Monitoring Measures
		- effectivity of access restriction measures along the transmission line and its towers. • The DGDC Human Resources Department will monitor the following on a quarterly basis: - effectivity of the implementation of good practices as per World Bank HSE Guidelines. • The records are to be reported to DGDC and any applicable regulatory authorities who then can document and respond to this information as part of their responsibilities.
Soils and Groundwater	All construction works	• The EPC Contractor will undertake routine monitoring of any spring flows (cold water), both baseline and during development in order to determine any potential effects on the system. DGDC will monitor the performance of the EPC Contractor.
Terrestrial Ecology	All Project construction works - Post-Hurricane Maria Specific Actions	The Habitat Management Procedure (developed by DGDC) will provide baseline terrestrial biodiversity monitoring recommendations for the site. Although detrimental in general terms, the recent decimation of local habitats and ecosystems at least provides a clear baseline to develop a monitoring programme especially for forest recovery and the key animal groups that use it along with monitoring improvements of aquatic species in water courses. DGDC will be responsible for monitoring of the Habitat Management Procedure.
MTPNP World Heritage Site	All construction activities	• DGDC will develop a MTPNP monitoring programme will be implemented for the five key species considered Threatened by IUCN: giant ditch frog, imperial parrot, red-necked parrot, forest thrush, and a species of tree frog (*Eleutherodactylus amplinympha*), recommended to be at every six months from pre-construction until the completion of one year of construction, and annually thereafter for a minimum of five years of operation. The programme should also include the ongoing monitoring in the Laudat and Trafalgar area for any other potential impacts on the OUV of the WHS. • The MTPNP monitoring programme will be agreed with input from the MTPNP managing authorities (National Parks Unit of the Division of Forestry, Wildlife and National Parks), and implemented prior to construction where appropriate. The monitoring programme outlined will enhance understanding of the ecology of the MTPNP and surrounding areas, and ensure that if any adverse effects on OUV were to occur, these would be detected in a timely manner and properly mitigated.
Traffic Management	All construction works	The EPC Contractor will undertake monitoring of construction traffic and traffic management measures to ensure compliance with the traffic management requirements outlined within the TMP. Activities to be monitored include: • Construction traffic movements to ensure truck drivers use the designated routes; • Traffic incidents/complaints from the public or officials to ensure that unpredicted changes in travel time due to incidents such as, for example traffic accidents, emergencies, natural disasters can be managed by specially trained personnel; and • Public roads to ensure that the roads in the vicinity of the site are clean at all times of clay, slurry or materials from the site. DGDC will monitor the performance of the EPC Contractor.
Working Conditions, Occupations and Safety	All construction works	• The EPC Contractor will undertake a schedule of regular safety inspections and monitoring of exposure to hazards. This will include the state of the site as well as the maintenance of equipment and a comparison to internationally published exposure guidelines. • The EPC Contractor Site Manager shall instigate measures to correct non-conformance in safety performance found during safety checks and inspections. A record of the safety checks and inspections, and resulting actions, shall be provided to the Health and Safety Management Committee every month.

Issue	Location of Monitoring	Proposed Monitoring Measures
		• DGDC, as principals, undertake independent audits of the EPC Contractor and their Subcontractor's Health and Safety performance to ensure that the health and safety practices as set out in their health and safety plans are being complied with. The audits will also check that no unsafe practices are being carried out at site. If unsafe practices are identified during the audits, work at the site should cease. The audits should be carried out once every two months. • All staff at DGDC and the EPC Contractor should be notified of all incidents/accidents which result in first aid treatment during the soil improvement programme and the construction of the power plant. Minor incidents along with the incident/accident investigation report should be supplied to DGDC once a month. Serious accidents that are Lost Time Incidents, or result in serious harm or a fatality should be reported immediately to DGDC. • Notification of accidents and incidents at the site during soil improvement and construction provide another means of monitoring the Contractor's safety performance. DGDC will monitor the performance of the EPC Contractor.

2.6 Operational Monitoring

Table 2.4 : Monitoring activities during operation

Issue	Location of Monitoring	Proposed Monitoring Measures
Air quality	Power Plant operation activities	The O&M Contractor will ensure the following monitoring is undertaken during operation: • Ambient monitoring for H_2S can be easily undertaken at sensitive locations (e.g. nearby residential areas) using low-level ambient H_2S monitors such as Odalog, which can be deployed at multiple locations for up to two months at a time. • Safety monitoring systems with warning alarms for high emissions of potentially hazardous gases, including H_2S, incorporated at the well sites (e.g. the power plant and reinjection sites), as well as providing direct safety measures in the event of a blowout, will highlight potential H_2S emissions issues which could arise during well commissioning and operation. All personnel and local residents will be made aware of the procedure should an alarm be activated. • For the Organic Rankine Cycle option, there will be infrared heat detectors and pentane vapour monitors installed at the power plant site around the working fluid condenser/equipment and cooling tower, for early detection of any leaks of pentane or heat sources. • All heat and pentane sensors if an ORC plant is selected will be checked and calibrated on an annual basis or as per the manufacturer's specifications. DGDC will monitor the performance of the O&M Contractor.
Environmental and Social Management Systems (ESMS)	All Project operation activities	During operation, DGDC will monitor and audit the operational ESMS, as described above for construction activities. Reporting of monitoring activities will be issued by DGDC to the Lenders every 6 months in the Biannual Environmental and Social Report.
Geothermal Resource	Key geothermal sites	• The O&M Contractor will conduct regular a monitoring programme of selected natural geothermal features to determine any changes to that measured in the baseline monitoring outside seasonal variations. Springs can change over time so there is a need for objective assessment, post commissioning. • During operation reservoir change (pressure, temperature and chemistry) will be monitored by O&M Contractor for regular testing of production wells. • The Reservoir Management Plan will include a monitoring system (such as slimhole downhole pressure sensors) that will monitor reservoir pressure throughout operation, both at the production and reinjection wells. In the event of any significant changes in reductions in reservoir pressure, in the vicinity of WW-01 that may cause adverse change to thermal features, this will be mitigated in the first instance by adjusting the relative flows to WW-R1 and WW-01. DGDC will monitor the performance of the O&M Contractor.
Hydrology	Settling ponds	The O&M Contractor will monitor the effectiveness of the settling pond on sediment should be undertaken during construction and ongoing operations, with spot samples assessed for Total Suspended Solids (TSS) at the inlet and outlet locations. Imhoff settling cones offer a cheap and viable method for quick onsite estimates of TSS from the inlet and outlet.

Issue	Location of Monitoring	Proposed Monitoring Measures
Hazardous Substances and Waste	Power plant operation activities	• To ensure the processes and procedures are operating effectively, the O&M Contractor will conduct regular audits of hazardous substance storage and the operation of the Hazardous Substance Management Plan. Audits will involve reviewing storage procedures, ensuring staff are appropriately trained and supervised, ensuring materials are stored and used in accordance with good international industrial practice, and identifying and recommending any areas for continual improvement. • As part of the Waste Management Procedure a monitoring plan will be developed to inspect waste collection skips, to check wastes are being separated correctly and hazardous wastes are not being included with non-hazardous. The inspection should also include a check of the waste skips and bins condition to be sure waste is being held securely and not able to impact the environment through leakage or being blown away. • Regular inspections to check that wastes are being separated and deposited in the correct bins for recycling and disposal. DGDC will monitor the performance of the O&M Contractor.
Noise and Vibration	Power plant operation activities	• The O&M Contractor will measure noise levels on a quarterly basis at the power plant site and the nearest settlements for a duration of at least 48 hours. Results from this monitoring are to be used to assess compliance with Dominica guidelines (Environmental Standards for Protection against Noise (June 2003)) and the WBG EHS Guidelines and to be reported to the relevant authorities. Noise monitoring data should also be made available for public access. • Power plant workers will make direct observation of machine maintenance should also be made to ensure that any noise-creating faults are treated.
Water Quality and Aquatic Ecology	Power plant operation activities	The O&M Contractor will ensure the following: • Visual inspection of oil interceptors for visible oil and settling ponds. • Monitoring of the discharge from oil interceptors and settling ponds every three months (with comparison to WBG EHS Discharge Guidelines) • Monitoring of effluent discharged from the package plant every six months. DGDC will monitor the performance of the O&M Contractor.
Social	All Project operation activities	The O&M Contractor and DGDC will ensure that the number of people being employed by the Project will be recorded and monitored from: 1) the three key Villages (Laudat, Trafalgar and Wotten Waven) and 2) the wider Roseau Valley, against predicted numbers of employees. • Surveys should be conducted to determine the number of new businesses generated by the development and the level of indirect employment. • A DGDC Community Liaison Officer will be responsible for updating and monitoring the implementation of the RAP and Grievance Mechanism defined in the Stakeholder Engagement Plan. • Ongoing consultation and communication with the local community will be required particularly with PAPs, vulnerable groups and key stakeholder groups. The minutes of meetings and signed lists of attendees will be completed and documented. • During the first four years of operation, on a quarterly basis, DGDC's department responsible for CSR will record the number of inhabitants of the three villages affected by the power plant to have received training, and nature of training received, disaggregated by age, sex and village/block. • During the first four years of operation, on a quarterly basis, the number of regular and ad-hoc meetings with communities will be recorded, as well as the minutes of meetings and signed lists of attendees.

