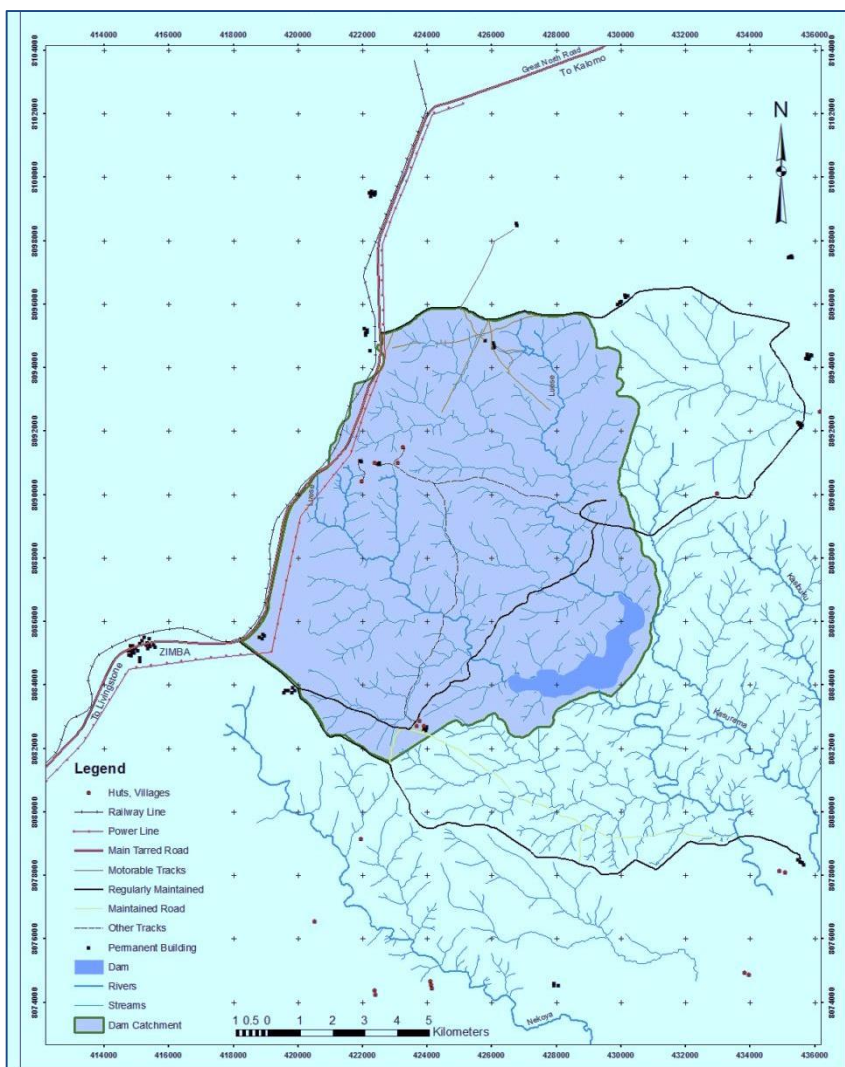


SILVERLANDS RANCHING LIMITED

ADDENDUM REPORT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED LUEZI RIVER DAM CONSTRUCTION PROJECT

Zimba District, Southern Province, Zambia



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We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

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ACRONYMS

EMA	Environmental Management Act
ERAP	Emergency Response Action Plan
ESIA	Environmental and Social Impact Assessment
FAO	Food and Agriculture Organisation
FSL	Full Supply Level
GPS	Global Positioning System
ICOLD	International Commission on Large Dams
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KEGS	Kasumwa Enviroconsult & General Supplies Limited
LULC	Land Use and Land Cover
RDA	Road Development Agency
SRL	Silverlands Ranching Limited
ZAWA	Zambia Wildlife Authority
ZEMA	Zambia Environmental Management Agency

1.0 INTRODUCTION

This report is an addendum to the Environmental and Social Impact Assessment (ESIA) for the proposed Luezi River dam construction project in Zimba District, Southern Province, Zambia. The proposed dam is being implemented by Silverlands Ranching Limited (SRL).

SRL has completed the Environmental and Social Impact Assessment (ESIA) for the proposed dam. The ESIA was submitted to the Zambia Environmental Management Agency (ZEMA) and was subsequently approved on December 20, 2013 (Appendix 1). ZEMA approved the dam as the submitted ESIA was in line with the provisions of the Zambia Environmental Management Act (EMA) of 2011 and other related regulations that were outlined in the final ESIA.

However, the ESIA was not only reviewed by ZEMA but also by the Multilateral Investment Guarantee Agency (MIGA) to which SRL has commitments. MIGA raised some concerns (highlighted in section 2.0 below) on the approved ESIA. MIGA recommended that these concerns be attended. It was agreed that an addendum report be compiled on the concerns raised. SRL engaged Kasumwa Enviroconsult and General Supplies Limited (KEGS) (the consultancy company that did the ESIA) to work on the concerns. Therefore, this report is an additional report to the ESIA that was approved by ZEMA in 2013. This report only deals with concerns that were raised by MIGA on the ESIA.

1.1 Brief Summary of the Project

SRL would like to be part of the efforts being made by the Zambian government and other private players to increase the national water storage capacity through the construction of dams. SRL recognises the important role the private sector can play in increasing irrigated land in Zambia and supports the government's stance on encouraging private sector participation. Taking advantage of this enabling environment, SRL intends to construct a dam for irrigation from the Luezi River, a tributary of the Kalomo River. The objective of the project is to mitigate the effects of droughts and recurrent scant and poorly distributed rainfall during the four months of the rain season in the area.

The project involves the construction of an earth dam and associated infrastructure to provide water for the irrigation of pasture and crops. The dam will be situated on SRL's Foresythe Estate in Zimba District, 7 km upstream from the Kalomo-Luezi River junction. The project site is 15 km off the Great North Road and 18 km from Zimba Town. The Luezi is a right bank tributary of the Kalomo River. The embankment for the proposed dam will be located on farm 1206 within the Foresythe Estate and will have a catchment area of 127 Km² with an average capacity of 14,000,000 m³ at Full Supply Level (FSL). The height of crest above river bed will be 23m and a throwback of 4,100m is expected with a surface area of 410 ha. The dam wall length will be 1,045m. The flow of the river usually stops by May and only patches or pools of water remain and by August the river dries up completely. Therefore, the presence of the dam will encourage environmental flow on what is currently a seasonal river that dries up. This is a significant benefit especially to both aquatic fauna and flora.

