



United Nations Disaster Assessment & Coordination (UNDAC)

DEMOCRATIC REPUBLIC OF CONGO EARTHQUAKE IN THE GREAT LAKES REGION



Map No. 4007 Rev. 0 UNITED NATIONS  
January 2004

Department of Peacekeeping Operations  
Cartographic Section

UNDAC Team  
ENVIRONMENTAL ASSESSMENT  
10<sup>th</sup> – 22<sup>nd</sup> February 2008

Alain Pasche (Environmental Expert, Switzerland)  
Dennis Bruhn (Environmental Expert, Denmark)

## Contents

1.	Introduction .....	3
2.	Environmental assessment overview .....	5
3.	Site specific environmental assessments .....	7

## 1. Introduction

### *Overview*

This report describes the activities, findings and recommendations of environmental experts deployed on a United Nations Disaster Assessment and Coordination (UNDAC) team in response to earthquakes in the Great Lakes region of the Democratic Republic of Congo (DRC). Intended audiences include national authorities in the affected areas, donors and other key partners of the Joint UNEP/OCHA Environment Unit (Joint Environment Unit). The report also provides background of the use of the new Flash Environmental Assessment Tool in this emergency. Earlier versions of this document were shared with national authorities at the time of the emergency.

### *Lake Kivu Earthquake*

An earthquake of magnitude 6.1 on the Richter scale struck the province of South Kivu, in Eastern Democratic Republic of Congo on Sunday 3 February 2008 at 07H35 GMT. The epicentre of the earthquake lies approximately 20 km north of the provincial capital, Bukavu, in the locality of Katana (Kabare Territory). Aftershocks were felt. A second earthquake was recorded 25 kilometres from Bukavu at 02H07 GMT with a magnitude of 5.4.

The National Government of DRC requested that an UNDAC team carry out an assessment of the damage and provide a risk analysis report. This UNDAC assessment, of which the environmental experts were part, took place 10-22 February 2008<sup>1</sup>.

### *Role of the Joint UNEP/OCHA Environment Unit*

The Joint Environment Unit is the United Nations mechanism to mobilize and coordinate the international response to environmental emergencies, including natural disasters with major environmental impacts. In situations such as the DRC disaster, the Joint Environment Unit has the primary functions of identifying any acute environmental issues, mobilizing assistance to ensure that they are addressed, and helping to ensure appropriate transition and follow-up so that less urgent, longer-term issues can be addressed during the recovery and rehabilitation phases. It normally does so by ensuring that the United Nations Disaster Assessment and Coordination teams sent to the affected areas contain at least one environmental expert who can conduct a rapid environmental assessment.

### *Flash Environmental Assessment Tool*

A sound methodology or tool to assess the environmental issues and impacts of disasters is vital. Several very good Rapid Environmental Assessment (REA) methodologies are available. However, until recently, no methodology existed for the period immediately following a disaster. The lack of an appropriate tool for this period was recognised during the 6<sup>th</sup> meeting of the Advisory Group on Environmental Emergencies (AGEE) in June 2005, following an independent assessment of lessons from the response to the Indian Ocean Tsunami-Earthquake disaster.

Accordingly, the Dutch National Institute for Public Health and the Environment (RIVM) was contracted by the Joint Environment Unit to develop a Flash Environmental Assessment Tool (FEAT). This tool is to be used

---

<sup>1</sup> For details of the UNDAC team mission please see the report, *United Nations Disaster Assessment & Coordination (UNDAC) Democratic Republic of Congo Earthquake in the Great Lakes Region*.

in the field immediately following natural disasters to assist in the identification of acute and/or life-threatening environmental impacts arising from the disaster. The Crisis Management unit of the Dutch Ministry of Housing, Regional Development and the Environment (VROM-CM) is also a key partner in this initiative.

The primary focus of the FEAT is on the identification of acute risks related to industrial infrastructure and natural systems. As a secondary consideration, the FEAT will also help to identify medium to longer-term issues, given that many of these may be evident, and should be identified, at the earliest stages following a disaster.