Issue	Location of Monitoring	Proposed Monitoring Measures
		• During the first four years of operation, the number of consultations with PAPs and number grievances received, treated and solved will be recorded through minutes of meetings and signed lists of attendees. • The Grievance database will be monitored with progress reported on a quarterly basis.
Soils and Groundwater	Power plant operation activities	The O&M Contractor will ensure routine monitoring of any spring flows (cold water) to be undertaken, both baseline and during development in order to determine any potential effects on the system. DGDC will monitor the performance of the O&M Contractor.
Terrestrial Ecology	All Project operation works - Post-Hurricane Maria Specific Actions	DGDC will develop a Habitat Management Procedure that will provide baseline terrestrial biodiversity monitoring recommendations for the site.
MTPNP World Heritage Site	All operation activities	• The monitoring programme during operation will be the same as that outlined above for construction. DGDC will be responsible for this monitoring programme.
Working Conditions, Occupational Health and Safety	All operation works activities	• The O&M Contractor OHS Plans and Health and Safety Management System will include a schedule of regular safety inspections and monitoring of exposure to hazards. This will include the state of the site as well as the maintenance of equipment and a comparison to internationally published exposure guidelines. Further details for the requirements of OHS Plans are presented in ESIA Volume 5: Technical Appendices, Technical Report – OHS and Working Conditions. • The O&M Contractor Site Manager shall instigate measures to correct non-conformance in safety performance found during safety checks and inspections. A record of the safety checks and inspections, and resulting actions, shall be provided to the Health and Safety Management Committee every month. • DGDC will undertake audits to check that no unsafe practices are being carried out at site. If unsafe practices are identified during the audits, work at the site should cease. The audits should be carried out once every two months. • All staff at the O&M Contractor should be notified of all incidents/accidents which result in first aid treatment during the soil improvement programme and the construction of the power plant. Minor incidents along with the incident/accident investigation report should be supplied to DGDC once a month. Serious accidents that are Lost Time Incidents, or result in serious harm or a fatality should be reported immediately to DGDC. • Worker occupational monitoring such as hearing and vision will be undertaken on an annual basis. • All heat and pentane sensors if an ORC plant is selected will be checked and calibrated on an annual basis or as per the manufacturer's specifications. • DGDC, as principals, undertake independent audits of the O&M Contractor Health and Safety performance to ensure that the health and safety practices as set out in their health and safety plans are being complied with. The audits will also check that no unsafe practices are being carried out at site. If unsafe practices are identified during the audits, work at the site should cease. The audits should be carried out once every two months.

2.7 Budget for Implementation

The implementation responsibility and estimated budgets for each required management plan (where available) and action are provided in Table 2.5. The management procedures/plans to be implemented during construction by the EPC Contractor will be developed for reviews by DGDC; whereby commitments have been made in to adhere to the Applicable Standards and mitigations set out in this ESIA. As such Table 2.5 only sets out additional costs to be incurred by DGDC over the 18-month construction schedule. The below estimates include budgets for resources and equipment to implement the ESMP as well as conduct training, environmental and social monitoring, analysis and reporting. Estimates for the Operation Phase are provided on the assumption that the O&M contract is for 20 years.

Table 2 5: Budget for ESMP Implementation

Item	Management Plan/Action	Responsibility	Estimate (EC $)
Pre-Construction			
1	Overarching Environmental and Social Management Systems preparation, institutional strengthening and implementation	DGDC	~300,000.00. Note: this is funded under AfD grant
2	Construction Environmental and Social Management System/Plan	EPC	Under EPC Contract
3	Air Quality Management Procedure and Air Quality Monitoring	EPC	Under EPC Contract
4	Chance Find Procedure	EPC	Under EPC Contract
5	Health, Safety and Environmental Plans	EPC	Under EPC Contract
6	Waste Management Procedure including recycling	EPC	Under EPC Contract
7	Hazardous Substance Management Procedure	EPC	Under EPC Contract
8	Emergency Response Plan	EPC	Under EPC Contract
9	Pest and Weed Management Procedure	EPC	Under EPC Contract
10	Stormwater Management Procedure	EPC	Under EPC Contract
11	Construction Noise Management Procedure and Noise Monitoring	EPC	Under EPC Contract
12	Erosion and Sediment Control Procedure	EPC	Under EPC Contract
13	Habitat Management Procedure and monitoring	DGDC	
14	Traffic Management Procedure	EPC	Under EPC Contract
15	Occupational Health and Safety Management System preparation	Jacobs OE	~20,000.00
16	Construction Occupational Health and Safety Management System/Plan	EPC	Under EPC Contract
17	Stakeholder Engagement Plan, ongoing community consultation and grievance mechanism management	DGDC/EPC	Part of DGDC normal operational costs which is ~ 850,000 per annum
18	Monitoring and Inspection of EPC Contractor ESHS Performance	Jacobs OE	Under OE Contract
19	Workers Code of Conduct	EPC	Under EPC Contract

Item	Management Plan/Action	Responsibility	Estimate (EC $)
20	Landscape Management Plan and Biodiversity Restoration	EPC	Under EPC Contract
21	Landslide Stabilisation Risk Management	EPC	Under EPC Contract
22	Subsidence Management lan	EPC	Under EPC Contract
23	Community Development Fund	DGDC	TBA
24	Workforce Development Strategy	DGDC	Part of DGDC normal operational costs which is ~ 850,000 per annum
25	Corporate Social Responsibility Programme	DGDC	Part of DGDC normal operational costs which is ~ 850,000 per annum
26	Sexually Transmitted Disease Management Plan	EPC	Under EPC Contract
27	Monitoring implementation of ARAP and Grievance Mechanism	DGDC	Part of DGDC normal operational costs which is ~ 850,000 per annum. Additional support to be funded by A\fD.
28	Cultural Education Programme	EPC	Under EPC Contract
29	Baseline Monitoring of Natural Geothermal Features	DGDC	Part of DGDC normal operational costs which is ~ 850,000 per annum
30	MTPNP Monitoring Programme	DGDC	~20,000.00
31	Biannual Environmental and Social Reports	DGDC	Part of DGDC normal operational costs which is ~ 850,000 per annum
32	Third Party Auditing of ARAP implementation	DGDC	~50,000.00
Operation			
1	Subsidence Management Plan	O&M	Under O&M Contract. O&M costs to be funded from tariff estimated at USD 1 to 1.4m PA
2	Traffic Management Plan	O&M	Under O&M Contract. O&M costs to be funded from tariff estimated at USD 1 to 1.4m PA
3	Operation ESMS	O&M	Under O&M Contract. O&M costs to be funded from tariff estimated at USD 1 to 1.4m PA
4	Operation Occupational Health and Safety Plans	O&M	Under O&M Contract. O&M costs to be funded from tariff estimated at USD 1 to 1.4m PA
5	Annual Environmental and Social Reports	DGDC	Part of DGDC normal operational costs estimated at ~850,00 per annum.
6	Ongoing Consultation and Communication with Local Communities and Monitoring of Grievance Mechanism	DGDC	Part of DGDC normal operational costs estimated at ~850,00 per annum.

