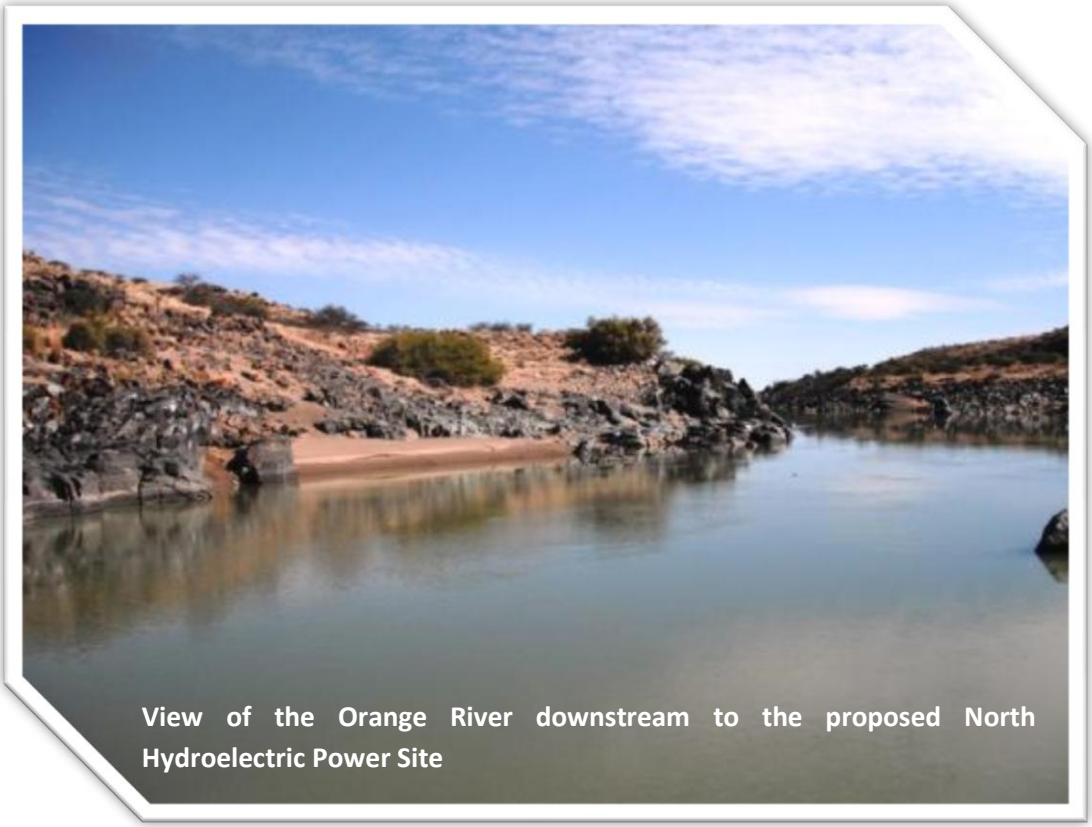
Public Review Document

Final Scoping Report for the Proposed Construction of the North Hydroelectric Power Site and Associated Infrastructure, Orange River, Siyancuma Local Municipality, Northern Cape

DEA Ref. No.: 14/12/16/3/3/2/507 **October 2013**



View of the Orange River downstream to the proposed North Hydroelectric Power Site

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EXECUTIVE SUMMARY

Sidala Energy Solutions (Pty) Ltd. (hereafter referred to as Sidala) is a South African based development company operating in the emergent renewable energy industry. An Independent Power Producer, the company has identified two sites along the Orange River between Hopetown and Douglas that have the potential of generating just under 40MW of power. Referred to as the *North* and *South* Sites, these would utilise the flows released from the Vanderkloof Dam to move through the hydroelectric power facility and mechanise the turbine for generation of electricity. This assessment investigates and describes the **North Site** only.

The facility will comprise of a weir in the river; a short canal with headrace, powerhouse and tailrace and an access road. The facility is proposed to have a design flow rate of approximately 100m³/s, with an average turbine-generator efficiency of approximately 85% and capacity output of 12 - 15MW. The placement of a weir in the Orange River will cause inundation of upstream areas, resulting in the formation of a dam, which shall have a full supply level of 1012 masl and maintain a surface area of 3.59km². The dam would be operated to be at full supply levels at all times, and will utilise larger discharges of water during hydropower generation at the Van Der Kloof and Gariep Dams to raise the water levels. As a consequence, the change occurring to the flow regime during the filling of reservoirs is minimal, and there will be no change of flow regime during operations.

The identification of the proposed site location was determined through investigation regarding geology, hydrology (flow duration only), physical properties such as river cross sections, tailwater and area inundation, site access and hydro potential. A sixty year operational period would ensue following construction with feed-in of electricity into Eskom's national grid.

This Final Scoping Report (FSR) focuses on identifying the environmental impacts associated with the **North Site**, situated on the Orange River between the Remainder of Farm Tullochgorum No. 158 and the Remainder of Farm Kameelsdrift No. 285. The FSR forms part of a greater Scoping and Full Environmental Impact Assessment (EIA) process, which is subject to the conditions of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the Environmental Impact Assessment (EIA) Regulations of 18 June 2010 and supporting guidelines.

Enviroworks (an Independent Environmental Consultancy) was appointed as the project Environmental Assessment Practitioners (EAP) to carry out this EIA process, so as to address the impact of the proposed activity; a practice which entails amongst others site surveys, impact identification, public participation, as well as impact rating and review.

The following outcomes are intended to be achieved through this FSR:

- Detail the nature and extent of the activity;
- Identify and describe feasible alternatives;
- Identify and describe potential issues linked to the proposed activity; and
- Quantify the level of investigation to be undertaken during the forthcoming EIA process.

Several factors assisted towards addressing these aims, through the involvement of role-players such as the project applicant, the engineering consultant, interested and affected parties (I&APs), stakeholders and specialist consultants.

Coupled to the publishing of this report, a 21 day comment period will run concurrently during which time stakeholders and I&APs have the opportunity to review all documentation and provide comment for further discussion, examination and integration into the EIA process. These comments, together with the FSR shall then be submitted to DEA for evaluation and decision-making. Hereafter, an Environmental Impact Assessment process will ensue, which shall comprise a broader study and the assessment of all identified and anticipated environmental impacts.

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ABBREVIATIONS AND ACRONYMS

CO_2e	Carbon Dioxide Equivalent
CRR	Comments and Response Report
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DEANC	Department of Environmental Affairs and Nature Conservation
DM	District Municipality
DMR	Department of Mineral Resources
DoE	Department of Energy
DSR	Draft Scoping Report
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
FSL	Full Supply Level
FSR	Final Scoping Report
Ha	Hectares
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IPP	Independent Power Producer
kV	Kilovolt
LED	Local Economic Development
LM	Local Municipality
LSA	Late Stone Age
MASL	Metres Above Sea Level
MSA	Middle Stone Age
MVA	Megavolt ampere

MW	Megawatt
NEMA	National Environmental Management Act
NERSA	National Energy Regulator of South Africa
SAHRA	South African Heritage Resources Agency
SDF	Spatial Development Framework
UNFCCC	United Nations Framework Convention on Climate Change
VIA	Visual Impact Assessment
WRYCM	Water Resource Yield Computer Model
WULA	Water Use Licence Application

INTRODUCTION

Sidala Energy Solutions (Pty) Ltd. (hereafter referred to as Sidala) is a South African based development company operating in the emergent renewable energy industry. The company has identified two sites along the Orange River between Hopetown and Douglas that have the potential of generating 30 - 40MW of power. Referred to as the *North* and *South* Sites, these would utilise the flows released from the Vanderkloof Dam. This assessment investigates the **North Site** only.

Globally, hydropower (both small and large) as a "renewable resource", represents 19% of the world's electricity production (*Paish 2002: 537*). Small-scale hydro is in most cases operated by means of in-stream flow, with no dam or water storage, making it a highly cost-effective, low impact technology for deployment in rural areas of developing countries. Once a hydroelectric power facility is constructed, the project produces no direct waste, and has a considerably lower output level of the greenhouse gases than fossil fuel powered energy plants.

Sidala intends to develop a hydroelectric power facility to harness the high level of renewable energy potential of the flows released from the Van der Kloof Dam. To capacitate the South African Government's commitment to reduce the countries' greenhouse gas emissions and transition to a low-carbon economy, the Department of Energy introduced the Renewable Energy Independent Power Producer Procurement Programme. The programme was designed to enable the contribution of renewable energy by independent companies towards a national target of 3 725 megawatts by 2030 (*Department of Energy 2012*).

On consideration of the feasibility of hydropower as a form of renewable energy generation, several aspects are important in determining the feasibility of the proposed development activity. These include topography, in-stream flow, dam reservoir backwater (inundation) effects on the upstream dam and ownership of land *(Van der Merwe 2013*). The Orange River is South Africa's longest river and a significant collection source for a substantial portion of the country's water. A variety of uses centre around the river as an important enabler, including it being a source of irrigation for agriculture, water for mining and industry, as well as providing small businesses and the public with opportunities for recreational, sporting and adventure type activities. These factors and impacts there on will need to be considered during the EIA phase of this application process.

1.1. Background to the project

The North Site small-scale hydroelectric power facility is proposed to be constructed on a portion of the Orange River, which falls between the Remainder of Farm Tullochgorum No. 158 and Remainder of Farm Kameelsdrift No. 285. The development shall comprise a weir and associated infrastructure, as well as a 132kV power line. The site is situated approximately 25km south-west of Douglas, and falls within the jurisdiction of the Siyancuma Local Municipality, situated within the greater Pixley ka Seme District Municipality. Near to the provincial road, the R385 runs to the East of the site and a gravel road to the West. Both these roads link Douglas in the North with Hopetown in the South.