The intended users of FEAT include members of United Nations Disaster Assessment and Coordination (UNDAC) emergency response teams and disaster management and/or environmental generalists who are familiar with field assessments, but who may have no specific background in assessing environmental emergencies *per se*. Users will be provided with basic training in the use of the FEAT and should be familiar with it before its use in disaster situations.

The FEAT is organized in modules that move from the general to the specific. The first module, for example, provides a cursory overview of the most probable serious risks in a disaster affected area (the so-called 'big and obvious' problems), and the last module will allow for an 'object assessment' of specific locations or facilities.

In December 2007, a small number of environmental experts were trained in the use of the FEAT.

The mission to Lake Kivu was a first opportunity to use a prototype of this new methodology. The results of the mission will be used to further enhance and develop the FEAT.

## 2. Environmental Assessment

### *Overview: activities of the UNDAC team environmental experts*

Upon arrival to Bukavu, the UNDAC Team environmental experts, in close cooperation with local experts and stakeholders identified a list of major infrastructure, industrial installations and landslides that potentially pose immediate impact on human life and health, and/or as well as longer term impacts on the nature environment, as a result of the earthquake. The FEAT was used as a basis for this. Key findings and recommendations follow.

### *General findings on landslides*

Bukavu suffers from pre-existing land slides which pose a direct risk to human life and health. Several landslides were assessed: at “Institut Technique Fundi Maendeleo” (ITFM) and “Lycée Wima” canyon, both within Bukavu, and at Nyakavogo in Bagira. ITFM and “Lycée Wima” canyon were both affected by the earthquake (i.e. the landslide area was reactivated), whereas the Nyakavogo in Bagira was unaffected. None of the new landslides have had any direct impact to human health. However, the ITFM landslide damaged the electrical line supplying a series of public buildings, public infrastructure and communities. It had not been repaired at the time of writing.

Overall, landslides are believed to be the biggest threat following the earthquake. The assessment clearly identifies the very dense settlement on the steep slopes on both sides of the landslide of the ITFM landslide to pose high risks in event of future earthquakes. Some houses are very likely to have been damaged by the earthquake, and some may be at risk of collapse. The loss of life cannot be excluded in future landslides. To identify the future potential risk to each installation from earthquake and/or from landslides it is important to map the fault system in the region and all historical reported landslides in Bukavu and to addresses the relationship between these two destructive mechanism. The outcome should be used to prepare a prioritized action plan to improve the condition of the storages facilities, and be a key element of city planning.

- **Recommendation: National authorities should consider conducting detailed mapping of the landslides and existing faults and develop an action plan.**
- **Recommendation: National authorities should consider relocation options for the people living on the steep slopes on both sides of the ITFM landslide.**
- **Recommendation: As noted in more detail below, several powerlines should be moved from at-risk areas.**

### *General findings related to infrastructure and industrial installations*

During the assessment of the infrastructure and industrial installations, no immediate, direct impacts on human health were observed. However, the assessment identified several issues that may pose high risks to humans in the event of new earthquakes, as well as issues that could have longer term impacts on human health and on life support systems, including from the spreading of contaminants into Lake Kivu.

In particular, the storage of oil and other chemicals at the industrial installations visited is generally conducted to very low safety standard. In the event of an earthquake these facilities could pose a major fire risk. Furthermore, none of the observed oil or chemical storage sites are designed to cope with a sudden leak. If affected by an earthquake or landslides they could lead to widespread pollution. Due to the location of the majority of these installations, the main risk would be pollution of Lake Kivu.