2.0 LIST OF CONCERNS RAISED

Table 1: List of concerns raised by MIGA on the ESIA

	Item	Concern
1	Aquatic Impacts	The ESIA does not contain sufficient baseline information regarding aquatic impacts, nor are the potential impacts identified. MIGA notes that the Zambia Environmental Management Agency (ZEMA) approval includes the requirement to “monitor upstream and downstream effects of the Luezi River to ensure that there are no significant disturbances to the Luezi River flow regime”. Please explain against which baseline setting the project will monitor in order to determine effects related to the project. Please also clarify if there are plans to conduct research related to the baseline.
2	Hydrology Information	The ESIA does not contain adequate information on hydrology, including baseline hydrological conditions. This information is required to understand how the reservoir and dam will impact the river / watershed, particularly when filling the reservoir and on an ongoing basis when topping up the reservoir. In addition, describe potential downstream impacts related to sediment and nutrient transport and water quality due to decreased flow. For example, changes in sedimentation may affect spawning areas for fish species and/or habitat for macroinvertebrates
		The ESIA contains commitments to “allow environmental flows for both the ecosystem and any other activity that may be undertaken downstream at any given time” (ESIA, page 83). Please provide details regarding the quantitative value of this downstream flow and how it was calculated, including the flow to allow during filling the reservoir and during the dry season.
3	Hydrogeology Information	The ESIA lacks information on the baseline hydrogeology and the potential adverse and beneficial impacts related to groundwater as a result of the permeability of the reservoir.
4	Watershed / Cumulative Impacts	The ESIA lacks information regarding potential cumulative / watershed impacts related to the project. Have such studies been carried out by any of the government agencies? A link to a guidance document is provided here: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publications/publications_handbook_cumulativeimpactassessment
5	Informal Water Users	The ESIA does not clarify downstream water users and ecosystem services, besides stating that there are no water rights already issued for the Luezi River. Please provide information regarding how the river is used by others, including informal users, and potential impacts the project may have related to these users and to the ecosystem services provided
6	Human Health Impacts	Please clarify if there are communities/ settlements or workers on the other side of the river which could be impacted by water borne diseases resulting from this project. The ESIA contains some information regarding settlements downstream of the reservoir and states no settlements in the

		area to be flooded, but location and or presence of settlements across the Luezi River is not clear.
7	Correspondence from the Department of Water Affairs (Appendix 5)	Please identify where Points 1 (dam failure), 3 (life span), 4 (bridge), and 5 (involvement of Technical Officers) from this correspondence have been addressed in the ESIA.
8	Commissioning and Maintenance Plans	Please provide details on the commissioning and maintenance plans for the project.
9	Sizing of the Reservoir	Please clarify if the reservoir will only be used by Silverlands Ranching or if water will be provided to other users. Please clarify how the reservoir was sized and the seasonal and annual river flow scenarios considered.

3.0 RESPONSES ON MIGA CONCERNS

3.1 Aquatic Impacts

In order to determine the aquatic impacts of the dam, the ESIA team conducted a further assessment of the aquatic environment to construct a baseline. The assessment involved;

- Producing a map of the entire Luezi catchment area to identify the important features such as tributaries and the source of the Luezi River.
- Random Sampling (using sampling nets) at certain points on the Luezi River and its tributaries to determine the presence of zooplankton and phytoplankton. The assessment involved the entire Luezi catchment.
- At the same sampling points where zooplankton and phytoplankton were assessed, vertebrates (such as fish) were also assessed.
- Sampling points were established upstream, near the dam area and downstream.
- Identification of the remaining riverine habitats upstream and downstream of the Luezi dam to determine whether some need special conservation.
- Assessment of the presence of red data Species using the IUCN Red List.
- Fish health assessment was based on an external examination of the skin and fins, eyes gills, opercula and the presence of ectoparasites.
- Assessment of aquatic vegetation.

The baseline data on the aquatic life within the Luezi catchment was used to determine the potential aquatic impacts of the dam. The assessment of the aquatic life within the catchment was done in May 2014 immediately after the rainy season. By that time, the flow of the river had stopped and only pools of water were present in some sections of the river. Sampling points were established on the upstream, at dam wall area and downstream of the river (Figure 1). The aquatic assessment performed during

the ESIA was done during the time when the river was completely dry (August to October). The Luezi River is completely dry between August and October. The river normally flows during the rainy season. This does not only happen to the Luezi but also the Kalomo River into which the Luezi flows. The Kalomo usually has pools of water during August to October.