The proposed facility will comprise a weir with powerhouse, switchyard, headrace and tailrace, as well as a dam wall.

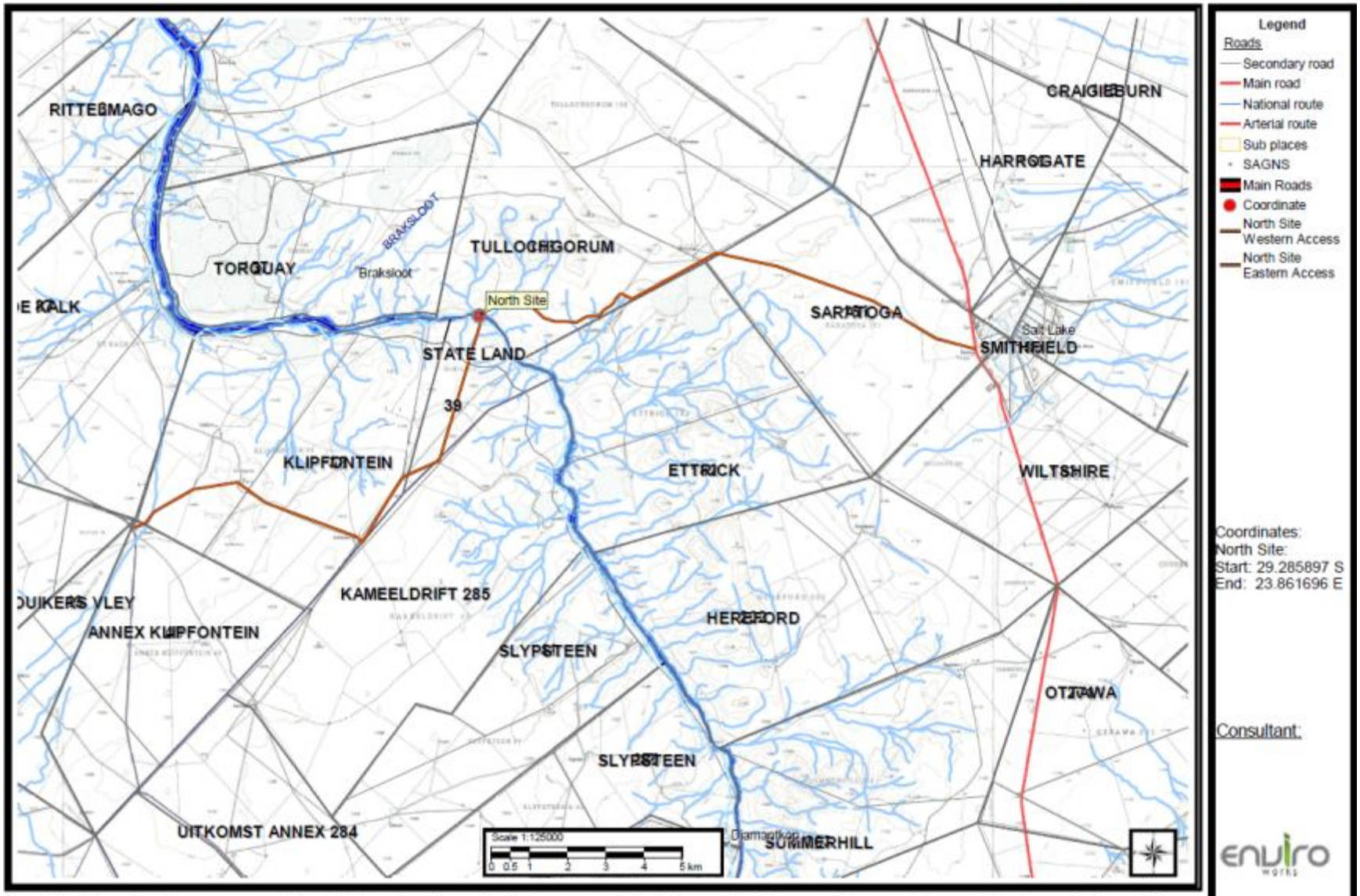
1.2. Applicant

Meerkat Hydropower (Pty) Ltd. is the project proponent and would be the owner of the proposed small-scale hydroelectric power development. The property adjacent the Orange River on which the proposed facility falls is privately owned, whilst the Department of Water Affairs maintains authority over water use for the Orange River and activities, which would impact on this river system.

1.3. Locality

The proposed small-scale hydroelectric power facility will be situated on the Orange River at coordinates -29.285897°; 23.861696° between the Remainder of Farm Tullochgorum No. 158 and Remainder of Farm Kameelsdrift No. 285. The site is accessible by use of existing gravel tracks traversing neighbouring farms to the site. A gravel road, currently being upgraded to tar runs parallel to the Orange River between Hopetown and Douglas on the western side. This road will provide access to the Farm Kameelsdrift No. 285. A well maintained gravel road links access to Farm Tullochgorum No. 158 via neighbouring farm portions with the regional road, the R385 that runs parallel to the Orange River on the eastern flank. One of these two roads is proposed to be upgraded, to allow for access of machinery and vehicles during construction and maintenance activities during operation of the proposed small-scale hydroelectric power facility.

Figure 1 below illustrates the locality of the proposed facility in relation to access routes, adjacent farm portions and nearby towns.



Locality Map for the proposed North Site Small-scale Hydropower Facility on the Orange River, adjacent the Remainder of Farm Tullochgorum 158 and Remainder of Farm Kameeldrift 285, Siyancuma Local Municipality, Northern Cape Province.

Figure 1: Locality Map

1.4. Alternatives considered

Three alternatives are considered and discussed in this report, two site alternatives and a "no-go" option. A brief description of each is provided below:

1.4.1 Site Alternative 1 (Preferred Alternative)

This site falls between the Remainder of Farm Tullochgorum No. 158 and Remainder of Farm Kameelsdrift No. 285, on the Orange River at a latitude of -29.285897° and longitude of 23.861696°.

As the preferred alternative, this site constitutes the most suitable placement of a small-scale hydroelectric power facility based on topographical features, physical appropriateness and hydrological flow data. Although cost and income represent important indicators, these fall subordinate to the former features, and would not vary significantly. Environmental and social impacts are however features that will be articulated further in this report and those forthcoming.

1.4.2 Site Alternative 2

This site is located between Portion 2 of Farm Torquay No. 157 and the Remainder of Farm Klipfontein No. 38, on the Orange River at a latitude of -29.287419° and a longitude of 23.835288°.

The site was formerly identified as the preferred alternative, however a direct proximity to un-alienated state land together with a less favourable topography that would result in a greater cross-sectional area and associated costs, deem this option as less favourable.

1.4.3 No-Go Option

This alternative would entail that the proposed development not be built and the site remain unchanged as it currently exists. More significantly, the secondary effect of inundation would be negated. This would prevent any anticipated environmental, socio-economic and cultural impacts from occurring; however, benefits towards social, economic and political commitments would not be realised.

1.5. Need and desirability of the proposed project

Several key factors can be cited as motivation, detailing for the need and desirability of such a facility. In summary these are:

- Alignment with National commitments to address Climate Change;
- Alignment with National commitments to renewable energy generation;
- Ensuring reliable and locally-supplied energy;
- Harnessing energy from a renewable source/resource;
- Economic stimulus to the local economy, and subsequent social benefits to local communities.

In order to contribute towards realising these goals, Sidala proposes the construction of the North Hydroelectric Powerplant on the Orange River, between the Remainder of Farm Tullochgorum No. 158 and Remainder of Farm Kameelsdrift No. 285, Siyancuma Local Municipality, Northern Cape.

The following question and answer section has been modelled around those required by the DEA in terms of their Basic Assessment Report form, and discusses and explains the needs and desirability in further detail.

i. Is the activity permitted in terms of the property's existing land use rights?

The proposed hydroelectric power site is, as such, not an agricultural activity (zoning of land adjacent to the Orange River) or a water use activity (for the Orange River itself), and is therefore not permitted in terms of the property's existing land use rights. A consent use, in terms of the existing land use, may need to be applied for to ensure that the proposed development would conform to the requirements of applicable planning legislation.

ii. Does the community/area need the activity and the associated land use concerned (is it a societal priority)? (This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate.)

The activity is not one identified in terms of the Siyancuma Local Municipality's IDP, however, it shall contribute substantially to the local and national economy through job creation and energy generation from a renewable resource.

iii. Are the necessary services with adequate capacity currently available (at the time of application), or must additional capacity be created to cater for the development?

No, all services would need to be installed if the proposed development were to be constructed.

iv. Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services and opportunity costs)?

No, the activity does not form part of the infrastructure planning of the municipality, however, infrastructure and services would be allowed for in the cost calculations for the projects by the proponent.

v. Is this project part of a national programme to address an issue of national concern or importance?

Yes, the proposed development would form part of the Department of Energy's Renewable Energy Independent Power Producer Procurement Programme.

vi. Do location factors favour this land use (associated with the activity applied for) at this place? (This relates to the contextualisation of the proposed land use on this site within its broader context.)