Site specific findings and recommendations are made in detail below, however four general recommendations are as follows:

- **Recommendation: National authorities should consider setting up of a risk assessment and management entity specialized in natural disaster prevention with a special focus on landslide and earthquake. The setup in Goma (Unité de Gestion des Risques) could serve as a model (see Annex 2).**
- **Recommendation: National authorities should consider developing an environmental emergency contingency plan based on risk mapping and risk assessment**
- **Recommendation: National authorities should consider carrying out a PCB inventory on old transformers**
- **Recommendation: National authorities should consider bringing all installations storing oil or other hazardous chemical up to a higher standard. This would include earthquake proof pipe connections and secured storage.**

*Site specific environmental assessments and recommendations*

Infrastructure and industrial installations damaged by earthquakes can pose risks for human life and health as well as have long term impact on the natural environment and livelihoods. Using the FEAT as a basis, the UNDAC team environmental experts developed a list of priority sites to visit for further field assessments. Table 1 summarizes the sites identified and assessed by the UNDAC Team. Detailed descriptions are provided below.

Table 1. Summary of site visits			
Site #	Name & location	Potential risks	Date of visit
1	Inspection provinciale de l'agriculture	Pesticides, fertilizers	14.02.08
2	Service national de l'électricité (administration)	Ruzizi dam: potential dam collapse and interruption of electricity distribution leading to regional power shortages	14.02.08
3	Régie des Eaux (water board)	Chemicals for water purification Interruption of water distribution	14.02.08
4	Kotecha-Plastic industry	Diverse chemical products	14.02.08
5	Gas station	Oil spill/fire/explosion	14.02.08
6	Chinese Public Works (utility company involved in infrastructure building)	Oil spill	14.02.08
7	Custom warehouse	Hazardous substances Storage	14.02.08
8	Business Petrol Oil	Oil spill	15.02.08

9	Société Exploitation du Pétrole	Oil spill	15.02.08
10	Bralima (Brewery)	Oil/chemical spill/toxic gas	15.02.08
11	Landslides: 1. "Institut Technique Fundi Maendeleo" (ITFM). 2. "Lycée Wima" 3. Bagira	Landslide posing direct risk to human health and infrastructure	18.02.08

*Site descriptions and recommendations*

**Site 01 : Inspection provinciale de l'agriculture**

Findings:

According to the Inspection Provinciale de l'agriculture, only larger commercial farming companies (tea, coffee, quinquina, sugar cane) use agrochemicals in the affected area. Due to high costs, local farmers do not use such products. Furthermore, due to the costs of agrochemicals, only limited quantities needed for seasonal treatments are reportedly stored at farms. Therefore, no central facilities to store large quantities of agrochemicals were needed. Also, as a result of the insecurity in the Kivu region, there is no import, storage or use of significant quantities of pesticides and fertilizer. All major industrial farming companies have ceased their activities.

Conclusions:

In the present environment pesticides and fertilizers do not pose a direct threat to human health or the natural environment. When the farming industry resumes its activities, pesticides and fertilizers could have long-term effects on the environment, especially the aquatic environment, if they are not managed properly.

- **Recommendations: No recommendations.**

**Site 02 : Service national de l'électricité**

Findings:

A concrete dam across Ruzizi River was constructed for the Ruzizi hydro-electric station. It provides electricity to the cities of Goma, Bukavu and Uvira and to Rwanda and Bujumbura (Burundi). The dam is equipped with four turbines and generators with a total capacity of 30.8 [mW]. Generator No IV has been out of operation since 1994 (8.6 [mW]).

One of the remaining turbines (generator No. III - 8.6 [mW] ) is presently at risk of breaking down because the valve which controls the inflow of water was damaged by the earthquake. The rotation speed of the turbine is now at maximum and can no longer be controlled.

It is understood that the World Bank will finance the rehabilitation of the generator IV which is presently out of order. In principle the funds will be made available in May 2008. According to the SNEL the repair of the valves on generator No. III can only be carried out after the complete rehabilitation of generator No IV.