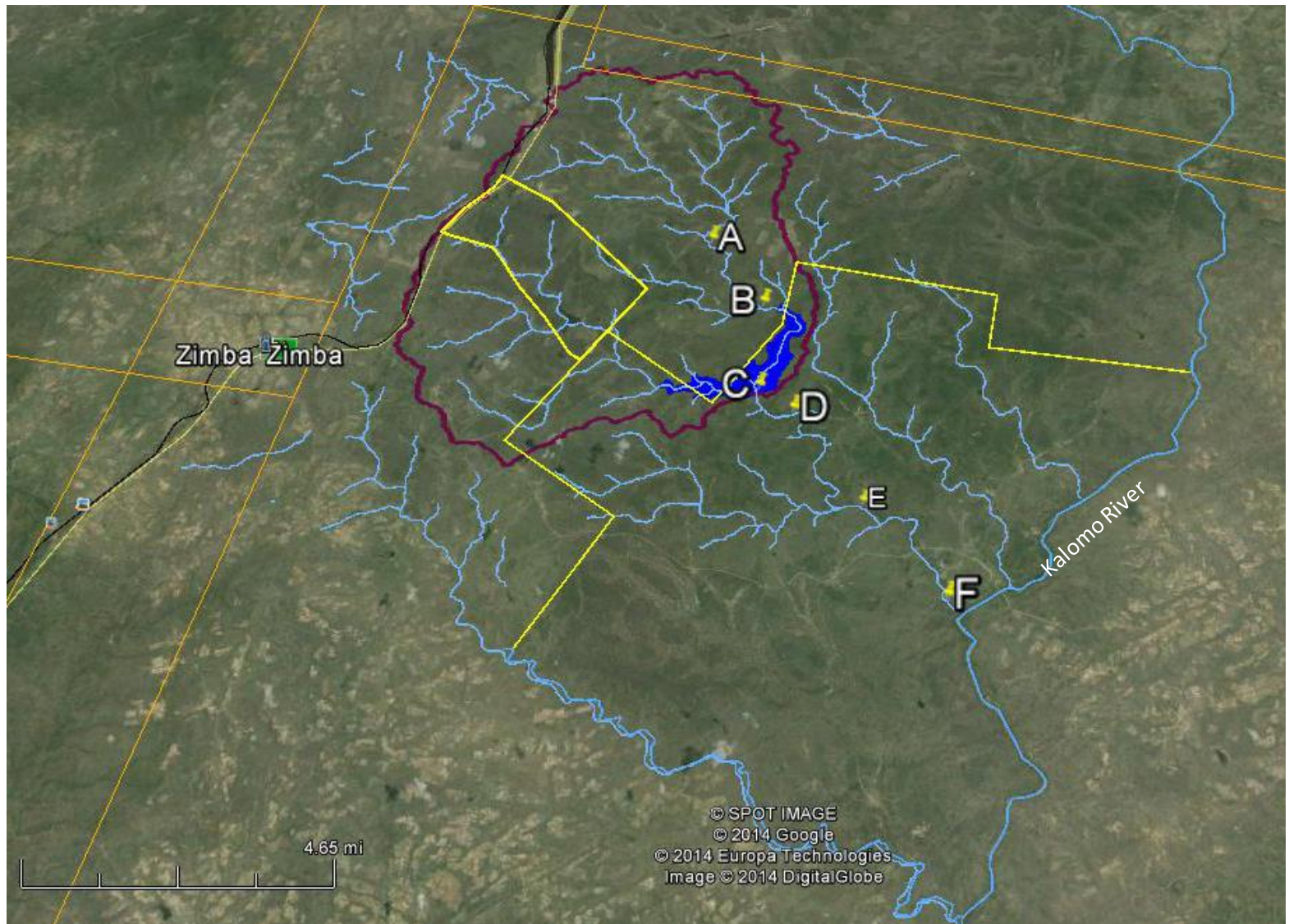


Figure 1: Distribution of sampling points along the Luezi River

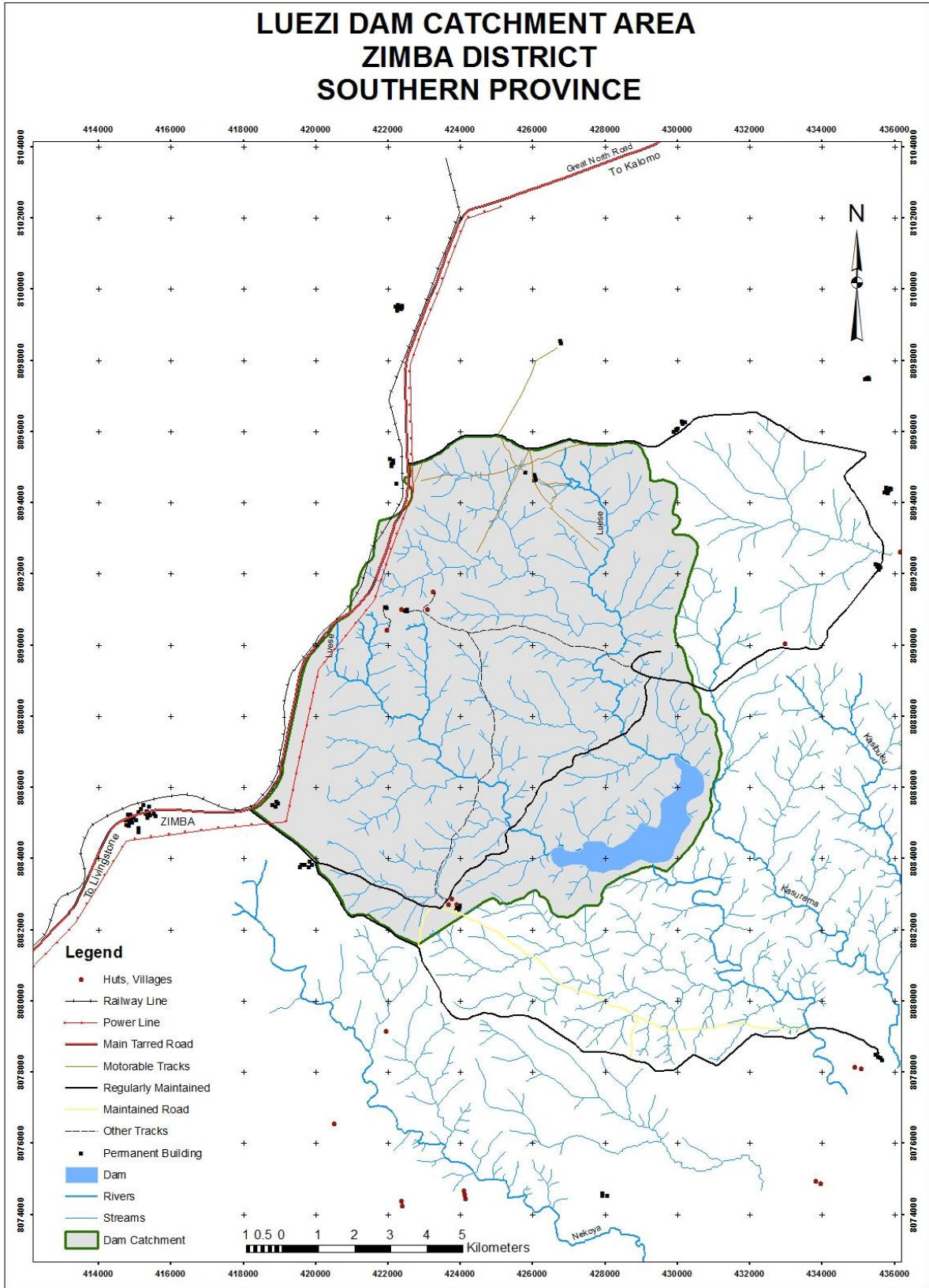


Figure 2: Luezi River Catchment Area

3.1.1 Results

Table 2: Results of the aquatic environment assessment

Site	GPS points		Planktons		Aquatic vegetation	Aquatic vertebrates
	East	North	Zooplanktons	Phytoplankton		
A	35427795	8089015	No water	No water	No Vegetation rocky stream banks and floor	No water
B	35429370	8086760	<i>Monostyla spp,</i> <i>Dicranophrus spp,</i> <i>Durellastylata</i>	<i>Mycrocystis, Closterium spp, Distigma spp, Sphaeroleaannulina, Durellastylata,</i>	Reeds (<i>Phragmites australis</i>)	<i>Tilapia rendalli, Clarias spp</i>
C	35429261	8083913	<i>Monostylafurcata,</i> <i>Durellastylata</i>	<i>Chlorella spp, Closterium spp, Distigma spp</i>	Reeds (<i>Phragmites australis</i>)	<i>Tilapia rendalli, Clarias spp</i>
D	35430244	8083175	No water	No water	Reeds (<i>Phragmites australis</i>)	No water
E	3542136	8080333	<i>Closterium spp,</i> <i>Distigma spp</i> <i>Synedrasp,</i> <i>Sphaeroleaannulina</i>	<i>Dicranophrus spp, Monostylafurcata, Durellastylata, collotheaornata</i>	Reeds (<i>Phragmites australis</i>)	<i>Gerris remigis Tilapia rendalli, Clarias spp Oreochromis macrochir</i>
F	35434303	8077569	No water	No water	No vegetation	No water