Item	Management Plan/Action	Responsibility	Estimate (EC $)
7	Monitor O&M Contractor ESHS Performance	DGDC	Part of DGDC normal operational costs estimated at ~850,00 per annum.
8	Routine Monitoring of Natural Geothermal Features	O&M	Under O&M Contract
9	Habitat Management Procedure and monitoring (once every 5 years)	DGDC	~20,000.00
10	MTPNP Monitoring (once 5 years after construction)	DGDC	~20,000.00
11	H&S Audits	DGDC	Part of DGDC normal operational costs estimated at ~850,00 per annum.
12	Worker Occupational Monitoring	O&M	Under O&M Contract
13	Air Quality Monitoring	O&M	Under O&M Contract
14	Reservoir Monitoring	O&M	Under O&M Contract
15	Noise Monitoring	O&M	Under O&M Contract

2.8 UPDATING OF ESMP

This ESMP will be updated, revised and reviewed internally on regular basis as set out in the ESMS to ensure the management plans remain relevant and are effectively mitigating the risks set out in this ESIA.

The ESMP will be monitored and reviewed on a bi annual basis. Furthermore in the event of an unforeseen impact and design change with respect to the Project Standards (including the GOCD and World Bank), the ESMP would be updated as necessary.

3. Framework Environmental and Social Management System

3.1 Introduction

This section provides a framework for the Environmental and Social Management System (referred to hereafter as 'the ESMS') that establishes a methodological approach to managing environmental and social risks and impacts in a structured way, on a continuous basis. DGDC will be responsible for implementing the ESMS ensuring compliance with national regulatory and Project Sponsor requirements.

The ESMS ensures there are appropriate environmental and social policies and procedures in place and that people consistently follow them. A key feature is continual improvement – an ongoing process of reviewing, correcting and improving the system. The most common method is the Plan-Do-Check-Act cycle (PDCA), shown below in Figure 3.1.

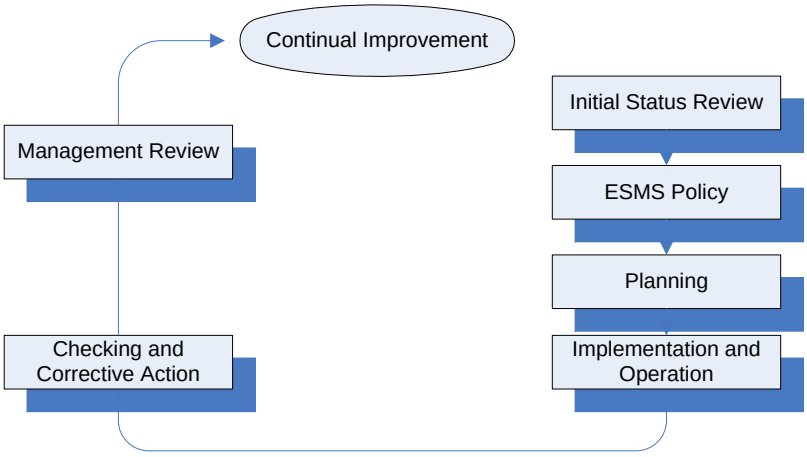

Figure 3.1: Elements of the Programme ESMS

The resources needed are planned, provided and managed to support the management plans and programs implemented during the project's lifecycle. Monitoring and measurements are done in order to track DGDC's and EPC Contractor's environmental and social performance, as well as feedback from the stakeholders. Information will be gathered from monitoring and measurements are analysed and presented to the DGDC Management Team. The DGDC Management Team will review and implement the Project ESMS and prepare plans for continual improvement of Project Sponsor's environmental and social performance.

The ESMS will be set out as follows:

- Overview of the ESMS;
- Organisational Roles and Responsibilities;
- Policies, Legal and Other Requirements;
- Identification of Risks and Impacts;
- Management programmes;
- Monitoring and Review;
- Stakeholder Engagement;
- Training; and
- Administration.

3.2 Structure of the ESMS

ESMSs are designed to establish a methodological approach to managing environmental and social risks and impacts in a structured way on a continuous basis. The structure of the ESMS that will be implemented for the construction and operation of the Project is shown in Figure 3.2 below:

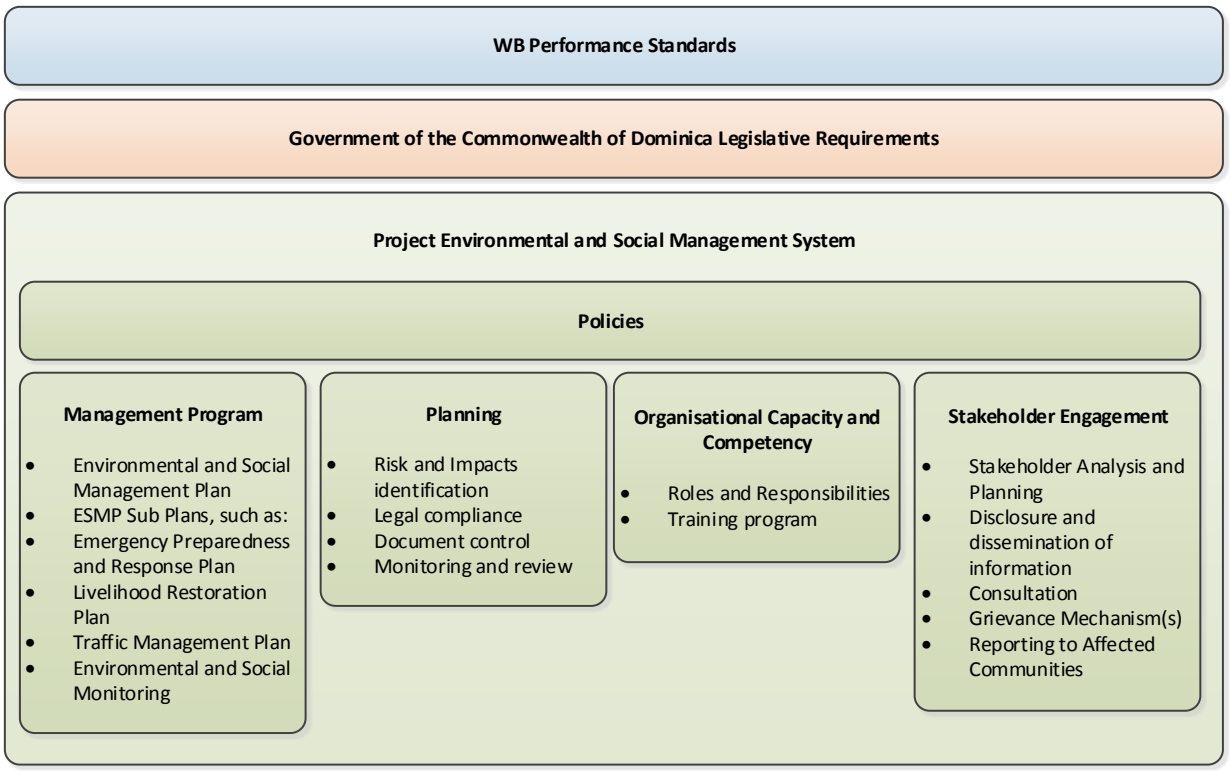

Figure 3.2: Structure of ESMS

3.3 Policies

3.3.1 DGDC's Environmental, Social, Health and Safety Policies

DGDC is committed to protect the health and safety of those who play major parts in our operations, and those who live in areas where they operate or use our products. Wherever we operate, we will conduct our business with respect and care for both the local and global environment and systematically manage risks so as to ensure a sustainable business growth. We will not be satisfied until we manage to eliminate any injury, occupational illness, unsafe practices and incidents of environmental harm from our activities.

To fulfil this commitment DGDC will ensure the social, environmental and health and safety statements outlined below are implemented and adhered to.

