THE GOLD STANDARD:
Project Design Document for Gold Standard Voluntary Offset projects

(GS-VER-PDD)

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The Gold Standard for VERs has received financial support from:

Explanatory information on how to complete the PDD and how to obtain Gold Standard registration can be found in the project developer's manual available on the Gold Standard website.

This template of the PDD is applicable for micro-, small- and large-scale projects. Note that the shaded boxes present information on the Gold Standard VER project development procedures. Project developers should delete these shaded boxes when preparing their PDD.

VOLUNTARY OFFSET PROJECTS

PROJECT DESIGN DOCUMENT FORM (GS-VER-PDD)
Version 01 - in effect as of: January 2006)

Contents

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity

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Title: Zengamina Mini Hydro Scheme

Version: 1.2

Date: 4th December 2007

A.2. Description of the project activity

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A 700KW mini hydro scheme is being constructed by the North West Development Trust at Kalene Hills, North-Western province at a site known historically as the Zambezi Rapids. The scheme is named after the elderly Chief Nyakaseya.

The purpose of the scheme is to provide cheap, clean and sustainable electric power to this remote part of Zambia in the Kalene Hill area of North Western Province of Zambia. It will remove dependence on diesel generators and will supply Kalene Hill hospital, Nyakaseya village, Ikelenenge Trading Centre and chief's palace, Sakeji and Hillwood Farm. Additionally, it will also provide electricity to small commercial entities at Chief's Ikelenge and Nyakaseya capitals on the west to Kalene Hill area and along the main road to Chief Ikelenge's capital, and thence to Hillwood farm on the east side of the area. The project could also provide an inexpensive energy option for lighting (displacing kerosene).

Once completed, the project will promote sustainable development in the area through removal of dependence on diesel generators at Kalene Hospital, Hillwood Farm and Sakeji school. It will also bring a new energy source to some households in the area. By so doing, it will significantly reduce local pollution (carbon monoxide, oxides of nitrogen, and smoke), thereby contributing to the health of the populace around this area, and greenhouse gases (GHGs to include CO2, CH4 and N2O). The project will also bring economic benefits through creation of opportunities for small and medium enterprise development to include agro-processing, and small scale mining. Social benefits will include use of money, to be saved from running expensive diesel electric engine, for purchase of medicines and other requirements at Kalene Hill Hospital. The project will create the basis of a self sustaining, developing local economy, and contribute significantly to poverty reduction.

Results of the main public consultation meetings held in the project area confirm that the project will contribute to sustainable development as provided by the results of the expert judgement below based on the report in Annex 3 "On the requirements of the Gold Standard on the assessment of sustainable development for Zengamina mini hydro, Kalene Hill Mission, North Western Province".

Please include in the description:
- the purpose of the project activity
- the view of the project participants of the contribution of the project activity to sustainable development (max. one page).
-the results from the sustainable development matrix

Section 3.4 of the Gold Standard VER Project Developer's Manual provides guidance on the methodology for assessing the project activity against the indicators of the sustainable development matrix.

Shown in the table below is an assessment of sustainable development based on Voluntary Gold Standard system. Supporting documentation for arriving at the scoring is provided in the table below, is shown in Annex 4, which is based upon expert judgement and the stakeholder consultation.

Table A2.1 Assessment of sustainable development based on Voluntary Gold Standard system.

Component Indicators (A list describing the indicators in more detail is presented in Appendix	Score (-, 0, +)
Local/regional/g/oba/ environment	
Water quality and quantity	0
Air quality (emissions other than GHGs)	+
Other pollutants (including, where relevant, toxicity, radioactivity, POPs, stratospheric ozone layer depleting gases)	+
Soil condition (quality and quantity)	0
Biodiversity (species and habitat conservation)	+
Sub total	+
Social sustainability and development	
Employment (including job quality, fulfilment of labour	+
* Livelihood of the poor (including poverty alleviation, distributional equity, and access to essential services)	+
* Access to energy services	+
Human and institutional capacity (including empowerment, education, involvement, gender)	+
Sub total	+
Economic and technological development	
* Employment (numbers)	+
Balance of payments (sustainability)	0
Technological self reliance (including project replicability, hard currency liability, skills development, institutional capacity, technology	+
Sub total	+
TOTAL	+

In conclusion and on balance, the indicators in table above clearly demonstrate that the project will no doubt bring more sustainable development benefits as opposed to continuation of the baseline.

A.3. Project participants:

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Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Zambia (host)	North West Development Trust	No
United Kingdom	Pioneer Carbon Ltd	Yes
Please list project participants and provide contact information in Annex 1.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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As specified in section 3.2.2. the Gold Standard VER Project Developer's Manual, the project can be located in any country that does not have a quantitative reduction target under the Kyoto Protocol.

A.4.1.1. Host Party(ies):

>> Zambia

A.4.1.2. Region/State/Province etc.:

>> North Western Province

A.4.1.3. City/Town/Community etc:

>> Mwinilunga district - Kalene Mission

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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The project site is situated 1000 km from the capital city Lusaka. The exact location is S11^{o} 07.472', E24^{o} 11.698'. Within the project area, the site is located 6km north of Kalene mission hospital on the track to Salujinga on the Zambezi River at a site known historically as Zambezi Rapids. The Zambezi is a small river at this location, being near its source some 50km away. The river flows along granite dome, falling about 17meters over about 300 m length of rapids. The site has been chosen since it has the necessary slope suitable to support the development of a mini hydro electric project. The Zambezi River has a very gradual fall up until the rapids section. At the rapids the river drops 5.4metres over the 300metre distance, which makes the water pressure "head" suitable to operate a small turbine.

Figure 4.1 Shows the general location of the site in Zambia and indicates the project site.

Zengamina Hydro Electric Scheme,

Zambezi River, NW Zambia

Figure 4.1 General location of Zengamina hydro electric scheme

The power line extends from the Chief's capital at Nyakaseya on the west, to Kalene area, along the main road to Chief Ikelenge's capital, and thence to Hillwood Farm and Sakeji School on the east side of the area.

The Zambezi river is 26metres in width upstream of the site, widening over the rapids to 60 meters in width before splitting into two channels around the island in the centre of a right angle bend in the course of the river. The catchment of the site is 600 square kilometres. Mean annual rainfall is 2100 mm and the minimum on the record is 1300mm.

A.4.2. Size of the project:

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The size of the project is 700kW and falls under the category Small Low Impact hydro, with a size limit of 15 MW – complying with the World Convention on Dams Guidelines.

It is a micro scale project as defined by the Gold Standard, projected to produce fewer than 5,000t CO2e reductions per year.

Please specify the size of the project (micro-, small- or large-scale project) according to the thresholds described in the Introduction of the Gold Standard VER Project Developer's Manual.

A.4.3. Category(ies) of project activity:

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The Project falls under Category A1 in Appendix A of the Gold Standard VER Project Developer's Manual: Renewable Energy

In this case, it is a 700KW mini-hydro replacing diesel electric plants at the Kalene Hills hospital, Hillwood farm and Sakeji School and providing electricity to previously unserved areas to include schools, clinics and commercial/industrial entities.

The mini hydro being developed is run of the river scheme consisting of low head weir (restraining wall for water), 300 metre canal (to channel water to the headpond), head pond (for settling the water to remove silt and debris and channels it into a 1.6 metre diameter penstock), 75 metre penstock and power house. The power house is housing electro-mechanical equipment, and control panel, which in turn is connected to a step up transformer on the ground level 20 metres from the power house. From the transformer will be power lines installed on wooden poles to transmit electric power to different locations along the 35km route.

The scheme is a run of a 'river' concept which will not store water upstream of the weir. The purpose of the civil infrastructure is to deliver water from the Zambezi River upstream of the rapids via a canal to a large diameter penstock conduit to the turbine. The penstock is above ground and cradled on masonry pedestals. The power station is concealed from view from large trees at the site of the river, and the tailrace leads the flow back to the river, downstream of the site.

Since the scheme is run-of a river, there is no displacement of people. Besides, the very small storage area will have minimum impact on vegetation as the rise in water level from the weir will be less than the flood levels in the river.

Based on the explanation above, the technology being employed is environmentally sound and safe, and it does not emit any GHGs. The transfer of technology is being made possible by kind donation of the equipment by friends of the Trust. Given below is an aerial pictorial view of the mini hydro site**.**

Please use the list of categories of project activities listed in Appendix A of the Gold Standard VER Project Developer's Manual.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

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In this project activity, the 700kW mini hydro being constructed will replace existing diesel electric plants at Kalene Hill mission, Hillwood Farm and Sakeji School and provide electricity to previously unserved areas. The amount of CO_{2e} to be reduced will be gradual starting with 558 tonnes in year 1 (2008) to 3631 tonnes in year 15 (2022). The cumulative projected emission reductions are 43,855 tonnes for the 15 year duration. Detail for the emission reductions calculations is provided in Section B.

To satisfy the Gold Standard Additionality screen, the following five parts were considered:

(1) Measurability of ERs (2) technology transfer (3) previous announcement (4) UNFCCC additionality tool (5) ODA

1. Measurability of emission reductions

The baseline for the Zengamina mini hydro project, follows that outlined in category 1.D Renewable Electricity Generation for a Grid of the Simplified M & P for Small Scale CDM project activities. .

The selection is appropriate because the alternative of this project is continued use of isolated thermal diesel generating units for electricity generation. CO2 emission reductions are equivalent to the energy exported from the plant in kWh multiplied by the emission factor of 0.8 kg CO_{2e} /kWh from table 1.D.1 of Appendix B of the simplified M&P for diesel baseline.

2. Introduction of technology and /or knowledge innovation to the host country

Technology in the form of plant and machinery was obtained from Germany, UK and India and therefore transfers both technology and knowledge into the host country.

3. Previously announced project screen

This project activity was initially identified as part of the activity of the African Rural Energy (AREED) Initiative 2001. At that point, there was no "champion" to drive the project. Later, Mr Charles Rea became interested in the project, and from inception, the concept of CDM and carbon finance was introduced to Mr Charles Rea. Specifically this was done through:

- Centre for Energy Environment and Engineering (CEEEZ) during its CDM Capacity Building programme in the Private Sector in Southern Africa (CDM-CAPPSA) project in 2001/2002.

- During the World Bank supported project "Increased Access to Energy Services"(IAES), Mr Charles Rea had discussions with Mr Mike Bess, World Bank consultant, who in turn also interested Mr Charles Rea to implement the project with CDM in mind. Annex 5 shows the Zengamina Mini Hydro Scheme Feasibility Study report, written in October 2003, which includes the financial analysis conducted by Mike Bess and Bob Chronowski conducted for the PCF on the IAES mission in October 2003. This was discussed with both Government and ZESCO (Zambia Electricity Supply Company) as early as October 2003.

- Annex 6 also shows further evidence for inclusion of carbon finance in early feasibility assessments, showing the memorandum 'Isolated Grid Hydroelectric Power Opportunities for CDM' written by Bob Chronowski with the Government and the Prototype Carbon Fund (PCF).

Therefore, whilst developing the project, Mr Charles Rea, the project proponent, considered carbon finance as integral to his financial and project plans.

4. UNFCCC Additionality Tool

To assess and demonstrate additionality of the project, the UNFCCC's Additionality Tool 3 was used based on the following steps.

Step 0: preliminarily screening based on the starting date of the project activity

- Project construction started in 2005 and it is expected that the project activity will commence in 2007, with transmission lines in place by start 2008.
- Although the project construction began prior to 2006 (a key date in the VGS), carbon finance was always considered vital in contributing to ongoing operation and maintenance once activity commenced (as explained above in previously announced screen, section A.4.4 (3)).
- The innovative nature of the VGS and its lower transaction costs for project of this scale compared to the Clean Development Mechanism means that the project has access to carbon finance.

Step 1: Identification of the alternatives to the project activity consistent with current laws and regulations.

- In the absence of the project activity there would be continued use of diesel.

Step 1b: Consistency with mandatory laws and regulations

The continuation of the existing situation is in compliance with all applicable legal and regulatory requirements of Zambia.

Having satisfied step 0 and step 1 additionality screens, additionality demonstration under the selected Small Scale project activity has been based on both barrier analysis and investment analysis.

Step 3a: Barrier Analysis

(i) Financial/Investment Barrier

- Various attempts and studies have been conducted by Kalene Mission in the last 40 years to construct a hydro-scheme at the Zambezi River rapids, but no development followed.

- Financing of the operations of Kalene Mission is mainly from donations from friends of the mission. Such donations have not included financial resources to implement the Zambezi river rapids mini hydro since the financing received was only adequate for the operations of the mission. It is only in 2002 that a feasibility study was initiated by friends of the Kalene Hill Mission. However, due to limited financial resources available in form of donations, the prevailing situation is that in the absence of project capital and revenue leverage through participation in the voluntary carbon market (VCM), the project activity would not be implemented due to financial barriers through operation.

- Additionally, the prevailing situation in Zambia is that in the absence of external capital and revenue leverage through participation in VCM, the project activity will not be implemented due to financial barriers. This is the case because projects of this magnitude in Zambia find lots of problems with funding from local financing for their implementation. Due to limited knowledge, local banks find such investments risky and in most cases they only provide short term financial support with high interests and short grace period.

- Commercial long term credit is not usually available from local financial institutions without additional incentives that come from VCM for this type of small scale project in view of the risks perceived by financial institutions. The project participants had initially approached several financial institutions, who had all declined to finance a new technology such as this.

- Simple cash flow analysis shows that without carbon finance, the project has negative cash flow in the early years. Without carbon finance, in the first few years the ongoing operation and maintenance would be unfeasible. Tariff income is not sufficient to ensure the continuation and viability of the project in this critical period. Carbon finance is helping to fill the gap and ensure the project continues through these important years whilst transmission lines are put in place and connections are made.

- The table below shows simple cash flow before loan repayments and depreciation of capital equipment, which demonstrates that without carbon finance the project is unviable. The financial assumptions are appended in Annex 7.

Table A.4.4.1

Net flow	2008	2009	2010	2011	2012
Without carbon finance	-$80,804	-$22,257	$20,340	$49,300	$61,265
Cumulative	-$80,804	-$103,060	-$82,720	-$33,421	$27,845
With carbon finance	$8,417	-$20,850	$21,755	$51,065	$63,209
Cumulative	$8,417	-$12,433	$9,322	$60,388	$123,597

Given significant depreciation and the difficulty in obtaining credit, it is vital the project breaks into profit as early as possible to ensure continuation and the completion of power lines and connections.

Furthermore, it is common for small hydro plants of this kind to face higher operational costs than expected, particularly in the early years, making the contribution of carbon finance even more critical.

(iii) Technology Barrier

- The type of technology being implemented in this project activity is new in Zambia and hence requires technology transfer and skills since Zambia as a country does not have a manufacturing base to produce the electromechanical machines for the mini hydro, and design, construction and commissioning experience.

iv) Prevailing Practice

- It is not common practice in Zambia for small private hydro plants to operate. This is so because hydroelectricity generation, transmission and distribution in Zambia is dominated by two large electric plants feeding the national grid and by isolated diesel plants, where there is no national grid. Additionally, since there has been no significant small hydro development serving isolated grids in Zambia, the proposed activity is also not “common practice”. Information on the type of technology currently being used for electricity generations from big hydro is readily available at both ZESCO limited and Ministry of Energy and Water Development.

Step 4: Common Practice Analysis

- In the history of Zambia’s hydroelectricity development, the emphasis has been on large hydro schemes dominated by the Government. Besides, the law did not allow the private sector to participate in this industry until 2001, when the Electricity Act was repealed to allow the private sector. The Zengamina mini hydro is the first of its kind to be run by the private sector and being in the small scale category. For theses reasons, the project is not common practice.

Step 5: Impact of GS VER registration

- The financial benefit from revenue obtained by selling the CO2 emissions reductions removed the financial barriers facing the project developer. In the absence of VCM, the project would have suffered negative cash flow in the critical early years as shown in section A.4.4 above, and there would be a high probability of failure without sufficient funding.

5. ODA additional screen

The financial resources being used to implement the project construction is from donations from the friends of Kalene Hill mission, and does not include ODA to the Zambian Government.

Records are available from the project proponent to confirm the source of funding which does not include ODA financing.

Following all steps of the additionality test, it can be clearly demonstrated that the proposed project activity is not the baseline scenario, faces significant barriers and is therefore additional.

Please explain briefly how anthropogenic greenhouse gas (GHG) emission reductions are to be achieved (detail to be provided in section B) and provide the estimate of anticipated total reductions in tonnes of CO_2 equivalent as determined in section E. Max. length one page.

Project participants should assess additionality in a conservative manner so as to avoid the crediting of business-as-usual activities. Please refer to the UNFCCC's "Tool for the demonstration and assessment of additionality" (see http://cdm.unfccc.int/EB/Meetings/016/eb16repan1.pdf) as explained in section 3.3.2 of the Gold Standard VER Project Developer's Manual.

A.4.4.1. Estimated amount of emission reductions over the crediting period:

>>
For systems where all fossil fuel fired generating units use diesel fuels, the baseline is the annual kWh generated by the renewable units multiplied by an emission factor for a modern diesel generating unit of the relevant capacity operating at optimal load as given in table 1D of Appendix B of the Simplified M & P for Small Scale CDM project activities-Indicative simplified baseline and monitoring methodologies for selected small scale CDM activity.

The energy production from Zengamina mini hydro project is assumed to grow from 697,976 kWh per annum to 4,538,684 kWh per annum during the 15 year crediting period, and will replace an equivalent capacity from diesel, and also taking account of suppressed demand delivering clean energy to new customers. Given in the table below is estimated amount of emission reductions over the crediting period.

Please indicate the chosen crediting period and provide the total estimation of emission reductions as well as annual estimates for the chosen crediting period in the following table.

Years	Annual estimation of emission reductions in tonnes of CO2 e
1	558.38
2	1,406.71
3	2,021.89
4	2,522.38
5	2,776.58
6	2,964.26
7	3,128.01
8	3,295.35
8	3,452.20
10	3,605.89
11	3,618.38
12	3,621.51
13	3,624.69
14	3,627.80
15	3,630.95
Total emission reductions (tonnes of CO2 e)	**43,854.96**
Total number of crediting years	15 years
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	**2,923.66**

SECTION B. Application of a baseline methodology

Baselines must be constructed in a conservative manner in order to reduce the risk of artificially inflating the number of VERs received by a project activity.

Section 3.3.4 of the Gold Standard Project Developer Manual provides further explanation on the interpretation of a conservative approach required for Gold Standard compliance.

Where project participants wish to propose a new baseline methodology (other than MethPanel, SSC WG or the UNDP MDG Carbon Facility approved methodologies), please direct it to the Gold Standard TAC to be approved and validated.

B.1. Title and reference of the approved baseline methodology applied to the project activity:

>>
Title: Replacement of Diesel Electric Plants Serving Isolated Grids with a Mini-hydro
Reference: Renewable Energy Projects (Type 1)
Specific: 1.D. Grid Connected Renewable Electricity Generation.
The reference has been taken from Appendix B of the simplified M&P for small scale CDM project activities – version 11.

Please refer to the UNFCCC CDM web site (http://cdm.unfccc.int/), appendix C to the simplified M&P for the small-scale CDM project activities or UNDP web site (http://www.undp.org/mdgcarbonfacility/index.html) for the title and reference list as well as the details of approved baseline methodologies or use the Gold Standard references when a new validated methodology has been used..

Please note that the table "Baseline Information" contained in Annex 2 is to be prepared in parallel to completing the remainder of this section.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

>>
The project activity is replacing fossil fuel based electric generating plants serving three isolated grids with a mini hydro which is a renewable energy resource.

In developing the baseline for the Zengamina mini hydro project, it is assumed that it will follow that outlined in category 1.D Renewable Electricity Generation for a Grid of Simplified M & P for Small Scale CDM project activities - Indicative simplified baseline and monitoring methodologies for selected small scale CDM activity.

The selection is appropriate and has to do with the fact that the alternative of this project is continuation of the use of isolated thermal diesel generating units for electricity generation. It involves replacement with hydro renewable energy generation that will supply energy to displace energy from the existing system. The capacity is 0.7MW, projected to generate under 5000t a year, which is therefore within the boundaries for small scale methodology.

Please justify the choice of methodology by showing that the proposed project activity meets the applicability conditions under which the methodology is applicable or the choice of submitting a new methodology to the Gold Standard TAC.

B.2. Description of how the methodology is applied in the context of the project activity:

>>

According to the baseline methodology activities contained in Appendix B of the Simplified M & P for Small Scale CDM project activities such as those derived from Zengamina mini hydro project, emissions reduction are those that result from application of the formula contained in B.1.1. The energy to be derived from this project is assumed to grow from 697,976 kWh per annum to 4,538,684 kWh per annum during the 15 year crediting period.