Six of 13 15kV-lines supplying the Bukavu region were damaged by the earthquake and need to be repaired or re-routed because they are crossing large landslides zones. Three out of the damaged six lines are reported as priorities since they supply important public buildings and infrastructure:

Priority power lines	Public building, public infrastructures and communities supplied
Institut technique "Fundi Mandele"	College Wima
	ITFM Technical Institute
	Radio and television aerials
	Orphan home "Village SOS"
	2 water pumping stations
	Villages
Hospitals of Braliva	2 hospitals (Only one is equipped with a back up generator. This later is unfortunately not powerful enough to fully cover the needs of the hospital)
Bagira II and III	Main Bukavu water disinfection plant
	Hospital of Bagira
	Large boarding school for girls
	City of Bagira

Power failures are frequent because the 3 lines that have been repaired temporarily, do not provide enough electricity to meet the needs of the inhabitants and of the public installations. For example, the water disinfection plant can only function at night because there is not enough electricity during day time. This means that water is not always purified.

SNEL has developed a plan to repair and secure these 3 lines. The budget for these works amounts to approximately 450'000 \$.

Two heavily damaged transformer stations (15kV to 0.4 kV) were also visited. They consist of small bricks buildings sheltering a transformer. In one of the installation visited the transformer had almost tipped over. SNEL will completely rebuild the two stations.

Considering the age of the infrastructure, it is very likely that the transformers are old enough to contain PCBs.

**Recommendations:**

- **The three priority power lines (noted above) should be relocated to a safe area that is not prone to landslide. They should be rebuilt in an earthquake-resistant manner (see Annex 1).**
- **The transformer stations should also be rebuilt in an earthquake-resistant manner.**
- **Progress of the rehabilitation of the damaged generators and turbines should be monitored and the damaged valve should be repaired as soon as possible.**
- **Strategic services including hospitals should be equipped with back-up power supply.**
- **Locations of landslides and fault which can disrupt the electric lines should be mapped in order to either stabilize the ground which support the poles, or to find alternative routes.**

- **A PCB inventory should be carried out on old transformers.**

### **Site 03 : Régie des Eaux (Water Board)**

#### Findings:

According to Régie des Eaux, the earthquake did not damage water supply infrastructure. No acute toxic chemicals (e.g. chlorine gas) are used for water purification. The water treatment process consists of decantation, and flocculation with aluminum sulfate (solid) followed by disinfection with calcium hypochlorite (solid).

Bukavu receives water from an installation located in Kabare (1'200 [m<sup>3</sup>/h]). The water is supplied by two main pipes (300 [mm] and 400[mm]). The length of this pipe system is approximately 30 km. Because of the lack of geological risk mapping the vulnerability of the water supply cannot be assessed.

Since access to the pipes is very limited (there is no road which can accommodate trucks and forklifts) maintenance and repair are difficult and time consuming. In most cases the maintenance equipment, spare parts and even the pipes have to be carried by hand.

#### Conclusions:

In the event of an earthquake or landslide, there are no acute toxic chemicals which could be released from the water purification plant, and there are no direct or significant consequences on the environment.

- **Recommendations: No recommendations.**

### **Site 04: Kotecha-Plastic industry**

#### Findings:

The Kotecha-Plastic industry is a private company producing plastic items such as buckets, jerry cans and bags. The facility is located in the center of Bukavu (S02°30'00'' EO 28°51'17''). The production is fully automated and uses only electric energy. The raw material consist of HDP granulates stored in 50 kg bags. Approximately 100 mt of this material is stored in the Kotecha premises. No other chemicals were observed during the plant visit.

#### Recommendations:

No major risks from the HDP were apparent and there are no recommendations for this site.

### **Site no. 05: Gas station**

#### Findings:

At the gas station visited, the gasoline is stored in underground tanks. All gas stations are reportedly built in the same manner.

#### Conclusions:

Damage to the tanks or pipes resulting from either an earthquake or landslide could release diesel or gasoline, which could pollute the soil and possibly the underground water.

There is also a potential risk of a fire in gas stations if pipes were fractured by an earthquake, igniting flammable vapours.

- **Recommendations: The integrity of the tanks should be assessed after each earthquake (pressure test for example). Fire risk should be further assessed.**

#### **Site no. 06 Chinese Public Works**

##### Findings:

The management confirmed to the UNDAC team that the company has two tanks for fuel oil storage. The tanks maintenance and control is outsourced to a specialized company. No additional information was made available by the company management, which denied the UNDAC Team access to the storage facilities.