Yes, the placement of the proposed development within the watercourse of the Orange River, would provide a beneficial source of kinetic energy through in-stream flow to power the proposed hydroelectric power site. It would however conflict with some existing land uses such as recreational activities (e.g. canoeing and fly-fishing) as well as (including, but not limited to) irrigation infrastructure, agricultural and built infrastructure and structures.

vii. Is the development the best practicable environmental option for this land/site?

This shall be assessed during the EIA process by means of an impact assessment process.

viii. Will the benefits of the proposed land use/development outweigh the negative impacts of it?

This shall be assessed during the EIA process by means of an impact assessment process.

ix. Will the proposed land use/development set a precedent for similar activities in the area (local municipality)?

The proposed development activity does not constitute a typical form of land use/development and would further limit the possibility of similar activities from taking place, due to impacts caused to in-stream flow and inundation.

x. Will any person's rights be negatively affected by the proposed activity/ies?

This shall be assessed during the EIA process by means of an impact assessment process.

xi. What will the benefits be to society in general and to the local communities?

The proposed hydroelectric power facilities may have a positive socio-economic impact on the country and the local communities because of the generation of renewable energy from a renewable resource as well as some job creation during the construction and operational phases.

1.6. NEMA EIA Regulations

The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) is the principle legislation governing Environmental Impact Assessment, under the authority of the National Department of Environmental Affairs.

NEMA makes provisions for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by Organs of the State and to provide for matters connected therewith. Section 2 of the Act establishes a set of principles, which apply to the activities of all Organs of State that may significantly affect the environment. These include the following:

- Development must be sustainable;
- Pollution must be avoided or minimised and remedied;
- Waste must be avoided or minimised, reused or recycled;
- Negative impacts must be minimised and positive impacts enhanced; and
- Responsibility for the environmental health and safety consequences of a policy, project, product or service exists throughout its entire life cycle.

These principles are taken into consideration when a Government department exercises its powers, for example, during the granting of permits and the enforcement of existing legislation or conditions of approval.

Furthermore, section 23 of the NEMA provide for general objectives of Integrated Environmental Management. In alignment with these objectives, the potential impacts on the biophysical and socio-economic environments have been identified and discussed. During the EIA process, these shall be assessed and evaluated, and mitigation measures provided for, where appropriate. These mitigation measures will be included in the Environmental Management Programme (EMPR) for the project.

In terms of the Environmental Impact Assessment Regulations of 2010 (Government Notices R544, R545 and R546 in Government Gazette No. 33306 of 18 June 2010), also referred to as Listing Notices 1, 2 and 3, respectively, several activities were identified to be triggered by the proposed development. Considering the nature and scale of these activities, it was identified that a full Scoping and Environmental Impact Assessment Process was necessary.

The concluding aspect of this process would be the issuing of an Environmental Authorisation by the competent authority, the National Department of Environmental Affairs (DEA). Only with this authorisation and supporting permits may the applicant lawfully commence with the intended activity, thus rendering this process critical in the feasibility and planning stage of the development.

The following listed activities are triggered by the proposed development:

Table 1: Listed activities triggered by the proposed development.

Regulation	Activity	Description of Trigger
No. R. 544, 18 June 2010	1. (i)	Construction of a facility generating less than 20MW of electricity.
No. R. 544, 18 June 2010	10(i)	Construction of a 132kV power line for transmission of electricity.
No. R. 544, 18 June 2010	11. (v) (xi)	Construction of a weir and hydroelectric power facility in the watercourse.
No. R. 544, 18 June 2010	18 (i)	Construction and establishment of a hydroelectric power facility on the banks of the Orange River.
No. R. 544, 18 June 2010	23 (ii)	Construction of a hydroelectric power facility along the Orange River on undeveloped land.
No. R. 545, 18 June 2010	10 (i)	Construction of a hydropower facility and weir within the one in ten year flood line of the Orange River.
No. R. 546, 18 June 2010	4	Construction of a road to provide access to the site.
No. R. 546, 18 June 2010	13	Site preparation and levelling to construct and install the facility in and adjacent to the river.

1.7. Other Legislation, Policy, Plans and Guidelines

Aside from the NEMA, several other key legislation, policy, plans and guidelines will be triggered, whilst others shall provide strategic goals and priorities for different resources and sectors. These are stratified into levels of National, Provincial and Local jurisdiction.

1.7.1. National level

The Constitution of the Republic of South Africa

The Constitution of the Republic of South Africa (Act No. 108 of 1996) in Section 24, states that everyone has the right to an environment that is not harmful to their health or wellbeing and to have the environment protected, for benefit of present and future generations, through reasonable legislation and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while prompting justifiable economic and social development. These principles should therefore be integrated into the project wherein such rights may be affected.

National Water Act, 1998 (Act No. 36 of 1998)

The **National Water Act, 1998** aims to ensure sustainable use of water through the protection of the quality of water resources for the benefit of all water users. Its principal focus is the equitable allocation and use of the scarce and disproportionately distributed water resources of South Africa. The Department of Water Affairs overseas implementation hereof and is the responsible authority for the issuing of permits for water use.

Section 21 of this Act defines types of water use, of which the following types are triggered by this proposed development:

- (c) Impeding or diverting the flow of water in a watercourse;
- (d) Engaging in a stream flow reduction activity;
- (e) Engaging in a controlled activity identified in Section 37(1)(c) a power generation activity which alters the flow regime of a water resource; and
- (i) Altering the bed, banks, course or characteristics of a water course.

In light of the triggering of these water uses, Enviroworks is actively engaging the Department of Water Affairs to ensure that a decision can be reached regarding such proposed activities on the Orange River.
A Water Use Licence Application (WULA) process is being implemented to address triggers of the National Water Act.

Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)

This Act aims to govern acquisition, use and disposal or mineral rights by delegating the state with power and control over mineral and petroleum resource of South Africa. The Department of Mineral Resources are the custodians of this Act and maintain an information database of all registered mining activities within the borders of South Africa.

Enviroworks has conducted Access to Information with the Department of Mineral Resources to determine what mineral rights are assigned to affected properties and the extent of such operations. Landowners have also been engaged to obtain further detail on such related activities.

National Heritage Resource Act, 1999 (Act No. 25 of 1999)

To assess the archaeological and paleontological sensitivity of the proposed development, specialist surveys are being conducted, in line with requirements of the National Heritage Resources Act, 1999 (Act 25 of 1999). This is triggered by the site being greater than 0.5 hectares in extent.

In terms of the National Heritage Resources Act, 1999, the South African Heritage Resources Agency (SAHRA) has a mandate to enforce the conditions of the Act, and hence oversees the management of heritage resources together with provincial heritage agencies.

Several Sections of Section 38 are triggered by the proposed activity. In addition, the region in which the proposed development falls, maintains a rich cultural landscape with multiple heritage landmarks and designated protected sites throughout. As a result, heritage specialist investigation is being undertaken to assess the implications of such a development on any such resources.

White Paper on Renewable Energy Policy in South Africa (2003)

The white paper is responsible for promoting and implementing renewable energy in South Africa. It sets a framework and vision for government's intent to meet renewable energy, policy principles, strategic goals and objectives. With a wealth of renewable resources, largely solar and wind, South Africa intends to promote the agenda of this policy. Critical outputs include meeting economic, technical and other developmental constraints, as well as fighting the effects of climate change through renewable energy activities.

In addition, through the support of renewable energy generation as supported in this policy, South Africa will make progress towards meeting their set target of 10 000 GWh of renewable energy contribution to final energy consumption by 2013 through biomass, wind, solar and small-scale hydro forms. Through this target, roughly 4% of the national energy demand shall be met (*DME 2003*).

Integrated Resource Plan for Electricity, 2010-2013

In accordance with the Energy Act of 2008, the Minister of Energy must develop and publish an integrated resource plan. To meet this requirement, the Department of Energy (DoE) and National Energy Regulator of South Africa (NERSA) assembled the Integrated Resource Plan (IRP) for the period 2010 to 2030. The critical objective hereof is to develop a sustainable electricity investment strategy for generation capacity and transmission infrastructure. Amongst other goals, the IRP is intended to improve the long term reliability of electricity supply by keeping pace with economic growth and development, as well as determining South Africa's capacity investment needs.

Objectives of the IRP include the evaluating of security of supply, and determining the least cost supply option and provide information on the opportunities for new investment. The plans outcomes found that South Africa will still be dependent on coal-fired options over the next 20 years and the construction of additional base load plants will be required from 2010. Committed generation is planned for 9.6 GW of nuclear, 6.3 GW of coal, 17.8 GW of renewable (including 8.4 GW solar) and 8.9 of other generation sources.

Electricity Regulation Act 2006 (Act No. 4 of 2006)

NERSA, under the mandate of the National Energy Regulator Act of 2004 (No. 40 of 2004) and subordinate legislation, such as the Electricity Regulation Act (No. 4 of 2006), has the authority to determine prices at and condition under which electricity may be supplied by licence to Independent Power Producers (IPPs). Presently, NERSA is undertaking requests for qualification and proposals for new generation capacity under the IPP procurement program, as well as updating and expanding the process in awarding electricity generation licences.

National Development Plan - 2030

The executive summary of the National Development Plan (NDP) initiates with the following paragraph, *"The National Development Plan aims to eliminate poverty and reduce inequality by 2030. South Africa can realise these goals by drawing on the energies of its people, growing an inclusive economy, building capabilities, enhancing the capacity of the state, and promoting leadership and partnerships throughout society."*

One of the enabling milestones of the NDP, 2013 is to:

- Produce sufficient energy to support industry at competitive prices, ensuring access for poor households, while reducing carbon emissions per unit of power by about one-third.