Given in the table below is the expected firm energy during the fifteen year period. This is based on projected daily kWh multiplied by the number of expected operational turbine days.

Year	***Electricity Generated (kWh)***
1	697,976
2	1,758,383
3	2,527,367
4	3,152,970
5	3,470,720
6	3,705,331
7	3,910,010
8	4,119,186
9	4,315,248
10	4,507,358
11	4,522,972
12	4,526,886
13	4,530,866
14	4,534,745
15	4,538,684

- thus adding an equivalent amount of CO2 emissions equivalent to the firm energy kWh multiplied by the emission factor of 0.8 kg CO2 EQUIV /kWh from table 1.D.1 of the simplified M&P for SSC project activities.

An extensive door to door demand survey was carried out. This provided a good understanding about what people use on energy currently, to assist in making the future demand projections. It also helped to project the ability to pay for services at different pricing levels. In addition, two World Bank experts visited the project and helped input into the projected consumption figures for the major stakeholders. The projected demand growth is set out in Tables 1 and 2 of Annex 7.

The data used to determine the hydro plant's capacity is provided in Annex 2.

Please explain the basic assumptions of the baseline methodology in the context of the project activity and show that the key methodological steps are followed in determining the baseline scenario. Provide the key information and data used to determine the baseline scenario (variables, parameters, data sources etc.) in table form.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered VER project activity:

>>

Energy supply in the Kalene Hill is currently being provided with three isolated diesel generated plants with their corresponding mini grids at Kalene Hill mission (200kW), Hillwood farm (100kW) and Sakeji School (50kW) .The current systems do not operate on 24hour basis due to limited energy supply. For example, all the three isolated systems operate only in the evening between three to four hours. The Zengamina mini hydro once operational will not only serve the existing demand but take account of suppressed demand from existing systems and in households. To achieve this, a power line has been constructed to feed into the existing micro grids and also serve previously un-served areas.

Plans to replace the diesel electric plant serving an isolated grid with mini-hydro have been on the drawing board for over 40 years. Implementation has not been possible due to lack of financial resources for project finance.

During the same period, Zambia was rated as a low credit-worth country as a result of a communist economy prevailing at the time. However, in the last 10 years, Zambia's credit-worthiness is slowly being restored as a result of Government's policy on liberalisation and market economy. Under this scenario, the private sector is being allowed to participate in energy business as IPPs. However, as a result of the past legacy, local financial resources are not readily available for local investors to implement projects of this nature.

In the absence of the project activity, the region's energy requirement would have been produced and generated by fossil fuel powered diesel plants for electricity generation. As indicated earlier, the Zengamina mini hydro project will reduce GHG emissions of a projected 43,855 tonnes over the 15 year crediting period. As energy from HEP is renewable, emissions will be zero. The emissions reductions are therefore calculated by multiplying the annual kWh projected to be generated by the hydro plant, by the relevant emission factor for diesel.

For the project period (15 years), this equates to:
54,818,702 kWh x 0.8kgCO2e/kWh = 43,855 tonnes CO2e

The prevailing situation is that in the absence of external capital and revenue leverage through participation in the carbon market, the project activity would not be implemented due to "financial/investment barriers", principally by a substantial projected loss in the first few years of operation. Furthermore, the technology is not common practice and without the project activity would remain too costly a tariff without the carbon finance for consumers. Additionally, technology barriers would also prohibit implementation of the project. The project will benefit from carbon revenue realised through the VCM, which will contribute towards the cost of O &M. For these reasons, the project is "additional" and is not the baseline scenario.

Elaboration of the additionality test briefly described above is given in A.4.4. paragraph 4 (UNFCCC additionality tool).

Explanation of how and why this project is additional and therefore not the baseline scenario in accordance with the selected baseline methodology. Include 1) a description of the baseline scenario determined by applying the methodology, 2) a description of the project scenario including national policies relevant to the baseline, and 3) an analysis showing why the emissions in the baseline scenario would likely exceed emissions in the project scenario.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

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Boundary

The project boundary, defined in Appendix B of the simplified modalities and procedures, encompasses the physical, geographical site of the renewable generation source. The project is situated on the Zambezi Rapids on which the project weir has been constructed. The Zengamina mini hydro project will cover the following load centres: Kalene Hill mission, Chiefs' Nyakaseya and Ikelenge palaces, Hillwood farm, and Sakeji school through a power line which has been constructed.

The Zambezi is a small river at this location, being near its source some 50km away. The catchment of the site is about 600 km^2 and the mean annual rainfall of the area is about 1500 mm. The maximum recorded rainfall is 2100 mm and the minimum on record is 1300 mm. The river flows along granite dome, falling about 17 meters over about 300 m length of rapids. The Zambezi River up until the rapids section has a very gradual fall. At the rapids the river drops 5.4metres over the 300metre distance, which makes the water pressure "head" suitable to operate a small turbine. The head is 17 meters and minimum and maximum flow rates are 5 m^3/s and 300 m^3/sec, respectively. Based on this inputs, the installed capacity of the project has been estimated at 700kW.

Areas of influence

The direct area of influence of the Zengamina mini hydro project comprises low head weir (restraining wall for water), 300metre canal(to channel water to the head pond), head pond(for settling the water to remove silt and debris and channels it into a 1.6 metre diameter penstock), 75metre penstock and power house. The power house is housing electro-mechanical equipment, and control panel, which in turn is connected to a step up transformer on the ground level 20 metres from the power house. From the transformer will be power lines installed on wooden poles to transmit electric power to different locations along the 35km route.

Within the baseline project boundary, are direct on-site emissions from fuel combustion of the diesel electric engines, and direct off-site from transportation of diesel from the Copperbelt to Kalene Hill as shown as shown in figure 4.1 below, which are not included in calculation of the emission reductions. Figure 4.2 shows the project boundary of the project activity. In the project activity boundary, leakages are assumed to be zero due to the negligible amounts of fuel of the following:

- Transportation of diesel required for the operations of the diesel electric engines during baseline conditions. This is so because calculations have shown that this amount is less than 2% of total combined diesel consumed for transportation and operations

- Transportation of hydro electric equipment and machinery from Lusaka to the site and during construction

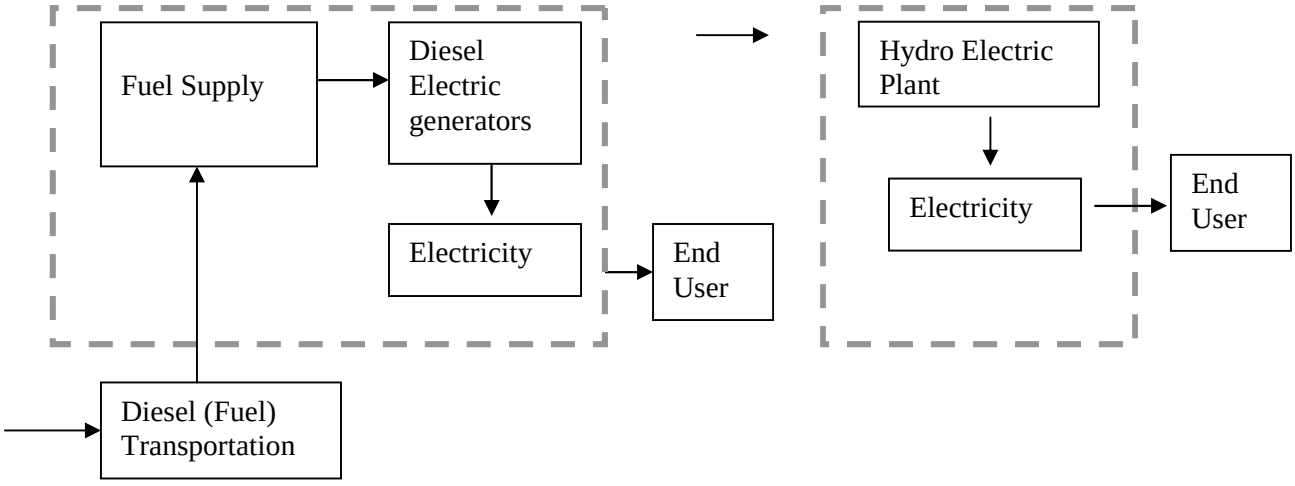

Figure 4.1 Baseline Project Boundary

Figure 4.2 Project Activity Boundary

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

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For systems where all fossil fuel fired generating units use diesel fuels, the baseline is the annual kWh generated by the renewable units multiplied by an emission factor for a modern diesel generating unit of the relevant capacity operating at optimal load as given in table 1D of Appendix B of the Simplified M & P for Small Scale CDM project activities-Indicative simplified baseline and monitoring methodologies for selected small scale CDM activity.

The energy derived from Zengamina mini hydro project is assumed to grow from 697,976kWh per annum to 4,538,684 kWh per annum during the 15 year crediting period, and will replace an equivalent capacity from thermal plants, and also taking account of suppressed demand.

It is postulated that this growth in demand for energy over the project period is currently suppressed due to the lack of access to energy services, due to their high cost and remote location of the communities surrounding the project within Zambia. There is a trend towards economic growth in the area and in the future any growth in energy usage in the absence of the Project Activity would come from fossil fuels. This applies to households as well as organisations. It is anticipated the hydro plant will supply a small amount of energy for use in cooking and water heating. In some instances this will displace firewood use (Official Zambian statistics from the State of the World's Forests and UN Global Forest Assessment (2005) indicate forest cover is still decreasing in Zambia, therefore firewood use is non-renewable). However, in the majority this usage will be from suppressed demand. Therefore it is valid to claim all the energy generated by this renewable energy project is reducing greenhouse gas emissions.

The baseline requires measurements and recording of electricity consumed on a monthly and yearly basis during the period of the project activity in kWh. This parameter is then multiplied by an emission factor of 0.8kgCO_2/kWh. The emission factor is obtained from table 1.D.1 "Emission factors for diesel

generator systems($kgCO2_{Equiv}$/kWh) under the simplified baseline and monitoring methodologies for selected small scale CDM project activity categories"

According to the baseline methodology activities contained in Appendix B of the Simplified M & P for Small Scale CDM project activities such as those derived from Zengamina project, emission reductions are those that result from application of the formula above. With project emissions are therefore zero as HEP is a clean energy.

Date of completing the final draft of this baseline section *(DD/MM/YYYY)*: (20/04/2007)
Name of person/entity determining the baseline:

Prof Francis Yamba
Centre for Energy, Environment and Engineering (Z) Ltd
Private Bag E721, Lusaka Zambia
Tel/fax : +260 1 240 267
Email: fdyamba@yahoo.co.uk / ceeez@coppernet.zm

This person is not a Project Participant

Please attach detailed baseline information in Annex 2. Please provide date of completion in *DD/MM/YYYY*. Please provide contact information and indicate if the person/entity is also a project participant listed in Annex 1.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>> January 2008

Duration of project activity : 15 Years

The starting date of a VER project activity is the date on which the implementation or construction or real action of a project activity begins.
The Gold Standard accepts projects that have been working towards GS VER registration after 1st January 2006.

C.1.2. Expected operational lifetime of the project activity:

>> 30y-0m

Please state the expected operational lifetime of the project activity in years and months (e.g. 2y-4m).

C.2 Choice of the crediting period and related information:

>>

Fixed 15 year period, appropriate for a micro scale project.

The fixed crediting period of 15 years has been chosen because this gives the best balance between security of income and reduction of transaction costs for the project.

Please state whether the project activity will use a renewable or a fixed crediting period and complete C.2.1 or C.2.2 accordingly.
Note that the crediting period may only start after the date of registration of the proposed activity as a VER project activity.

C.2.1. Renewable crediting period

>> N/A

Each crediting period shall be at most 7 years for small- and large-scale projects and 7 years for micro-scale projects and may be renewed at most two times, provided that, for each renewal, the verifier determines and informs the Gold Standard that the original project baseline is still valid or has been updated taking account of new data where applicable;

C.2.1.1. Starting date of the first crediting period:

>> N/A

Please state the dates in the following format: (DD/MM/YYYY). For a definition of the term "starting date", please refer to the UNFCCC CDM web site.

C.2.1.2. Length of the first crediting period:

>> N/A

Please state the length of the first crediting period in years and months (e.g. 2y-4m).

C.2.2. Fixed crediting period:

>> Yes – 15 years.

Fixed crediting period shall be at most ten (10) years for small- and large-scale projects and fifteen (15) years for micro-scale projects..

C.2.2.1. Starting date:

>>

Starting date of the project activity: 2005 (construction started)

Starting period of crediting period: January 2008 - when electricity will be transmitted through the power lines to the communities from the hydro scheme.

Please refer to section A.4.4, section 4 Additionality Tool, step 0 for further explanation.

Please state the dates in the following format: (DD/MM/YYYY). For a definition of the term "starting date", please refer to the UNFCCC CDM web site.

C.2.2.2. Length:

>> 15 years 0 months

Please state the length of the crediting period in years and months

SECTION D. Application of a monitoring methodology and plan

This section shall provide a detailed description of the monitoring plan, including an identification of the data and its quality with regard to accuracy, comparability, completeness and validity, taking into consideration any guidance contained in the methodology.

The monitoring plan is to be attached in Annex 3. The Gold Standard requirements for the monitoring plan can be found in section 3.5.1 of the Gold Standard VER Project Developer's Manual.

The actual project performance must be assessed against the projected outcomes of the sustainable development assessment, on an annual basis. Where quantitative measurements are required information on the relevant data to be collected should be noted in the table presented in Annex 3.

If an EIA has been conducted, then the table needs to be extended to allow:

1) Assessment of the implementation and effectiveness of the identified mitigation measures.
2) Assessment of the implementation and effectiveness of the identified compensation measures.
3) Monitoring of the impacts.

Operational entities will verify that the monitoring methodology and plan have been implemented correctly and check the information in accordance with the provisions on verification. This section shall provide a detailed description of the monitoring plan, including an identification of the data to be collected, its quality with regard to accuracy, comparability, completeness and validity, taking into consideration any guidance contained in the methodology, and archiving of the data collected.

Please note that data monitored and required for verification and issuance are to be kept for two years after the end of the crediting period or the last issuance of VERs for this project activity, whatever occurs later.

For further information on monitoring, see section 3.5.1 of the Gold Standard Project Developer Manual. For more information on the Sustainable Development Assessment and EIA requirements, see sections 3.4.1 and 3.4.2.

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>

The methodology to be used for monitoring purposes is that for Type 1. D., renewable energy electricity into a grid. In this case, mini-hydro generating electricity supplying an existing isolated grid currently served by diesel electric plants. This specifies that 'monitoring shall consist of metering the electricity generated by the renewable technology'.

The monitoring plan involves measurement of electricity generated with the help of a kWh meter on monthly, and yearly basis. The electricity generated in kWh will be multiplied by the emission factor of 0.8kgCO_2/kWh mentioned in Section B5 to obtain baseline emissions. This information will be supplemented by metering records for individual customers.

Please refer to the UNFCCC CDM and Gold Standard web site for the name and reference as well as details of approved methodologies. Any monitoring methodology needs to meet the Gold Standard requirements and this will be subject to validation.

If a national or international monitoring standard has to be applied to monitor certain aspects of the project activity, please identify this standard and provide a reference to the source where a detailed description of the standard can be found.

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

The methodology selected is applicable since it applies to renewable energy generation from hydro that displaces electricity from fossil fired units, in this project from diesel.

Please justify the choice of methodology by showing that the proposed project activity and the context of the project activity meet the conditions under which the methodology is applicable.

D.2. 1. OPTION 1: Monitoring of the emissions in the project scenario and the baseline scenario

Data shall be archived for 2 years following the end of the crediting period. Please add rows to the table, as needed.

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

N/a – with project is assumed to be zero emissions.

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.1.2. Data to be collected in order to monitor project performance on the most sensitive sustainable development indicators:

Sustainable Development Indicator	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Frequency of monitoring	Comment
Economic	*Indicator*	*Employment numbers*	*Quantity*	*m*	Continuously updated	It is projected that several new jobs will be created, including 10 full time and around 40 casual staff. Staff numbers are maintained on the company books, which will be used in the monitoring of this indicator. This is detailed further in Annex 3.
Social	*Indicator*	*Livelihood of the poor in relation to poverty alleviation and access to essential services*	*Qualitatively assessed*	*e*	Annual	Qualitative stakeholder assessment will be used to assess impacts on poverty alleviation. This will include some consultation with key stakeholders. This is detailed in Annex 3.

Social	*Indicator*	*Access to essential services – number of connections made/number organisations connected*	*Quantity*	*m*	Continuously	Records of number of connections made, and which organisations are connected, will be maintained continuously. These will be available for annual monitoring of this indicator. This is detailed further in Annex 3. This is detailed further in Annex 3.

Note: Indicators are as elaborated in table A.2.1 and in Annex 3.

D.2.1.3. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)

>>

Formulae should be consistent with the formulae outlined in the description of the baseline methodology.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
EG_Y	Net electrical output	Electricity supplied by the project. Monitoring will be carried out by a KW hour meter in the power station, by another meter on the main substation transformer, and at each transformer along the way.	kWh	m	Continuous	100%	Electronic and paper records	Results can be cross checked by the records of revenue collection by end user. See Annex 3 for detail.

EF_{BL}	Emission factor coefficient	CO2 Emission coefficients of generator systems	kgCO 2/kWh	c	At the beginning of the project	100%	Electronic	IPCC default

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)

>>

The emission reduction *ERy* by the project activity during a given year *y* is the difference between baseline emissions (*BEy*), project emissions (*PEy*) and emissions due to leakage (*Ly*), as follows:

$ER_y = BE_y - PE_y - L_y$

where the baseline emissions (*BEy* in tCO_2) are the product of the baseline emissions factor (EF_{BL} in tCO_2/kWh) times the electricity supplied by the project activity to the grid (EG_y in kWh), as follows:

$BE_y = EG_y * EF_{BL}$

Formulae should be consistent with the formulae outlined in the description of the baseline methodology.

D. 2.2. OPTION 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

Formulae should be consistent with the formulae outlined in the description of the baseline methodology.

D.2.3. Treatment of leakage in the monitoring plan

Monitored data shall be archived for 2 years following the end of the crediting period. Please add rows to the table below, as needed.

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

No sources of leakage have been identified.

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

N/A
>>

Formulae should be consistent with the formulae outlined in the description of the baseline methodology.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)

>>

The emission reduction *ERy* by the project activity during a given year *y* is the difference between baseline emissions (*BEy*), project emissions (*PEy*) and emissions due to leakage (*Ly*), as follows:

$ER_y = BE_y – PE_y – L_y$

where the baseline emissions (*BEy* in tCO_2) are the product of the baseline emissions factor (EF_{BL} in tCO_2/kWh) times the electricity supplied by the project activity to the grid (Eg_y in kWh), as follows:

$BE_y = EG_y * EF_{BL}$

Formulae should be consistent with the formulae outlined in the description of the baseline methodology.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
kWh	*low*	*Frequent calibration of kWh meter and Correlation of main kWh meter readings with meters from major customers and customer groups and confirmation of power consumption.*

Data items in tables contained in sections D.2.1 or D.2.2, as applicable.

D.4. Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

The North West Development Trust is a Non Governmental organisation with a Board of Trustees including 6 members. The Board of Trustees are responsible for policy formulation and guidance. Zengamina power Ltd. Has day to day management of the Trust's operations handled by a management team headed by Charles Rea. Charles Rea is an engineer with over 30 years of experience and many years working in micro hydro.

The management of the project activity will record and monitor all the parameters required to estimate emission reductions generated by the project. A kWh meter will record energy supply and metering records will be monitored for individual customers.

D.5 Name of person/entity determining the monitoring methodology:

>>

Prof Francis Yamba
Centre for Energy, Environment and Engineering (Z) Ltd
Private Bag E721, Lusaka Zambia
Tel/fax : 260 1 240 267
Email: fdyamba@yahoo.co.uk / ceeez@coppernet.zm

The person is not a Project Participant

Please provide contact information and indicate if the person/entity is also a project participant listed in Annex 1 of this document.

SECTION E. Estimation of GHG emissions by sources

Please fill section E. following the selected baseline and monitoring methodologies.

E.1. Estimate of GHG emissions by sources:

>>

Since the project activity involves a mini hydro power station, which is a renewable energy source, the project CO_2 emissions are assumed to be zero. That is, $PE_y = 0$

Please provide estimated anthropogenic emissions by sources of greenhouse gases of the project activity within the project boundary (for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent). Alternatively, provide directly estimated emission reductions due to the project activity.