A and B: Taken from upstream
 C: Taken at the dam hall position
 D, E and F: Taken from downstream

3.1.1.1 Plankton

Plankton (phytoplankton and zooplankton) are a natural food item for fish and other vertebrates and their presence in an aquatic ecosystem indicates life. However the quality and quantity reflects on the nature of the aquatic ecosystem. In the Luezi, the pockets of water indicated a rich availability of plankton. The presence of the dam will enhance the availability of plankton both upstream (within the area that will be flooded) and downstream (because of the environmental flow that will result). This aspect will be a significant benefit as it will promote aquatic biodiversity and the growth of riparian vegetation along the river.

3.1.1.2 Aquatic Vegetation

Aquatic weeds can also be efficient indicators of water quality, and their presence may enhance water quality due to their ability to absorb excessive loads of nutrients. These properties have been used in wastewater treatment as well as in bio manipulation of water bodies for enhancing fish production" (FAO Fish Tech Paper No. 396, 2000). The Luezi River had very little aquatic vegetation at the time of the survey - only three aquatic plants were identified as shown in the table 2. This can be attributed to the seasonality of the river. When the dam fills, there will be significant environmental benefits both upstream and downstream. Since the Luezi is completely dry from August to October until the start of the next rainy season in November, the flooded area upstream and environmental flow downstream that will result from the presence of the dam will improve aquatic biodiversity within the river environment. Figures 3 and 4 show some portions of the river during the time of the survey in May 2014.



Figure 3: Part of the Luezi River - Up Stream



Figure 4: Part of the Luezi River - Down Stream

3.1.1.3 Fish Health Assessment

The fish in the pools in the stream were found to be healthy with no signs of ecto-parasites. Creation of the dam will have a positive impact (will turn the river into a perennial one) and as such there will be no stranded fish in pools that later die due to lack of water or poor water quality. It is expected that other fish species such as *Oreochromis macrochir*, *Serranochromis robustus* and *Tilapia sparrmanii* will be present in the river when the dam is in operation.

3.1.1.4 Assessment of the Presence of Red Data Species

There were no fish species recorded that are on the red list; however there is need to avoid introduction of fish species like *Oreochromis niloticus* as it has a negative impact on the *Oreochromis andersonii* (native fish species) that is found in the Kalomo River into which the Luezi flows. This aspect will be avoided as there are no farmers who are involved in rearing of the exotic fishes (*Oreochromis niloticus*) within the area. SRL with the help of the Fisheries Department will biannually collect data on the fish species present to check for the presence of *Oreochromis niloticus* in the river.

3.1.2 Impacts of the dam on the aquatic environments

- The creation of a new environment for a variety of species (indigenous) that can be stocked to maintain the ecological balance.

Stocking of the dam with a variety of indigenous fish species such as Oreochromis andersonii, Tilapia rendalli, Oreochromis macrochir, Serranochromis robustus and Clarias spp. These fish species can be bought from hatcheries in Mvandi and Kalomo

- The construction of the dam will enhance the availability of water flowing in the Luezi River as the dam will act as a reservoir and will have a controlled environmental flow. This will contribute positively to the ecology of the River and associated aquatic life.
- The creation of a reservoir provides a habitat for wetland species, especially water birds. The reservoir can also be a source of water to animals and plants in the adjoining areas and, where such areas have become unnaturally dry, this can be a significant environmental benefit. The Zimba area is within a low rainfall region (below 900mm per year) and prone to drought.
- The blocking of a river and the formation of a reservoir significantly alters the ecological conditions of the river, adversely impacting species and the ecosystem. There are changes in pressure, temperature, oxygen levels and even in the chemical and physical characteristics of the water. However, the presence of the dam on the Luezi will not result in such a negative impact as there will be environmental flow downstream through the pipework in the dam wall. This will promote aquatic life as there will be sustainable environmental flow in the river which was lacking because of the river being seasonal.

The environmental impacts of dams and mitigation measures to deal with them have been documented extensively (e.g. Bizer, 2001).

Environmental flows will be allowed to ensure ecological balance downstream. For the Luezi River, no communities downstream use the river but flows will be allowed to ensure the sustenance of aquatic biodiversity downstream (section 6.4.4.13 page 70 of the ESLA).

3.2 Hydrology Information

There are no flow meters on the Luezi and therefore no public data is available to show the quantitative value of downstream flow. The river has not been monitored by the Department of Water Affairs and no literature is available on the Luezi catchment.

With regards to the environmental flow, there is no stipulation on the amount to be released based on the water permit. The amount that can/should be released has not yet been determined. The flow will vary at different times in the year and be dependent on initial filling, subsequent top up, level of water in the dam and annual rainfall. There will, however, be some permanent flow because all earth dams leak to some extent, which will be preferential to the flood waters which went down the river in the rainy season previously.

For details on the flow and sizing of the dam, please refer to the *Preliminary Investigation - Surface Hydrology Assessment for Potential Dam Sites* report by Imagen Consulting - dam site 5.

3.3 Hydrogeology Information

There is no available data on the hydrogeology of the area. Two boreholes that have been sunk near the dam will act as baseline and will be used for future monitoring of the beneficial impacts related to ground water and the permeability of the reservoir. The depth of the boreholes is 70 meters and approximately 500m from the dam area. When they were sunk in April 2014, no water was found but later in May 2014, water started appearing. These may be used to monitor and provide valuable data on the hydrogeology of the area. Environmental

3.4 Watershed / Cumulative Impacts

There have been no studies carried out by any government agencies or any other organisation for this area. Discussions with Water Affairs and other relevant government agencies indicate that there are no other dams proposed either on the Luezi (which for nearly all its length, runs within SRL property) or the Kalomo (Figure 4). According to IFC, 2013, Cumulative impact assessment and management is appropriate whenever there is concern that a project or activity under review may contribute to cumulative impacts on one or more Valued Environmental and Social Components. The proposed dam project by SRL is the first major dam project in the area and consequently, there will be no need to undertake a cumulative impact assessment.