The proposed hydroelectric power facilities, for which the geotechnical investigation will be undertaken, will make a positive contribution towards this milestone.

National Infrastructure Plan, 2012

In terms of the National Infrastructure Plan (NIP), the proposed hydroelectric power facility would contribute to Strategic Integrated Projects (*SIP) 8: Green energy in support of the South African economy: Support sustainable green energy initiatives on a national scale through a diverse range of clean energy options as envisaged in the Integrated Resource Plan (IRP 2010)*.

1.7.2. Provincial Level

Northern Cape Provincial Spatial Development Framework

The Northern Cape Provincial Spatial Development Framework (NCPSDF) was formulated in 2011 to meet the requirements of the Northern Cape Planning and Development Act, 1998 (Act No. 7 of 1998) and the Municipal Systems Act, 2000 (Act No. 32 of 2000). Prepared in accordance with a bioregional planning approach adapted to suit the site-specific requirements of the Northern Cape, the NCPSDF recognises that no region or area should be planned and managed as an 'island' in isolation from its surroundings. Together, unit areas form part of the broader environment and the mutual relationships and linkages between adjacent units must be understood and applied.

The framework aims to act as a policy and strategy providing direction and guidance for:

- future land use,
- spatial context for provincial sectoral strategies,
- promoting a developmental state,

- alignment of environmental management priorities, and
- mobilising the overarching objective of the Northern Cape Provincial Growth and Development Strategy (PGDS) to build prosperous, sustainable and growing provincial economy to eradicate poverty and improve social development.

A focus for achieving sustainable development as discussed in the framework, requires four areas of capital, being environmental, human, infrastructure and monetary. The plan further stresses the need for integrated participation, positive interventions and innovative finance.

With relevance to the NCPSDF, the proposed development aligns with the goals for intelligent land use, development of local government infrastructure and implementation of environmental management policy and planning processes to ensure sound development is achieved.

Northern Cape Provincial Growth and Development Strategy (NCPGDS)

The Northern Cape Provincial Growth and Development Strategy (NCPGDS) (2004 – 2014) highlights the most significant growth and development challenge as the reduction of poverty, and that only through long-term sustainable economic growth and development shall this be achieved. Important areas where growth can be achieved include agriculture and agro-processing, transport and tourism. In support of such growth areas the creation of opportunities for life-long learning, improvement of labour force skills to enhance productivity and expanding access to education and knowledge shall lead to the further realisation of such growth.

The inclusion of macro-level objectives shall mobilize these primary growth areas. Such objectives include the developing of human and social capital, improving the efficiency and effectiveness of governance and associated institutions and enhancing infrastructure for economic growth and development. The North site would contribute towards meeting this strategic objective.

1.7.3. District and Local Level

Pixley Ka Seme District Municipality Integrated Development Plan from 2011-2016

The Pixley ka Seme District Municipality presides over eight constituent local municipalities. The Municipality envisions that the Integrated Development Plan **(**IDP) will enable the council to work with citizens, groups and communities of the region to identify sustainable ways of meeting their social, economic and material needs, as well as to improve the quality of their lives.

The document identifies the development priorities for the district over a five year period, with a mandate to promote a developmental municipality and promote sustainable development in the region through effective and efficient service delivery. This with the aim to improve the health and living conditions of the poor, generate local economic development and job creation.

Siyancuma Local Municipality Integrated Development Plan 2012-2013

The Siyancuma Local Municipality IDP maintains key themes around increasing economic growth, improving community self-reliance, achieving service excellence and sustainability led by strengthened leadership and good governance, and a mutual approach between stakeholders (*Siyancuma Integrated Development Plan 2012-2013: 10*). The plan recognises the IDP as providing

institutions with the opportunity to plan ahead amidst a framework of recognised and accessible resources (*Siyancuma Integrated Development Plan 2012-2013: 12*). The proposed development would align with objectives of the IDP to generate jobs and activities for local employment procurement of labour could be motivated for. The Community Work Programme of the local municipality could be supported in this regard.

The development may further reduce scope 3 greenhouse gas emissions (Other Indirect Emissions) for the local municipality through the consumption of locally generated electricity supplementing the power supply grid, which would align with a National Sub-output objective of the IDP.

Siyancuma Local Municipality Local Economic Development Plan 2012

This document provides an approach to sustainable economic development that encourages residents of local communities to work together to stimulate local economic activity for improved quality of life. The vision of the document is to deliver sustainable development, economic growth and development, local employment creation and a high quality of life for all, diversified local economy and education and skills development. This proposed development can be considered to address four of these five provisions. The document aligns in many respects with components of the IDP.

1.8. Environmental Assessment Practitioner

Enviroworks was appointed by Sidala Energy Solutions (Pty) Ltd. as the independent Environmental Assessment Practitioner (EAP) to conduct a Scoping and Full EIA process for the proposed project.

Enviroworks, a Small, Medium and Micro-sized Enterprise (SMME) company was established in November 2002. Although the formal establishment of this company took place then, it is backed by 25 years of professional service and experience in the environmental field. The qualifications and expertise of our professional team forms the backbone of the company's continued success.

The vision of Enviroworks is to provide excellent, cutting edge Environmental Management Solutions and Services, underpinned by a team of professional consultants together with our associated network of specialist partners and project managers. Through an integration of skills and expertise, it is believed that Enviroworks will deliver exceptional, competitive services for task execution and to meet deliverables.

Enviroworks through our years of experience and industry presence, assures the seamless execution and roll out of tasks to achieve projected results on time. The company continuously engages existing and emerging legislation, guidelines and practices, to ensure the execution of qualitative and appropriate studies. Our past experience on renewable energy projects further benefits our understanding of technology-related processes and the impacts thereof.

- *The project EAP is Mark Day, Senior Environmental Specialist at Enviroworks.*

Mark Day has been employed as an environmental consultant at Enviroworks since March 2010. With expertise in environmental management and associated legal processes, Mark has rapidly

gained insight into the field through the engagement and conducting of numerous projects across South Africa. His principal knowledge relates to environmental impact assessments, public participation, compliance monitoring and research-related discourses. A strong background in community engagement and facilitation, together with excellent project management skills, ensures that Mark delivers streamlined and integrated deliverables to his clients. Strong report writing and investigative skills enable Mark to contribute significantly towards ensuring an integrated assessment process. A copy of the Curriculum Vitae of this consultant can be viewed in **Appendix A**.

- *The internal reviewer is Pieter de Villiers, General Manager and Senior Environmental Consultant at Enviroworks*

Pieter de Villiers maintains nearly 10 years of experience in the environmental management arena. The skills gained during this time provide him with the ability to coordinate projects and manage teams effectively. Pieter serves as general manager providing leadership to staff and overseeing all company projects and services areas. He also functions as a Senior Environmental Consultant and maintains projects of his own.

2. SCOPING PROCEDURE

The Department of Environmental Affairs and Tourism (DEAT) (now called the DEA) (2002) describes scoping as an important tool for involving the public in the environmental assessment process, and for structuring assessment studies. It is through scoping, that priorities of the environmental assessment are set. The conditions and terms of reference for the subsequent Environmental Impact Assessment phase is based on issues and concerns that are raised during scoping.

The DEA further encourages the contribution of all stakeholders and I&APs to take part in scoping activities, so as to ensure optimal and rigorous investigation preceding the EIA phase.

2.1. Purpose of the Scoping Phase

The main purpose of the scoping process is to identify issues surrounding the proposed project. Furthermore, it is by this process that issues of I&APs are documented and provided for decision-makers to assess, issues which are important for decision-making are prioritized, early engagement of stakeholders and I&APs, feasible alternatives are identified and legal, policy and planning measures pertinent to the project are identified. Issues are identified through (DEAT 2002).

In respect to the proposed development, measures enabling the scoping process include:

- Site investigations,
- Professional judgement,
- Review of available literature,
- A comprehensive public participation process.

2.2. Steps of the Scoping Phase

DEAT (2002) identifies three primary procedural steps which are followed when scoping:

- Planning the scoping procedure;

- Stakeholder engagement to identify key issues; and
- Reporting on terms of reference for the next phase of the assessment.

Each step can be described as follows:

2.2.1. Planning the scoping procedure

The objectives of such a step are to identify authorities and I&APs to be involved; define the roles and responsibilities of authorities and I&APs; find agreement on the process to be followed; generate background information to spur on the involvement of authorities and I&APs; and identify the most suitable strategies for communicating with I&APs.

Such planning for this process was achieved through the generation of a preliminary list of stakeholders and I&APs that would need to be made aware of such a proposed development. The provision of a Background Information Document was made, providing preliminary details on the nature of the project, location, steps to the assessment process, how I&APs can participate and contact information of the EAP.

2.2.2. Stakeholder engagement to identify the key issues

The objectives of engaging stakeholders include ensuring agreement on the scoping process to ensue; providing access to project information; guaranteeing that I&APs understand what is being proposed and why; determining principal issues for consideration in the assessment; scheduling issues by level of importance; and developing a strategy for resolving key issues.

These objectives were mobilised through active engagement of authorities and stakeholders identified as key national, regional and local role-players and documentation of issues in a comment and response table.

2.2.3. Reporting on the terms of reference for the next phase of the assessment

The objectives of this final stage are to provide closure on all issues to be investigated in the environmental impact assessment and by specialist studies to be undertaken; as well as provision of responses as to how concerns raised have been integrated into the EIA process.