Social

- *Support the long-term development of the communities DGDC serve.*
- *A work environment free of harassment or discrimination on the basis of gender, physical or mental state, race, nationality, religion, age, family status or sexual orientation, or any other attribute recognised by the laws of the country in which the Company operates.*

- *A culture of respect, trust and mutual understanding fostered through open, two-way communication, positive encouragement of employees' participation in discussions and willingness to discuss issues and concerns raised at any level in the organisation.*

Environment

- *Comply fully with all applicable environmental laws and regulations.*
- *Ensure that all key environmental impacts are identified and managed in a responsible manner.*
- *Continuously improve our environmental performance.*
- *Monitor and report the environmental performance of our business.*
- *Provide the training and resources necessary to meet our environmental responsibilities.*

Health and Safety

- *That all employees and contractors understand that working safely is a condition of employment, and they are responsible for their own safety and safety of those around them.*
- *Manage all projects through their life-cycles in a way that protects safety and health and minimizes their impacts on the environment.*
- *Work with governments and stakeholders where we operate in order to develop regulations and standards aiming at improving people's safety and health and the environment.*
- *Maintain a secure work environment to protect ourselves, our contractors and company's assets from injury, property loss or damage resulting from hostile acts.*
- *Communicate our commitment in this policy to our contractors.*

Separate plans relating to assessment, monitoring and control of environmental and social aspects will be prepared by the EPC Contractor, once they are appointed. These plans will align with DGDC's ESMS, which will cover both construction and operation phases.

3.4 Alignment with the World Bank Performance Standard

In accordance with World Bank Performance Standard 1 the structure of the ESMS incorporates the following elements, as shown in Table 3.1:

Table 3.1: Alignment with the World Bank Performance Standard (PS) 1

WLG PS 1 for ESMS	Description
Policy	Policies that define DGDC's environmental and social commitment/objectives and the principles that guide the project to achieve sound environmental and social performance are described in Section 3.4.
Identification of Risks and Impacts	The process for identifying and assessing environmental and social risks is described in ESIA Volume 1: Introduction, ESIA Volume 2: EIA and ESIA Volume 3: SIA. The primary mechanism is the completion of an Environmental and Social Impact Assessment for the construction and operation of the Project.
Management Programmes	The management programmes used to mitigate potential environmental and social risks and impacts are described in ESIA Volume 4: ESMP, Framework ESMS and Assessment Against WB Standards. This includes preparation of an ESMP, which will contain procedures/plans to address specific issues in the appropriate level of detail.
Capacity/Competency	The roles, responsibilities and authorities for implementation of the ESMS are defined in Section 3.5 and training requirements are described in Section 3.11.
Emergency Preparedness/Response	Emergency preparedness and response is addressed in ESIA Volume 5: Technical Appendices, Technical Report – Working Conditions, Occupational Health and Safety, as part of the Management Programmes that are applicable to the construction and operation of the Project.

WLG PS 1 for ESMS	Description
Monitoring and Review	Section 3.9 describes the monitoring that will be carried out to ensure environmental and social performance standards are being met and the ESMS is being implemented effectively.
Stakeholder Engagement Communications and Grievances Reporting to Affected Communities	An overview of stakeholder engagement is provided in Section 3.10, which addresses: • Stakeholder analysis and planning • Disclosure and dissemination of information • Consultation and participation • Grievance mechanism • Reporting to affected communities.

The ESMS is a 'living' document, which will be reviewed and updated in accordance with the ESMS Management Review Procedure to ensure it maintains its relevance. At a minimum the ESMS will be reviewed before commencing each new phase of work and on an annual basis.

3.5 Roles and Responsibilities

3.5.1 Construction Phase

Management of environmental and social risks and impacts during construction will primarily be the responsibility of the EPC Contractor through the EPC Contract.

During the construction phase, DGDC will review and monitor the EPC Contractor's performance in accordance with the DGDC's Occupational Health and Safety (OHS) performance standards and related management plans/procedures to ensure alignment with the overall Project ESMS. Further details for the requirements of OHS Plans are presented in ESIA Volume 5: Technical Appendices, Technical Report – OHS and Working Conditions. DGDC is responsible for reporting every six months to relevant authorities regarding the findings of the reports.

The key personnel responsible for ensuring good environmental practice on site during construction will be confirmed once the EPC Contractor has been appointed.

3.5.2 Operation and Maintenance (O&M) Phase

The O&M Contractor will operate the power plant and will be responsible for recordkeeping and reporting, maintenance inspections, execution of routine maintenance, periodical maintenance and major overhaul in accordance with the Project ESMS. The O&M Contractor will prepare separate operation management plans and procedures that align with the Project ESMS. he O&M Contractor will also develop an overall organisational structure for environmental responsibilities on site.

he O&M Contractor will establish, maintain, and strengthen as necessary an organisational structure that defines roles, responsibilities and authority to implement the ESMS and ESMP. Specific personnel with clear lines of responsibility and authority are designated in this section. Key ESMS responsibilities are defined and will be communicated to the relevant personnel and to the rest of the O&M Contractor team. Sufficient management sponsorship and human and financial resources will be provided on an ongoing basis to achieve effective and continuous ESMS performance.

Example roles and responsibilities are described in Table 3.2. However, these will need to be confirmed prior to construction/operation of the Project.

Table 3.2: Example roles and responsibilities for implementation of ESMS

Role	Responsibilities
Project Manager	• Review and approve strategic Project HSE Policy and Objectives. • Approve the Project environmental protection plan and other procedures. • Define roles, responsibilities and provide resources for ensuring that environmental requirements are implemented and maintained in all areas of Project activities. • Ensure that Project Environmental Management System is managed in a structured manner throughout the site organization. • Ensure sufficient resources are available to support the implementation of the Project Environmental Management System. • Review suitability and effectiveness of the Project Environmental Management System, etc.

Environmental Control Supervisor	• Ensure that the environmental requirements are established, implemented and maintained across the Project site activities, specifically including:
	  • Identification and assessment of environmental aspects.
	  • Environmental objectives, targets and environmental management program.
	• Develop and maintain environmental documents (e.g. Project environmental plan and control plans or procedures) and records.
	• Monitor adherence to the Project environmental policy & objectives, alerting management of non-compliance, and providing advice on remedial actions, through environmental audits, reviews, inspections etc.
	• Monitor and verify closeout of actions arising from environmental audits.
	• Report periodically to the Project management on the performance of the Project environmental management system.

HSE Manager	• The HSE Manager has an overarching responsibility for the management, monitoring, inspection, and reporting of HSE aspects during construction/operation. The HSE Manager will have the knowledge, skills, and experience necessary to perform their work, including up-to-date knowledge of GoCD legislation and the international requirements as listed in Legal Requirements Register. The HSE Manager will also possess the knowledge, skills, and experience to implement the specific measures and actions required under the ESMS.

Role	Responsibilities
Operations Manager	The Operations Manager has overall responsibility for the construction of the Project and associated infrastructure. In particular, the Operations Manager will: • Maintain an awareness of the applicable GoCD legal requirements, potential HSE implications, and relevant operational controls among the construction workers. • Manage implementation of standard operational procedures for implementing the ESMS. • Communicate the latest work programme to the HSE Manager on a daily basis to effectively manage and monitor the potential HSE risks and impacts associated with the upcoming works. • Ensure the ESMS is communicated, implemented, and maintained by the Operations Contractor and any Subcontractors. This includes: a) Reviewing and approving training plans. b) Ensuring appropriate training is carried out for employees. c) Reviewing and approving the site's Emergency Preparedness and Response Plan. Further details of the outline of an Emergency Response Plan are located in ESIA Volume 5: Technical Appendices, Technical Report - Occupational Health and Safety and Working Conditions. d) Reviewing and approving the monitoring programme and HSE mitigation measures onsite, and implementing corrective and/or preventive actions in accordance with the operational control procedures. e) Monitoring compliance with the ESMS Periodically evaluating the effectiveness of the ESMS. f) Delegating a clear line of responsibility for HSE protection to the EPC Contractor and any. g) Subcontractors
Community Liaison Officer	The Community Liaison Officer will act as DGDC's representative to the affected communities and external stakeholders. DGDC will establish a clear reporting structure among the Community Liaison, Project Manager, Site Manager, HSE Manager and other relevant senior staff to effectively respond to stakeholder concerns and to manage reputational risks for the Project.
All other employees	All personnel employed for the operation of the Project are responsible for carrying out their roles in accordance with the ESMS.