3.5 Informal Water Users

Most of the Luezi River and the entire downstream part of it is within the Foresythe Estate (Figure 4). There are no other water users. The nearest local communities are 10km away from the proposed dam area and are located on the other side of the Kalomo River (Figure 4). The communities do not use the Luezi River at all but use the Kalomo River. No other farms have water rights to the Luezi mainly because it is seasonal. The farm workers who live on the property will not be impacted either for whatever reason as they currently do not use the Luezi for any purposes.

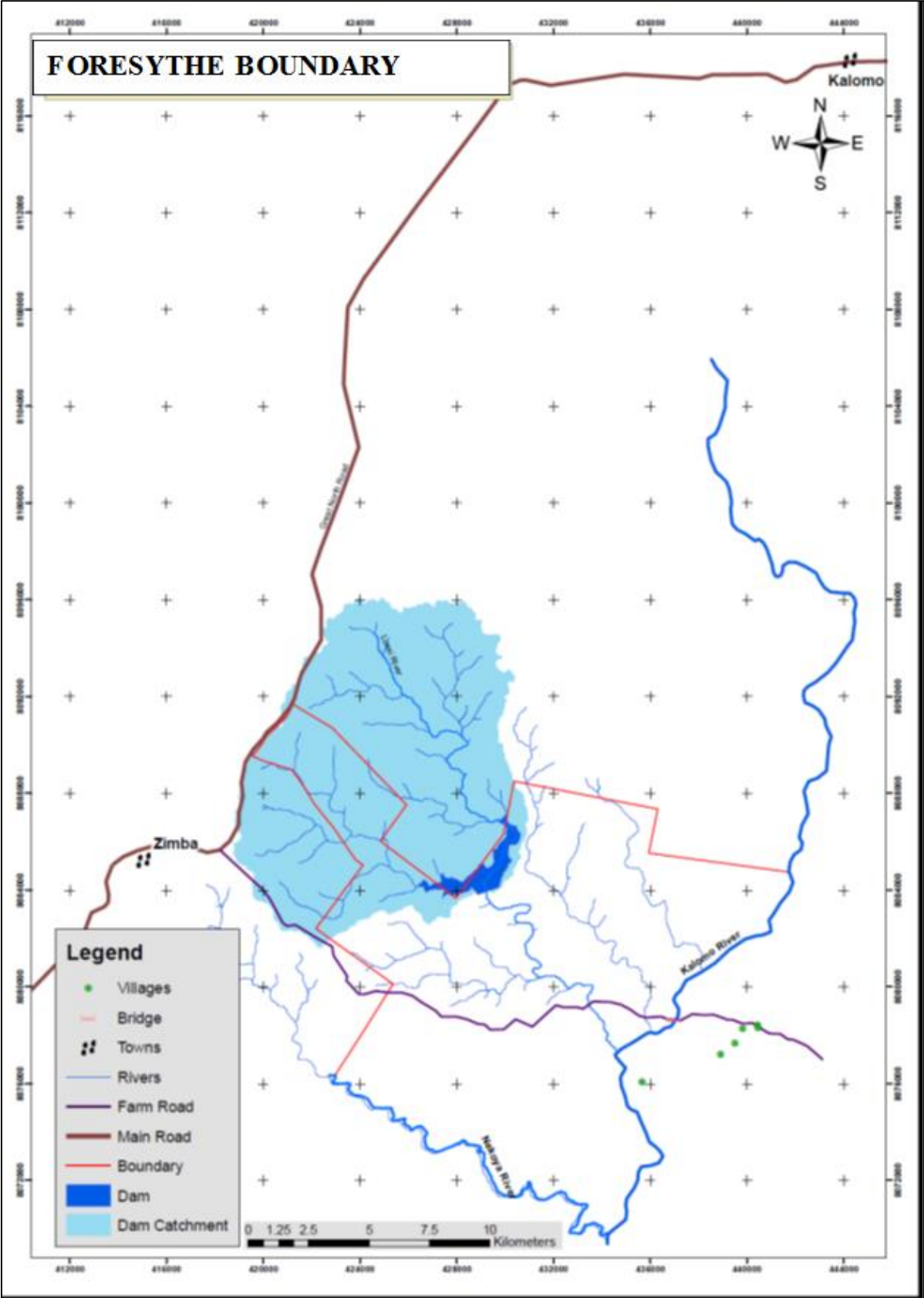


Figure 5: Foresythe Boundary

3.6 Human Health Impacts

Dams in the tropical regions of the world, especially those that are below 1,000 m. elevation, pose a significant threat of vector breeding. Mosquitoes, which are carriers of malaria, filaria, dengue and other diseases, breed in small pools of water created on the edges of a reservoir due to the lowering and raising of its water level. In some areas, snails, which are carriers of schistosomiasis, are also found to proliferate because of dams. To reduce the risk of contracting malaria and to contain malaria cases, it is recommended to implement measures to manage malaria and control vectors. This will be done in conjunction with the Ministry of Health.

There is no human habitation upstream and downstream of the river. As mentioned in section 3.5 and depicted in Figure 4, the nearest communities is 10km away from the dam and therefore will not be impacted in any way by its construction. No communities or individuals apart from SRL will be using the dam. The workers on the estate will not be using the dam for any purpose, except possibly for recreation such as fishing, and their residences and work sites are sufficiently high above the river bed.

3.7 Correspondence from the Department of Water Affairs

The concerns by Water Affairs (Appendix 5 in the ESIA) were raised during the preparation of the Terms of Reference prior to the ESIA commencing and were attended to.

3.7.1 Dam Failure, Life Span and the Bridge

The possibility of the dam failing is very low as it will be designed according to standards taking into consideration the prevailing environment in the area (Refer to *Luesi Dam – Dam Break Analysis and Selected Downstream Inundation Mapping* by Royal HaskoningDHV). With the correct maintenance, it is likely that the dam will last for a considerable number of decades.

Degraded catchments, excessive rainfall or over-filling of reservoirs, may make it necessary to suddenly release large quantities of water from the reservoir in order to protect the dam structure. Such sudden releases can be disastrous for people living downstream, for their crops and for entire ecosystems.

The failure of the dam, where the structure collapses and allows the reservoir to partially or totally drain out, would be a catastrophe for downstream ecosystems and human populations. There are many causes of dam failure. It can be due to faulty design or construction, use of sub-standard materials, over-topping due to surplus water, deliberate sabotage or bombing or because of severe earthquakes. In some cases, where the dam structure might remain intact, the neighbouring hillsides crumble having the same effect as the dam collapsing.

