16.0 MITIGATION AND MONITORING PLAN

16.1 Proposed Mitigation Measures

There are a number of mitigation measures which the developer can implement to reduce or negate potential impacts and in meeting the concerns of local stakeholders about the nature and intent of his project (see **Table 16.1**). Public perception or misconception of this project has created fertile grounds for conflict. The bottom line is that the developer and all stakeholders need to work together to create a project that is environmentally acceptable and socially just. Measures that should be implemented include:

- The developer should produce a detailed development plan for all phases of the proposed project. This plan should give the full conceptual framework for the development, main objectives, methods to be used for the development accompanied by detailed maps for the siting of the facilities and full description of the required technologies to be installed to support the operation. Although much of this information is not currently available, it is nevertheless possible to begin with the seismic stage and develop the plan as new information emerges. This plan should be made widely accessible to all stakeholders,
- US Capital Energy should appoint a community Liaison Officer to interface with the community on a daily basis ,
- While developmental work is in progress, community leaders should be invited to observe the progress of the work and to ask questions and voice concerns on site,
- The developer should develop an environmental and social agenda as part of a broad based strategy that guides operating policies and decisions ,
- At regular intervals, coordinate with an independent outside body to analyze and evaluate the progress of community relations ,
- Establish a tripartite committee consisting of SATIIM, the DoE and US Capital Energy to resolve disputes ,

- US Capitol Energy should work with SATIIM to finance the cost of monitoring the seismic lines into the STNP as well as the monitoring of water quality, vegetation and soils where required ,
- In consultation with the GoB, US Capital Energy should post a bond to cover any inadvertent damage to the biodiversity and integrity of the STNP ,
- Conduct a thorough review of management practices as a way of finding opportunities for improvement and set priorities for action ,
- Regularly audit and evaluate the development to ensure that:
  - It is complying with all applicable legislation and guidelines,
  - It is carrying out the monitoring program prescribed in this ES and in particular the Environmental Management Plan,
  - In every way the company is complying with the provisions of its environmental compliance plan.

It is important from the outset that an acceptable limit of change be established before any development takes place and proper indicators established to determine whether those limits have been breached. Acceptable limits will depend on the location of the site, sensitivity of identified habitats and the views of the local stakeholders. These indicators should be cost effective and easy to measure as long as they are verifiable. The developer should seek to form collaborative partnerships with other institutions involved in natural resource management work in the area.

In addition the developer can take the following measures to ensure the integrity of the ecosystems in which he will operate:

- Execute work within the Tropical evergreen lowland peat shrubland with sphagnum ecosystem, with extreme and efficiency, on the grounds that this is a unique ecosystem in the region and falls within a national park and is also the main basis for the designation of the area as a Ramsar Site.
- It is imperative that the scientific research team and SATIIM representatives be there at all times while traversing this unique ecosystem.

- Conduct or cause to be conducted a survey of the area prior to embarking on the proposed development with particular emphasis on endangered or vulnerable species including fish, mammals, birds and amphibians before any further phase of work.
- Conduct frequent sampling to detect changes in the baseline parameters especially in terms of groundwater and surface waters to be better able to determine the impact of the development activities on the area's environment,
- Collaborate with any ongoing conservation efforts in the project area to ensure that endangered wildlife are not unduly disturbed,
- Support any local conservation initiatives in the area seeking to protect similar habitats, which are likely to be used by fauna that may be displaced by the development either in this phase or subsequent phases,
- Ensure that equipment operators and site supervisors are properly sensitized to the need of protecting the flora and fauna from undue disturbances.

TABLE 16.1: SUMMARY MITIGATION MATRIX OF MAIN DEVELOPMENTAL IMPACTS

IMPACT CATEGORY	PRINCIPAL IMPACTS PER CATEGORY	RECOMMENDED MITIGATION MEASURES PER CATEGORY
Adverse impact on Local Ecosystems	I. Impact to Sphagnum Bog Ecosystem II. Introduction of invasive species	I. Work with extreme caution in the ecosystem, and can enter only with the presence of the scientific research team, and representatives of SATIIM and NEAC representation. II. Do not disrupt natural drainage within this ecosystem III. Do not introduce seeds or plants into the park, clean equipment before entering park
Displacement of Wildlife	I. Decreased visitor appreciation. II. Loss of natural ecological balance. III. Disruption of the food chain. IV. Decreased regional biodiversity	I. Avoid unduly disturbing wildlife, their nest or roosting sites. II. Absolutely no hunting or fishing should be allowed including the collection of eggs or juveniles or any animal parts. III. Sensitize managers, staff and to the importance of wildlife and to their need for food and shelter. IV. Collaborate with other groups monitoring wildlife activities. Support wildlife conservation in similar habitats outside the development. V. Create conditions favorable to the natural movement and migration of marine and terrestrial fauna. VI. Incorporate wildlife conservation presentations into all group trips into natural areas.
Solid Waste Management	I. Pollution of the land, ground water and coastal ecosystem from waste	I. Sort garbage into biodegradable, non-biodegradable and toxic categories before disposal.