##### Conclusions:

Because of lack of reliable information it is impossible to assess the potential risk posed by the fuel oil storage tanks.

- **Recommendations: No recommendations can be made.**

#### **Site 07: Custom warehouse**

##### Findings:

Storage of hazardous substances in the custom warehouse is reportedly not permitted. The hazardous substances which arrive in Bukavu get custom clearance immediately and are dispatched without further delay to the importer's premises.

##### Conclusions:

Based on the information provided, the goods stored in the custom warehouse do not present any substantial risk.

- **Recommendations: No recommendations.**

#### **Site 08: Business Petrol Oil**

##### Findings:

Business Petrol Oil is a privately owned oil company located on the shoreline of Lake Kivu. The facility consists of 5 above ground storage tanks (AGST) and 6 under ground storage tanks (UGST).

The AGST are placed directly on the ground without any bunding to prevent small leaks polluting the ground or oil flowing directly into the lake in case of a major spill. The tanks are connected with fixed piping. According to the site manager, only one of the above tanks (capacity 100 m<sup>3</sup>) is being used for diesel fuel.

The UGST farm consists of 6 tanks with an unknown volume, 3 being used for diesel fuel and 3 for petrol. The UGST are all contained inside a concrete structure. The status of the underground part of the concrete structure could not be assessed during the visit. No visible damage was observed on "roof" of the construction.

At present no oil is being handled at the site due to lack of supply, and no damage to the site was reported or observed during the site visit.

#### Conclusions:

The installations were observed to be of very low standard. In event of an earthquake the facility could pose a direct risk to the population. There is both the risk of fire and pollution from leakage of fuel into the lake. Minor oil spills from the daily handling of oil at the facility are also believed to pose a long term risk to Lake Kivu as oil seeps into the ground, and eventually enters the lake via the ground water.

- **Recommendations: All tanks should be fitted with flexible pipe connections in order to absorb minor movements from an earthquake. In order to prevent a major oil spill entering the lake, all ABST should be bunded. Bunding should be to 120% of the capacity of the tanks.**

#### Site 09: Société Exploitation du Pétrole

##### Findings:

The facility located on the shoreline of Lake Kivu. The facility consists of a 1000 m<sup>3</sup> AGST and 4 UGST with a total capacity of 70 m<sup>3</sup>. The AGST is placed on a concrete platform surrounded by a soil-bund. With the exception of some minor fractures in the office building no damage to the facility was observed.

All piping has been installed with fixed connections. The unloading/loading of trucks takes place on a concrete plate. The fractures in the concrete plate are believed to be related to poor construction and lack of maintenance rather than to earthquake activity. The pump station is placed on a concrete plate without bunding.

The bunds are drained of rainwater by a valve which empties into a small field between the facility and the lake. The valve controlling this drainage system was open.

##### Conclusions:

The installations are of very low standard and in the event of an earthquake the facility poses a direct risk to the population. The AGST tank poses a fire risk and leakage could cause environmental pollution. The soil-bund surrounding the AGST only gives limited protection. The open valve is allowing oil to drain into the lake. Minor oil spills from the daily handling of oil are polluting the ground and eventually enters the lake via the ground water. This poses long term risks.

The concrete plate at the unloading/loading site will give some protection from oil seeping into the ground from small spills. It will not provide protection if there were to be a major oil spill from road tankers delivering fuel.

- **Recommendations: The valve in the drainage system must be closed to prevent surface runoff of oil into the lake in the event of a major spill. The existing soil-bund must be replaced by a concrete bund with the capacity of 120% of the capacity of the tank, including a tight concrete bottom plate. Bunding is also required around the pump station.**

#### Site no. 10: Bralima (Brewery)

##### Findings:

The Brewery is a privately owned enterprise belonging to an international group.