In case of dam failure of the proposed Luezi dam, there is low risk to human health and safety of workers and communities living downstream because the flood water will be dispersed over a wide plain and therefore by the time it reaches communities or the bridge it will have little impact. The

stream bed of the Luezi itself is wide enough that any habitations or sites where workers or community members may be working are sufficiently high above the river bed. SRL will have an Emergency Response Action Plan (Appendix 2).

3.7.2 Involvement of Technical Officers

Technical officers from the relevant departments were involved throughout the ESIA process and officers from Waters Affairs are required to inspect the start of the dam construction and continue to do so throughout the life of the dam.

ZEMA conducted physical site inspections after the draft ESIA was prepared and then followed with public hearings with all stakeholders involved before approving the project. The stakeholders during the scoping meetings, physical site inspections by ZEMA and the public hearing included all government departments including Water Affairs. ZEMA was satisfied that issues raised by Water Affairs and other stakeholders were tackled in the ESIA and as such approved the project based on the physical inspections conducted, the public hearing and the content of the final ESIA.

Table 3: How concerns and issues were addressed

Issue	Sub Issue	Comment	How the Concern/Issue was addressed
Employment	Recruitment procedure for the proposed Luezi dam and the Silverlands Ranching Limited Estate	Concern that local population and contractors are given preference in employment and concern for how local people will be identified in employment recruitment process	The issue was addressed in Table 32, page 85 and Table 34, page 95.
		Concern of lack of education and skills among the local communities and implications for employability	
		Concern regarding provision of on-job training for unskilled, skills transfer to locals	
	Impact of employment policy on influx of people into the area and ability to control influx through employment policy		
	Corruption in the recruitment process	Concern of gender equality in recruitment and employment of vulnerable persons (elderly, disabled and widowers)	
Stakeholder Engagement Issues	Need to be continuously updated on future exploration and mining activities	Concern on the availability of all documents concerning the project including EIA final report	The Terms of Reference and the draft and final copies of the ESIA were made available by the consultant to all stakeholders for comments. ZEMA also conducted a public hearing before approving the ESIA.
	Need to be updated on community development projects by the developer;	Concern on how the company will work with stakeholders especially community members	
Health and Safety Issues	Threat to human health and safety	Health concern from communities and their livestock in case of dam failure Increase in the population of crocodiles in the Luezi River	Addressed in the ESIA, sections 7.1.1 and 7.1.2 on page 76
	Safety of the bridge	Concern on whether Luezi bridge will be redesigned as current state cannot contain the pressure of water in an event of dam failure	
Local development issues	Construction, Upgrade and Maintenance of Existing Public Infrastructure and Services	Community school Rural health Centre Public roads	Was addressed during scoping and public hearing meetings
		Corporate Social Responsibility Initiatives	
Loss of Biodiversity	Natural habitats and flora and fauna due to vegetation clearance	Concerned with the population of fish in the river	Addressed in the ESIA pages 81 and 82
	Ecosystem fragmentation	Concerned with disturbance of the ecosystem	
Accessibility and use of the dam by local community	Fishing activities on the dam by local communities	Concern on whether local communities will be allowed to use the dam for fishing	Was addressed during the scoping meetings and the public hearing. Communities are 10 km away from the dam area and therefore fishing will be difficult as they have no accessibility to the dam that falls within SRL property. Workers on the Ranch may be allowed though with much care to prevent drowning
	Limited Mobility of Community Members	Will the community have access to the water especially during dry season	Communities are far away from the dam but will benefit from the environmental flows that will be allowed for the Luezi river that gets into the Kalomo River to which communities have access.

3.8 Sizing of the Reservoir

On information on how the dam was sized and the seasonal and annual river flows scenarios considered please refer to the *Preliminary Investigation - Surface Hydrology Assessment for Potential Dam Sites* report by Imagen Consulting - dam site 5.

The Reservoir will be primarily used by Silverlands Ranching Limited. A small part of the flooding area will be on another private farm. The owner of the farm will use the water for his animals. He has already agreed to have his part of the farm flooded. The letter of consent was included in the ESIA (Appendix 8).

3.9 Other Issues

3.9.1 Source of Crushed Stones to be used during Construction

The crushed stones to be used during construction will be sourced from the Road Development Agency (RDA) quarry operated by Inyatsi Construction Limited at Senkobo, located 75km from the Foresythe Estate. SRL is not involved in quarrying and will buy crushed stones from Inyatsi Construction Limited, the company engaged by RDA to work on the Zimba/Livingstone road and township roads in Livingstone. RDA has permits to operate the quarry from the site as this was covered in the EIA for the road rehabilitation project. There will be no issues for SRL to buy the stones from the RDA as the quarry has necessary permits from Livingstone City Council and ZEMA.

3.9.2 Excavated Soils during construction

The excavated soils during construction will be used to build the dam wall.

3.9.3 Washing away of the bridge on the Luezi River

With building of the dam, this is less likely to happen as the flow down the river will be controlled and there will not be the sudden flash floods that have happened in the past. The bridge is about 8 km from the dam (Figure 4) and as a result the flood from the dam will have little effect in case of dam failure.

3.9.4 Climate Change and the Dam project

Large dams (according to the International Commission on Large Dams (ICOLD), a large dam is defined as one with an embankment height of more than 15 metres or a storage volume exceeding three million m³) and their impounded reservoirs are types of infrastructures that trigger most often a large-scale change in land use and land cover (LULC) due to the multiple purposes they serve. The Luezi dam project falls within this category. With the construction of this kind of dam, more arable land may be irrigated with impounded surface water. The changes in land cover may lead to increased availability of local moisture and significantly impact local scale circulation (Niyogi *et al.*, 2010; Takata and Yasunari, 2009). Local scale here refers to ranges between 10 and 100 km. One such local effects of LULC change can be a modification of rainfall (Avisar and Liu, 1996; Cotton and Pielke, 2007; Pielke *et al.*, 2009).

Dams such as the proposed Luezi dam are catalysts for systematic change in LULC and hence it is physically plausible to expect a gradual change in the local climate and rainfall patterns in the impounded river basin attributed directly to the multiple land use development that reservoirs produce (Degu, 2011).

While the impact of climate variability and change on artificial dams has been studied at local/regional scales for some time (Hamlet and Lettenmaier, 1999; Christensen *et al.*, 2004), the converse (impact of dams on local/regional climate) has not been explored as much. It has been recently argued that very little is known on how dams modify storms under certain atmospheric conditions and the consequential implication on hydrology and dam safety (Hossain *et al.*, 2010; Hossain, 2010).