E.2. Estimated leakage:

>>

Leakage is equal to zero since the amount of fuel used for delivering the equipment and machinery to site and during construction is negligible. That is $L_y = 0$

Please provide estimate of any leakage, defined as: the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and that is measurable and attributable to the project activity. Estimates should be given for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>

The sum of project CO2 emissions and leakage is equal to zero. That is $Pe_y + L_y = 0$.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>

The baseline emissions (BE_y in tCO_2) are the product of the baseline emissions factor (EF_{BL} in tCO_2/kWh) times the electricity supplied by the project activity (EG_y in kWh), as follows:

$BE_y = EG_y * EF_{BL}$

$BE_Y = 54,938,304 * 0.8 = 43,950,643$

Estimates should be given for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>> The emission reduction ER_y by the project activity during a given year y is the difference between baseline emissions (BE_y), project emissions (PEy) and emissions due to leakage (Ly), as follows:

$ER_y = BE_y - PE_y - L_y$

ER_Y = 43,950,643 – 0 = 43,950,643

E.6. Table providing values obtained when applying formulae above:

>>

The emission reduction ER_y by the project activity during a given year y is the difference between baseline emissions (BE_y), project emissions (PEy) and emissions due to leakage (Ly), as follows:

$ER_y = BE_y – PE_y – L_y$

Year	***Electricity Generated (kWh) (EGy)***	***EF (kg $CO2_{EQUIV}$/kWh (EFBL))***	***Emission Reductions (ton$CO2_{EQUIV}$)(BEy)***
1	697,976	0.8	558.38
2	1,758,383	0.8	1,406.71
3	2,527,367	0.8	2,021.89
4	3,152,970	0.8	2,522.38
5	3,470,720	0.8	2,776.58
6	3,705,331	0.8	2,964.26
7	3,910,010	0.8	3,128.01
8	4,119,186	0.8	3,295.35
9	4,315,248	0.8	3,452.20
10	4,507,358	0.8	3,605.89
11	4,522,972	0.8	3,618.38
12	4,526,886	0.8	3,621.51
13	4,530,866	0.8	3,624.69
14	4,534,745	0.8	3,627.80
15	4,538,684	0.8	3,630.95
Total	**54,818,702**	**0.8**	**43,854.96**

The ex post calculation of baseline emission rates may only be used if proper justification is provided. Notwithstanding, the baseline emission rates shall also be calculated ex-ante and reported in the GS-VER-PDD. The following table should be filled in.

Year	**Estimation of project activity emission reductions (tonnes CO_2 e)**	**Estimation of baseline emission reduction (tonnes CO2 e)**	**Estimation of leakage (tonnes CO_2 e)**	**Estimation of emission reductions (tonnes CO_2 e)**
1	0	558.38	0	558.38
2	0	1,406.71	0	1,406.71
3	0	2,021.89	0	2,021.89
4	0	2,522.38	0	2,522.38
5	0	2,776.58	0	2,776.58
6	0	2,964.26	0	2,964.26
7	0	3,128.01	0	3,128.01
8	0	3,295.35	0	3,295.35
9	0	3,452.20	0	3,452.20
10	0	3,605.89	0	3,605.89

11	0	3,618.38	0	3,618.38
12	0	3,621.51	0	3,621.51
13	0	3,624.69	0	3,624.69
14	0	3,627.80	0	3,627.80
15	0	3,630.95	0	3,630.95
Total	**0**	**43,854.96**	**0**	**43,854.96**

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

Given below are the ECZ environmental impacts assessment and VGS on EIA requirements for run-off river projects.

1.0 ECZ Environmental Impacts Assessment

In accordance with the Environmental Protection and Pollution Control Act (Act No. 12 of 1990) under the jurisdiction of the Environmental Council of Zambia (ECZ), any project for development has to pass through two stages, namely

- Preparation of the Environmental Project Brief (EPB)
- Preparation of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP)

In the environmental brief, the following issues need to be adequately described:

- Description of the project;
- Description of the site
- Brief description, including surrounding environment to include environmental effects of the project
- Description of project activities
- Description of raw materials and their potential environ effects
- Technology and process to be used
- Products and by-products of the project
- Environmental effects of the project
- Social-economic impacts of the project
- Impact of management plan
- Effect to neighbouring states

Once the ECZ considers the project brief complete, ECZ then sends the EPB to different agencies to include the local municipality council, Energy Regulation Board (ERB), etc. Once the comments have been received, and ECZ is satisfied that the project will have no significant impact on the environments or sufficient mitigation measures and to ensure the acceptability of the anticipated impacts, the ECZ issues a letter of “No Objection” with conditions as appropriate to that effect.

If however, ECZ feels that a project may cause significant impacts on the environment and these have not been mitigated, or that all significant environmental issues have not been properly dealt with, then in such a situation ECZ demands a full Environmental Impact Assessment (EIA).

In this, case the following elements are required:

- Description of the project;
- Description of the proposed site;
- A brief description of the site and the surrounding environment including specifying any information necessary to identify and assess the environmental effects of the project;
- Description of the project activities during planning, construction, operation and closure/decommissioning or abandonment phases;
- Description of the raw material inputs into the project and their potential environmental effects; A description of the products and by-products of the projects;
- Environmental effects of the projects, and reasonable alternatives including the direct, indirect cumulative, short term and long term effects;
- Social economic impacts of the project such as resettlement of the affected people;
- An impact management plan containing a description of measures proposed for preventing, minimising or compensating for any adverse impact, and enhancing beneficial effects, and measures to monitor effluent streams or important environmental features which may be affected by the project;
- An indication of whether the environmental of any neighbouring state can be affected; An executive summary, stating the main findings and recommendations and shall be signed by every individual person involved in its preparation.

The Zengamina mini project went through the process above and the relevant authority Environmental Council of Zambia (ECZ) gave a letter of no objection at the Environmental Project Brief (EPB) level.

See Annex 4 for the letter of no objection.

2.0 GS VER on EIA requirements for run-off river projects

Management Domain	Relevant to the project Basic Requirements	Comments
Minimum Flow	Goal is a dynamic flow regime, which qualitatively simulates the natural hydrological regime	Addressed in the design
	Minimum flow which guarantees habitat quality and prevents critical oxygen and chemical concentrations	Addressed in the design
	No disconnection of lateral rivers	N/A
	Minimum water depth for fish migration during critical periods	Addressed in the design and to be monitored
	Lateral and vertical connectivity (flood plains and groundwater) shall not be substantially disturbed	N/A
	Provides sufficient transport capacity for sediments	Addressed in the design
	Landscape compartments shall not be destroyed	Addressed in the design

	Flood plain ecosystems shall not be endangered	Addressed in the design
	Conservation of locally adapted species and ecosystems	Addressed in the design
	Rate of change of water level should not impair fish and benthic populations	Addressed in the design and to be monitored
Hydropeaking	Reduction in water level should not lead to drying of the water course.	Addressed in the design
	Protective measures if flood plain ecosystems are impaired.	Addressed in the design
	No isolation of fish and benthic organisms when water level decreases	Addressed in the design and to be monitored
	No impairment of spawning habitat for fish	Addressed in the design and to be monitored
Reservoir management	Are there feasible alternatives to reservoir flushing?	Addressed in the design and to be monitored
	Changes in reservoir levels should not impair lateral ecosystems (flood plains, river shores, …)	N/A
	Connectivity with lateral rivers should not be impaired	N/A
	Sediment accumulation areas should be used as valuable habitats, where feasible.	Addressed in the design
	Special protection of flood plain ecosystems if they are impaired	N/A
Sediment management	Sediments have to pass through the power plant.	**No**
	No erosion and no accumulation in the river bed below storage dams and water intakes because of a deficit in sediments	Addressed in the design and to be monitored
	Sediment transport should sustain morphological structures, which are typical for the river.	**N/A**
	No accumulation of sediments below dams	Addressed in the design and to be monitored
Power plant design	Free fish migration upwards and downwards (as far as technologically feasible)	Addressed in the design
	Protection of animals against injury and death stemming from power plant operations (turbines, canals, water intakes, …)	Addressed in the design
Social impacts	Cultural landscapes	Addressed
	Human heritage (including protection of special ethnic groups)	N/A
	Preservation of lifestyles	Not disturbed
	Empowerment of local stakeholders in the decision-making process (about	Addressed

	mitigation and compensation of social impacts)	
	Resettlement of local population under similar or better living conditions (than prior to the project)	No resettlement
	Build additional social infrastructure, sufficient to cope with population increase (due to migration induced by the project)	Not an issue

This section should describe how the Gold Standard requirements are met.

The project proponent needs to perform an EIA, if:

1) the host country legislation requires an EIA to be performed;
2) additional guidance from the GS requires an EIA to be performed.

These requirements are included in Section 3.4.2 of the Gold Standard VER Project Developer's Manual for both small-/large-scale projects and micro-scale project.

Please attach the documentation to the GS-VER-PDD.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>> Environmental Impacts are not considered significant. See Appendix 2 in Annex 4 Stakeholder Consultation Report for letter of no objection from the Zambian Government.

SECTION G. Stakeholders' comments

G.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

The project site has special circumstances, which need to be taken into account whilst considering the fulfilment of the Gold Standard guidelines on public consultations. The project site is 1,000km away from Lusaka the capital city with very bad road infrastructure to the extent that newspapers rarely reach this region. Due to lack of electricity most people do not listen to the news through radio and TV, which inevitably they do not posses.

Besides, being a rural area there are no NGOs in the area working with the Gold Standard from our knowledge. However, A comment was received by the Gold Standard Office on receipt of the original project PIN preceding project registration. Four international NGOs were contacted:

- WWF International
- REEEP

- Greenpeace International
- Mercy Corps International

Dr Marianne Moscoso-Osterkom, International Director of REEEP responded:

> *"As I have mentioned on the phone REEEP is happy to endorse the GS project, and we are very pleased that our funding of the GS VER standard is now contributing to the sustainable development."*

As regards publicity of consultations, Mr Charles Rea was requested to write a letter to the administrators of the two local chiefs' palaces at Nyakaseya and Ikelenge to invite the local community to a meeting to be held at Nyakaseya basic school and Ikelenge high school, respectively. It should be noted that at this level, the only administration available is by the Chiefs and there is no Government administration as such. In turn the administrators of the Chiefs' palaces cleared this request from the Chiefs, and the local community were informed accordingly through the respective headmen of surrounding villages and local business representatives, who in turn informed the various stakeholders to attend the meetings as proposed. The Chiefs' palaces at Ikelenge and Nyakaseya helped to organise the consultation meetings since they are the custodian of the people in region, in the absence of Government representation.

The questionnaire which was prepared based on a combination of the Gold Standard and Zambia's CDM sustainable development was a guide in the asking of the questions. Prior to the start of the public consultations meetings, Mr Charles Rea explained the objective of the meeting and briefly described the project. The main questions which the participants were requested to comment on, were the benefits and problems they see in relation to the implementation of the project from the different perspectives. After which, the participants started contributing and provided responses as outlined in the Report in Annex 4. In view of the relatively low level of literacy in the region, we thought that the responses should freely come from them rather than us asking direct questions in relation to the indicators in the questionnaire. Nevertheless, as the meeting proceeded, leading questions were posed in relation to economic, environmental and social benefits. In particular, participants were requested to comment on the negative effects of the project and such as those related to culture and heritage etc. Upon collection of the responses, the organisers had to make expert judgment of the responses in relation to questionnaires.

Additionally, consultations/meetings were made at Kalene Hill Mission (with the hospital management), Sakeji School (with the Headmaster), and Hill Wood Farm (with the farm manager). It was felt that the process thereby sought and received a broad cross section of local opinion, suitable for a project of this type.

Please describe the process by which comments by local stakeholders have been invited and compiled. An invitation for comments by local stakeholders shall be made in an open and transparent manner, in a way that facilities comments to be received from local stakeholders and allows for a reasonable time for comments to be submitted. In this regard, project participants shall describe a project activity in a manner which allows the local stakeholders to understand the project activity.

The Gold Standard Public Consultation Process requires at least two public consultations for small- and large-scale projects and one round for micro-scale projects. The exact requirements for the Stakeholder consultation are included in Section 3.4.3 of the Gold Standard VER Project Developer's Manual.

G.2. Summary of the comments received:

>>

Gold Standard Office input after submission of original PIN in avance of registration confirmed the original plans to incorporate carbon finance into business plans woudl be an important aspect of additionality and wanted to see tihs documented. This has been addressed in section A.4.4. (3) Previously Announced Project Screen.

(i) Summary of comments from the two public consultations meetings

- Participants were happy for the electricity because more jobs will be created through companies coming to the region to exploit existing mineral resources and bring factory for pineapple processing.
- Women in Nyakaseya village are happy for electricity since cooking will be done using electric cookers and ironing will be easier using electric irons,
- Participants were happy with electricity because they can now install electric driven hammer mills, which currently are being driven by diesel engines, and diesel is extremely expensive".
- "The coming of electricity will improve the livelihood of the people through creation of jobs.
- Participants were happy with electricity since it will now be possible to have water pipe supply line serving the villages."
- Women were happy to see electricity coming to the village because child birth at Kalene Hill Mission Hospital can now take place when it is due since electricity will be available all the time.

(ii) Summary of comments from Kalene Hill Hospital management.

- With the coming of hydro electricity, it is will now be possible to undertake emergencies and providing facilities for child birth for mothers all the time.
- Besides, there will be significant savings since use of expensive diesel will be eliminated
- The number of patients attended to will increase and there will be an improved environment to examine the patients and be able to undertake investigations.
- The operating theatre will work in a suitable air conditioned environment since currently the theatre operates on natural light with windows open.
- Other benefits of electricity will include use of 24hour lighting in the delivery room, use of vacuum cleaners, cell phones, electric irons, electric geysers, and washing machines for cleaning of linen.
- Electricity will also improve the security of the hospital and reduce pilfering of linen and improve on hospital record keeping.

(iii) Summary of comments from *Sakeji School:*

- The benefits of introducing electricity will be to ensure that electricity is available for 24 hours, aimed at further improving the quality of education since the pupils will have more time to use the computers for learning purposes.

- Electricity will also encourage the teachers to spend more time on preparations and also have longer hours for recreation through listening to radio and TV.
- Besides water heating will now be done by electricity to reduce the temptation of suppliers of firewood from obtaining it from unsustainable sources.

(iv) Summary of comments Hillhood Farm.

- With the coming of electricity, the farm will also go into irrigation for growing crops and increase production of dairy products and beef from the farm.
- The more electricity available, the more dairy products will be produced, and hence more fridges will be available to produce both daily products and the beef.
- Since Angola is a good market for wheat, the farm has plans to go into wheat production to serve this market.
- With availability of electricity there will be improved environment for lighting, welding, battery charging on a 24 hour basis. ”

For details please refer to Annex 4.

Please identify stakeholders that have made comments and provide a summary of these comments.

G.3. Report on how due account was taken of any comments received:

>>

The comments from the meetings were almost entirely positive and did not require the PDD to be altered after the community consultation.

The public consultations report was distributed to all the stakeholders to include the Chiefs’ palace, Kalene Hill Mission, Hillwoodfarm and Sakeji school. So far only Kalene Hill mission has come back with comments as quoted below.

“Dear Professor Francis Yamba,
Greetings from Kalene,
Thank you for taking the trouble to visit Kalene several weeks ago.
Charlie has given me the report on the mini hydro project that you prepared for submission to CLIMATECARE-UK.
As the representative of Kalene Hospital, which is a major stakeholder in this project, I completely endorse the report, and the importance that you have attached to the development of sustainable energy in this area.
I noted, with some amusement, that it was claimed that, at present, women are allowed to give birth only during the hours that the generator supplies electricity! I feel sure that it was intended to stress the greater convenience that will be provided by 24 hour electricity.
The report will be passed to Chief Nyakaseya for his comments.
Yours sincerely, Dr.Vivian Davies”

Please explain how due account have been taken of comments received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Please copy and paste table as needed.

Organization:	North West Development Trust
Street/P.O.Box:	Box 160010
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State/Region:	NorthWestern Province
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E-Mail:	bex1@zamtel.zm
URL:	http://west-lunga-trust.org
Represented by:	Charles Rea
Title:	Project Advocate & Technical Director
Salutation:	Mr
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Represented by:	Tom Morton
Title:	Managing Director

Salutation:	Mr
Last Name:	Morton
Middle Name:	SD
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Personal E-Mail:	tom.morton@pioneercarbon.com

Annex 2

BASELINE INFORMATION

Please provide a table containing the key elements used to determine the baseline for the project activity including elements such as variables, parameters and data sources. For approved methodologies you may find a draft table on the UNFCCC CDM web site.

Hydro Capacity

The Zambezi is a small river at this location, being near its source some 50km away. The catchment of the site is about 600 km^2 and the mean annual rainfall of the area is about 1500 mm. The maximum recorded rainfall is 2100 mm and the minimum on record is 1300 mm. The river flows along granite dome, falling about 17meters over about 300 m length of rapids. The Zambezi River up until the rapids section has a very gradual fall. At the rapids the river drops 5.4metres over the 300metre distance, which makes the water pressure "head" suitable to operate a small turbine. The head is 17 meters and minimum and maximum flow rates are 5 m^3/s and 300 m^3/sec, respectively. Based on this inputs, the installed capacity of the project has been estimated at 700kW.

Key assumptions for the baseline development are as follows:

1. Determine the number of operating hours for end use activities such as hospital services, cooking street lighting and power supply for commercial activities on a 24 hour basis.
2. Determine the load in kW for each end use activities
3. Estimate the consumption profile in kWh based on (1) and (2) on a daily and annual basis for the base year
4. Assume an annual average electricity consumption growth rate as given in table A.N.1 below. Original data is shown in Table 1 'Projected kwh demand growth' of Annex 7, which is based on network connections made shown in Table 2 'Number of connections' in Annex 7.

Table A.N.1 Annual Average Electricity Consumption Growth Rate

	Year	**Annual Average Electricity Consumption Growth Rate(%)**
	2	152%
	3	44%
	4	25%
	5	10%
	6	7%
	7	6%
	8	5%
	9	5%
	10	4%
	11	0%
	12	0%
	13	0%
	14	0%
	15	0%

Annex 3

MONITORING PLAN

The actual project performance must be assessed against the projected outcomes of the sustainable development assessment as defined in section 3.5.1 of the Gold Standard VER Project Developer's Manual, on an annual basis. Where quantitative measurements are required information on the relevant data to be collected should be noted in the table presented below. For those indictors where a qualitative assessment is to be made a narrative explanation should be provided.

If an EIA has been conducted, then the table needs to be extended to allow:

1) Assessment of the implementation and effectiveness of the identified mitigation measures.
2) Assessment of the implementation and effectiveness of the identified compensation measures.
3) Monitoring of the impacts.

The information requirements for the sustainable development indicators and Environmental Impact Assessment are fully detailed in section 3.4.1 of the Gold Standard VER Project Developer's Manual.

The monitoring plan will involve the following activities:

1. Achieved emission reduction on an annual basis will be determined through measurements of kWh generated from the main meter multiplied by the emission factor as elaborated in table D2.1.3. The figures measured will be counter checked with the kWh to be sold through the consumer metering systems. A database will be maintained which holds details of every connection, which will be linked to current power usage and billing information. This will be updated monthly. Paper records will be kept as backups.

2. Indicators of sustainable development will be qualitatively/quantitatively assessed based on the "Indicators of the sustainable development matrix" elaborated in table A.2.1. The most important indicators to be assessed will include employment, livelihood of the poor in relation to poverty alleviation and access to essential services:
    a. **Employment numbers**
    It is projected that several new jobs will be created, including 10 full time and about 40 casual staff. Staff numbers are maintained on the company books, which will be used in the monitoring of this indicator. Employee information, including casual labour, including wages, taxes and social security are tracked on an Access Database. Paper documents will be retained as back up. If any new businesses have been established, best efforts will be made to obtain data on locals employed.

    b. **Access to energy services**
    Records of number of connections made, and which organisations are connected, will be maintained continuously. These will be available for annual monitoring of this indicator.

A database will be maintained which records all details of every connection made, including: date of connect, customer name, area, service type (e.g. residential, commercial), transformer number, phase number and contact details. This information will be linked to current power usage and billing information, which will be updated each month. Paper records will be kept as backups.

c. Livelihood of the poor in relation to poverty alleviation

Qualitative assessment will be made by an independent party on the impact of the project on poverty alleviation. This will be conducted annually, and will draw on the methods used for the initial sustainable development assessment.

This will include consultation with key stakeholders, including: Nyakaseya and Ikelenge Chiefs' Palace representatives and respective village members, Kalene hill Mission Hospital, Sakeji School and Hillwood Farm. Participants from any new large enterprises introduced in the area will also be targeted, using open and closed questions.

Example questions to be used are indicated below:

<u>Village members</u>

- If they have no connection, why not? (for example they could be out of grid reach for the plant)
- Have they been impacted by the hydro plants' existence?
- Have they noticed a change in income?
- Have they been able to invest in any economic activities as a result? (e.g. opening a saloon, mills, welding)
- Are they running any appliances in the household which they didn't before? (e.g. TV, radio, fridge)
- Has there been any change in their access to lighting? How has this affected their life?