The two main possible sources of concern are:

- a large above ground fuel oil storage of 120 [m<sup>3</sup>] (4 tanks)
- a tank containing 400 kg of liquefied ammonia gas

The fuel oil storage is placed on a platform of backfill with insufficient retention capacity. Any damage to the tanks would release of fuel oil into the brewery yard and into the drainage system leading to the lake. The tank containing the ammonia is placed loosely on two breeze blocks of approximately 1 metre high. Both storages have rigid piping system.

Conclusions:

An earthquake could knock over the tank fracturing the pipe system. This would release a toxic gas (ammonia) into a densely populated area.

Both storages facilities are unsafe and could lead to a dangerous discharge of toxic gas and/or fuel and oil.

- **Recommendations: A thorough risk evaluation should be carried out by the safety engineers of the company and appropriate measures implemented to ensure a safe working environment and to prevent the contamination of the lake and air.**

#### **Site no. 11: Landslides (detailed description)**

Findings:

Three main landslides were assessed: the “Institut Technique Fundi Maendeleo” (ITFM), and “Lycée Wima” canyon both within Bukavu and Nyakavogo in Bagira. Assessment results are as follows.

“Institut Technique Fundi Maendeleo” (ITFM):

The ITFM landslide is located in Kadutu along the ridge and the Buholo Fault. The Buholo Fault along the eastern side of the ridge is characterized by steep slopes. The ITFM Landslide has been active prior to the recent earthquake. The previous landslide cuts through a drainage canal leading to an increased infiltration of surface water into the area during the rain season.

The recent earthquake has clearly reactivated the old landslide area. This increased the area affected by land slides, and new fissures in the soil along the ridge of the new landslide were observed. On both sides of the landslide, habitation on the steep slopes is very dense.

The new landslide did not have any direct impact on human health but the electrical line supplying a series of public buildings, public infrastructure and communities was broken and has still not been repaired (see site description 02, above).

“Lycée Wima”canyon:

The “Lycée Wima” canyon landslide is located at the bottom of the ridge just across the ITFM landslide and within the same fault system. A creek crosses the bottom of the canyon. The canyon has clearly been affected by the earthquake. A series of small landslides and new fissures in the soil along the ridge of the canyon were observed. The sides of the canyon are approximately 10 meter high and close to vertical. The new landslides in the canyon seems to be accelerating the erosion of the sides along the canyon

“Nyakavogo, Bagira”

The Nyakavogo landslide is located along the northern slope of the hill on which village of Bagira is built. Close to Bagira is the Nkwinja Nyakovogo fault running in a NNE-SSW direction. The landslide first appeared in July 1997, and was reactivated again in August 2006.

During the site visit, landslide reactivation was not observed. The previous landslide cuts through a drainage canal leading to an increased infiltration of surface water into the area during the rain season.

According to SNEL the power supply line supplying a series of public buildings, public infrastructure and communities was damaged by the 1997 (see site description 02, above).

Conclusions:

“Institut Technique Fundi Maendeleo” (ITFM):

The area around the reactivated landslide is very likely to cause new landslides in the near future. The mechanism for triggering a new or a series of new landslides in this area could include a new earthquake or infiltration of surface water into the fractured soil along the ridge, or a combination of these two factors. The risk of new landslides is believed to increase during the rain season. Infiltration of surface water from the broken drainage canal at the landslide will increase the risk of new landslides in the area triggered by water.

The main direct risk to human health in the area from new landslides is the very dense settlement on the steep slopes on both sides of the landslide. These houses are very likely to be damaged, could be at risk of collapse, and the loss of life cannot be excluded. In case of a major landslide the buildings of ITFM are likely to be affected and in worst case partly collapse.

Secondary risk from new landslides is the damage to infrastructure including the access road and supply of electricity and water.

“Lycée Wima”canyon:

The landslides and accelerated erosion in the canyon do not pose any direct risk to human health. However the electrical power supply for the Hospitals of Braliva is at risk of being damaged, which could leave hospitals without power.

“Nyakavogo, Bagira”

The landslide itself is not believed to pose any direct risk to human health. However a reactivating of the Nkwinja Nyakovogo fault might lead to new landslides in the area causing damage the infrastructure such as the road running parallel to the ridge. In a worst case scenario, houses close the existing landslide zone might be damaged by a new landslide.