The study by Degu and others (2011) reports that large dams influence local climate most in Mediterranean, and semi-arid climates, while for humid climates the influence is least apparent. According to the Millennium Ecosystem Assessment (2009), Zambia is within the semi-arid areas in Southern Africa. The introduction of the dam (open water body) in the Zimba area adds sufficiently more moisture than the sparsely vegetated surroundings resulting in clear spatial gradients of water vapor flux which may create a distinctly different local climate (Degu *et al.*, 2011).

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4.0 APPENDICES

Appendix 1: ESIA approval letter

	ZAMBIA ENVIRONMENTAL MANAGEMENT AGENCY		
	Head Office Corner of Church & Suez Roads P.O. Box 35131 Lusaka, Zambia Tel: +260-211-254130/254023/254059 Fax: +260-211-254164/256658	Northern Regional Office Jacaranda Road P.O. Box 71302 Ndola, Zambia Tel: +260-212-621048/610407 Fax: +260-212-610246	Livingstone Office Plot No. 555 Junction Obote / Naru Roads Livingstone, Zambia Tel / Fax: +260-213-321297
	Chirundu Border Office Lusaka Road P.O. Box CRU31 Chirundu, Zambia Tel/Fax: +260-211-515261		
	<i>In reply please quote</i>		

No:

ZEMA/INS/101/04/1

December 20, 2013

The Director
Silverlands Ranching Limited.
P.O. Box 610003, Zimba
Plot B Mukwa Drive, Eureka Park
LUSAKA.

Dear Sir,

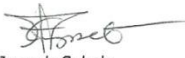
REF: PROPOSED CONSTRUCTION OF A DAM PROJECT ON THE LUEZI RIVER IN ZIMBA DISTRICT

Reference is made to the above captioned project report submitted to the Zambia Environmental Management Agency (ZEMA) on **September 11, 2013** for consideration in accordance with the requirements of the Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997.

ZEMA has since reviewed the Environmental Impact Statement (EIS) and based on the information provided by yourselves and from written and verbal comments from interested and affected parties and our site verification inspection findings; the said EIS has been **Approved**.

Find attached to this Decision Letter, conditions governing the approval.

Yours faithfully,


Joseph Sakala
Director General
ZAMBIA ENVIRONMENTAL MANAGEMENT AGENCY

Cc: The Council Secretary, Zimba District Council-**ZIMBA**
The Director, Water Resources Management Authority - **LUSAKA**

All correspondence to be addressed to the Director General - Head Office
Email: info@zema.org.zm, Website: www.zema.org.zm
Emergency Toll Free No. on Zamtel Lines: 953

EMERGENCY RESPONSE ACTION PLAN

INTRODUCTION

This section describes the purpose of this Emergency Response Action Plan (ERAP). It describes the extent of dam hazard area, identifies those responsible for dam operation and implementation of the ERAP as well as describing the procedures for training staff, reviewing, testing and updating the plan. It provides contact information and describes actions to be taken in an event of such flooding.

The purpose of this ERAP is primarily to safeguard lives and secondarily to reduce property damage of local communities who live within the Luezi catchment and beyond in an event of flooding caused by a large volume of runoff from or failure of the Luezi Dam.

DAM HAZARD AREA

For purposes of this report, the dam hazard area is the area that would suddenly get inundated in an event of Luezi Dam failure. The proposed dam is an embankment earth dam with crest height of 23m above river bed and throwback of 4,100m. The dam wall length will be 1,045m. The catchment area is 127km² with an average capacity of 14,000,000 m³ at Full Supply Level (FSL). The embankment for the proposed earth dam will be located on farm 1,206 on the Foresythe Estate belonging to SRL in Zimba district, 7 km upstream from the Kalomo-Luezi River junction.

RESPONSIBILITY AND AUTHORITY

SRL will be responsible for maintaining the Luezi Dam and the operations manager assisted by a team of engineers and craftsmen will be responsible for the operation of the dam. The operations manager will be the ERAP Coordinator and will have an overall responsibility for implementing the ERAP plans for all dams, including training staff and periodic reviewing, testing and updating of the plan. A designated mobile telephone number for the operations manager will be provided as an emergency contact telephone number and circulated to all staff and the public by displaying at strategic places including notice boards. The operations manager will regularly observe the dam. Inspections and routine maintenance would be done three times a year. During high water level conditions, the operations manager will be on 24hrs call. Specifically, the operations manager will be responsible for the following;

- Ensure the ERAP is reviewed and updated annually and copies of the revised ERAP are distributed to all concerned.
- Serving as the primary contact person responsible for coordination of all emergency actions.
- Preparing emergency management personnel for possible evacuations when required.
- Determining the emergency level as soon as an emergency event is observed or reported.
- Notifying staff at Zimba District Disaster Management and Mitigation Committee.
- Providing updates of the situation to the relevant authorities in making timely and accurate decisions regarding warnings and evacuations.

- Warnings and order evacuation of people at risk downstream of the dam.
- Decide when to terminate the emergency.

IDENTIFICATION OF EMERGENCY

Identification of an emergency involves events or conditions that indicate an emergency. This is followed by defining the levels of emergency and deciding how staff and the general public will be notified in the event of an emergency.

When dam failure has occurred or when dam failure is imminent the situation is described as an emergency. Floods are a major cause of dam failure and therefore monitoring the dam during high water level conditions is critical. However, failure may also occur during normal conditions, and this failure tends to be the most dangerous because the resulting flood would be sudden. The operations manager and his team shall pay particular attention to indicators of a potential dam failure which include;

- New sinkhole in reservoir area or on embankment
- Sudden or rapidly proceeding slides of the embankment slope
- Damage to dam or appurtenances that has resulted in uncontrolled water release
- Excessive seepage or cloudy seepage through the abutments or embankments
- Settlement or cracking in the embankment
- Large cracks in the spillway
- Noticeable movement of the spillway
- Spillway flowing with active gully erosion
- Overtopping flow eroding the embankment slope
- Slumping or sloughing of the embankment
- Excessive erosion on the embankment, below the spillway, or at the abutments

ACCESS TO THE SITE

Access to the site is one of the important factors in responding to an emergency. This access can be severely hampered during major storms. Such storms also cause floods creating a requirement to get to the site. This section provides information on gaining access to the site and the various methods available.

Vehicles

SRL has the following equipment at their disposal to travel to the site

- Four wheel drive SUVs
- Motorcycles
- Van
- Loader

NOTIFICATION GUIDELINES

The responsibility for notification of staff, the public and relevant authorities will lie with the operations manager. Two critical steps will define the notification process. The first step will be the detection of an unusual or emergency event. The second step will be the classifying of the event into one of the following three emergency levels:

Emergency level 1:–

It's a non-emergency but, unusual event and slowly developing. This situation would not be normal but not yet a threat to the operation or structural integrity of the dam. However, it may continue to deteriorate. The operations manager and his team will investigate the situation and recommend actions to be taken.