<u>Hospital – one representative</u>

- How many hours access to electricity do they now have?
- How many did they have before?
- Is the energy supply more reliable?
- How has the energy access changed activities in the hospital?
- What has it been used for? (e,g, refrigeration, 24h maternity services)
- Has there been an increase in number of patients able to be treated? (give the figures if available)

<u>School (with connection) – one representative per school</u>

- Has the access impacted them? How?
- Have they increased attendance as a result? (from what to what)
- Has there been an increased use of lighting? Has this improved the schooling?
- Others e.g. has there been greater use of computers?

<u>Farm – one representative</u>

- How has the hydro plant and connection impacted the farm?

- Have you realised an increase in income as a consequence?
- E.g. has there been an increase in reliability of refrigeration?
- E.g. has there been greater irrigation? How has this impacted the farm e.g. greater yield of more crops?

<u>New enterprise e.g. pineapple canning</u>

- Was the presence of the hydro plant a key factor in the decision to open this business? Why?
- How many locals are employed?
- How is this business benefitting the local community?

3. Environmental Council of Zambia (ECZ) under its Act will also be monitoring the mitigation measures which have been proposed in the Environmental Project Brief to include; the proper function of the weir and its effects on upper stream vegetation and growth, effects of weir on fish stocks in the river above stream, ensuring water flow both to the mini hydro and the river rapids section and re-colonising of vegetable along the canal and pipeline sections of the project.

4. The results of monitoring in (3) above will serve as an input into the satisfaction of the Voluntary GS requirements on “EIA requirements for run-off river projects”

Annex 4

Stakeholder consultation Report

REPORT ON THE REQUIREMENTS OF THE GOLD STANDARD ON THE ASSESMENT OF SUSTAINABLE DEVELOPMENT FOR ZENGAMINA MINI HYDRO, KALENE HILL MISSION, NORTHWESTEN PROVINCE

FOR SUBMISSION TO PIONEER CARBON

April 2007

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1.0 BACKGROUND

Zengamina hydro is a community based project which is being administered by North West Development Trust in Mwinilunga, North-western province of Zambia. The project site has special circumstances, which need to be taken into account whilst considering the fulfilment of the Gold Standard guidelines on public consultations. The project site is 1000km away from Lusaka with very bad road infrastructure to the extent that news papers rarely reach this region. Due to lack of electricity most people do not listen to the news through radio and TV, which inevitably they do not possess. Besides, being a rural area there are no NGOs working with the Gold Standard in the area who are aware of the gold standard, from our knowledge.

As regards publicity of consultations, Mr Charles Rea was requested to write a letter to the administrators of the two chief palaces at Nyakaseya and Ikelenge to invite the local community to a meeting to be held at Nyakaseya basic school and Ikelenge high school, respectively. It should be noted that at this level, the only administration available is by the Chiefs and there is no Government administration as such. In turn the administrators of the Chiefs palaces cleared this request from the Chiefs, and the local community were informed accordingly through the respective headmen of surrounding villages and local business representatives, who in turn informed the various stakeholders to attend the meetings as proposed. The Chiefs palaces at Ikelenge and Nyakaseya helped to organise the consultation meetings since they are the custodian of the people in region, in the absence of Government representation. The stakeholders have been consulted through all along.

Participation of NGOs who have endorsed the Gold standard was not possible since there no local/international NGOs who have endorsed the Gold Standard in the region and let alone in Zambia

The questionnaire which was prepared based on a combination of the Gold standard and Zambia's CDM sustainable development was a guide in the asking of the questions. The main questions which the participants were requested to are the benefits and problems they see in relation to the implementation of the project from the different perspectives. After which, the participants started contributing and provided responses as outlined in the report. In view of the relatively low level of literacy in the region, we thought that the responses should freely come from them rather than us asking direct questions in relation to the indicators in the questionnaire. Nevertheless, as the meeting proceeded, leading questions were posed in relation to economic, environmental and social benefits. Upon collection of the responses, CEEEZ had to make expert judgment of the responses in relation to questionnaires. Additionally, consultations/meetings were made at Kalene Hill mission, Sakeji School, and HillWood Farm.

The screen for sustainable development for Zengamina mini hydro was considered in three parts in accordance with Gold Standard requirements, mainly

- EIA requirements
- Public consultation

- Sustainable Development Assessment

A 700KW mini hydro scheme is being constructed by the North West Development Trust at Kalene Hills, North-Western province at a site known historically as the Zambezi Rapids. The scheme is named after the elderly chief Nyakaseya.

The purpose of the scheme is to provide cheap, clean and sustainable electric power to this remote part of Zambia in the Kalene Hill area of North Western Province of Zambia. It will remove dependence on diesel generators and will supply Kalene Hill hospital, Nyakaseya village, Ikelenenge Trading Centre and Chiefs Palace, Sakeji and Hillwood Farm. Additionally, it will also provide electricity to small commercial entities at chief's Ikelenge and Nyakaseya capitals on the west. to Kalene Hill area and along the main road to chief Ikelenge's capital, and thence to Hillwood farm on the east side of the area. The project will also eliminate use of kerosene for lighting purposes, and firewood for cooking purposes

2.0 EIA REQUIREMENTS

In accordance with the Environmental Protection and Pollution Control Act (Act No. 12 of 1990) under the jurisdiction of the Environmental Council of Zambia (ECZ), any project for development has to pass through two stages, namely

- Preparation of the Environmental Project Brief (EPB)
- Preparation of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP)

In the environmental brief, the following issues need to be adequately described:

- Description of the project
- Description of the site
- Brief description, including surrounding environment to include environmental effects of the project
- Description of project activities
- Description of raw materials and their potential environ effects
- Technology and process to be used
- Products and by-products of the project
- Environmental effects of the project
- Social-economic impacts of the project
- Impact of management plan
- Effect to neighboring states

Once the ECZ considers the project brief complete, ECZ then sends the EPB to different agencies to include the local municipality council, Energy Regulation Board (ERB), etc. Once the comments have been received, and ECZ is satisfied that the project will have no significant impact on the environments or sufficient mitigation measures and to ensure the acceptability of the anticipated impacts, the ECZ issues a letter of "No Objection" with conditions as appropriate to that effect.

If however, ECZ feels that a project may cause significant impacts on the environment and these have not been mitigated, or that all significant environmental issues have not been properly dealt with, then in such a situation ECZ demands a full Environmental Impact Assessment (EIA). In this, case the following elements are required:

- Description of the project
- Description of the proposed site

- A brief description of the site and the surrounding environment including specifying any information necessary to identify and assess the environmental effects of the project.
- Description of the project activities during planning, construction, operation and closure/decommissioning or abandonment phases
- Description of the raw material inputs into the project and their potential environmental effects
- A description of the products and by-products of the projects
- Environmental effects of the projects, and reasonable alternatives including the direct, indirect cumulative, short term and long term effects.
- Social economic impacts of the project such as resettlement of the affected people
- An impact management plan containing a description of measures proposed for preventing, minimising or compensating for any adverse impact, and enhancing beneficial effects, and measures to monitor effluent streams or important environmental features which may be affected by the project
- An indication of whether the environmental of any neighbouring state can be affected.
- An executive summary, stating the main findings and recommendations and shall be signed by every individual person involved in its preparation.

In the case of Zengamina Mini Hydro project, at the beginning of the project in 2004, an EPB, submitted to the ECZ. A copy of the EPB submitted, is attached in appendix I. After submission of the EPB, the ECZ made the assessment and accepted the EPB without going into the next stage of full EIA. For this purpose, a letter of "No Objection:" was issued. This letter (attached in Appendix II) authorised Zengamina mini hydro to proceed with the implementation of the project, with the following conditions

- The Water Board at the Ministry of Energy and Water Development grants the project permission to abstract water from the Zambezi River.
- Zengamina mini hydro to submit to ECZ an audit report of the operations of the mini hydro within twelve to thirty six months of the operations.
- Zengamina adhered to the mitigation measures proposed in the EPB.

3.0 PUBLIC CONSULTATIONS

Prior to the public consultation in the project area, a preliminary public consultation check list based on a combination of Gold Standard and Zambia's CDM Sustainable Development Assessment Criteria was prepared (Appendix III).

A public consultation visit was then arranged for the project area at Kalene Hill Mission-a distance of 1000 km from Lusaka. The Trip was undertaken from 28th March to 2nd April 2007. Public consultations took place on 30th March at Nyakaseya Village and Kalene Hill Mission, and 31st March at Ikelenge, Sakeji School and HillWood Farm.

3.1 Nyakaseya Village

A public consultation meeting was held in Nyakaseya village at Nyakaseya Basic School, altogether 48 persons participated in the meeting and a list of the participants is provided in Appendix IV. The methodology used involved asking of questions on the benefits and problems the project will bring to the village. Given below are the responses from some of the participants:

Participant 1: Ronald Chizawu

"We are happy with this project because so many things which were hindering development in the past are now possible such as having lighting for reading, radio and TV and refrigeration of food stuffs, and electricity for economic activities such as welding and charging of batteries."

The participant however asked the question if the electricity was going to be free and a number of connections to be made.

Charles Rea Replied: "Electricity provision was for a fee and 350 households will initially be provided with electricity and these were selected on a voluntary basis and are prepared to pay for the Electricity."

Charles Rea further explained "After 350 households were connected the low voltage line will be extended to other villages, but this requires more financial resources since grid extension is expensive at US$15,000 per kilometre".

Participant 2: Watson Chikasa
"Everybody is happy with electricity since it will bring more people back from urban areas to rural areas. Kalene Hill Mission Hospital will attend to many patients due to longer working period arising from availability of electricity."

Participant 3: Mrs Malichi
"Happy to see electricity coming to the village because child birth at Kalene Hill Mission Hospital can now take place when it is due since electricity will be available all the time. Currently child birth only takes place during day time and three hours in the evening up to 21.45 hours when diesel electricity is switched off. Also because of limited electricity, it is currently a big problem to refrigerate dead bodies at the mortuary before burial takes place.

Participant 4: Kutela John
"Complained that electricity being provided wont reach all the people in the village, and why are others being left out."

Charles Rea replied "Low voltage distribution will be extended to other areas in the village, but only within 1 km from the power line"

Participant 5: Kadochi John
"Very happy to bring electricity since my children can now get involved in income generating activities such as carpentry and welding. My children can also use electricity to improve their business."

Participant 6: John Mukanda (School Pupil)
"Happy to bring power to their school because in the past, it was difficult to study, and now the school children will now know the benefits of computers. The school will now be able to undertake practicals and laboratory work, which were not possible in the past due to lack of electricity. Studying will also be easier"

Participant 7 Winter Kasongo
"Very happy to have electricity because I can now get involved in activities such barber shop and hair saloon."

Participant 8: Edward Kalombi
"We are happy for the electricity because more jobs will be created through companies coming to the region to exploit existing mineral resources and bring factory for pineapple processing .Currently pineapples are going to waste due to lack of electricity for processing and preservation"

Participant 9: Mrs Gertrude Kalusa
"Women in Nyakaseya village are happy for electricity since cooking will be done using electric cookers and ironing will be easier using electric irons, and hence reduce time being spent by women and children for collecting firewood for cooking from far places"

Participant 10: Joseph Kutela
"We are very happy with electricity because we can now install electric driven hammer mills, which currently are being driven by diesel engines, and diesel is extremely expensive".

Participant 11:Charles Shimo
"The coming of electricity will improve the livelihood of the people as it will assist to do jobs easily as people in town currently do. Electricity will also enable listening to the radio and refrigerate food stuffs"

Participant 12: Kazembi K
"Electricity will assist eradication of poverty though creation of more jobs by companies who are going to come to exploit existing natural resources and it will also assist to do welding jobs for repair of bicycles and motor vehicles. Currently we travel 40km to do these welding jobs."

Participant 13: Local Councillor Hon. Nyakaseya
"I am happy with the electricity, since I will now be able to implement my plan of establishing a tailoring and design training school to help school leavers acquire such skills. The councillor further asked when the electricity will actually be switched on."
Charles Rea promised that electricity will be switched on by the end of May.

Participant 14: Gilbert Alufonso
"Will the extension of the electricity reach the Angolan border which is 20Km away?"
Charles Rea replied that Rural Electrification Agency in Lusaka can be approached to extend the grid since this project's financial resources will not be able to reach the Angolan Border.

Participant 15: John Kambanjela
"We are happy with electricity since it will now be possible to have water pipe supply line serving the villages."

3.2 Kalene Hill Mission Hospital

A meeting was held with Dr. Vivian Davis, Surgeon and Hospital Administrator.
"The hospital serves Kalene Hill mission, Nyakaseya and Ikelenge villages and neighbouring countries Congo DR and Angola. Currently, Electricity is only served for 4 hours per day from 18.00hours to 22.00hours. There is no electricity the whole day and after 22.00hours. Cooking is done by fire wood and charcoal and sometimes bottle gas which is expensive since it has to be sourced from Kitwe a distance of 600km. The refrigerators are currently run by paraffin and lighting in the ward is provided by paraffin tiller lamps.

Because of this status quo, it is not possible to undertake emergencies and giving birth for mothers all the time is also not possible. Besides, use of diesel is expensive and the hospital is currently spending US$29,000 to operate only 4hours a day, therefore the coming of electricity will remove these barriers above. Besides the number of patients attended will increase and there will be an improved environment to examine the patients and be able to undertake investigations such as blood tests and scans. Additionally, the operating theatre will work in a suitable air conditioned environment since currently the theatre operates on natural light with windows open.

Other benefits of electricity will include use of 24hour lighting in the delivery room, use of vacuum cleaners, cell phones, electric irons, electric geysers, and washing machines for cleaning of linen. Electricity will also improve the security of the hospital and reduce pilfering of linen and improve on hospital record keeping since computers will now be used for this purpose. The diesel bill will be eliminated and the hospital will ensure that energy efficiency appliances are used to reduce the electricity bill.

The adjacent school will also benefit from provision of electricity since they will be able to use computers for their learning purposes and also undertake lab and practical work".

3.3 Sakeji School:

A meeting was held with the headmaster Mr Poidevin. "Sakeji School is one of the load centres to be connected to Zengamina mini hydro, a distance of 25km. "Sakeji School is situated at the tip of the North-Western Province of Zambia, near the source of the Zambezi River and is close to both Angola and Congo DR with a distance of less than 20km. Despite its remote location, Sakeji offers excellent boarding amenities and modern education facilities to about 100 pupils per year.

The school generates its own electricity for various uses. It has a 10kW turbine producing AC current for the school. Provision of electricity is supplemented by a wheel turbine which together with 10*50 Watt solar panels produce 110Volt DC current for computer applications. The school also has a standby diesel generator which provides 220V power as a backup. Despite having its own electricity, and use of energy efficiency lighting and measures, this is not sufficient since the total demand is estimated at 50 kKW, as a result cooking and heating water are still undertaken using firewood and solar geysers, the latter, as additional. For this reason, Sakeji school urgently needs additional electricity which will be supplied from Zengamina mini hydro.

The School has an environmentally friendly policy on firewood collection as it only uses dead trees and use of grown eucalyptus trees. Cooking will still continue based on firewood obtained sustainablly, and using improved firewood stoves but water heating will be provided through electricity.

The benefits of introducing electricity will be to ensure that electricity is available for 24 hours, aimed at further improving the quality of education since the pupils will have more time to use the computers for learning purposes. Electricity will also encourage the teachers to spend more time on preparations and also have longer hours for recreation through listening to radio and TV. Besides water heating will now be done by electricity to reduce the temptation of suppliers of firewood from obtaining it from unsustainable sources".

3.4 Ikelenge Trading Centre, Chiefs Palace and Basic School

A public consultation meeting was held at Ikelenge with a participation number of 60 persons and given below are the responses from some of the participants. (Appendix V)

Participant 1: Mr Simon Chinyembo
"We appreciate the coming of power to Ikelenge because energy is important if development was to be improved in the area. The electricity will bring the same conditions as those on the line of rail where there is electricity 24hours service and this in turn will bring positive contribution to the area by attracting investment and use of other machinery such as welding and hammer mills for income generating activities. Power is important since it will now attract more teachers to come to the school."

Participant 2 : Makuya Arnold
"As a teacher we appreciate the coming of electricity because without electricity Ikelenge surrounding area can turn into a desert due to increased use of firewood for cooking, which in turn will preserve the trees in the forest. With electricity more investors will come to the area and more government workers will be encouraged to come to Ikelenge since they can now use their electrical appliances. With electricity there is no excuse for government workers to come to Ikelenge when they are transferred."

Participant 3:Mrs Kameli A Alice
"We want electricity at the high school so that we can introduce a boarding school and improve on the pass rate due to increased educational environment and to enable more children who pass to enter the Nursing School at Kalene Hill Mission Hospital, which is now being re introduced. With availability of electricity more students will come from other towns to come to the high school."

Participant 4: Kamalondo Milton
"A place like Ikelenge school needs energy to enable use of ICT for both the pupils and teachers. Electricity will also bring increased farming activities through irrigation and with power it will be possible for us to teach health science since currently we cannot undertake laboratory wok due to lack of electricity. With electricity most government policies on agriculture, health and education can now be implemented."

Participant 5: Mr. Kapepa
Asked a question, "What is the target area for electricity to enable other people to benefit? The coming of electricity on the other hand will bring some negative aspects such as increased population and associated problems of HIV and AIDS. "

Charles Rea responded to the question as follows "Low voltage distribution will b served 1Km either way from the power line and further extension will not be possible due to limited resources, but advised that the community of Ikelenge could approach the Rural Electrification Authority in Lusaka for further electrification."

Participant 6: Mailoni Muleya (Business man)
"Electricity will bring business to the area since it is now possible to open a super market and extend the hours of business. The supermarket will be able to preserve food stuffs for a longer time."

Participant 7: Musenge Andrew

"This electricity brings an era of change to Ikelenge, since it will bring additional business because of its international access route to Angola and Congo DR. More people will now come from these countries to purchase goods and services and contribute to increased business to Ikelenge and hence create more jobs."

Participant 8: Kamponde Paul
"With the coming of electricity, the community will get more involved in business since equipment needing electricity like grinding mills and welding machines will be brought to the area thereby encouraging local communities to create their own small industries."

Participant 9: Kapapilu Timo
"Happy about electricity coming to the area. Although, it will not touch all the areas, those who will be connected will be empowered to enable them send their children to school for education. Additionally, since pineapples are widely grown in the area, it will now be possible to construct a canning factory to preserve the pineapples for export. Because of this factory, farmers will now expand their fields and consequently improve their livelihoods through increased incomes."

Participant 10: Makayi J.K
"What is Government policy to assist the community to own businesses such as Zengamina mini hydro?"

It was explained by Prof. Yamba that the Government has established Rural Electrification Authority whose mandate is to assist with capital to set up a business like Zengamina hydro but will require a business plan and with equity contribution from the project proponent.

Participant 11:Kambanjela J
"This area has a lot of minerals as evidenced by the exploitation of such in Angola and therefore we hope that the coming of electricity will exploit this potential."

Participant 12: Kayeyi J
"It appears that power is not enough to reach all the areas since only 1mm either way from the power line will be served. Are there any plans to expand the project?"

Participant 13: Mututa Solomon
"I am concerned about the project in respect to the timeline, when the project will reach Ikelenge and I also to know the plans when this electricity can be extended to other areas beyond the 1Km target of the project and since power is not enough. We hear rumors that power will only go to Sakeji school without passing through Ikelenge. We also want to know if power will be extended to thatched houses."

Charles Rea replied that "For extension beyond the project, the community is encouraged to approach the Rural Electrification Authority to provide funds to extend the grid beyond the project target. As for the future Kalene Hill Mission has plans to develop further mini hydros in the area but this will depend on availability of resources. We have also heard about this rumor of electricity not coming to Ikelenge but this is not true because the electricity poles have already been brought and are being erected and it is planned that electricity will reach Ikelenge by end of August. Thatched houses will also be provided with electricity since a Ready Board technology will be used which does not need electrical connections in the house."

Participant 14: Local Priest

"People are impatient in the area and therefore it is important that the time scale set is adhered to and also improve on the communication to the community to avoid such rumors occurring."

Hillwood Farm

A meeting was held with Mr Ros Fergurson of Hillhood Farm. "The farm is served by 2 diesel generators-25 and 40 KW capacity and only operates for limited hours from 18.00hours to 22.00hours, and occasionally operates in the day time when animals are being killed at the abattoir and welding jobs are required. More power is therefore required to ensure that all the fridges are operational all the time since part of the farm activity is animal keeping.