Such objectives are met through this report, which shall provide baseline information on all spheres of the development, details on issues which have materialised and draft terms of reference for specialist studies.

2.3. Public Participation

A comprehensive public participation process has been conducted and remains ongoing to ensure that I&APs remain informed of the proposed development and to ensure that all I&APs and stakeholders have the opportunity to raise their concerns and/or comments. Proof of consultation of all parties to date can be found in **Appendix C**: Public Participation Document.

2.3.1. Notification and Registration Process

The following measures were implemented to date:

- Placement of an advertisement in Die Noordkaap Newspaper on the 26th June 2013;
- Placement of A2 size Site Notices on the 23rd July 2013 on surrounding farms, as well as two notices in Douglas and Hopetown each;
- Engagement of affected landowners via telephone and email notification on the 23rd July 2013;
- The following surrounding landowners were informed of the project by means of a Background Information Document via email notification, and afforded the opportunity to comment of the project by means of an Interested and Affected Parties Comment Form:

Farm/s	Contact Person
Lot 271, Rem Kameeldrift 285, P. 8 Disselfontein 77	Mr Leon Ferreira
Ettrick 82, Rem. Ettrick 82, Rem. Hereford 202	Mr Louis Nel
Torquay 157	Mr Frans Wiid
Summerhill 203, Rem. Summerhill 203	Mr Bobby Bertrand
Slypsteen 41	Mr Hendrik Le Roux
Rem. Klipfontein 38	Mr Frans Wiid
Rem. Slypsteen 41	Mr Gerald Daniels
Rem. Slypsteen 42, Rem. Farm 270	Mr Pieter Van Wyk
Rem. Tullochgorum 158	Mr Louis Nel

- Authorities and stakeholders were informed via telephone and email notification on and after the 23rd July 2013. These were:
  - Siyancuma Local Municipality — Mr. W Stadhouer
  - Ward Councillor — Mr. Johannes Mosetle
  - Pixley Ka Seme District Municipality — Mrs. Viv Jones
  - Department of Environment & Nature Conservation — Ms. Anga Yaphi
  - Department of Water Affairs — Ms. R Nobela
  - Eskom — Mr. B Williams; Mr. G van Schalkwyk
  - National Energy Regulator of South Africa — Mr. Martin Untiedt
  - South African Heritage Resources Agency — Ms. Kathryn Smuts

The following persons and organisations responded to notification and registered on the project:

- Surrounding landowners
  - Remainder of Farm No. 39 — Mr. Leon Ferreira
- Stakeholders
  - Department of Water Affairs — Mr. Dries Visser; Mr. Vernon Blair; Ms. Jackie van Bosch; Ms. Thembe Olebogang; Mr. Carlo Schrader
  - South African Heritage Resources Agency — Ms. Kathryn Smuts
  - Vanderkloof Water Use Association — Mr. Johan van Graan

- Interested and Affected Parties
    - The Fly Guides — Mr. Chris Van Der Post
    - Aurecon (Pty) Ltd — Ms. Louise Corbett

Registered I&APs will be communicated with further on the application, whilst unresponsive stakeholders and I&APsshall be engaged for comment during the upcoming Draft Scoping phase.

2.3.2. Issues and Responses

The following table provides a summary of key issues and responses given to date:

Table 2: Issues and Response Table	
Issue	**Response**
Party: Mr. Leon Ferreira (28 July 2013)	**Enviroworks: Mr. Mark Day (5 Aug 2013)**
Mr. Ferreira requested the height to which the water level shall rise to.	The water level shall rise to between 1010m-1015m (North Hydroelectric Power site) and between 1030m – 1035m (South Hydroelectric Power site).
He commented on the presence of river pumps, rafting camp, hunting camp, diamond gravels and archaeological sites.	The party was requested to provide a list of assets and locations thereof to capture sites, which may be impacted on.
Mr. Ferreira commented on the negative impact to tourism potential to affected properties and market value.	A lease agreement between the proponent and the party may offset any market value loss.
Party: Mr. Leon Ferreira (4 Sept 2013)	**Enviroworks: Mr. Mark Day (4 Sept 2013)**
Mr. Ferreira identified two properties under his ownership, which would be affected, namely Farm Kameelsdrift 285 and Farm Disselfontein 77.	
Comments pertaining to Farm Kameelsdrift 285:	*Response to comments on Farm Kameelsdrift 285:*
Diamond mining activity is underway on the farm, which carry large financial outlays;	Enviroworks has submitted an application to the Department of Mineral Resources for Access to Information on all mining activity on farms to be affected by inundation, so as to identify mining right holders.
Two central pivots, which shall be reinstalled following rehabilitation, the mining area is proposed for other land use. The sites where these shall be installed will be inundated by the facility;	
Rafting activity on the farm will be impacted on.	For all described land uses and features, Enviroworks requested that the party provide GPS coordinates for further investigation.
Comments pertaining to Farm Disselfontein 77:	
The farm contains a rafting camp with bushman paintings, both which will be inundated. Furthermore the hells gate and hubly bubbly rapids will disappear.	
Water pumps and associated pipeline to transfer between 3.2 and 3.6 million litres/hour for irrigation, will be flooded. This may result in	

immense losses to agricultural activities.	
Party: SAHRA (20 Aug 2013)	**Enviroworks: Mr. Mark Day (20 Aug 2013)**
SAHRA provided interim response to the information uploaded to the SAHRIS online portal. The detailed that an archaeological Phase 1 Assessment and Paleontological investigation be conducted.	Enviroworks acknowledged the comment and indicated that such studies shall be conducted.
Party: Ms. Louise Corbett (27 Aug 2013)	**Enviroworks: Mr. Mark Day (27 Aug 2013)**
Ms. Corbett requested to be registered as an I&AP to the project and requested the Megawatt size for each facility and flow volume.	Enviroworks acknowledged registration and indicated that the proposed North Hydroelectric Power site would have a Megawatt capacity of 22MW and 150 m^3/s flow rate, whilst the proposed South Hydroelectric Power site would have a Megawatt capacity of 18MW and a 150 m^3/s flow rate.
Ms. Corbett emailed (09 Oct 2013) to confirm registration on the project, as well as suggesting the contacting of Ms. Jacoline Mans (Department of Agriculture, Forestry and Fisheries) and Ms. Natalie Uys Department of Environmental Affairs and Nature Conservation (DENC.	Enviroworks confirmed registration of the party (09 Oct 2013) and provided a download link for the DSR. Officials from DAFF and DENC were contacted by Enviroworks, as indicated by Ms. Corbett.
Party: The Fly Guides – Mr. Chris Van Der Post (1 Sept 2013)	**Enviroworks: Mr. Mark Day (1 Sept 2013)**
Fly-fishing business operations for Smallmouth Yellowfish shall cease due to the flooding of rapids; The section of the Orange River between Douglas and Hopetown remains un-sploit; Agreements for use with Farm Disselfontein 77 and Kameelsdrift 285 shall be affected; Concerns over fish migration paths for Smallmouth and Largemouth Yellowfish and the 'blockages' thereto; Navigation of the river will be seriously impacted on, whilst cataraft structures which rely on fast-flowing water shall become un-useable as a result of slowed in-stream water movement. Financial investments due to marketing conducted to date shall be lost.	Enviroworks acknowledged registration and requested GPS coordinates for the sections of the river where operations are conducted.
Party: Department of Water Affairs – Numerous (Sept 2013)	**Enviroworks: Mark Day (5 Sept 2013)**
On the 15th May 2013, Sidala Energy Solutions and Aecom conducted an initial meeting with the Department of Water Affairs to introduce the project and obtain initial concerns. The following concerns were raised: - The hydrology computer model to be implemented in the undertaking of the hydrological study must be the latest	

version used by DWA; - The incremental increase of evaporation loss by the schemes should be investigated; - The downstream impact of the projects and especially the filling of the reservoirs be clarified.	
Since the inception of public participation in July 2013, various officials from the DWA Affairs have registered on the project. These are Mr. Dries Visser, Mr. Vernon Blair, Ms. Jackie van Bosch and Ms. Thembe Olebogeng. These officials represent directorates of both the Northern Cape and Free State regional offices of the DWA. DWA requested hard copies of the DSR to be provided to their office. This was submitted to the DWA on the 20th Sept 2013.	Enviroworks acknowledged registration with all parties. Dries Visser and Vernon Blair indicated that Water Use Licence Applications are to be submitted to the DWA. Enviroworks requested that a pre-consultation meeting be scheduled. A pre-consultation meeting was held with DWA at the Bloemfontein Office with Mr. Pius Lerotholi on the 17th September 2013. It was confirmed that the Water User Associations (WUA) must be informed of the proposed development; that a Hydrological Study would need to be conducted; and that the EIA would constitute supporting documents on submission of the Water Use Licence Application forms.
Party: Vanderkloof Water User Association – Mr. Johan van Graan (9 Sept 2013)	**Enviroworks: Mark Day (9 Sept 2013)**
Mr. Van Graan requested to be registered.	Enviroworks acknowledged receipt and registered the Vanderkloof Water User Association Mr. Van Graan was further corresponded with via telephone and email, at which time the contact details of all water users registered with the WUA be provided, to enable Enviroworks to inform these individuals/organisations. This was not provided to Enviroworks up to date.
Party: Department of Agriculture, Fisheries and Forestries: Directorate: Forestry Management – Ms. Jacoline Mans (10 Oct 2013)	**Enviroworks: Mark Day (10 Oct 2013)**
Ms. Mans provided registration details and indicated that impacts on riparian vegetation may trigger interest from her unit, as well as impact on any protected trees. The party shall be provided with a CD copy of all further reports for comment. In addition, she provided the details of Ms. Anneliza Collett, a representative for the Department of Agriculture, Forestry and Fisheries: Directorate: Land Use and Soil Management.	Enviroworks acknowledged correspondence and confirmed that engagement on relevant issues would be made with the party.
Party: Department of Agriculture, Forestry and Fisheries: Directorate: Land Use and Soil	**Enviroworks: Mark Day (10 Oct 2013)**