3.6 Legal and Other Requirements

An important component of identifying and evaluating relevant environmental and social risks and impacts is defining the legislative framework within which the Project will operate. This includes Dominica National legislation and international requirements such as the World Bank Performance Standards. Details on these standards are provided within Volume 1 of the ESIA.

3.7 Identification of Risks and Impacts

To appropriately manage the Project, an understanding of the potential risks and impacts that may affect the environmental, social, health and safety aspects is required. The outcomes of this ESIA will be incorporated into the ESMS.

During construction and operation of the Project there will be ongoing monitoring of environmental and social aspects, reviews of compliance with the ESMS and an evaluation of the effectiveness of the ESMS. These monitoring events and reviews provide opportunities to review the environmental and social aspects of the project, determine whether the appropriate controls are working or need to be improved. In addition, they will help to identify any new aspects. This process is summarised in Figure 3.3.

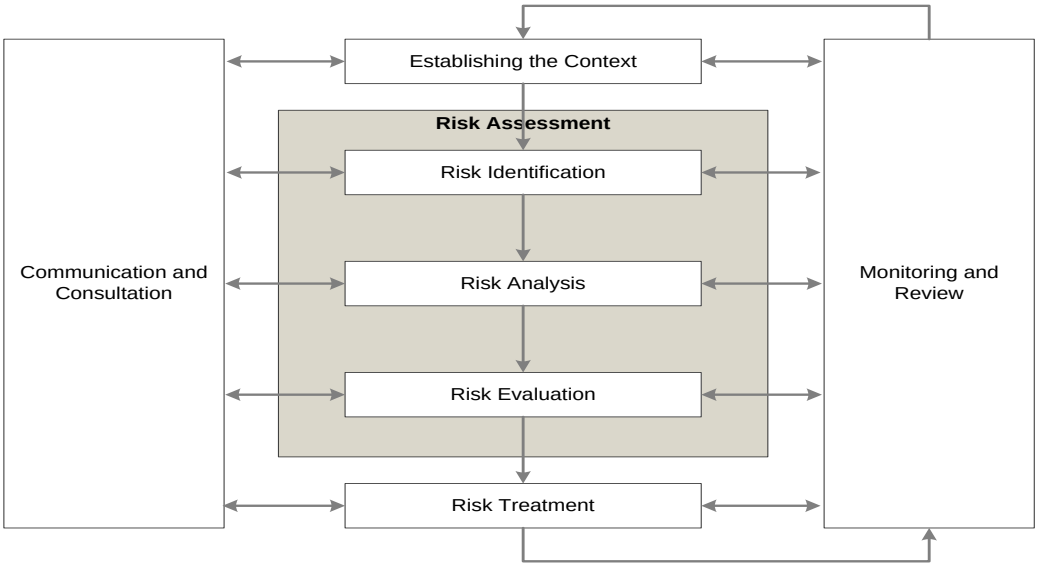

Figure 3.3 : Risk Assessment Process

All relevant project environmental and social aspects will be captured in the Aspect Registers: an example of this is provided in ESIA Volume 5: Technical Appendices. Any new aspects that are identified can then be assessed and rated in accordance with the risk rating systems described in ESIA Volume 5: Technical Appendices, and added to the Aspect Registers.

3.8 Management Programmes

3.8.1 Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) as outlined in Section 2 of this Report, describes and prioritises the actions needed to implement mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified in this ESIA relevant to the Project.

3.8.2 Procedures

The ESMS provides a structure and procedures as to how the mitigation and monitoring measures as set out in the ESMP will be implemented. Procedures may include existing documents developed by the DGDC, or be developed by external parties. Procedures may include the following (as outlined in Figure 3.2):

- Environmental and social management;
- Planning;
- Health and safety;
- Organisational capacity and competency; and/or
- Stakeholder engagement.

General Structure of Procedures

The following general structure should be applied to all ESMS Procedures:

1) **Project Sponsor Statement:** Outlines the commitment of the Project Sponsors to good environmental and social practices. May make reference to existing statements, policies or procedures.

2) **Project Context:** Outlines the overall context of the project and the purpose of the procedure.
3) **Purpose of Procedure:** Outlines the purpose of the procedure and which other related documents should be read alongside it.
4) **Scope of Procedure:** Outlines the mitigation measures proposed by the procedure and what specific tasks the management, mitigation and or monitoring covers.
5) **Procedure Details:** Provides detailed guidance including the following:
    a) Roles and responsibilities in relation to activities for both the Project Sponsors and any subcontractors;
    b) Definition of keys terms;
    c) Schedule of works;
    d) Verification and monitoring;
    e) Reporting of non-conformities;
    f) Details of training in relation to the procedure;
    g) Any forms that will accompany the procedure; and
    h) Auditing of procedure.

3.8.3 Contract Management

A Contractor Management Procedure is required that establishes the necessary environmental, social and health and safety criteria for EPC Contractors, Subcontractors and contracted services. This is very important given that the construction will be contracted to an external party and the operation and maintenance of the Project will be partly contracted to external service providers. Recommended procedural information for reporting includes:

- Contract Risk Assessment;
- Contract Pre-Qualification;
- Contractor Safety, Health, Environment, and Community Management;
- Contractor Register; and
- Contract Close-out.

These should be supported by a register of contractors, which includes information on pre-qualification requirements and contractor approvals.

3.9 Monitoring and Review

3.9.1 Monitoring of Environmental and Social Aspects

The ESMS will set out DGDC's policies and procedures for managing, mitigating and monitoring environmental and social impacts. Monitoring will be carried out in order to determine whether environmental and social outcomes are being achieved. Monitoring requirements will be specified in a monitoring plan (or plans), which identify:

- The type of monitoring that is to be carried out;
- Where monitoring is to take place;
- How frequently monitoring will be carried out;
- The parameters that will be tested for;
- The applicable objectives and performance standards; and

- Who will conduct the monitoring.

3.9.2 ESMS Review

Reviews of the ESMS will be conducted throughout construction and operation of the Project and where necessary changes should be made to the documentation to ensure that it remains relevant. These reviews as a minimum should be undertaken very six months during construction and annually for the operation phase.

3.9.3 ESMS Auditing

Routine auditing will be carried out to determine the level of compliance with the ESMS and evaluate the effectiveness of the ESMS. A procedure will be developed along with an auditing programme to define:

- Timing;
- Scope;
- Audit criteria;
- Reporting of audit findings; and
- Process for implementing corrective actions.

An audit checklist should be produced to maintain consistency if different auditors are utilised.

3.10 Stakeholder Engagement

The purpose of stakeholder engagement is primarily for transparency to the community, to inform them of the Project and associated construction activities, and the impacts it has on them and the environment. This provides an avenue for stakeholders to understand the Project impacts, how the impacts are being managed. A key aim of the stakeholder engagement is to provide stakeholder the opportunity for comment. Their comments/views will be considered by DGDC.

A Stakeholder Engagement Plan (SEP) has been prepared for the Project (refer to ESIA Volume 3: Social Impact Assessment). These will address the requirements described in the following sections.

3.10.1 Stakeholder analysis and planning

In order to conduct effective engagement some analysis is required of the type of stakeholders and the best means of communication with them with regards to the project and its potential impacts. Particular attention should be paid to vulnerable or disadvantaged groups.

3.10.2 Disclosure and dissemination of information

Disclosure of relevant project information helps potentially affected communities understand the potential risks, impacts and opportunities of the project. DGDC should provide such people with access to relevant information on:

- The purpose, nature, and scale of the project;
- The duration of proposed project activities;
- Any risks to and potential impacts on such communities and relevant mitigation measures;
- The envisaged stakeholder engagement process; and
- The grievance mechanism.

In addition, DGDC will need to prepare and maintain a procedure for external communications that includes methods to

- Receive and register external communications from the public;
- Screen and assess the issues raised and determine how to address them;
- Provide, track, and document responses, if any; and
- Adjust the management program, as appropriate.

DGDC are also encouraged to make publicly available periodic reports on their environmental and social sustainability.

3.10.3 Consultation and participation

Consultation with potentially affected communities and individual stakeholders will ensure they have an opportunity to provide input on the Project, its potential impacts, possible alternatives and the proposed mitigation and monitoring measures. The extent and nature of engagement activities will depend upon the nature of degree of effects.