Currently, LPG gas is used for refrigeration but it is expensive to use it since it has got to be sourced from 600 km on the Copperbelt Province. With the coming of electricity, the farm will also go into irrigation for growing crops and increase production of dairy products and beef from the farm. The more electricity available, the more dairy products will be produced, and hence more fridges will be available to produce both daily products and the beef. Since Angola is a good market for wheat, the farm has plans to go into wheat production to serve this market. With availability of electricity there will be improved environment for lightning, welding, battery charging on a 24 hour basis. "

4.0 SUSTAINABLE DEVELOPMENT ASSESSSMENT

Based on the responses of the various stakeholders, an expert judgement was done to assess sustainable development to be brought to the area based on the combination of the Gold Standard and Zambia's CDM sustainable development criteria from Appendix III.

Table 4.0 Assessment of sustainable development based on expert judgement

INDICATOR	RANKING		COMMENTS
	GS VER	Zambia's	
Economic **1. Contributing to competitiveness at a micro-level, like industry**	0	Moderately important	Currently there are not so many businesses to compete with
2. Positive effects on the balance of payment	0	Moderately important	Although the region will not directly save foreign exchange, in the long run, Zambia as a country will save this forex since all the petroleum products are imported
3. Improved sectoral productivity, growth and linkages leading to higher contribution to GDP	0	Moderately important	Contribution to GDP will be possible through increased SME activities and production on pineapple processing and small scale mining

INDICATOR	RANKING		COMMENTS
	GS VER	Zambia's	
4. Reduction of energy intensity (energy used per unit product) at a micro level	2	Extremely important	Switch to hydroelectricity will reduce energy intensity related to diesel electric generation.
5. Increasing share in the contribution of renewable energy to the energy supply mix at a macro-level	1	More important	Micro hydro is a renewable resource which will replace expensive diesel electric plant
6. Job creation	2	Extremely important	More jobs will definitely be created through improved agriculture, commercial, small scale mining and agro-processing. It is stated by the hydro plant manager that 10 full time jobs and 10 part time jobs have been created within the hydro plant. Local opinion estimates a pineapple factory could create 50 jobs.
Environment and health			
1. Reduction of GHG emissions (CO_2, CH_4, N_2O) aimed at enhancing global environmental integrity	1	More important	GHG emissions will be reduced through switch to mini hydro renewable resource
2. Reduction of local emissions (SO_2, NO_x, CO, NMVOC) impacting on air	2	Extremely important	Reduction of indoor pollution arising from firewood/charcoal and kerosene combustion despite the amount being negligible
3. Reduction of local emissions (SO_2, NO_x, CO, NMVOC) impacting on water resources	0	less important	Currently, local pollution does not affect water resources
4. Reduction of local emissions (SO_2, NO_x, CO, NMVOC) impacting on land	0	less important	Currently, local pollution does not affect on land
5. Reduction of local emissions (SO_2, NO_x, CO, NMVOC) impacting on bio-diversity	1	More important	Avoidance of use of firewood for cooking and heating will result in protection of the forest base in the area. Despite the amounts being negligible.
6. Reduction(contribution) of noise and vibration or release of light energy and radiation	0	Less important	

INDICATOR	RANKING		COMMENTS
	GS VER	Zambia's	
7. Reduction to recreation facilities	0	Moderately important	Currently this is not a problem to the project area
8. Reduction to infrastructure development(homes, industry, recreation, churches, hospitals)	0	Moderately important	The current recreation and tourist facilities of the site vis a vis viewing the rapids will not be affected due to the environmentally designed micro hydro system
9. Restriction to resources such as ground water, surface water forestry and agriculture, fisheries and tourism	1	More important	No infrastructure development is being affected as part of the project implementation
10. susceptibility to earthquake, landslides erosion, flooding or extreme or adverse	1	More important	More important in the sense that ground water, surface water, forestry, agriculture, fisheries will not be severely affected More important in the sense that soil erosion and flooding are unlikely to occur
Social			
1. Contribution to poverty reduction through local employment	2	Extremely important	More jobs will definitely be created through improved agriculture, commercial, small scale mining and agro-processing (specified above)
2. Contribution to more equitable distribution of resources (reduction of wealth disparities)	2	Extremely important	Increased job creation and activities will contribute to reduction in wealth disparities
3. Increase in percentage of rural and peri-urban population with access to energy supply	2	Extremely important	Use of electricity will bring increased access to use of modern energy services
4. Affordability of the project product (s).	1	More important	Currently households and hospital are spending more on energy services typically in the range of US$25/month, and US$ 29, 000 per year
	1	More important	

INDICATOR	RANKING		COMMENTS
	GS VER	Zambia's	
5. Capacity building (e.g. transfer of technical skills)			respectively Skills acquired by local staff in the development of the project can be used for other mini hydro projects planned for the area
6. Reduction of health hazards	2	Extremely important	
7. Contribution to access to social amenities	2	Extremely important	Use of electricity will contribute to r reduction of indoor air pollution caused by charcoal/firewood and kerosene combustion, though limited.
8. Contribution to social changes (traditional styles or employment)	1	More important	Use of electricity will enhance use of radio and TV, and improve communications through use of mobile phones Use of electricity will not affect any traditional styles or employment

In conclusion and on balance, the indicators in table 4 clearly demonstrate that the project will no doubt bring more sustainable development benefits as opposed to continuation of the baseline.

APPENDICES TO THE STAKHOLDER CONSULTATION REPORT

Appendix 1 Environmental Brief Submitted to ECZ Submitted by Zengamina Mini Hydro (covered under Annex 3)

1. **Description of Project**

This project brief is to illustrate the development of a mini hydro electrical scheme on the Zambezi River close to its source in the Mwinilunga District. The scheme is a 'run-of river' scheme. The exact position is S 11°07.472', E 024°11.698'. (See regional and areas maps in appendix) This Hydro Electrical Project

is being developed to supply power to the Ikelenge district, which currently is not proposed for electrification by the national supply corporation - ZESCO. There are immediate requirements for this power, namely Kalene Hospital, the town of Ikelenge, Sakeji School and Hillwood Farms. This district has never been developed, largely due to the lack of electric power as the main methods of generation all use diesel fuel. It has been well established that further development will take place if electricity is available.

2. Description of Site (Fig. MV 1.1.4)

The site that has been chosen to develop this hydro-electric scheme is a section locally named 'the rapids'. The Zambezi on its course to Angola flows over a broad section of granite rock domes. These granite rocks cause the river at this point to spread out thinly causing small rapids and eddies. The length of the 'rapids' section is approximately 300 metres.

This site has been chosen since it has the necessary slope suitable to support the development of a mini Hydro electrical project. The Zambezi River up until the rapids section has a very gradual fall, hence its windy course. At the 'rapids' the river drops 15.4 metres over the 300 metre distance, which makes the water pressure 'head' suitable to operate a small turbine. It is proposed that phase one will have a generated power capacity of 700 KW, and it is hoped that in time this capacity will be increased to one megawatt. This power would immediately improve the services of the Kalene Hospital, which at this time operates using diesel generator. Historically, the services have been hampered by the inefficiency of the use of diesel generators and the high cost, and is only able to run for short periods of the day. Ikelenge town would have improved services, and small business would increase. Hillwood Farm wishes to increase its capacity to grow crops in the area, and wishes to put in irrigation schemes to support this, but without electricity this is not possible.

Alternative sites for this development could not be found on the Zambezi due to the poor slope of the river before this point, or after as it goes into Angola. The site chosen is also more suitable for its position to reach Ikelenge district with the power line distances envisaged.

3. Brief site description, including surrounding environment

The predominant vegetation type of the surrounding area is Miombo Woodland, and Zambezi Riverine. Close to the 'rapids' section' predominant tree species are: Diplorhynchus condylocarpon, Albizia versicolor, Combretum sp, Berchemia discolor, Uapaca kirkiana and Parinari curatellifolia, Ozoroa reticulata. Grass species dominant in project development site are: Loudetia simplex (dominant species), Panicum sp., Bothriochloa sp., Setaria sp. and Hyparrhenia sp.

Environmental Effects of the Project

Weir (Dwg. MV 1.3 & 4)
A weir of 1 metre will be built out of natural stone at the head of the rapids section. This weir's function will be to capture water for the mini Hydro scheme. This weir will be built so that it does not remove all the water from the rapids section of the Zambezi. The aesthetic and environmental aspects of retaining the 'rapids' has been seriously considered in this development, and the developers are determined to see that this area retain its natural beauty. Since the wall will only be one metre high, water will be allowed

to overflow down onto the rapids section. The weir will act as a retaining structure for water to be re-directed along a canal constructed along the northern bank.
NB. No water will be lost from the river in this process, it will only be re-directed to enter at a different point below the rapids section.
Canal (Dwg MV1.3 & 8)
A canal will be built from the weir to a point where sufficient 'head pressure' can be acquired, to down flow along a sealed pipe into the Mini Hydro turbine. The canal is proposed to run an approximate length of 300 metres. This canal will be built to run along side the main river course over a set route on contour. It will be approximately 1.0 metres in depth and 6 metres wide. The canal will be built into the granite dome that runs along the river. The canal will need to be blasted into the rock. The canal blasting will be done by professional engineers with blasting experience of 35 years, to ensure that the impact is restricted to the canal route only. It is vital that the blasting be done with precision, so as to ensure that the canal will function correctly, and that the flow of water is not impaired by excess friction. The canal construction process will impact the granite rock dome on the river shore, but vegetation in this area is very minimal as it is confined to sedges and grasses mainly comprising of Loudetia sp. Disturbance outside of the blasting area will be minimal due to the precision of the blasting process.

Penstock Pipe to Mini Hydro (Dwg 1 .10)
The canal will only reach as far as required for water to be directed towards the turbine system. The water from this point will be contained into a steel water pipe approximately 1.6 metres in diameter. This volume of water will ensure the turbine is able to optimally operate to produce sufficient power needed for the anticipated capacity output of 700KW. This pipeline will travel downhill. It is proposed that this pipeline be elevated on concrete supports above the ground. This ensures the capability to maintain the pipeline and carry out inspections with ease. This pipeline will travel approximately 75 metres until it reaches the Mini Hydro turbine housing. This pipeline will travel through open woodland, which is comprised of small sparsely spread trees and grassland. The trees comprising mostly of; Diplorhynchus condylocarpon, Burkea africana, Combretum sp., Parinari curaetilifolia, and Brachystegia sp. The route of the pipeline will be chosen for minimal disturbance. Once re-growth has occurred, the pipeline will quickly be obscured by vegetation, and the pipe will be painted a green colour that will suit the surrounding vegetation.

Mini Hydro Turbine Housing (Dwg 1.14)
The mini hydro will be housed in a masonry structure, that will be recessed in the ground of approximately 7x4 metres in size. It is proposed that the Mini Hydro will be housed approximately 30 metres from the main river. This ensures ease of access to maintain the mini hydro, make the positioning of exiting power lines easier, as well as keeping the unit above any potential flood line. The Mini Hydro unit will be founded in the ground, and surrounded by a concrete and stone wall, that will ensure protection from rain water run-off. The Mini Hydro will also be positioned behind the riverine vegetation on the river shoreline, so that it will not be able to be seen. Being below ground level it will also obscure any noise that might come from the turbine in operation.

Turbine water re-entry into river (Tailrace)
Once the water has passed through the turbines, the water will have slowed down to approximately 1.5 metres per second. The water is slowed due to the turbines removing the maximum energy from the flowing water. The re-entering water will then flow down a tailrace channel at the river water level, and will enter the Zambezi River in a still water section below the last rapids section. This water will have very little effect on the surrounding environment, the only feature being that the water will be more oxygenated than before entry into the turbines.

NB. No water will be lost from the river in this process, it will only be re-directed to enter at a different point below the rapids section.

4. Description of project activities

Planning
During the planning phase, the site will be visited by surveyors, engineers and specialists in their fields to assess their role and give precise information as to the actual requirements to fulfil this project. Markers will be put in place to guide the construction engineers with precision.

Construction
During construction those people concerned with the project development will be living near to site, but away from sensitive areas, so as to reduce impact on the area. Engineers and other specialists will be based at Kalene Mission hospital.

Safety wear will be required by all workers on site during the project period-this will include helmets, safety boots, eye and ear protection, and gloves. A safety officer will be present on site and first aid will be immediately available, and the hospital will be on call 6km away if there is an emergency.

In addition, all consumables will be stored correctly on site, away from the water course, and within a contained area in case of spillage or contamination going into the river. No vehicles or oils will be allowed near to the water course, and careful monitoring for oil spillage or other contaminants will be maintained to avoid pollution of the water course.

Explosives will be stored in an approved ‘magazine’ and will be under constant guard for the duration of blasting on site, in accordance with regulations as defined in the mining act. Only registered blasters will be allowed to operate the explosives.

Pit latrines will be installed at least 100m away from the river, and all garbage will be disposed off the site in a suitable manner.

The initial phase will be to build the weir section at the head of the rapids. This will be done during the dry season months while the Zambezi is low.

Operation
Once the Mini Hydro scheme is in operation, there will be little permanent activity on the site. Since this kind of project is designed to be low maintenance, it is expected that there will be two watchmen and engineers on site. The watchmen will be employed from the surrounding area and housing will not be provided to them on site. Their role will be to see to the maintained security around the Mini Hydro, so equipment is not tampered with or stolen. They will also be responsible for checking the function of the weir and canal system. The engineer will be housed on site to be at hand for the operation of the turbines and associated equipment including the power line. He will also be responsible for ensuring peoples safety in the area, and informing them of the project activities.

5. Description of Raw Material inputs & their potential Enviro effects

Weir

The weir will be constructed from concrete and natural granite from the blasted canal area. The weir will have specialised mechanical gates to gauge water flow and de-silting in the system. These materials will have no effects on the water quality other than a small amount of excess sand, stone and cement introduced into the system for a brief time during construction. This will have no marked long term effects since the amounts will be so small. The working surface in this area is massive rock, and biotic life will not be adversely affected by activities, since there is little other than rock algae. This site of construction is used also as a regular river crossing by local inhabitants, and therefore is regularly impacted for this purpose. Fish stocks will not be inhibited by the weir barrier, as mechanical de-silting gates will regularly through the day and night allow water flow through, allowing those fish which cannot go over the weir to pass unaffected, ensuring the 'rapids' section remains populated with small fish in the eddy sections.

Canal
The canal will be constructed by blasting through the granite rock along side the rapids section of the river. Normal fracture explosive (gelignite) will be used in this process, and it will have no effect upon the river or outside environmental systems. A small wall along each edge of the canal will be constructed to aid in the prevention of the inflow of rainwater runoff introducing silt into the hydro turbines, these low walls will also help in preventing people and small creatures unintentionally from falling into the canal structure. This wall will be constructed with masonry using native granite rock. It will also aid in masking and softening the appearance of the canal to viewers.

Penstock Pipe
This pipe will be made from steel and will measure 1.6 metres in diameter. These pipes will be elevated on concrete pedestals at approximately 6 metre sections. The pedestals will not be higher than 1.5 metres. The pipeline will travel through low density vegetation, that will not be adversely affected. The predominant grasses will recover the following rainy season, and will serve also to obscure the pipe from view.

Mini Hydro Turbine housing
The turbine will be housed in a stone masonry structure that will be partially below ground level. This excavation will be lined with stone and concrete to ensure no runoff from rainwater, and to keep the equipment area clean. The Mini Hydro Unit is self contained and produces no effluent of any form while working and requires only flowing water to ensure its operation. The turbine will be a slow speed unit ensuring also the survival of small fish passing through it to the river below. The river is heavily fished above the weir, fish stocks are low, so the turbine is not expected to alter fish stock populations downstream. The rapids section also forms a natural barrier to 'game fish' populations wishing to travel up or downstream.

Tailrace Canal
This canal will be approximately 1.5 metres in width and allow slow moving water from the turbines back into the river mainstream. The canal will be lined with masonry to prevent erosion of the side slopes of the canal and entry to the river. This water is not contaminated in any form, but only oxygenated. No water is lost in the processing of power and all water taken from the river, is returned to the river. The oxygenated water might have an increased effect on fish concentrations at the point of entry.

Power lines
The power lines to transport the electricity from the power station will be constructed along the main existing roads for 26 km, to necessary consumers along the way. 14 metre high, treated saligna (Gum)

poles will be used to carry the power lines. These poles will be planted into the ground into a small hole no wider than 700mm in size. The materials used will have no negative environmental impact. Only vegetation growing in those specific sites will be cleared, and trees that are likely to interfere with power lines will be cut to a suitable height, and not removed completely. Care will be taken to ensure that maximum vegetation will be maintained and that only that which directly interferes with the establishment of poles will be removed.

6. Technology and processes to be used

Weir
The weir will act as a retaining wall for water to be captured for the generation of hydro power. This weir will not stop the flow of water over the rapids section of the Zambezi. The weir is designed only to retain sufficient water to drive the turbine, the rest will then overflow the weir. Within the weir special anti-silting gates will be built. These gates are designed in high water to open automatically to allow flood water to flush out the lower portion of the weir wall. This ensures that silt does not build up behind the weir causing damage to the turbine equipment. These anti-silting gates will also be kept slightly opened at all times, so regardless of the river level, water will continually flow over the rapids area, ensuring all life forms remain unaffected by the weir.

Canal
The canal to channel water to the mini hydro will travel approximately 300 metres. The water depth in the canal will be approximately 1.0 metres. Stepped ramps will also be in place along the canal to ensure that people can climb out of the canal. Chains will also be hung at intervals along the route, so in the event of someone falling in, they will be able to grab hold of these to assist in their being able to climb out. The canal will have 2 metre wide walk ways over the top. This will serve two purposes; firstly to provide a safe walk way over the canal, and secondly to channel rainwater from the high ground over the canal, and back into the river below.

Header pond
The header pond will be the point at the end of the canal, where the water will be settled to remove silt and debris, and then will be channelled into a 1.6 metre diameter steel pipe. This pond will be built approximately 2 metres high, and will be constructed with masonry using the native granite from the canal.

Mini Hydro
The mini hydro will be housed in a masonry structure measuring 7x4 metres. The technology inside the power house will be a water turbine, which will be slowly spinning in order to ensure maximum fish survival . The turbine will drive a generator plant, which will be controlled by a circuit. There will be no visual impact of the development from the site of the rapids as there is a dense screen of vegetation along side the river in this area of the site.

Transformer
A step-up transformer will be installed at about 20 metres away from the power station to step up the power for transmission along the power lines to where the power will be used.

Power lines
Power lines will be installed on wooden poles to transmit electric power to different locations that will need power along the 26km route. These power poles will be about 14 metres in height and spaced about

100 metres apart. The poles will be erected in holes that will be excavated in the soil or the rock. The power line will be constructed along the access road on the east side of the site to ensure that there is minimal visual impact on the site. A wayleave of approximately 15 metres will be used along side the road ways to protect the power lines from shorting or accidental damage due to vegetation.

7. Products & by Products of the project

This project is designed to be clean running and non-polluting to the environment in any way. The only by-product of this development is electrical power. There is no contamination of water, and water removed is re-introduced back into the river system ensuring that the flow rate of the river is not affected.

8. Environmental effects of the project

Weir
The weir wall is to be built at approximately 1.0 metre high from ground level across the river flow. This weir will be built out of masonry using natural granite, ensuring that the weir has a more natural appearance. This weir will raise the water level behind the wall to 1.0 metre. It is anticipated that this rise in water will have an effect of heightening the water level to a distance of 100 metres behind the weir. The predominant trees currently growing in the vicinity are by enlarge flood tolerant species such as Syzigium guineense. The flooding of the area behind the weir will also be contained by the river banks as it is retained within the high water flood line levee. Effects of this will improve fishing in this area with certain game species enjoying the respite of deeper, stiller water. It may in some cases, encourage game fish breeding in certain species such as Tilapia sparrmanii, Tilapia rendalli, Oreochromis andersonii, and Oreochromis macrochir. The weir system is to be fitted with automatic anti-silting gates to open during floods. (See working drawings of ‘Scour Gates’ in appendix) These gates will be maintained to ensure a continuous flow of water over the rapids, along with water in flood season going over the weir wall and through the gates. Vegetation in the water along the rapids is sparse, and is comprised essentially of sedges and algae. These species will not be adversely affected by the new development.

Canal
The canal channelling water to the Mini Hydro will be built by blasting with precision, a channel of exact size through the granite rock along the river. The development of this canal will not have any environmental effect on this area, since it is being built out of massive granite. The granite is not heavily vegetated along the course where it is to be built. The vegetation comprises of sedges (Cyperus sp.), grasses (Loudetia simplex, Hyparrhenia tamba, Bothriochloa insculpta) and a few small trees (Diploryhnchus condylocarpon, Burkea africana and Parinari curaetilifolia). Since this vegetation is rooted in shallow soil there are no large plant species. The canal will not destabilise the zone along the river shoreline. The canal will have a small stone and concrete wall (approx 300mm high) constructed along its edge, which will open where the walkways over the canal have been constructed, which will allow excess rainwater to return to the river. These walls will also act as retainers for soil particles and allow similar re-growth to the present to take place again. No erosion will take place, since the water will all be channelled through solid granite rock.