Management – Ms. Anneliza Collett (10 Oct 2013)	
The correspondent indicated that Khuthala Dlamini would constitute the relevant official for the Northern Cape province, but that all correspondence can be directed through Ms. Thoko Buthelezi (liaison official at DAFF).	Enviroworks acknowledged correspondence and indicated that all correspondence to DAFF (with the exception to Ms. Mans), shall be sent to Ms. Thoko Buthelezi for internal routing.
Party: Department of Agriculture, Forestry and Fisheries: Help Desk & Administrative Office – Ms. Francina (Surname not given) (10 Oct 2013)	**Enviroworks: Mark Day (10 Oct 2013)**
Ms. Francina indicated that the application and request were sent to the liaison office for registration.	Following receipt of a case number for the South Hydroelectric Power Site, Enviroworks requested from the official that the case details for the North Hydroelectric Power Site be provided as well.
Party: Department of Environmental Affairs and Nature Conservation (DENC): Ms. Natalie Uys (09 Oct2013)	**Enviroworks: Mark Day (10 Oct 2013)**
Ms. Uys requested to be registered as a stakeholder on the proposed projects.	Enviroworks acknowledged receipt and confirmed registration to the project database.
Party: Kakamas Hydro: Ms. Mercia Grimbeek (14 Oct 2013)	**Enviroworks: Mark Day (14 Oct 2013)**
Ms. Grimbeek requested to be registered as a stakeholder on the proposed projects. On the 22nd October 2013, Ms. Grimbeek provided the following questions: **For the South Project** 1. What is the expected energy yield from the project? 2. How will the flow regime (i.e the variation of flow) downstream of the project change due to construction of the dam and operation of the power station? **For the North Project** 1. What is the expected energy yield from the project if only the North project is constructed? 2. What is the expected energy yield from the project if both the North and South projects are constructed?	Enviroworks acknowledged receipt and confirmed registration to the project database. Enviroworks response to these questions is as follows: **For the South Project** 1. 80 – 100 GWh/annum 2. These projects will not abstract any water. Releases associated with the normal flow will be discharged during river diversion and during impoundment. Larger discharges during generation of hydropower at Van der Kloof and Gariep will be used for raising the water levels of the new dams. There will therefore be minimal change of flow regime during filling of reservoirs, and no change of flow regime during operation. **For the North Project** 1. 70 – 90GWh/annum 2. 150 – 190GWh/annum

3. In the case where only the North project is constructed, how will the flow regime (i.e the variation of flow) downstream of the North project change due to construction of the North dam and operation of the North power station?	3. If only the North project is constructed, there will be minimal change of flow regime during filling of reservoirs, and no change of flow regime during operation.
4. In the case where both the North and South projects are constructed, how will the flow regime (i.e the variation of flow) downstream of the North project change due to construction of the both the North and South dams and operation of the North and South power stations?	1. If the North and South projects are constructed, there will be minimal change of flow regime during filling of reservoirs, and no change of flow regime during operation.
Furthermore, could you please advise of the dates for either a public participation or focus group meeting as I would be keen to attend.	No public meeting has been planned for to date. If the needs or interest presents itself, this shall be arranged for.
Party: Oranje Vaal Water User Association: Ms. Lizelle Beukes (21 Oct 2013)	**Enviroworks: Mark Day (21 Oct 2013)**
Ms. Beukes was provided with project information and invited to register as an interested and affected party on the project.	Enviroworks requested for the party to register to the project database.
Party: Douglas Agricultural Association: Ms. J. Van Staden (09 Oct 2013)	**Enviroworks: Mark Day (09/21 Oct 2013)**
No comments have been received up to date.	Enviroworks contacted the party with an invitation to register as an interested and affected party.

3. OVERVIEW OF THE PROPOSED PROJECT

3.1. A Background on Hydroelectric Power

Paish (*2002: 538*) describes hydropower as being in use for some 2, 000 years, but primarily for the milling of grain. In the 19th century, waterwheels were experimented with as a potential means for generating electricity and towards the end of the century, wheels were being replaced with turbines as investigations into the technology grew. The first half of the 20th century saw exceptional growth in the use of hydropower and today it stands as the most significant of 'renewables' for electrical power production globally (*Paish 2002: 539*). This is substantiated by the International Journal of Hydropower and Dams which in 2000 reported that the global technically feasible hydro potential is estimated at 14 370 TWh/year of which 8080 TWh/year is deemed economically feasible. At the time, hydropower provided 19% of the world's electricity, compared to 2% for all other renewable forms combined (*Paish 2002: 539*).

The fundamental process involves the conversion of water pressure by hydro-turbines into mechanical shaft power that subsequently drives an electricity generator or other machinery. Herein, the available power is proportional to the product of pressure and volume flow rate, demonstrated by the following formula:

$$P = \eta \rho g Q H$$

In **Figure 2**, *P* is the mechanical power produced at the turbine shaft (Watts), *η* is the hydraulic efficiency of the turbine, *ρ* represents the density of water (kg/m^3), *g* is the acceleration as a result of gravity (m/s^2), *Q* correspond to the volume flow rate moving through the turbine (m^3/s) and *H* is the pressure head of water over the turbine (*m*) (*Paish 2002: 540*).

Energy is therefore derived to make power by the force of water moving from a higher elevation to a lower elevation. Water then turns the turbine at enormous speeds. The turbine rotates, via a connected shaft to an electrical generator, and this generator creates electricity. It is the turbine and generator working in combination that converts "mechanical energy" into "electric energy".

Once a hydroelectric complex is constructed, the project produces no direct waste, and has a considerably lower output level of the greenhouse gas carbon dioxide (CO2) than fossil fuel powered energy plants. Hydroelectric plants also tend to have longer economic lives than fuel-fired generation, with some plants now in service which were built 50 to 100 years ago. Operating labour cost is also usually low, as plants are automated and have few personnel on site during normal operation (*Fouche 2011*).

According to energy experts South Africa has moderate hydroelectric potential, and the establishment of small hydroelectric projects around the country could help provide a sustainable future energy supply (*Fouche 2011*). Because of the shortage of energy supply faced in South Africa, the government is in the process of authorising independent power producer licences. This process is also aimed to diversify the countries energy mix by bringing in renewable energy technologies. Small hydro power plants (<10MW) is one of the qualifying criteria for the refit and will contribute to the country's target of 10 000 GWh by 2013. The proposed North Hydroelectric Power Site may sell Carbon Credits through the Clean Development Mechanism (CDM) as recognised by the UNFCCC.

The Orange River is major river confluence in South Africa supporting a myriad of land use along its banks, such as agriculture, mining and recreation. The river further supports a functioning aquatic ecosystem and provides an important perennial source of water for surrounding terrestrial ecosystems. Factors of predictable water supply together with the availability of comprehensive information on current and future flows, make the potential for the operation of a hydropower facility possible. Key feature of such supply are that the system maintains a constant flow through interventions by various water management schemes upstream to the site of the proposed development; and that this flow is timed and predictable.

3.2. Project Alternatives

Only site alternatives have been investigated for the proposed development. The technology being proposed has been identified based on several site variables as the most suitable and site appropriate. No layout or design alternatives have been proposed to date.

3.2.1. Site Alternative 1 (Preferred Alternative)

This alternative comprises the construction of a weir for 20m above the river bed level. This site falls between the Remainder of Farm Tullochgorum No. 158 and Remainder of Farm Kameelsdrift No. 285, on the Orange River at a latitude of -29.285897° and longitude of 23.861696°. The project

consists of a Hydropower Plant together with a dam. The plant shall comprise of a concrete gravity dam with a power house and bottom outlets. This facility has the potential to be inundated during extreme events, but has been designed to accommodate these criteria.

As the preferred alternative, this site constitutes the most suitable placement of a small-scale hydropower facility based on topographical features, physical appropriateness and hydrological flow data. Although cost and income represent important indicators, these fall subordinate to the former features, and would not vary significantly. Environmental and social impacts are however features that will be articulated further in this report and those forthcoming.

3.2.1.1 Hydrology Model

An initial meeting with the Department of Water Affairs, conducted on the 15th May 2013, raised the follows requirements for investigation by the hydrology investigation:

- The hydrology computer model must be the latest version used by DWA;
- The incremental increase of evaporation loss by the schemes should be investigated;
- The downstream impact of the projects and specially the filling of the reservoirs be clarified.

3.2.1.1.1. Stream Flow Hydrology

An investigation by Van der Merwe *(2013:6)* of the stream flow was conducted, based on historical flow records provide by three gauges (D3H012-just below the Van Der Kloof Dam; D3H008 – at the weir on the Orange River just upstream of Douglas; and D7H012 – just below the confluence of the Orange and the Vaal Rivers). Due to the location of the proposed site for the North Hydroelectric Power Facility, gauge D3H008 provided the most representative data.

- *Historical Flow Data*

On reviewing historical flow data, Van der Merwe *(2013:6)* determined that those measures recorded between periods 1992 to 2012, represented current development levels and operational conditions in the catchment and as such was used to determine flows at the required assurance level.