	permeate. II. Visual impacts from accumulation of waste.	II. Purchase products in bulk to reduce need for packaging, III. Educate staff on the management of waste generated during the seismic stage, IV. Plan purchasing to reduce amount of toxic and non- biodegradable products. V. Remove waste from site and take out to a suitable landfill site.
Water Resources	I. Pollution of ground and surface water during the seismic stage	I. Avoid clearing lines within 10m of any creek or river to avoid erosion along slopes which can result in siltation. II. Do not place charges within 50m of any stream or creek and 100m of any river. III. Monitor water quality within the seismic impact zone during the 6month seismic phase and compare to the baseline.
Energy Supply	I. Visual, sound and waste disposal impacts	I. Recycle batteries and used oil. II. Ensure that generators are adequately muffled and placed within a sound attenuating structure
Transportation	I. Damage to local ecosystems and creation of wildlife barriers. II. Impacts to air quality from Dust Creation	I. Restrict access roads to existing road network. II. Avoid sensitive sites and areas frequented by endangered species III. Use water trucks in villages to reduce dust creation, IV. Avoid high speeds
Noise	I. Noise impacts resulting in public comments	I. Conduct detonation only during daylight hours during normal working times, II. Inform community about intention to commence blasting III. Where blasting occurs within 25m of any residential building use plywood screening of no less than 1.5cm thickness.

16.2 Environmental Monitoring

The environmental monitoring programme will involve the frequent assessment of ground and surface waters which are the only environmental factors that are liable to sustain any significant impacts from the seismic survey.

During the preparation of the ES covering the drilling and potential extraction phases a comprehensive monitoring program will be developed covering surface and groundwater but will also include ichthyofauna, amphibians, mammals and the local avifauna populations. The monitoring of fish within the rivers and creeks will give a good indication of water quality overall, while amphibians are very sensitive to changes in their immediate environment and birds are good indicators of habitat quality overall. The monitoring of mammals, especially the predators will give an indication of the stability and viability of the food chain. Very little baseline data exists for the area, and the implementation of the proposed project creates an opportunity to generate information that is necessary to assist policy decisions in regards to the development process. This monitoring program will cover quantitative as well as qualitative parameters.

The monitoring of surface and groundwater will involve the assessment of a number of basic water quality parameters including pH, dissolved oxygen and temperature as well as for substances associated with the seismic testing. Although the running of the cutlines for the seismic study will not of itself produce many of these substances, there is the chance that they will be produced in subsequent phases of the project and the monitoring for this phase can itself act as a baseline for those phases.

The time interval between the collection of samples depends on the water body and its specific characteristics. An interval of one month between the collection of individual samples at a station is generally acceptable for characterising water quality over a long time period (e.g. over a year in a river). If significant differences are suspected or detected, samples may have to be collected daily or on a continuous basis. Individual samples taken at a given station should be obtained at approximately the same time of day if possible, because water quality often varies over the course of the day. Exceptional conditions of stream flow are frequently of interest because it is at maximum and minimum flow rates that extreme values of water quality are reached. For example, when

flowing at its peak rate, a river usually carries its greatest load of suspended material, while pollutants will be the least diluted when a river is at minimum flow.

It is usual to take samples of groundwater at only one depth. Frequency of sampling is low for large, deep, confined aquifers, which typically have long residence times, but higher (perhaps monthly) for shallow, unconfined aquifers with short residence times. Sampling should be supplemented by occasional mapping to describe the aquifer fully.

Sample collection should be frequent enough to enable an accurate calculation of the mean concentrations of the variables included in the monitoring programme. The frequency of sampling required to obtain a desired level of confidence in the mean values depends on statistical measures, i.e. standard deviation and confidence interval.

16.2.1 Water Resources and Quality Monitoring Plan

Considering the lack of water quality and quantity information and absence of baseline water quality information a comprehensive monitoring program is necessary. Water quality and quantity monitoring programs should reflect the possible impacts of the project/activities undertaken. In addition, the program should reflect the possible seasonal and impact changes in volumes, chemical, physical and biological characteristics of the water courses, water bodies and aquifers. The removal of the vegetative cover and the associated vehicular movement along the access roads are expected to provide pathways for the increased transportation of eroded sediments towards the creeks and rivers.

i) Water Quality Parameters

The following parameters should form the core of any monitoring program for the project area. **Table 16.2** gives the parameters to be monitored.

Table 16.2: Water quality monitoring parameters.

Parameters	
a. Total Nitrate b. Salinity c. DO d. COD e. BOD f. PH g. Sulphates h. Hardness	i. Phosphate j. Conductivity k. Heavy metals l. (Total metals, mercury, lead, copper etc.) m. Total dissolved solids n. Hydrocarbons o. Arsenic

ii) Flow Monitoring

Water quantity is necessary to determine the environmental concentration of the chemical, biological parameters.

1. Bimonthly discharges at Sarstun Village, Black Creek, and Graham Creek confluences with the main Sarstoon river channel.
2. Bimonthly Discharges at Otoxha Village, Crique Sarco, Go to Hell Creek, Conejo Creek, and Sunday Wood Creek confluences with the Temash River.
3. Bimonthly discharges at Jordan, Santa Ana, and Boom Creek confluences with the main Moho Channel.

iii) Quality Monitoring

1. Bimonthly water quality measurements at Sarstun Village, Black Creek, and Graham Creek confluences with the main Sarstoon river channel and at the coastal outlet.
2. Bimonthly water quality measurements at Otoxha Village, Crique Sarco, Go to Hell Creek Conejo Creek and Sunday Wood confluences with the Temash river, the Temash lagoon and at the coastal outlet.
3. Bimonthly discharges at Jordan, Santa Ana, and Boom Creek confluences with the main Moho Channel and at the coastal outlet.