Header pond
This pond will be positioned at the end of the canal. The pond will be to allow water to settle and deposit silt particles and debris before entering the pipes to take water to the Mini hydro. The Header pond will be a square structure built out of masonry using native granite, and will rise 2 metres above the ground.

The structure will be built onto a granite rock base as an extension of the canal. It is not expected to cause negative environmental effects other than visual. This visual impact will be softened by constructing it from native granite and in time will blend in well with the surrounds.

Penstock pipe to Mini Hydro
The pipeline delivering water to the Mini Hydro will be 1.6 metres in diameter. This pipeline will be steel and will be mounted on concrete and stone pedestals as it travels for approx 75 metres downhill to the Mini Hydro. Vegetation removal will be minimal, as the route for the pipe is mostly clear, with only a few small trees and grass obstructing the route. The trees will not be uprooted, but only cut back, and allowed to re-grow once the pipe has been established. The pipe will be painted a suitable green colour to blend it into the environment. The masonry pedestals will be approximately 2x1 metre in size, and will vary in height depending on the topography, but to ensure the pipe is level. These pedestals will be at approximately 6 metre intervals and will be founded on massive granite at a depth of approximately 0.5 metre to ensure stability. The pipe will have minimum impact, and in time vegetation will obscure it from view. The pipeline will not be visible from the west side of the river, or from the rapids, as it is screened behind the riverine forest.

Mini Hydro
The mini hydro will be housed in a masonry structure which will be partially below ground level. The site chosen for this construction is also sparsely vegetated and therefore will cause little environmental damage to the surroundings. The operation of the Mini turbine will cause no disturbance as it has a quiet operation involving the passage of water through an enclosed turbine, the slowed water is released back into a tailrace canal for release into the river below the rapids section.

Power-lines
Power-lines will be established from the mini hydro station. Power-lines will be installed on wooden poles to transmit electric power to different locations that will need the power along the 26km route. These power poles will be about 14 metres in height and spaced about 100 metres apart. He poles will be erected in holes that will be excavated in the soil or the rock. The power-line will be constructed along the access road on the east side of the site to ensure that there is minimal visual impact of the site.

A wayleave of approximately 15 metres will be used along side the road ways to protect the power lines from shorting or accidental damage due to vegetation. Care will be taken to ensure that the line will not have large adverse effects of the vegetation or other features in its construction. The route chosen along the road side, has already been impacted due to removal of trees for agriculture and villages.

The overall effects of this project on the environment are minimal. When compared to power production facilities using alternative sources of energy such as coal or other fossil fuels, this project has a very clean method of producing electricity, with no envisaged long-term effects on the environment, either in the river or on its boundary.

Reasonable alternatives

Given the remote location of this project, no reasonable alternatives could be found, as the river has a rapids section only at this point before entering Angola. The drop or gradient of the river at this point is

also the greatest over a 70km section of river, and no other site would offer the necessary gradient to provide 'head' to drive turbines to produce the necessary required 700KW power output.

Other alternatives for energy have been utilised. Solar power is used in all the mission localities and at Sakeji school, but only for lighting and for water heaters. A water wheel providing about 5 kW has been in use at Sakeji school for over 60 years to provide hydro power; however the demand has risen in excess of the supply. Water rams are used to supply water, but in small volumes.

Wind energy has not been used due to the diurnal and seasonal variations that preclude this source as it is too unreliable.

The main grid is located 380 km away to the east, and it is not likely that there will be extensions to the west due to government policy to rely in local private hydro schemes in remote locations such as this one. Plans are proceeding for construction of mini Hydro schemes at the two nearest government centres at Mwinilunga and Kabompo.

9. Socio economic impacts of the project

No negative socio economic impacts have been gauged in this project.

Currently the local community make use of this section of river for clothes washing, small scale fishing and a river crossing point. These uses will in no way be negatively influenced by the implementation of this project. The fishing opportunities may actually increase above and below the site. Since the river is shallow over a long section, alternative crossing points are easy and safe to use. The canal section will be clearly marked and protected by a low masonry wall. The canal will also have 2 metre wide walk ways over the top at intervals of approximately 100 metres, these will allow for easy and safe crossing. If someone were by accident to fall into the canal the water will only be slow moving at a rate of approximately 1.5 metres per second, and ramps will be built internally to allow people to climb out, as well as steel chains suspended for them to take hold of.

The project developers and consultants have spoken with the surrounding community, and the local community response is extremely positive, since the expectation of electric power to the area has been anticipated for over 40 years. Benefits vary from:
direct access to the power by local villagers
employment opportunities to locals while constructing the project and to a small extent after commissioning
increase in the potential for industry, such as better farming practices with irrigation schemes offering higher agricultural yield along with increased labour employment. A Pineapple factory has been proposed in the area for many years, but without electrical power this has not been feasible, but there are already plans to build this with the advent of electricity supply.
improved facilities in the area of Ikelenge District. Kalene Mission Hospital will be able to improve its services to the community. The hospital until now has operated with only diesel generated power at great expense and limited efficiency. Electrical power will transform this facility.
Schools and homes in the Ikelenge District will have access to electric power for the first time.

No re-settlement of people will be necessary for this project.

10. Impact Management Plan

Since this project has little in the way of negative environmental impact, the operation will take into account the sustainability of the project in the long term.

Once this project has been commissioned, staff will be employed to consistently ensure that the Mini Hydro operates at optimum efficiency. Their responsibilities will relate to:

To ensure that local people and visitors are kept informed of the operation, its benefits and any dangers surrounding its operation.
The weir functioning correctly, ensuring water flow to both the Mini Hydro and the river rapids section.
To oversee the security and presence of people on the site so that nothing is tampered with or people do not have accidents related to the Mini Hydro operation.
To act as conservation officers in promoting the health of the environment to the local people with regards to the river, surrounds and the areas utilisation as a whole.

Environmental monitoring will take place regarding the following:

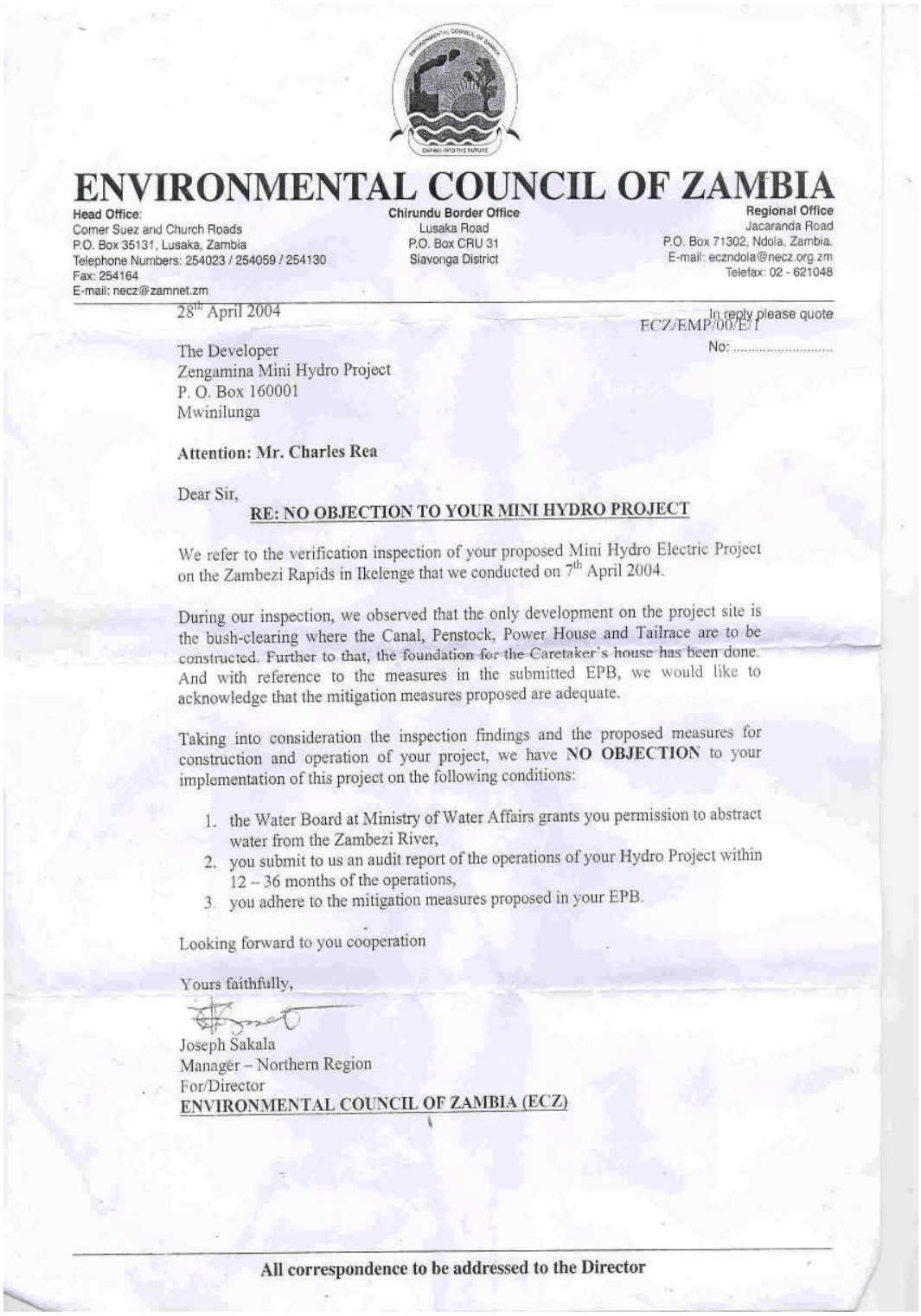
The weir and its effects on upper stream vegetation and growth.
The effects of the weir on fish stocks in the river above stream with the raised water effect.
The weir's effect on the rapids section, ensuring that water is constantly flowing over this area, to sustain all macro and micro organisms.
The re-introduction of oxygenated water into the river with special interest in the fish concentrations at the point below the rapids section.
The re-colonising of vegetation along the canal and pipeline sections of the project.

Since the Hydro Project has a long-term life span, it is in the interests of the developers to ensure that the river and its habitat are best taken care of.

11. Effects to neighbouring states

The scheme is a 'run-of river' power station and thus will have no impact on the storage of water in the river. Since the effects of this project are of a local nature, they do not have any measured impact into the neighbouring state of Angola where the Zambezi River flows.

Appendix II Letter of No Objection from ECZ



ENVIRONMENTAL COUNCIL OF ZAMBIA

Head Office:
Corner Suez and Church Roads
P.O. Box 35131, Lusaka, Zambia
Telephone Numbers: 254023 / 254059 / 254130
Fax: 254164
E-mail: necz@zamnet.zm

Chirundu Border Office
Lusaka Road
P.O. Box CRU 31
Siavonga District

Regional Office
Jacaranda Road
P.O. Box 71302, Ndola, Zambia.
E-mail: eczndola@necz.org.zm
Telefax: 02 - 621048

28th April 2004

In reply please quote
ECZ/EMP/00/E/1
No: .....

The Developer
Zengamina Mini Hydro Project
P. O. Box 160001
Mwinilunga

Attention: Mr. Charles Rea

Dear Sir,

RE: NO OBJECTION TO YOUR MINI HYDRO PROJECT

We refer to the verification inspection of your proposed Mini Hydro Electric Project on the Zambezi Rapids in Ikelenge that we conducted on 7th April 2004.

During our inspection, we observed that the only development on the project site is the bush-clearing where the Canal, Penstock, Power House and Tailrace are to be constructed. Further to that, the foundation for the Caretaker's house has been done. And with reference to the measures in the submitted EPB, we would like to acknowledge that the mitigation measures proposed are adequate.

Taking into consideration the inspection findings and the proposed measures for construction and operation of your project, we have **NO OBJECTION** to your implementation of this project on the following conditions:

1. the Water Board at Ministry of Water Affairs grants you permission to abstract water from the Zambezi River,
2. you submit to us an audit report of the operations of your Hydro Project within 12 – 36 months of the operations,
3. you adhere to the mitigation measures proposed in your EPB.

Looking forward to you cooperation

Yours faithfully,

Joseph Sakala
Manager – Northern Region
For/Director
ENVIRONMENTAL COUNCIL OF ZAMBIA (ECZ)

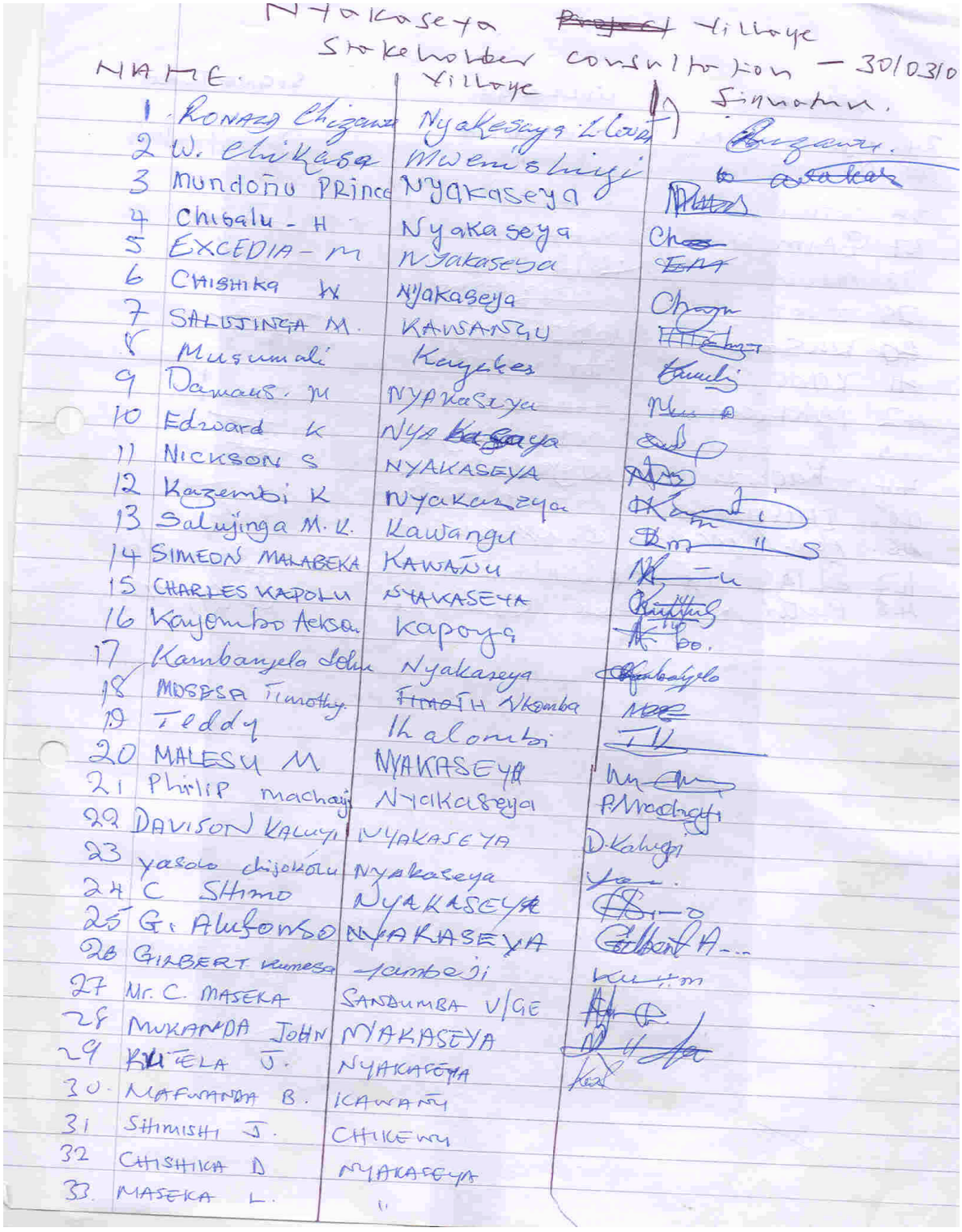
All correspondence to be addressed to the Director

Appendix III A combination of Gold Standard and Zambia's CDM Sustainable Development Assessment

INDICATOR	RANKING (NORMAL)					TOTAL
	1	3	5	7	9	
	Weakly important	Less Important	Moderately Important	More Important	Extremely Important	
Economic **7. Contributing to competitiveness at a micro-level, like industry** **8. Positive effects on the balance of payment** **9. Improved sectoral productivity, growth and linkages leading to higher contribution to GDP** **10. Reduction of energy intensity (energy used per unit product) at a micro level** **11. Increasing share in the contribution of renewable energy to the energy supply mix at a macro-level** **12. Job creation** **Sub - total**						
Environment and health **11. Reduction(contribution) of GHG emissions (CO_2, CH_4, N_2O) aimed at enhancing global environmental integrity** **12. Reduction(contribution) of local emissions (SO_2, NO_x, CO, NMVOC) impacting on air** **13. Reduction(contribution) of local emissions (SO_2, NO_x, CO, NMVOC) impacting on water resources** **14. Reduction(contribution) of local emissions (SO_2, NO_x, CO, NMVOC) impacting on land** **15. Reduction(contribution) of local emissions (SO_2, NO_x, CO, NMVOC) impacting on bio-diversity**						

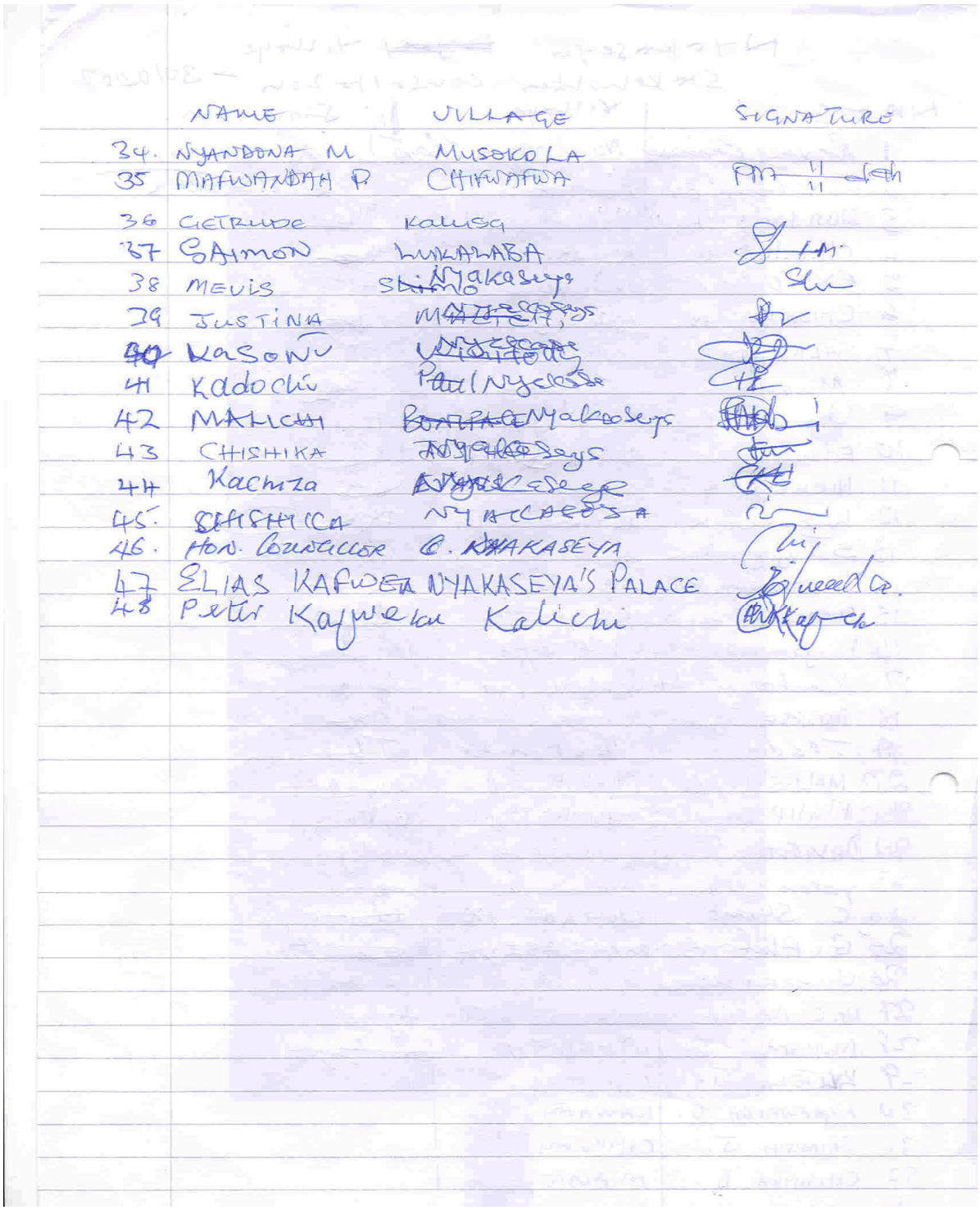
INDICATOR	RANKING (NORMAL)					TOTAL
	1	3	5	7	9	
	Weakly important	Less Important	Moderately Important	More Important	Extremely Important	
16.Reduction(contribution) of noise and vibration or release of light energy and radiation **17.Reduction (Restriction) to recreation facilities** **18.Inhibition to infrastructure development(homes, industry, recreation, churches, hospitals)** **19.Restriction to resources such as ground water, surface water forestry and agriculture, fisheries and tourism** **20. susceptibility to earthquake, landslides erosion, flooding or extreme or adverse** **Sub total**						
Social **9. Contribution to poverty reduction through local employment** **10.Contribution to more equitable distribution of resources (reduction of wealth disparities)** **11.Increase in percentage of rural and peri-urban population with access to energy supply** **12.Affordability of the project product (s).** **13.Capacity building (e.g. transfer of technical skills)** **14.Reduction of health hazards** **15.Contribution to access to social amenities** **16.contribution to social changes (traditional styles or employment)** **Sub total**						