Despite the value of gauge D3H008, it does not reflect the long term records of extreme events with longer recurrence intervals. As such, a Water Resource Yield Computer Model (WRYCM) was used by Van der Merwe for the pre-feasibility phase.

- *WRYCM computer software*

Van der Merwe *(2013:7)* obtained the WRYCM model configuration for the Orange and Vaal River system from DWA, which is used to manage and plan water resource developments on these watercourses. Rigorous testing of the configuration of the system was conducted and the results thereof widely accepted.

Two relevant scenarios exist on this model, namely current day (2009 development model) and the future development level with Lesotho Highlands Phase 2 (Pholihalii Dam included). The WRYCM was used to simulate monthly flows of a 64 year period for both time slice periods. Ten sequences

were generated, which gave a low incidence in the probable range of the flow duration curves. Of these ten sequences, sequence 100 represented the average and was used further to determine the hydropower potential at different assurance levels.

The historically gauged flows at D3H008 show how the modelled flows with the inclusion of Pholohali Dam, will primarily influence the peak flows with little impact on flows below 100 m^3/s. The historical data from gauging weir D3H008 further shows key flow percentile of 50% and 90% are 66 and 31 m^3/s respectively. The flow duration curve, together with a total turbine access, pipe and generator efficiency of 85%, dam size, net generating head and an initial estimate of 0.5m friction loss were all factors considered in determining the power potential *(Van der Merwe 2013:7).*

3.2.1.1.2. Flood Hydrology

Based on investigations by Van der Merwe *(2013:8),* normative statistical, deterministic and empirical methods for flood calculations could not be applied in the conventional manner due to the large catchment areas, complexity of the catchments and the impact of the flood attenuation in the Gariep and Van Der Kloof Dams.

As a result of the aforementioned points, the recommended flood hydrology of the Gariep and Van Der Kloof Dams were utilised to address this aspect. The contributing areas were determined from published data on the tertiary and quaternary catchment areas.

Peak discharge estimates were determined through the review of historical flow data and the latest Flood Frequency Analysis for both Gariep and Van Der Kloof Dams, as provided by the Department of Water Affairs, generated by Doornkuilen Flow Gauging Weir and Markdrift Flow Gauging Weir.

According to Van der Merwe *(2013:10)*, the estimated virgin inflows into Van Der Kloof Dam were based upon the recommended peak inflow discharges at Gariep Dam by means of multiplying the recommended inflow peaks for Gariep Dam with the square root of the two catchment areas of the dams. Estimated peak discharges for the proposed site were then based upon the virgin Regional Maximum Flood (RMF) for both Gariep and Van Der Kloof Dams, as well as upon the result of the Statistical Methods EV1 Distribution at Doornkuilen Flow Gauging Weir. These results were compared in order to arrive at recommended peak discharges at the proposed site

3.2.**1.**1.3**. Evaporation Loss**

Due to the damming of the Orange River, the North Hydro Power Site will inundate upstream areas, creating a dam, which at Full Supply Level (FSL), shall fall at 1012 masl and maintain a surface area of 3.59 km^2 (See Appendix F for an illustration of the inundation contour).

Van der Merwe *(2013:3)* determined the average evaporation losses at the Van Der Kloof Dam at 2.13 m per year, with an evaporation volume of ±7,6 million m^3/year. The author cited the Hydro Power Operating Analysis, which recorded the evaporation loss between Van Der Kloof Dam and Marksdrift gauging weir at being 55.3 million m^3/year. The evaporation loss from the North site dam would be 3.4 million m^3/year. Factoring in an average flow (as determined by the Water Resource

Yield Computer Model) of 66 m³/s the flow shall be 2 081 million m³/year. The loss from the South Site would therefore be 0.16% of this flow, which is seen as nominal.

3.2.1.2. Layout of the weir site

High flood peaks of the structure necessitate the need for the spillway to be as lengthy as possible, resulting in a concrete gravity structure for the entire weir. The layout shall comprise:

- An ogee-type **spillway** with a stilling basin;
- A **river outlet system** constructed near the river bed to minimise the excavation and if required, a bridge structure will be constructed to provide access to this;
- The system will comprise an intake structure, dam wall and outlet component;
- A **power house** with intake area, powerhouse facility and outlet.

Van der Merwe *(2013: 22), d*etermines that sedimentation yield from the incremental catchment area downstream of the Van Der Kloof Dam and the position in front of the inlets to the turbines, will need to be investigated. A river diversion cannel will flush the area in front of the turbines by providing gates on the bottom outlets.

3.2.1.3. Site Elevation

The river cross-section and stage-capacity curve of a site have a major influence on the economic viability of hydroelectric power facilities. According to BKS (2012: 14), the stage-capacity curve indicates which site will have the lowest height for the highest storage volume and the river cross section should indicate which site has the least cost for a certain height.

In addition to cost effectiveness of a weir, the foundation compatibility to the concrete structure is important and therefore acceptable bearing pressures in the foundation for a concrete gravity structure and excavation depth are critical. As mentioned above, the cross-section of the river remains an important consideration, due to its dependency on the weir height. For example, a weir height of 20m has a cross-section of 320m, but if this was increased to a height of 40m the cross-section would increase to 410m.

Site alternative 1 was identified as having an efficient river cross section through comparison of the top length and the volume of concrete required to construct a 20m high weir at each site and position. For this site the length of the crest was 320m whilst the concrete volumes was recorded at approximately 76 000m³, lower than that of the site alternative. Figure 2 on the page to follow provides a 3D model view of the proposed facility.

3.2.1.4. Engineering Geology

BKS (2012: 20) conducted a preliminary review of the foundation conditions at the site, which were based on the published 1:250 000 Geological Map 2922 Prieska; geological information on the Torquay Dam site contained in a report on the Orange River Development Project and Replanning Study prepared for DWAF by BKS and Ninham Shand in May 1998; as well as Google Earth images of July 2005.

The reviewed materials found that site is underlain by andesitic lava of the Ventersdorp Group. Foundation conditions described the river channel as irregular strong rock requiring an average of 2m excavation, whilst the river banks consist of alluvial sand and boulders on irregular strong rock surface which would require average excavation of 6m. Flanks to a height of 20m above the river bed level were described as weathered rock requiring an average excavation of 6m, while curtain grouting to an average depth of 20m would be needed.

3.2.1.5. Topographical Survey

A topographical survey of the site was conducted, which included 6 cross sections at 25 m intervals of the river extending approximately 250 to 300 m from the centre line of the river. A ±150 m wide section of the river was therefore surveyed at each site.

3.2.1.6. Power House

The selection of a turbine unit was based on a first order determination and to determine if any fatal flaws could be identified with the river topography and high flood peaks. The specific speed at which water will cause the turbine to rotate is based on a certain head (m), flow (m^3/s) and speed (revolutions per minute (rpm)). Where flows are above 40 m^3/s, heights of up to 20m and speed above 200 rpm, BKS (*2012: 16*) recommend an axial flow vertical Kaplan turbine. An illustration of the power generation facility and associated turbine is provided in figure 3 below