- Recommendations for “Institut Technique Fundi Maendeleo” (ITFM):
  - The people living close to the landslide zone should be relocated, and future development of the area for housing must be prevented.
  - Power lines should be re-routed as noted in site description 02
  - Diverting of the broken drainage canal, in order to reduce infiltration of surface water into the area.
  - In order to reduce the effect of future landslides, deforestation of the area must be prevented and reforestation of the slope with trees with a deep root system should be implemented.
- Recommendations for “Lycée Wima”canyon:
  - Reroute the power line supplying the Hospitals of Braliva. See site description 02 for details.

- Recommendations for “Nyakavogo, Bagira”
  - Diverting of the broken drainage canal, in order to reduce infiltration of surface water into the area.
  - Reroute the power line, see site description 02
  - In order to reduce the effect of future landslides, reforestation of the slope with trees with a deep root system should be implemented.

## Annex 1: Provisional cost estimate for electricity distribution network

### *Findings*

13 lines of 15 kV supply the whole Bukavu region. 6 of them are in poor condition and should be repaired or moved because they are crossing large landslides zones. Amongst these 6 lines, 3 are a priority because they are supplying important public buildings and infrastructure:

Line	Public building, public infrastructures and communities supplied
Institut technique “Fundi Mandele”	College Wima
	ITFM Technical Institute
	Radio and television aerials
	Orphan home “Village SOS”
	2 water pumping stations
Villages	
Hospitals of Braliva	2 hospitals (Only one is equipped with a back up generator. This later is unfortunately nor powerful enough to fully cover the needs of the hospital)
Bagira II and III	Main Bukavu water disinfection plant
	Hospital of Bagira
	Large boarding school for girls
	City of Bagira

Power failures are frequent because these 3 lines which have been repaired temporarily do not provide enough electricity to meet the needs of the inhabitants and of the public installations. For example, the water disinfection plant can only function at night because there is not enough electricity in the day time.

Any reduction in the electricity network would lead to increased deforestation as the urban population return to charcoal as the principal fuel for cooking

### *Recommendations*

The 3 above mentioned lines should be relocated in safe area which are not prone to landslide and built in way which is sympathetic with the earthquake environment

### *Proposal*

1. Purchase of material and equipment:
2. Local manpower
3. International support (consultant electrical engineer)

### *Provisional Budget*

\$450,000

### *Timescale*

1 year

## **Annex 2: Provisional cost estimate for a Risk Management and Disaster Preparedness Unit**

The increasing seismic activity in the Lake Kivu Rift has put the population at greater risk from both earthquakes and landslides. A comprehensive risk management mechanism is required to reduce this risk. A risk management unit set up by the government in Bukavu and supported by the international community could fulfill this role. This unit would should initiate preparedness measures and improve the response in case of a natural disaster.

### *Findings*

In general, there is a lack of awareness amongst the private and public sectors about natural disasters and their possible consequences on the population, the infrastructures and the environment.

There is no mechanism in place for risk assessment, management and mitigation.

Existing information, studies and surveys concerning the natural disasters in the region should be collated in one focal point to serve as a base for further investigation and for risk management.

### *Conclusion*

There is an urgent requirement to establish a risk management unit in Bukavu for earthquakes and landslides. This would provide:

- Reliable information on the most vulnerable area (risk mapping)
- An inventory of measures which should be taken to give better protection to the population, infrastructure and the environment
- Urban and rural planning which takes into consideration the risk of earthquakes and landslides

### *Recommendations*

Create in Bukavu a Risk Assessment Unit (Unité de Gestion des Risques) similar to the one which exists in Goma.

### *Proposal*

1. Establishment of the Bukavu Risk Management Unit (Expansion of Goma Risk Assessment Unit)  
Office/ Staff/ Equipment/ vehicle
2. Information Management and Workshops
3. Hazard mapping and contingency planning
4. International support

### *Provisional Budget*

\$800,000

### *Timescale*

2 years