Appendix IV Nyakaseya Village Stakeholder Consultation



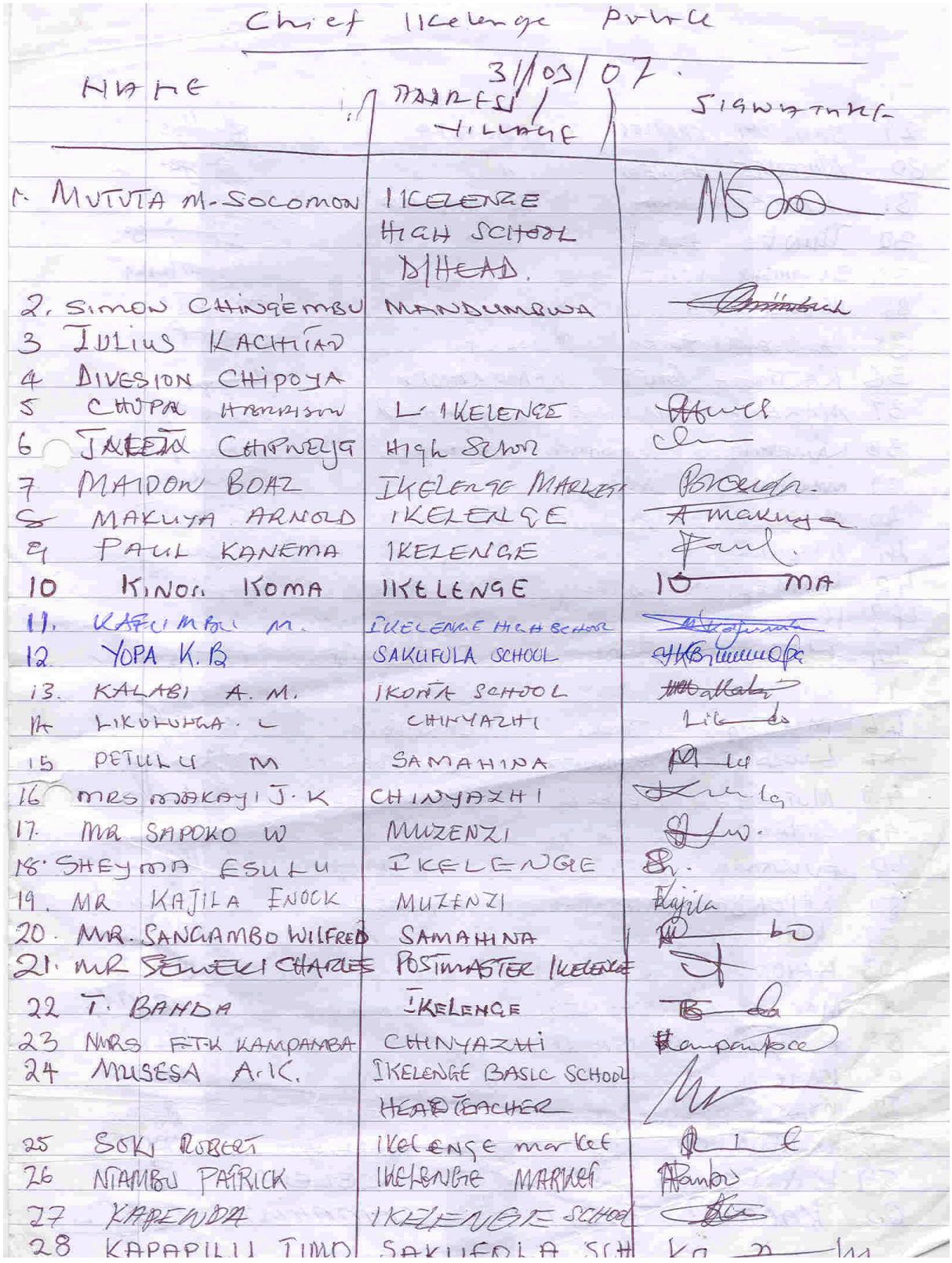
Nyakaseya ~~Project~~ Village
Stakeholder consultation – 30/03/10

	NAME.	Village	Signature.
1	Ronald Chizawa	Nyakaseya Village	
2	W. Chikasa	Mwenshinji	
3	Mundonu Prince	Nyakaseya	
4	Chisalu - H	Nyakaseya	
5	EXCEDIA - M	Nyakaseya	
6	Chishika W	Nyakaseya	
7	Salujinga M.	KAWANGU	
8	Musumali	Kayekes	
9	Damaus. M	Nyakaseya	
10	Edward K	Nya~~ka~~seya	
11	Nickson S	NYAKASEYA	
12	Kazembi K	Nyakaseya	
13	Salujinga M. K.	Kawangu	
14	SIMEON MALABEKA	KAWANGU	
15	CHARLES KAPOLU	NYAKASEYA	
16	Kayombo Aekson	kapoya	
17	Kambanjela John	Nyakaseya	
18	MOSESA Timothy	TIMOTH Nkomba	
19	Teddy	Ihalombi	
20	MALESU M	NYAKASEYA	
21	Philip machaya	Nyakaseya	
22	DAVISON KALUYI	NYAKASEYA	
23	yasolo chisokolu	Nyakaseya	
24	C Shimo	NYAKASEYA	
25	G. Alufonso	NYAKASEYA	
26	GILBERT Kumesa	Lambeji	
27	Mr. C. MASEKA	SANDUMBA V/GE	
28	MUKANDA JOHN	NYAKASEYA	
29	KATELA J.	NYAKASEYA	
30	MAFUMANDA B.	KAWANGU	
31	SHIMISHI J.	CHIKEWA	
32	CHISHIKA D	NYAKASEYA	
33	MASEKA L.	"	



	NAME	VILLAGE	SIGNATURE
34.	NYANDONA M	MUSOKOLA	
35	MAFWANDAH P	CHIFWAFWA	
36	GETRUDE	Kalisa	
37	SAIMON	LUKALABA	
38	MEVIS	Nyakaseya	
39	JUSTINA		
40	KASONU		
41	Kadochi	Paul Nyakaseya	
42	MALICHI	Nyakaseya	
43	CHISHIKA		
44	Kachiza		
45.	CHISHICA	NYAKASEYA	
46.	HON. COUNCILLOR	C. NYAKASEYA	
47	ELIAS KAFWEA	NYAKASEYA'S PALACE	
48	Peter Kafwaka	Kalichi	

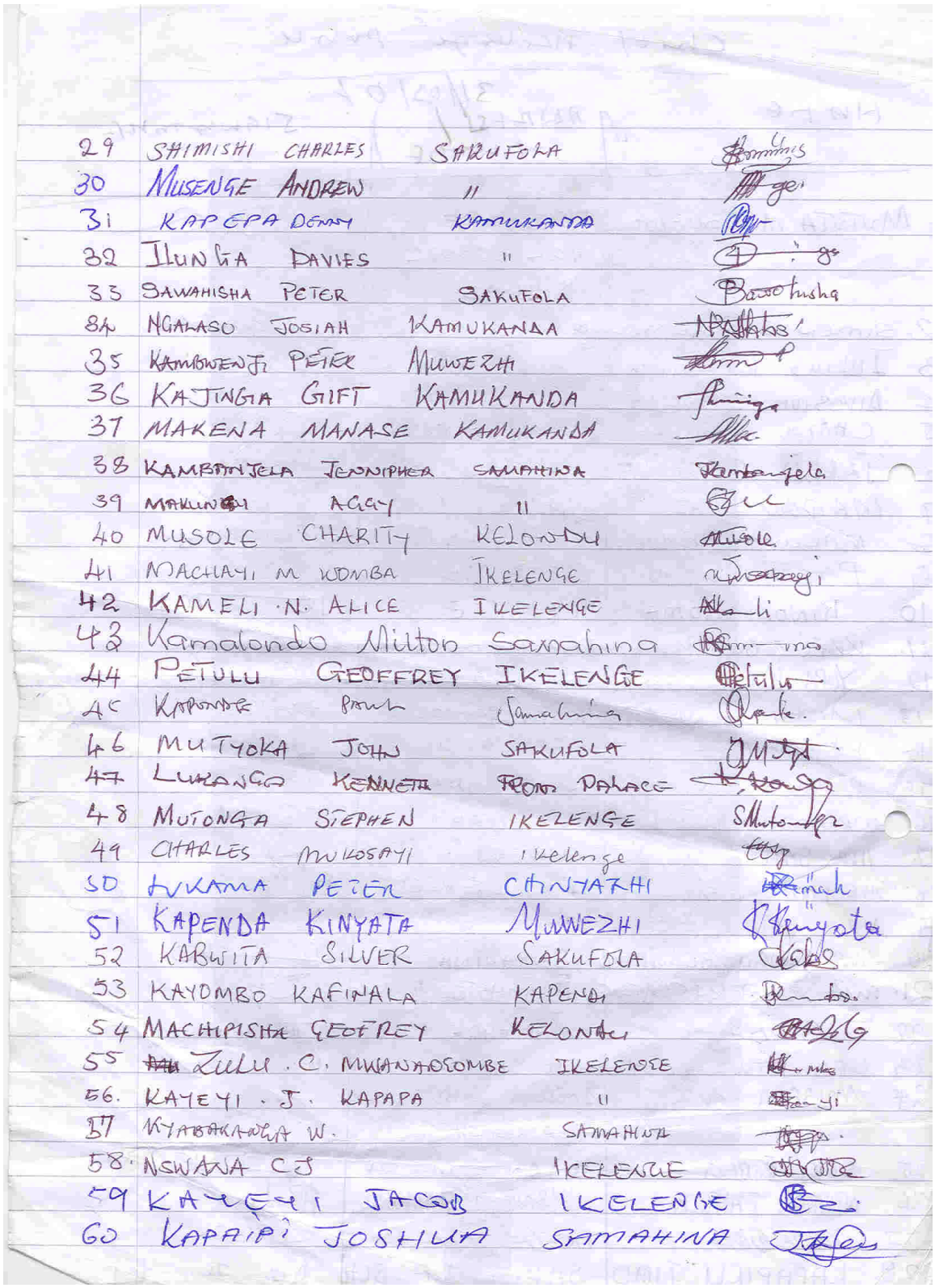
Appendix V. Ikelenge Public Consultation



Chief Ikelenge Parish

31/05/07.

NAME	ADDRESS / VILLAGE	SIGNATURE
1. MUTUTA M. SOCOMON	IKELENGE HIGH SCHOOL D/HEAD.	
2. SIMON CHINGEMBU	MANDUMBWA	
3 JULIUS KACHIAN		
4 DIVESION CHIPOYA		
5 CHIPPA HANNISON	L. IKELENGE	
6 JAKETA CHIPWEYA	High School	
7 MAIDON BOAZ	IKELENGE MARKET	
8 MAKUYA ARNOLD	IKELENGE	
9 PAUL KANEMA	IKELENGE	
10 KINON KOMA	IKELENGE	
11. KAFUMBU M.	IKELENGE HIGH SCHOOL	
12. YOPA K. B	SAKUFOLA SCHOOL	
13. KALABI A. M.	IKONA SCHOOL	
14 LIKUNGWA. L	CHINYAZHI	
15 PETULU M	SAMAHINA	
16 MRS MAKAYI J. K	CHINYAZHI	
17. MR SAPOKO W	MUZENZI	
18. SHEYMA ESULU	IKELENGE	
19. MR KAJILA ENOCK	MUZENZI	
20. MR. SANGAMBO WILFRED	SAMAHINA	
21. MR SENEKI CHARLES	POSTMASTER IKELENGE	
22 T. BANDA	IKELENGE	
23 MRS FTK KAMPAMBA	CHINYAZHI	
24 MULESA A.K.	IKELENGE BASIC SCHOOL HEAD TEACHER	
25 SOKI ROBERT	IKELENGE MARKET	
26 NTAMBU PATRICK	IKELENGE MARKET	
27 KAPENDA	IKELENGE SCHOOL	
28 KAPAPILU TIMO	SAKUFOLA SCH	



29	SHIMISHI	CHARLES	SAKUFOLA	
30	MUSENGE	ANDREW	11	
31	KAPEPA	DENNY	KAMUKANDA	
32	ILUNGA	DAVIES	11	
33	SAWAHISHA	PETER	SAKUFOLA	
34	NGALASO	JOSIAH	KAMUKANAA	
35	KAMBWENJI	PETER	MUWEZHI	
36	KAJINGIA	GIFT	KAMUKANDA	
37	MAKENA	MANASE	KAMUKANDA	
38	KAMBANJELA	JENNIPHER	SAMAHINA	
39	MAKUNGU	ACCY	11	
40	MUSOLE	CHARITY	KELONDU	
41	MACHAYI M	KOMBA	IKELENGE	
42	KAMELI N.	ALICE	IKELENGE	
43	Kamalondo	Milton	Samahina	
44	PETULU	GEOFFREY	IKELENGE	
45	KAPONDE	Paul	Samahina	
46	MUTYOKA	JOHN	SAKUFOLA	
47	LUKANGA	KENNETH	ROAD PALACE	
48	MUTONGA	STEPHEN	IKELENGE	
49	CHARLES	MULOSAYI	Ikelenge	
50	LUKAMA	PETER	CHINYAKHI	
51	KAPENDA	KINYATA	MUWEZHI	
52	KABWITA	SILVER	SAKUFOLA	
53	KAYOMBO	KAFINALA	KAPENDA	
54	MACHIPISHA	GEOFREY	KELONDU	
55	ZULU	C. MWANAKOSOMBE	IKELENGE	
56.	KAYEYI	J. KAPAPA	11	
57	KYABAKAMBA	W.	SAMAHINA	
58.	NSWANA	CJ	IKELENGE	
59	KAYEYI	JACOB	IKELENGE	
60	KAPAIPI	JOSHUA	SAMAHINA	

Annex 5 Original feasibility Report

ZENGAMINA MINI HYDRO SCHEME
ZAMBEZI RAPIDS
KALENE HILL, NWP, ZAMBIA

FEASIBILITY STUDY REPORT

By

Charles Rea, MICE.
Mwinilunga Ventures Ltd.
Box 160010,
Mwinilunga
Zambia

October, 2003

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MV 1.11	Header pond details
MV 1.12	Trash rack detail
MV 1.13	Penstock details
MV 1.14	Power house
MV 1.15	Schematic for power circuit

1. INTRODUCTION

A 700 kW hydro scheme is planned on the Zambezi river, in the northwest corner of Zambia, at a site known historically as the Zambezi Rapids. The scheme is named after the elderly chief Nyakaseya. The Zambezi is a small river at this location, being near to the source some 50 km away. The river flows over a granite dome, falling about 17 metres over about 300 metres length of rapids.

The purpose of the scheme is to provide electricity to this remote part of Zambia and reduce the dependency on diesel generators in the area. The hospital, clinics, schools, farms and general population will all be beneficiaries of the availability of reliable power supply at reasonable cost.

Several studies have been conducted in the last 40 years to construct a hydro scheme at this location, but no developments followed. In 2002, a feasibility study was initiated by friends of Kalene Hill Mission, and this report details the findings of the study.

2. LOCATION OF THE SITE

The site is located about 6 km north of Kalene Hill Mission hospital on the track to Salujinga. Figure MV1.1.1 shows the general location of the site in Zambia. Figure 1.1.2 indicates the location in the North west province of Zambia and Figure MV1.1.3 indicates the area served by the proposed power line. The power line will extend from to the Chief's capital at Nyakaseya on the west, to Kalene area, along the main road to Chief Ikelene's capital, and thence to Hillwood Farm and Sakeji school on the east side of the area.

3. TITLE DEEDS

The approval of the local chief Nyakaseya has been granted in writing and the scheme is named after him. The process has commenced to secure title to the land where the site of the scheme is proposed. The local municipal council in Mwinilunga is supportive of the project and has given approval to proceed with acquisition of the land from the government.

4. WATER RIGHTS

The water right application is pending approval, but as it is a 'run of river' scheme there is no difficulty anticipated with the water right.

5. GEOLOGY AND HYDROLOGY

The geology of the area of the rapids is massive granites of the basement complex which are exposed at the surface over much of this area. The overlying quartzites and meta-sedimentary rocks of the Katanga sequence are exposed in the hills to the south of the site. A mantle of Kalahari sand covers the surface to various depths, except at the site of the scheme where the granites are exposed. The granite is extremely hard and is typically domed with sheeter joints and occasional subvertical joints.

Figure MV1.1.4 shows an air photograph of the entire rapids indicating the schematic layout of the proposed civil works. The Zambezi river is about 25 metres in width upstream of the site, widening over the rapids to about 60 metres, before splitting into two channels around an island in the centre of a right angle bend in the course of the river. The area is attractive and has been in use for many years by visitors who enjoy recreation in the area.

The catchment of the site is about 600 km^2 and the mean annual rainfall of the area is about 1500 mm. The maximum recorded rainfall is 2100 mm and the minimum on record is 1300 mm. The minimum flow in the river in November has been estimated on three different occasions by engineers at 5 m^3/sec, and the peak flow is estimated to be in excess of 300 m^3/sec. There are no gauges on the river to confirm these figures.

6. GENERAL ARRANGEMENT OF THE SCHEME

The purpose of the civil works is to deliver water from the Zambezi river, via a canal to a penstock to generate hydroelectric power at the base of the rapids.

The general layout of the site is shown on Drawing MV 1.2, which is a survey of the entire site. The general layout of the scheme has not changed since the original pre-feasibility study in 1964.

The civil works are designed to:

- pass large order floods without damage to the works
- transport sediment through the off-take structure
- minimize head loss through the system in order to maximize the driving head for power generation.
- make the works safe for human occupancy in the area
- be aesthetically acceptable
- be durable with minimal maintenance

The proposed site is suitable for a low level gravity weir with a canal on the right bank to divert the water along contour to the head pond area above the power station.

Sedimentation is expected in the reservoir and the canal, and provision has been made for automatic sluice gates to flush out sediments during periods of peak flow.

The water will be transported to the turbine in a large diameter penstock conduit. The penstock will be above ground and cradled on masonry pedestals. Provision has been made in the civil works for a second phase which will double the capacity of the scheme.

The power station will be concealed from view behind large trees at the side of the river, and a tailrace will lead the flow back to the river, downstream of the site at the base of the main rapids.

A step up transformer station will be located near to the power station and a power line will be constructed around the north east of the rapids, following the access road to the bridge crossing upstream of the site.

The power line will follow the main road system to Kalene Hill Mission, and thence to the other centres.

7. ENVIRONMENTAL IMPACT

The preservation of the site for future tourism has been of primary importance in planning the scheme. Designs have been prepared to minimize the visual impact of the structures for visitors to the site.

The scheme will replace diesel generators in the district and this will have an immediate positive impact on carbon emissions in the area.

The scheme is a 'run-of-river' concept which will not store water upstream of the weir. There will be no displacement of people. The very small storage area will have minimal impact on vegetation as the rise in water level from the weir will be less than the flood levels in the river.

The project brief from the environmental consultant is included in Appendix 2.

8. POWER DEMAND

The research has been conducted in the main centres of usage as follows:

- Kalene Mission and Hospital - present demand 100 kW
  - 5 year demand 200 kW
- Kalene and Nyakaseya villages - no supply at present
  - 5 year demand10 kW
- Ikelene Mission - no supply at present
  - 5 year demand 50 kW
- Ikelene town - no supply at present
  - 5 year demand 50 kW
- Other villages - no supply at present
  - 5 year demand 35 kW
- Hillwood Farm - present demand 30 kW
  - 5 year demand 200 kW
- Sakeji School - present demand 16 kW
  - 5 year demand 75 kW

The growth of the demand for the energy is likely to be substantial due to the requirements for irrigation at Hillwood Farm in the short term and the possibility of a pineapple factory at Ikelene being developed within the first five years of commissioning.