3.10.4 Grievance mechanism

A grievance mechanism should be established to enable potentially affected communities to air their concerns and grievances about the DGDC's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the Project; should seek to resolve concerns promptly, using an understandable and transparent consultative process that is readily accessible, and at no cost to such affected communities. The mechanism should also ensure there is no retribution to the party that originated the issue or concern.

3.10.5 Reporting to affected communities

DGDC should provide periodic reports to the potentially affected communities describing progress in implementation of project actions that involve or may impact on them as well as addressing issues that the communities have raised.

3.11 Training

DGDC shall identify the knowledge and skills necessary for implementation of the ESMS and identify training requirements for its personnel and contractors engaged during the construction and operation of the Project.

All persons responsible for undertaking work during the life of the project must be trained on the contents of the ESMS. Training shall include, but is not limited to:

- Definition of the environment;
- Need for environmental protection and conservation;
- Impacts of construction activities on the environment;
- Adequate mitigation measures against such impacts;
- Emergency preparedness and response plan (further details of the outline of an Emergency Response Plan are located in ESIA Volume 5: Technical Appendices, Technical Report - Occupational Health and Safety and Working Conditions);
- Social responsibility during construction e.g. being considerate to local residents;
- Project ESMS policy and objectives;
- The Project ESMP;
- Health and Safety Management System; and

- Current applicable laws and regulations.

A Training Procedure should be developed that includes:

- Inductions (identifying different types that may be required);
- Training needs identification;
- Training schedule;
- Assessment of competency;
- Recognition of prior learning;
- Evaluation of training; and
- Records.

All training information, records and certificates should be properly documented and filed. An audit of the ESMS is likely to seek verification that all project personnel have been given the appropriate training. This will require a comprehensive training/induction register.

3.12 Administration

3.12.1 Human Resources

DGDC shall develop human resources (HR) policies and procedures which are consistent with the requirements of World Bank Performance Standards and Dominica national labour laws. The HR policy and manual will provide standard compliance with local labour laws, a description of functions/positions and requirements, general benefits, and give guidance on employee's selection, hiring and promoting procedures.

All employees will receive a copy of this manual at their first day at work. The HR manual will include:

- Prohibition of any type of child and/or forced labour;
- The implementation of equal opportunity and non-discriminatory hiring and promotion policies;
- Description and full disclosure of the worker's/employees' rights and duties, including freedom of association and collective bargaining; and
- A non-retaliatory grievance mechanism to receive and process any complaints from employees on work related conflicts or issues.

Compliance with these policies and procedures will also be mandatory to all contractors, suppliers, and sub-contractors.

3.12.2 Document Control

Document control will be carried out in accordance with a Document Control Procedure, which will address the following:

- Controlled documents;
- Controlled document preparation;
- Document reference notation (document numbering);
- Review of documents;
- Approval of documents; and
- Document recording and removal.

A document register will be prepared to capture all relevant ESMS documents, spreadsheets, registers and maps.

3.12.3 ESMS Review and Auditing

As identified in Sections 3.9.2 and 3.9.3 there will be periodic reviews and audits of the ESMS. Any changes to ESMS documentation that result from these shall be made in accordance with the Document Control Procedure outlined in Section 3.12.2.

3.12.4 Reporting

DGDC shall report to the relevant financial institutions and government authorities on the implementation of ESMS as required. Progress reporting by the EPC Contractor to DGDC will also be carried out as required.

3.13 Environmental Aspects Register

The environmental aspects will be scored using the rating system set out in the Tables 3.1-3.3 below. Each aspect is assigned a rating for likelihood and another for consequence, which are used to determine the significance. An example of an Aspects Register is included in Table 3.4: it is anticipated that this will be used as a template for the full Aspects Register to be included in the Project ESMS.

Table 3.1 : Likelihood

Descriptor	Probability	Frequency	Historical
Almost Certain	>1 in 10	Several times per year	Has occurred frequently in the company
Likely	Between 1 in 10 and 1 in 100	About once per year	Has occurred once or twice in the company
Possible	Between 1 in 100 and 1 in 1,000	Once in 1-10 years	Has occurred many times in the industry
Unlikely	Between 1 in 1,000 and 1 in 10,000	Once in 10-100 years	Has occurred once or twice in the industry
Rare	<1 in 10,000	< Once in a 100 years	Unheard of in the industry

Table 3.2: Consequence Rating

Descriptor	Safety	Cost	Schedule	Environment	Reputation
Catastrophic	1 or more fatalities or total permanent disability	>$10M	>2 years change to schedule	Permanent impact, long term (decades) regional impact	Adverse global media coverage. Major stakeholders terminate. Company at stake.
Major	1 or more partial disabilities	$1M-10M	1-2 years to change to schedule	Long term (decades) local area impact. Medium term (years) regional impact	Adverse national media coverage. Company on notice
Moderate	Lost time injury	$100k-$1M	6-12 months change to schedule	Medium term (years) local area impact. Short term(months) regional impact	Long term (weeks), local media and local interest
Minor	Medical attention, light duties	$10k-$100k	2-6 months change to schedule	Short term (months) local area impact	Short term (days), local media and local interest

Insignificant	Minor injury/illness. First aid needed. No lost time injury	$0-$!0k	<2 months change to schedule	Temporary impact (days/weeks) to immediate area	Local interest only, quickly forgotten

Table 3.3: Significance Rating

Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium	High	High	Very High	Very High
Likely	Medium	Medium	High	High	Very High
Possible	Low	Medium	Medium	High	High
Unlikely	Low	Low	Medium	Medium	Medium
Rare	Low	Low	Low	Medium	Medium

Table 3.4: Example Aspects Register

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
Vehicle transport of equipment and personnel	Emission of greenhouse gases through combustion of fossil fuel	Project site	Almost Certain	Insignificant	Low	Minimise vehicle movements.	Likely	Insignificant	Low
	Contamination of land, surface and groundwater from leaking fuel	Project site	Possible	Minor	Medium	Maintain vehicles in good working order to prevent leaks of oil and fuel Vehicles to carry spill kits All personnel to be provided spill response training as part of site induction.	Unlikely	Insignificant	Low
	Damage to terrestrial flora and fauna	Project site	Possible	Minor	Medium	Vehicles to travel along designated access tracks and avoid disturbing new areas as much as possible	Unlikely	Minor	Low

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
						Minimise vehicle movements. Note the location, number and state (alive/dead) of any threatened species so that these may be clearly marked on a map			
						Advise project staff during induction of the species that should be noted if encountered			
	Noise disturbance	Project site	Almost Certain	Insignificant	Medium	Vehicles primarily used during daylight hours	Possible	Insignificant	Low
	Disturb/displace community activities	Project site	Possible	Moderate	Medium	Regular/routine community consultation/communication to ensure awareness of works programme amongst villagers.	Possible	Minor	Medium
Vehicle transport of hazardous substances and waste	Spill/leak of hazardous substances (in particular n-pentane) and waste onto land or into water	Project site	Possible	Minor	Medium	Hazardous substances and waste to be transported in sealed containers	Unlikely	Minor	Low
						Hazardous substances and waste placed in drip trays to			

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
						contain minor leaks/spills			
						Vehicles to carry spill kits			
						Prepare Spill Response Plan			
						All personnel to be provided spill response training as part of site induction			
Travel on foot	Damage to flora and fauna	Project site	Possible	Insignificant	Low	Limit personnel to designated tracks and project areas where possible	Unlikely	Insignificant	Low
						Instruct personnel not to interfere with local wildlife or vegetation			
						Advise project staff during induction of the species that should be noted if encountered			
Vegetation clearance	Damage to flora and fauna	Project site, reinjection line & access tracks	Almost Certain	Moderate	Medium	Minimise vegetation clearance by using existing tracks where possible	Likely	Minor	Low
						Advise project staff during induction of the species that should be noted if encountered			