Emergency level 2:–

It's a potential dam failure situation, rapidly developing. This situation may eventually lead to dam failure and flash flooding downstream, but there is not an immediate threat of dam failure. Should this occur, the operations manager will closely monitor the condition of the dam and periodically report the status of the situation to the relevant authorities. If the dam condition worsens and failure becomes imminent, Zimba Disaster Management and Mitigation Committee, workers and communities will be notified immediately of the change in the emergency level to ensure people at risk are evacuated. SRL working in conjunction with relevant authorities will facilitate the process. Meanwhile, the operations manager and engineers will evaluate and recommend remedial actions to prevent failure of the dam. This emergency level will also be applicable when flow through the earth spillway has or is expected to result in flooding of downstream areas.

Emergency level 3: –

It's urgent and dam failure is imminent or in progress. This is an extremely urgent situation when a dam failure is occurring or obviously is about to occur and cannot be prevented. Flash flooding will occur downstream of the dam. This situation will also be applicable when flow through the earth spillway is causing downstream flooding of people and roads. The operations manager will inform relevant authorities including Zimba District Disaster Management and Mitigation Committee while at the same time make arrangement for immediate emergency services to evacuate all the people at-risk.

PERIODIC TRAINING, REVIEW, UPDATING AND TESTING

The ERAP will from time to time be reviewed, updated and tested. Training of members of staff to handle an emergency situation at Luezi Dam will be a continuous process. Annually the operations manager will verbally review the plan with members of staff to explain the procedures to follow in the event of an emergency, address any changes that need to be made in the plan, answer questions regarding the procedures, and test their understanding of the plan by stimulating a dam failure.

TERMINATION

Whenever the ERAP has been activated, an emergency level has been declared, all ERAP actions have been completed, and the emergency is over, the ERAP operations will eventually have to be terminated. The operations manager, in liaison with Zimba Disaster Management and Mitigation Committee will be responsible for terminating ERAP operations and relaying this decision to SRL. It is then the responsibility of the operations manager to inform others (team of engineers and dam operators) to notify others that the event has been terminated.

In an event of an Emergency of Level 3 event that has not caused actual dam failure, the engineers will inspect the dam to determine whether any damage has occurred that could potentially result in loss of life, injury, or property damage. If it is determined that conditions do not pose a threat to

people or property, the engineers may advise the operations manager to terminate EAP operations as described above. SRL through the operations manager shall ensure that the Dam Safety Emergency Situation Report is completed documenting the emergency event and all actions that were taken then avail copies to relevant authorities including the Water Board.

A summary of emergency events, suggested remedial action and responsible person is elaborated in the table below.

Emergency Event	Emergency remedial actions	Responsibility
EMERGENCY LEVEL 1: Non-emergency , unusual event and slowly developing		
Suspected Dam Failure	<ul style="list-style-type: none"> • Mobilise technical staff to investigate the event • Continue monitoring the situation • Open the gates to allow more flow and avoid bleaching 	
Embankment overtopping	<ul style="list-style-type: none"> • Place sandbags along the low areas of the top of the dam to reduce the likelihood of overtopping and to safely direct more water through the spillway. • Cover the weak areas of the top of the dam and downstream slope with riprap, sandbags, plastic sheets, or other materials to provide erosion resistant protection. 	Operations Manager Team Of Engineers Dam Operators
Embankment movement	<ul style="list-style-type: none"> • Open outlet(s) to lower the reservoir to a safe level at a rate proportionate with the urgency and severity of the condition of the slide or slump. If the gate is damaged or blocked, pumping or siphoning will be employed instead. • Repair settlement of the crest by placing sandbags or earth and rock fill material in the damaged area to restore freeboard. • Stabilise slides on the downstream slope by placing a soil or rock fill buttress against the toe area of the slide. 	Operations Manager Team Of Engineers Dam Operators
EMERGENCY LEVEL 2: Potential dam failure situation, rapidly developing		
Seepage and sinkholes	<ul style="list-style-type: none"> • Open principal spillway gate to lower the reservoir level as rapidly as possible to a non-erosive velocity. If the gate is damaged or blocked, pumping or siphoning will be employed instead. • If the entrance to the seepage origination point is observed in the reservoir (possible whirlpool) and is accessible, plug the entrance with readily available materials, such as hay bales, bentonite, soil or rock fill, or plastic sheeting to reduce flow. • Cover the seepage exit area(s) with several feet of sand/gravel to hold fine-grained embankment or foundation materials in place. Alternatively, • Construct sandbag or other types of ring dikes around the seepage exit areas to retain a pool of water, providing backpressure and reducing the erosive nature of the seepage. • Prevent vehicles and equipment from driving between the seepage exit points and the embankment to avoid potential loss from the collapse of an underground void. 	Operations Manager Team Of Engineers Dam Operators
Seepage and sinkholes	<ul style="list-style-type: none"> • Open principal spillway gate to lower the reservoir level as rapidly as possible to a non-erosive velocity. If the gate is damaged or blocked, pumping or siphoning will be employed instead. • If the entrance to the seepage origination point is observed in the reservoir (possible whirlpool) and is accessible, plug the entrance with readily available materials, such as hay bales, bentonite, soil or rock fill, or plastic sheeting to reduce flow. • Cover the seepage exit area(s) with several feet of sand/gravel to hold fine-grained embankment or foundation materials in place. Alternatively, 	Operations Manager Team Of Engineers Dam Operators

	<ul style="list-style-type: none"> • Construct sandbag or other types of ring dikes around the seepage exit areas to retain a pool of water, providing backpressure and reducing the erosive nature of the seepage. • Vehicles and equipment from driving between the seepage exit points and the embankment to avoid potential loss from the collapse of an underground void. 	
EMERGENCY LEVEL 3: Urgent, dam failure imminent or in progress		
Potentially Disastrous Event of Dam Failure	<ul style="list-style-type: none"> • Contact emergency services that include fire brigade, disaster management Unit and others. • Issue warnings, close roads, and evacuated people at risk. • Alert the general public and immediately evacuate at-risk people and close roads as necessary. • Maintain continuous communication and provide the relevant authorities with updates of the situation to assist him in making timely decisions concerning warning and evacuations. • Record all contacts that are made, all information, observations, and actions taken on the Event. • Ensure everyone follows procedure by stay away from any of the failing structures or slopes and out of potential breach inundation areas. 	Operations Manager Team Of Engineers Dam Operators