The figures for demand in the villages and at Ikelene centre are a low forecast due to the low level of incomes in these areas. The estimates for domestic demand have been based upon the number of salaried employees and business men and women in the area, and are in general conformance with the present demands at Mwinilunga and Kabompo towns in the same province. A survey of energy spending at present has been conducted.

It is estimated that the 5 year demand curve will reach the maximum output of the first turbine. A second phase is planned which will supplement the peak demand requirements using a day storage reservoir upstream, and a second turbine to double the output.

9. PRELIMINARY DESIGN

9.1 Civil Works

The design is very simple as shown in plan with Dwg. MV 1.2. A low level off take weir will divert a portion of the river to flow in a canal on the right bank to a head pond above the power station. A large diameter pipe will convey the water down to the power station and thence back to the river at the base of the rapids.

Drawing MV 1.3 shows the plan of the weir site at the top of the rapids. The elevation of the main overflow section is 1202 m, with elevated sections on either side of the main spillway. Details for the weir cross section are shown on Dwg. MV 1.4. The construction of the weir is proposed with masonry using local granite blocks from the canal excavation.

Two automatic scour gates will be constructed in the main overflow section to de-silt the reservoir in times of flooding. The design of these scour gates is shown on Dwg. MV 1.5.

The cross section of the weir structure is shown on Dwg. MV 1.6 and the intake for the canal is shown on Dwg.MV 1.7.

The canal will be elevated initially over the first 50 metres due to the shape of the granite outcrop in the vicinity of the weir. Dwg.MV1.8 shows the detail of the canal section. A sediment chamber will be constructed within this elevated section to flush out any sediment that may enter the canal during the wet season. The sediment chamber will incorporate a third automatic sluice gate.

The canal will be partially in rock cut as shown in Dwg. MV 1.8. The dimensions of the canal will allow for 7 m^3/sec, which is the estimate for the requirement of power generation. Future requirements will be provided by raising the sides of the canal and head pond. The sides of the canal will be raised to prevent accidental entry to the canal. Exit points will be provided in case of emergency.

Drainage from the small catchments above the canal will be channeled to bridging points at intervals along the canal, which will also provide access across the canal for pedestrian and animal traffic. The details are shown on Dwg. MV 1.9.

The general layout for the penstock area is shown in detail on Dwg. MV1.10. The penstock will be about 75 metres in length, leading from the head pond to the power house directly down contour.

The head pond is shown on Dwg. MV 1.11. The head pond and the portion of the canal leading to it will be elevated to accommodate the penstock pipes delivering the water to the turbines. The construction of the head pond will be with masonry using the local granite blocks, except for the surround for the penstock which shall be of concrete.

The head pond will have a trash rack to prevent debris or people from entering the penstock during operation. Steps will be provided in the head pond in case of emergency. The details of the trash rack are shown on Dwg. MV 1.12.

The penstock pipe has been designed as a 1.7 metre diameter welded steel pipe with epoxy lining to reduce friction losses and to minimize corrosion in the longer term. The details are shown on Dwg. MV 1.13. The pipe will be manufactured in Kitwe and transported on low loaders to the site. A mobile crane will lift the pipes onto masonry pedestals which will cradle the penstock and allow for welding in situ. The pipe will be elevated about half a metre above natural ground level, except where the topography is depressed. Natural drainage will not be affected by the construction of the penstock.

The power station will be located near the base of the rapids at a point above the high water level. The power house will be designed to allow for future expansion to two turbines - Dwg. MV 1.14. An excavation will be made to lower the turbine within 4.5 metres of the low water level to maximize the available head at the site. The structure will be partially tanked to prevent water rise during a major flood, in order to maintain the power supply during these events.

A tailrace will consist of an open channel from the power house to the gully that exists directly to the south of the proposed structure. The gully leads directly to the river at the base of the rapids.

9.2 Hydro-mechanical Works

The choice of turbine has yet to be finalized, but it is likely to be a cross flow turbine with an alternator rated at 500 kW. The control will be of the hydraulic governor type rather than load control to minimize the flow of water through the proposed system during periods of low flow in the river. Switch gear and lightening arrestors will be installed to cater for electrical control. Quotes from the suppliers are given in appendix 3.

9.3 Electrical Works

The alternator will operate at a voltage of 6.2 kVA, which will be raised to a transmission voltage of 33 kVA at a substation near to the power house. A local supply of 400 VA will be installed for the scheme administration and surrounding villages.

The power route has been surveyed and the preliminary design is given in appendix 4. To summarize: there will be a 33 kVA main line to Kalene Mission, and then on to Ikelene town and mission, and finally to Hillwood Farm.

The preliminary schematic for the power circuit is shown on Dwg. MV 1.15. This is currently under revision.

A substation will be situated at Kalene Hill mission with a 400 V line to Nyakaseya on the west and to Tambatamba area on the east. Another substation will be situated at Ikelene town with a step down to 400 V for the local supply and for transmission back along the line to the villages on the route. The final substation will be at Hillwood Farm with a 400 V line to Sakeji School.

The power line will be constructed using treated gum poles which is the standard practice in Zambia. A way leave of 15 metres is required for the power line and this will be routed to avoid existing development wherever possible. Some compensation will be granted to local people where structures will have to be relocated, or where fields exist within the way leave for the proposed power line.

Local supply to villages en route will be 400 V leading from pole mounted, step down, transformers at a central location. The supply of power to the individual consumers will be by overhead cables and meters will be installed at each location.

10. COST ESTIMATES

The cost estimates for the scheme are broken down into the different categories of work as summarized below:

	Amount USD
1. Civil works – weir, canal, headpond, structures	236 000
2. Penstock	100 000
3. Turbine	650 000
4. Transmission line and substations	689 000
5. Contingency estimate 15%	251 250
Total estimate	+- 1.925 million

11. ECONOMIC ANALYSIS

A preliminary financial analysis of the proposed scheme has been conducted by the Centre for Energy in Lusaka. Various options have been analyzed relating to tariff structure and subsidy predictions. Sales of *carbon credits* to first world countries have been evaluated in the analysis. The full results of the study are given in Appendix 5.

General assumptions for all scenarios are as follows:

1 Equity Subscription is 33 % of total investment cost inclusive of working capital and interest during construction.
2 The Loan portfolio is 67 % of total investment cost inclusive of working capital and interest during construction.
3 The loan is amortized over a period of 10 years at an interest rate of 8 per cent per annum payable on reducing balance of the principal amount.
4 Repayment of the loan is on a yearly basis.
5 The cut off rate or discount rate is 10 per cent
6 Cost of 1 tonne of carbon credit = US$5/tonne
7 Annual growth rate in the demand is 20%, starting from a low value of 250 kW as the starting power demand prediction
8 Management and repair costs have been included at 5% per annum

Scenario I – $2 million investment for entire project

Tarriff US$	IRR %	NPV $'000	Pay Back Years	Investment $'000	Cum.Bal $'000
.02	-0.02	(1208.25)	16	2000	(702.40)
.04	5.54	(614.04)	13	2000	801.37
.06	9.87	(19.84)	10	2000	2305.14
.08	13.48	574.36	9	2000	3808.92
.10	16.64	1168.56	8	2000	5312.69

Scenario I shows full investment into civil works and generation equipment (i.e turbines) plus operating costs for transmission. Financial viability at lower tariff rates is unattractive with negative Net Present Values. Acceptable results are shown from a tariff rate of 10 cents.

Scenario II - $0.75 million investment which excludes transmission line costs

Tarriff US$	IRR %	NPV $'000	Pay Back Years	Investment $'000	Cum.Bal $'000
.02	8.78	(86.46)	11	750	570.60
.04	16.38	507.74	8	750	2074.37
.06	22.26	1101.94	6	750	3578.14
.08	27.17	1696.14	6	750	5081.92
.10	31.47	2290.35	5	750	6585.69

Scenario II shows investment exclusive of distribution and transmission costs. The financial viability of this scenario shows good results at 4 cents per unit, the NPV's and the cumulative cash balances are all positive.

Scenario III: $2 million investment with CDM + no deposit

Tarriff US$	IRR %	NPV $'000	Pay Back Years	Investment $'000	Cum.Bal $'000
.02	3.36	(939.94)	15	2000	243.26
.04	9.52	(83.59)	12	2000	2767.37
.06	13.90	772.77	10	2000	5291.48
.08	17.42	1629.12	9	2000	7815.59
.10	20.43	2485.47	8	2000	10339.70

Scenario III shows full investment into civil works and generation equipment (i.e turbines) plus operating costs for transmission. The benefits of CDM accrue from annual cash inflows of Electricity sales together with credits from Carbon Dioxide emission reductions. The results indicate that viability starts at a rate of about 8 to 10 cents per unit.

Scenario IV: $2 million investment with CDM + 33% deposit

Tarriff US$	IRR %	NPV $'000	Pay Back Years	Investment $'000	Cum.Bal $'000
.02	3.62	(832.22)	15	1810.90	355.14
.04	10.15	24.13	12	1810.90	2879.25
.06	14.73	880.48	10	1810.906	5403.36
.08	18.41	1736.83	9	1810.90	7927.47
.10	21.54	2593.18	8	1810.90	10451.58

Scenario IV shows full investment into civil works and generation equipment (i.e turbines) plus operating costs for transmission. This scenario has benefits that accrue from annual cash inflows of Electricity sales and 33 per cent down payment on credits from Carbon Dioxide emission reductions (i.e based on a cumulative total of CO_2 for 21years). The results indicate that viability starts at a rate of about 8 cents per unit with the deposit from CDM.

Scenario V: $2 million investment with 50% subsidy

Tariff US$	IRR %	NPV $'000	Pay Back Years	Investment $'000	Cum.Bal $'000
.02	3.96	(562.43)	15	1375	480.32
.04	12.42	293.92	11	1375	3004.43
.06	18.09	1150.28	9	1375	5528.54
.08	22.62	2006.63	8	1375	8052.65
.10	26.54	2862.98	7	1375	10576.76

This scenario shows a 50/50 share of investment by a supporting mechanism and the Investor. The results indicate that viability starts at a rate of about 6 cents per unit.

For such an investment to be viable, the tariff has to be affordable by the local populace and by the main supporters of the project – being the mission. The general tariff in Zambia is between 2 to 3 cents per unit.

It is generally considered that for such projects, an IRR of 20% is reasonable together with a payback period in under 10 years.

Therefore, based on the analysis above, even with carbon credits accruing in the long term, a subsidy on the major portion of the project is necessary. This subsidy could take the form of donations of equipment or financial support for a portion of the project such as the power line/transmission costs.

12. CONCLUSIONS

The technical feasibility of the proposed project has been demonstrated in terms of simple engineering designs to achieve the potential for power generation at the Zambezi rapids. A low weir off-take structure with a canal leading to a penstock and power station will provide the head to drive a power plant of 700 kW. Future demand will be provided by construction of a day storage reservoir and a duplicate penstock and power plant.

The civil works have been planned with minimal impact on the environment and future tourist potential of the site. The EIA has been approved by the Environmental Council of Zambia.

Full support has been given by the local community, the chiefs of the area, and the rural council. The land application has been approved and is in process for official documentation.

Financial aspects have been carefully considered. Assumptions have been made in predicting an equity portion of 33% being raised by the stakeholders. The economic analysis demonstrates clearly that for the sale of electricity at an affordable rate in this rural context, even with carbon credits accruing in the long term, a supporting

mechanism of about 50% of the project cost is needed in the form of a grant or donations of equipment.

The target tariff structure is between 6 to 8 cents per unit which is more than the tariffs throughout Zambia, but more in accordance with regional structures to which the Zambian tariff rates are trending towards.

With no subsidy, the project will require tariff structures of the order of 10 cents per unit, but the projected growth in demand may be much reduced from the anticipated 20% annual growth in this rural setting. As the project is intended to promote rural development, slow growth is considered undesirable from the social perspective. Therefore it is incumbent on the project supporters to endeavour to raise some form of subsidy to make the project viable.

Management of the project will be provided by Zengamina Power Ltd., a local company in the district. A qualified electrical engineer will be recruited to live at the power station and provide services to the power plant and transmission works. A staff of linesmen and technicians will be provided to support the electrical engineer. A telephone network is planned within the grid to serve the local populace and provide communications for servicing of the transmission grid.

Annex 6 Hydro opportunities assessment

Isolated Grid Hydroelectric Power Opportunities for CDM

R. Chronowski – October 2003

In reviewing the reports made available through ZESCO and the Ministry of Energy, reports from the Water Development/Office for Promoting Private Power Investment for small isolated grid hydroelectric power projects, and from the Mission Team Field trip inspections it can be confirmed that multiple technically viable[1] resources are available to be implemented. It is also clear that in Zambia diesel is the baseline for isolated grid applications. The largest issue to be faced for hydroelectric power development in rural grids will be in securing adequate revenue producing demand other than in peak hours to produce a viable financial result. The capital cost estimates per kW installed varied in the studies from about US$1,250[2] as the lowest to over $3,500 per kW installed with some approaching $5,000 per kW depending on the configuration. Most of the studies estimated costs of $2,500 – 3,500 per kW installed, many without considering any additional distribution system costs or considering any financing costs (fees, interest during construction, and start-up capital). It is not likely that installed costs much above $2,000 per kW (not considering distribution system costs) can produce financially viable projects even with CDM revenue inputs. Since both electricity revenues and CDM revenues are dependent on kWh actually produced, the demand-side of the project (plus the electricity price and capital cost) becomes the critical path to viability.

In the UNOPS NORPLAN/ZESCO April 2000 study ***Small Hydropower Pre-Investment – Northwestern Province*** 4 projects were presented in various configurations as the priority opportunities. These sites were studied at capacities from 1,200 kW to 34,000 kW. The basic conclusions to be made looking at the Economic Analysis presented in Annex 4 to the study is that the projects are all demand starved, hence revenue starved, as presented, with annual capacity factors in the first 10 years for most cases much too low to produce viable revenues at a reasonable tariff. With low annual kWh delivery there would be low CDM revenue potential for improving the financial performance or for lowering the tariff. The project viability hurdle will be a financial one, but that has been the historic case. It is possible that with a combination of appropriate capacity sizing and increased efforts to locate near-term demand viable projects can be developed. The **West Lunga River** project sized at **2 MW** for **Mwinilunga** appears to be a viable early phase project. It has the advantage of a potentially reasonable cost site, an existing distribution grid with base demand, and an identified project sponsor. The project success will be dependent on verifying the low-end capital cost from the various cost estimates, and preparing a realistic but aggressive new connection program to increase the annual factor potential beyond that suggested by the UNOPS/NORPLAN/ZESCO study.

The Mission Team did meet with a potential project sponsor for a project called the **"Zambezi Rapids"** project. This project was orally reported to initially be a 750 kW hydroelectric project with a combination of about 18 meters head, adequate water potential at +/-12 cubic meters per second, and

[1] The majority of the sites are low head sites with about 4 - 18 meters of head. Low head sites are technically viable, but will have adverse cost implications as the head diminishes. One site was estimated to have 100 meters of head potential with 5.15 MW of capacity, but the financial analysis in that report is not appropriate.

[2] This estimate (and all of the others reviewed) is likely too low by at least 20 – 25% when financing fees, interest during construction, and start-up capital needs are considered. The actual cost in this specific case (Shiwang'andu Project) will likely be closer to or above US$1,500 per kW installed if the technical aspects of the study are accurate.

very limited civil works requirement. That combination could result in a hydroelectric power plant installed cost near the $1,000 per kW point. Since there is no existing distribution system but there are existing diesel-based anchor customers to connect (missions, large farm irrigation systems, etc.) the low capital cost potential could enable the significant distribution system costs to be borne without killing the project financial return potential and reasonable cost of service potential. With that said, the situation that exists for isolated grids in Zambia is such that the most probable Carbon finance source would have to be that of "Small Projects" under Kyoto as would be serviced by the **Community Development Carbon Fund** of the World Bank that will pay a limited premium for the Emission Reductions associated with the project implementation.

The ***Mchimadzi Hydro Power Energy Limited*** Business Proposal submitted to OPPPI appears to have some technical merit but the financial presentation does not present the actual financial hurdles to be cleared. The estimated installed cost for generation and transmission systems is US$15.12 million or just under $3,000 per kW. What cannot be positively determined is if the estimate for transmission considers all of the distribution network cost requirements, although the report suggests that it is included. The grid and electrical infrastructure costs of $3.84 million divided by 17,000 connections yields an individual connection cost of $225 in difficult terrain which is lower than what has been seen anywhere else in the world. In addition, the financial analysis in the report presents a 15 year case assuming 17,000 customers from day one, each paying $8.00 per month for the service. If the generation costs can be verified as accurate, which is possible for a 100 meter head site that isn't too technically challenging, the demand side warrants a revisit since a financially viable arrangement might be possible with the addition of ER revenues, a reasonable starting demand, and a progressive new connections program over a reasonable period.

The Shiwang'andu project described in the UNIDO/GEF PDF B Project Report could also be a good example of what might work in its 1,000 kW configuration, if more productive demand can be found/created and combined with CDM revenues. The installed cost appears to be reasonable for a relatively simple site; an existing isolated diesel grid exists upon which to build an extended system, and there appears to be potential demand to be realized.

Annex 7 Financial assumptions

See attached excel sheet.

Annex 8 Sakeji Village Load Estimates

From: Bert Mast [mastbl.204@musenga.org]
Sent: Monday, December 01, 2003 7:22 AM
To: Charlie Rea
Cc: crae@zamnet.zm
Subject: Sakeji Elect. Load Est.

Dear Charlie,

Here is the estimate that I came up with.
Sakeji Electrical Load Estimate
Dwelling for single person x 5
Present load - 7 x 21 watt energy saving bulbs

plus the following wish list:
- 200 watts computer system
- 1500 Watts microwave oven
- 150 watts small stereo system or TV
- 1500 Watts hot water heater
- 650 watts small water kettle or small clothes iron
- 800 watts refrigerator
- 3000 watt hot plate

Dwellings for families x 5
Present load - 10 x 21 watt energy saving bulbs

plus the following wish list:

- 300 watts computer system
- 1500 Watts microwave oven
- 250 watts small stereo system or TV
- 2500 Watts hot water heater
- 650 watts small water kettle or small clothes iron
- 800 watts refrigerator
- 3000 watt hot plate

Main School Kitchen
Present load- 1000 watt cold room only

plus the following wish list:
- 3 x 800 watt freezers -
- 800 watt refrigerator -
-1500 watt microwave oven
- 600 watt food mixer, juicer, coffee grinder
- 3000 watt hot water heater
- 10 x 40 watt fluorescent lights
- 12,000 watt electric range & oven

Administration office & Staff Lounge
Present load

- 5 x 300 watt computer systems
- 1500 watt kettle
- 1,000 watt photo copier
- 800 + 200 watts lighting
- 150 watt radio battery charger
- 500 watt small refrigerator
- 650 watt water kettle

Dormitory & Dorm parent rooms
present load

- 1,000 watts lighting -
- 100 watt bug zapper
- 500 watt electric toys
- 500 watt stereo system & TV

plus future wish list:
- 10,000 watt, water heating
- 3,000 watt total, 4 washing machines

Laundry
Present load nil

plus Future wish list:

- 4 x 1,500 watt clothes irons
- 200 watts lighting

Classrooms x 8
Present load - 8 x 80 watts
- 1,800 watts (12 computers) for computer lab

plus future wish list
- 3,000 Watts lighting
- 300 watts outside night lights
- 1,000 Watt misc. (vacuum cleaner, overhead proj.)
- 1000 watts for more computers

Work shops
Present load

- 100 watts
- 2,000 watts table saw

- 3,000 watts power tools
- 8,000 watt Mig welder

Water pump
- 1,300 watt

Night lighting
Present nil
Future
- 80 x 15 watt (1,200 watts)
- 20 x 15 watt (300 watts)

Present average load is between 9 - 11 KVA which is supplied by hydro and diesel
Future expected load would be between 30 - 45 KVA

I hope this is helpful to you.

Sincerely,
Bert Mast

Annex 9 – 11

Please see attached excel documents.

Annex 9 – Energy Survey 2004
Annex 10 – Estimates of demand by Work bank expert 2004
Annex 11 – Kalene mission load survey 2003

Annex 12 Hillwood Farm load estimate

-----Original Message-----
From: PeterFisher [mailto:nchila@catwalk-international.com]
Sent: Monday, December 01, 2003 8:48 PM
To: crea@zamtel.zm
Subject: Turbine-Mwinilunga

Dear Charlie,

You mentioned you would like to know our power estimates I think that initially we would be comfortable with 100KVA first year progressing up to 250KVA, over three years.

Regards
Peter