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
	Reduced visual amenity	Project site, reinjection line & access tracks	Likely	Minor	Medium	Minimise vegetation clearance by using existing tracks where possible	Possible	Minor	Medium
	Noise disturbance	Project site, reinjection line & access tracks	Likely	Minor	Medium	Regular/routine community consultation/communication to ensure awareness of works programme amongst villagers. The use of machinery to create access tracks will be limited to daylight hours	Likely	Insignificant	Low
	Contamination of land, surface and groundwater from leaking fuel	Project site, reinjection line & access tracks	Possible	Minor	Medium	Maintain vehicles in good working order to prevent leaks of oil and fuel Vehicles to carry spill kits All personnel to be provided spill response training as part of site induction	Unlikely	Minor	Low
Earthworks	Reduced visual amenity	Project site, reinjection line & access tracks	Possible	Minor	Medium	Install screening measures	Possible	Insignificant	Low
	Erosion and sedimentation	Project site, reinjection line	Almost Certain	Minor	High	Prepare Erosion and Sediment Control Plan	Possible	Minor	Medium

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
		& Project site, reinjection line & access tracks				Seeding of stockpiled soil to stabilise Following completion of the exploration activities, assess whether disturbed areas such as access tracks are required for long term operations. Rehabilitate all disturbed areas not required for long-term operations using sterile seed mixes			
	Dust generation	Project site, reinjection line & access tracks	Almost Certain	Minor	High	Seeding of stockpiled soil to stabilise Carry out watering of exposed areas and stockpiles as required to suppress dust. Minimise size of exposed areas and stockpiles	Unlikely	Minor	Low
	Noise disturbance	Project site, reinjection line & access tracks	Likely	Minor	Medium	Regular/routine community consultation/communication to ensure awareness of works programme amongst villagers.	Likely	Insignificant	Medium

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
						The use of machinery to create access tracks will be limited to daylight hours			
	Contamination of land, surface and groundwater from leaking fuel	Project site, reinjection line & access tracks	Possible	Minor	Medium	Maintain vehicles in good working order to prevent leaks of oil and fuel Vehicles to carry spill kits All personnel to be provided spill response training as part of site induction	Unlikely	Minor	Low
Vegetation clearance	Damage to flora and fauna	Project site, reinjection line & access tracks	Likely	Minor	Medium	Minimise vegetation clearance Rehabilitate all disturbed areas not required for long-term operations using sterile seed mixes	Possible	Insignificant	Low
	Wood wastage	Laydown Area and Power Plant	Unlikely	Minor	Low	Remove felled trees from the area and stockpile in an area where landowners and local communities can access them for building materials.	Unlikely	Minor	Low
	Reduced visual amenity	Project site, reinjection line	Likely	Minor	Medium	Minimise vegetation clearance	Possible	Insignificant	Low

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
		& access tracks							
	Disturb/displace community activities	Project site, reinjection line & access tracks	Likely	Minor	Medium	Identify and compensate landowners for use of their land Regular/routine community consultation/communication to ensure awareness of works programme amongst villagers.	Likely	Insignificant	Medium
	Noise disturbance	Project site, reinjection line & access tracks	Likely	Minor	Medium	Regular/routine community consultation/communication to ensure awareness of works programme amongst villagers. The use of machinery for vegetation clearance will be limited to daylight hours	Likely	Insignificant	Medium
	Contamination of land, surface and groundwater from leaking fuel	Project site, reinjection line & access tracks	Possible	Insignificant	Low	Maintain vehicles in good working order to prevent leaks of oil and fuel Vehicles to carry spill kits	Unlikely	Insignificant	Low

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
						All personnel to be provided spill response training as part of site induction			
Construction / installation of temporary buildings	Reduced visual amenity	Laydown Area and Power Plant	Possible	Insignificant	Low	Introduce screening measures	Possible	Insignificant	Low
	Noise disturbance	Laydown Area and Power Plant	Likely	Minor	Medium	The use of machinery to construct temporary buildings will be limited to daylight hours	Possible	Insignificant	Low
Lighting	Disturb local residents and fauna	Laydown Area and Power Plant	Almost Certain	Insignificant	Medium	Position lighting to shield adjacent dwelling as much as possible	Possible	Minor	Low
						Turn off all unnecessary lighting at night to avoid attracting migratory birds			
Storage of equipment and machinery	Contamination of land and/or groundwater from fuel leaking from vehicles	Laydown Area and Power Plant	Possible	Minor	Medium	Maintain vehicles in good working order to prevent leaks of oil and fuel	Unlikely	Minor	Low
						Drip trays placed under fuel tanks			
						All personnel to be provided spill response training as part of site induction			

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
	Reduced visual amenity	Laydown Area and Power Plant	Possible	Insignificant	Low	Low	Introduce screening measures	Insignificant	Low
Storage of hazardous substances	Spill/leak of hazardous substances causing contamination of land and/or groundwater	Laydown Area and Power Plant	Possible	Moderate	Medium	Hazardous substances stored in a location where they are: 1) Secure 2) Covered 3) In sealed containers 4) Inside a bunded container with sufficient capacity to contain a spill	Unlikely	Minor	Low
						Spill response plan in place			
						All personnel provided spill response training as part of site induction			
						Spill kits available in all locations where hazardous substances are kept.			
	Fire resulting in explosion	Laydown Area and Power Plant	Possible	Moderate	Medium	Store flammable substances away from ignition sources	Unlikely	Moderate	Medium

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
						Smoking prohibited when in close proximity to hazardous substances			
	Reaction of hazardous substances causing explosion	Laydown Area and Power Plant	Possible	Moderate	Medium	Store incompatible substances separately	Unlikely	Moderate	Medium
Storage of general waste	Poor waste management may lead to littering and contamination of land	Laydown Area and Power Plant	Likely	Minor	Medium	Install bins to collect general waste Separate food waste and provide to locals as animal feed if desired. If not, food waste is to be buried	Unlikely	Minor	Low
Storage of hazardous waste	Spill/leak of liquid waste causing contamination of land and/or groundwater	Laydown Area and Power Plant	Possible	Minor	Medium	Separate hazardous waste from general waste Hazardous waste stored in a location where it is: 1) Secure 2) Covered 3) In sealed containers 4) Inside a bunded container with sufficient capacity to contain a spill	Unlikely	Minor	Low

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
						Spill response plan in place All personnel provided spill response training as part of site induction Spill kits available in all locations where hazardous substances are kept.			
Washing down vehicles, equipment and drilling casings	Contamination of land and/or groundwater	Laydown Area and Power Plant	Likely	Minor	Medium	Use biodregadable cleaning agents where necessary	Unlikely	Minor	Low
Refuelling	Contamination of land, surface and groundwater	Laydown Area and Power Plant	Possible	Moderate	Medium	Refuel in designated refuelling areas only Drip trays and bunding to be in place at refuelling areas at all times Personnel instructed in use/handling of substances and in spill response. Spill kits to be held at refuelling location(s)	Unlikely	Moderate	Medium
Domestic camp activity	Noise disturbance	Laydown Area and Power Plant	Likely	Insignificant	Medium	All personnel to behave in accordance with code of conduct	Unlikely	Insignificant	Medium

Aspect/Activity	Impact	Location	Likelihood	Consequence	Significance	Mitigation	Likelihood	Consequence	Treated Significance
Use of generators	Emission of greenhouse gases through combustion of fossil fuel	Laydown Area and Power Plant	Almost Certain	Insignificant	Medium	Minimise the number of generators Minimise use of generators by switching them off where possible	Likely	Insignificant	Medium
	Noise disturbance		Almost Certain	Insignificant	Medium	Minimise the number of generators Provision of manufacturer specified mufflers.	Likely	Insignificant	Medium
Ablutions	Contamination of land, surface and groundwater	Laydown Area and Power Plant	Almost Certain	Insignificant	Medium	Install and maintain septic tank	Unlikely	Insignificant	Low

4. Assessment Against with World Bank Performance Standards

The purpose of the ESIA is to identify and assess key environmental and social impacts of the Project. The technical data provided within the ESIA, will also provide the basis for assessing the Project against and the World Bank Performance Standards for Private Sector Activities (2013), and they are shown in Table 4.1 below.

Table 4.1 : Assessment of the Project against the WBG Performance Standards for Private Sector Activities (2013)

Performance Standard	Objectives	Comment
1. Assessment and Management of Environmental and Social Risks and Impacts	• To identify and evaluate environmental and social risks and impacts of the project. • To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment. • To promote improved environmental and social performance of clients through the effective use of management systems. • To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately. • To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.	• The ESIA has been undertaken in accordance with PS1. • The ESIA provides a summary of a large amount of technical assessment work assessing the environmental and socio-economic impacts and risks of the Project. • Where possible, environmental impacts have been minimized and avoided in the design through technology choice, power plant siting and route selection for the reinjection line, as discussed in ESIA Volume 1: Introduction, Section 4. • A Grievance Mechanism has been proposed to enable effective and efficient response to grievances raised, as provided in the SEP which is contained in ESIA Volume 5: Technical Appendices. • The Grievance Mechanism was socialised within the community during the 2017 community consultation meetings. • Consultation with Affected Communities is being undertaken in accordance with the SEP for the Project (refer to ESIA Volume 3: SIA, Section 5 and ESIA Volume 5: Technical Appendices). Affected Communities will also be consulted with as part of the Abbreviated Resettlement Action Plan (ARAP) (ESIA Volume 5: Technical Appendices).
2. Labour and Working Conditions	• To promote the fair treatment, non-discrimination, and equal opportunity of workers. • To establish, maintain, and improve the worker-management relationship. • To promote compliance with national employment and labour laws. • 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. • To promote safe and healthy working conditions, and the health of workers. • To avoid the use of forced labour.	• All Occupational Health and Safety (OHS) systems for the Project will be developed and implement that meet the requirements of Performance Standard 2. • Technical Report – Working Conditions, Occupational Safety and Health (ESIA Volume 5: Technical Appendices) outlines the working conditions and occupational health and safety procedures for the Project. • Working conditions will comply with local regulatory requirements, International Labour Organisation Guidelines, as well as any additional initiatives that are part of the normal approach adopted by the organisation involved at each phase of the Project. • OHS systems will contribute towards improved working conditions. • A Worker's Grievance Mechanism has been prepared and will be implemented for the construction and operation phases. This is contained in Technical Report –

Performance Standard	Objectives	Comment
		Working Conditions, Occupational Safety and Health (ESIA Volume 5: Technical Appendices) • Labour will be employed in accordance with Dominica labour laws, which prohibit the use of force and child labour.
3. Resource Efficiency and Pollution Abatement	• To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related GHG emissions.	• Resource efficiencies have been summarised in ESIA Volume 1: Introduction, Section 4 regarding Project justification, and have been considered throughout the Project design and technology selection decisions. • Environmental and social impacts associated with pollution have been assessed in ESIA Volume 2: EIA and ESIA Volume 3: SIA of this ESIA and mitigation measures have been proposed. • GHG reduction measures are outlined in ESIA Volume 2: EIA, Section where total GHG emissions are estimated to be 9,462 tonnes CO2-e per year for the Project. With reference to the 25,000 tonnes CO2-e per year threshold for the requirement of publically reporting of GHG emissions, it is not considered necessary to report annually on GHG emissions. The total CO2-e per year is considered to be significantly less than a fossil fuel derived energy source and therefore the Project is considered to have Moderate Beneficial significant impact.
4. Community Health, Safety and Security	• 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. • 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.	• The health, safety and security of Affected Communities could potentially be impacted by the Project. This ESIA has been prepared with consideration to the impacts on these Affected Communities. • Incidents in the construction and operation of the power plant that have the potential for offsite consequences have been assessed and are regarded as being acceptable (refer to ESIA Volume 2: EIA). • ESIA Volume 3: SIA outlines the potential impacts, and a range of mitigation measures have been recommended to reduce impacts on communities to a Minor (acceptable) significance level, including controlling access, developing emergency response procedures, and implementing disease prevention measures. • Under the recommended mitigation measures, Security Guards will be trained on human rights issues, and the Project will coordinate with local government security forces on human rights and security matters.

Performance Standard	Objectives	Comment
5. Land Acquisition and Involuntary Resettlement	• 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 cost 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 tenure at resettlement sites.	• Construction and operation of the plant will require the acquisition of land for the power plant itself and for associated infrastructure. • Development of the power plant site and reinjection route pipeline will result in the acquisition of up to 11 properties either partially or in their entirety, and as a result cause physical displacement of three households and economic displacement of four farmers. • For construction of the power plant, reinjection route and associated infrastructure, two full properties at the power plant and a portion of six other properties along the reinjection line would need to be acquired. This would include three structures, one of which is residential, one intended for residential use and one used for livestock. These properties would be directly displaced by the Project footprint. In addition, three of the properties are in close proximity to the power plant site expected to be affected by noise, construction and visual impacts and are thus being considered for resettlement. • The six properties impacted by the construction of the reinjection route would only require acquisition of a portion of the property to accommodate a 10 m corridor. As the percentages required of each property are generally small, there is still an opportunity to minimise resettlement/livelihoods impacts during the design phase by placing the reinjection line route in the areas of least impact within each property. • Along with experiencing physical displacement, some of the parties affected by resettlement for the proposed power plant site and the reinjection pipeline route may experience economic displacement effects as many of the affected properties include agricultural crops, livestock, and trees. • For land acquisitions and resettlement associated with the power plant footprint, noise impacts, and the reinjection pipeline, an Abbreviated Resettlement Action Plan (ARAP) has been prepared which will provide guidance for addressing land acquisition and resettlement impacts, in line with WB Performance Standard 5. • The ARAP has been developed in consultation with affected parties and as well as providing where appropriate and / or cash compensation and livelihood restoration measures including consideration of those considered to be severely affected and or vulnerable.

Performance Standard	Objectives	Comment
		• The ARAP has also addressed any impacts associated with livelihood restoration (i.e. those affected through economic displacement). • The process will be undertaken in accordance with the disclosure methods stipulated in the SEP.
6. Biological Conservation and Sustainable Management of Living Natural Resources	• To protect and conserve biodiversity. • To maintain the benefits from ecosystem services. • To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.	• This ESIA has assessed the impacts of the Project on biodiversity, including freshwater and terrestrial ecology in ESIA Volume 2: EIA and ESIA Volume 5: Technical Appendices, (MTPNP Impact Assessment and Terrestrial Ecology Impact Assessment). • The proposed geothermal development is located approximately 450 m from the WHS boundary at the closest point. As such, an assessment of potential impacts on the WHS is required, consistent with the International Union for the Conservation of Nature (IUCN) World Heritage Advice Note on Environmental Assessment (IUCN, 2013). The ESIA contains a separate report to address this in ESIA Volume 5: Technical Appendices, (MTPNP Impact Assessment). • A range of measures have been incorporated in the Project design, mitigation and monitoring to promote sustainable management of living resources, including minimizing habitat destruction through site and route identification; design and implement control procedures sediment, dust and noise impacts; and the design of a MTPNP monitoring programme will be implemented for the five key species considered Threatened by IUCN: giant ditch frog, imperial parrot, red-necked parrot, forest thrush, and a species of tree frog (*Eleutherodactylus amplinympha*).

Performance Standard	Objectives	Comment
7. Indigenous Peoples	• To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. • To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. • To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. • To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle. • To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present.	• As discussed in the ESIA Volume 3: SIA, PS7 is not considered to apply to the Project. This is because people living in the Project area are not categorised as indigenous. They are part of the mainstream society, and do not have any specific economic or cultural activity different from the rest of the society. They participate fully in the socioeconomic life of the society.
8. Cultural Heritage	• To protect cultural heritage from the adverse impacts of project activities and support its preservation. • To promote the equitable sharing of benefits from the use of cultural heritage.	• This ESIA assesses the impact of the Project on cultural heritage, and specifically in ESIA Volume 3: SIA, Section 7. • No direct impacts on physical cultural heritage are anticipated as all known cultural artefacts are located outside the Project boundaries. It is also very unlikely that any cultural artefact will be found during earthworks activities. • A Chance Find Procedure will be implemented by the EPC contractor and all its Subcontractors to address the risk of finding cultural heritage artefacts. A Code of Conduct for workers will also be developed by the EPC Contractor.

4.1 Conclusion

This ESIA summarises a large amount of technical work undertaken to assess the impacts of the proposed Project. The ESMP sets out mitigation and monitoring actions that address the key environmental and social impacts identified in the analysis. Implementation of the mitigation, management and monitoring measures in the ESMP for each phase of the Project will ensure that the environmental and social impacts of the Project overall will be acceptable.