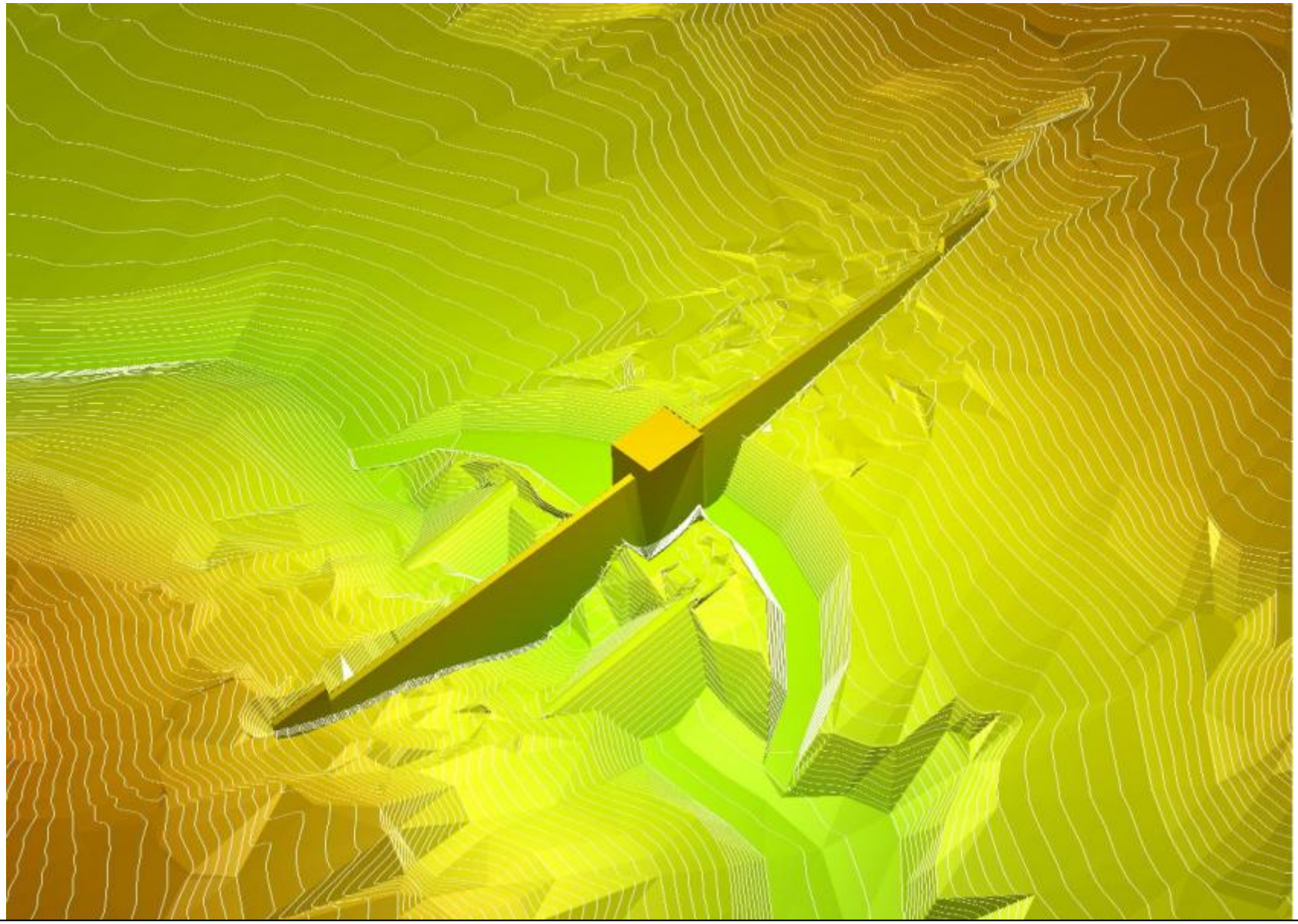


Figure 2: A 3D Model view of the proposed North Site Hydroelectric Power facility (Source: BKS 2013).

.3.2.1.7. Dam Design

In determining the design of the proposed dam, various contributing factors, including the optimum height, river diversion, tail water analysis, stability analysis of concrete gravity dam, seepage control, spillway and layout, must be assessed. The dam design and contributing aspects shall be discussed in the Environmental Impact Report.

3.2.1.8. Power Transmission Elements

An overhead transmission line of 132kV is necessary, based on the rated current and volt-drop indices. The proximity of the site location to the nearest substation is 24km. Van der Merwe *(2013:23)* provided a design for the transmission of electricity, based on the electricity current to be generated at the site and the voltage drop over the assumed distance (distance from site to nearest substation).

The following table provides a summary of transmission information:

Table 3: Summary of transmission information

Description	North Site
Generating Capacity (MW)	12.5
(MVA)	15.5
Line Voltage	132
Distance to Substation	22.8
Rated Current	120 A
Chosen Conductor	Fox
Volt Drop	2.76%

3.2.1.9. Access Roads

Two access routes are proposed, one from the east (access from the R357 road) and the other from the western orientation (access from the R385 road). BKS (*2012: 18*) identifies the latter as being more preferable, due to the status of the R357 as a gravel road at the time of this investigation, however this road is currently being upgrade to tar. The access road connecting the site to one of these regional roads, would be built over existing gravel routes lessening the impact to surroundings.

3.2.1.10. Dam Footprint Issues

BKS (*2012: 19*) described that the reservoir footprint would not pose an impact on social and environmental aspects of the region since the larger the footprint, the greater the acquisition, environmental mitigating and re-establishment cost would be. It would however be pertinent to identify sensitive environmental and social features and model the footprint around such significances as far as possible, so as to retain intrinsic site value instead of simply only planning for reinstatement expenses per se.

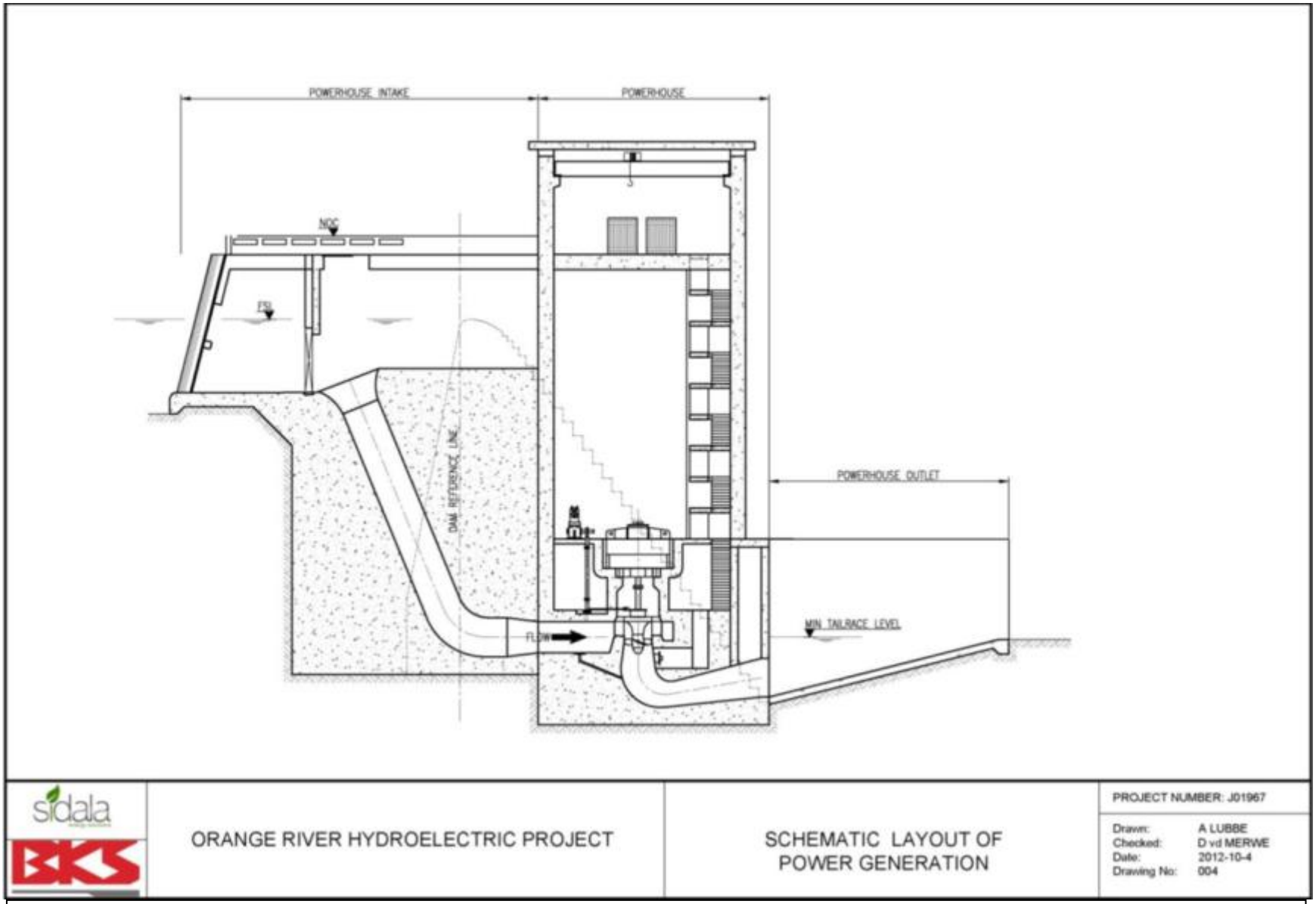


Figure 3: Illustration of the axial flow vertical Kaplan turbine proposed for use.

3.2.2. Site alternative 2

This option maintains similar features to the preferred site alternative hence only factors reducing its favourability will be mentioned. The site is located at -29.287419°; 23.835288°, approximately 2.5km east of the preferred site alternative.

Principal factors rendering it less favourable to site alternative 1 are:

- **Un-alienated state land**

The site falls adjacent to un-alienated state land, which would require engagement of the state to negotiate lease of the affected land. This could prove to be a lengthy process, while avoidance of delays based on process timeframes would be minimised through engagement with private landowners, which would be the case for the preferred site alternative.

- **Topography**

The suitability of the topography at this site is lower than that of the preferred site alternative, since the site would have a greater cross-sectional area resulting in a greater development footprint and higher cost.

Based on these two anomalies, this alternative was deemed to be less favourable.

3.2.3. The No-Go or 'Do-Nothing' Alternatives

This alternative would entail that the proposed development not be constructed and the site remains unchanged as it currently exists. More significantly, the secondary effect of inundation would be negated. This would prevent any anticipated environmental, social economic and cultural impacts from occurring.

4. BROAD DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

4.1. Climate

The region experiences summer and autumn rainfall with very dry winters (*Mucina & Rutherford 2006: 517*). A Mean Annual Precipitation (MAP) of between 250mm – 450mm occurs, whilst frost is of reoccurrence in winter. The mean monthly maximum and minimum temperatures for the nearby town of Douglas are 39.7°C and -4.6°C for January and July respectively.

4.2. Topography

The sites is characterised by undulating terrain with rocky dolerite sills prevalent, whilst the river is flanked by relatively steep slopes.

4.3. Geology and Soils

Mucina and Rutherford (2006: 517) described this as a highly fragmented on Ecca and Dwyka Group sediments and Karoo dolerites as well as on Ventersdorp Supergroup lavas. The area is characterized by dolerite sills forming ridges and plateaus and slopes of koppies and small escarpments with erosion terraces prevalent. Alternating layers of mudstone and sandstone are overlain by dolerite sills. Prominent soil forms are Mispah and gravel-rich Glenrosa forms of origin from Jurassic dolerite, whilst calcrete-rich soils occupy the lowlands (*Mucina & Rutherford 2006: 517*).

A geotechnical investigation is proposed to be conducted during the Environmental Impact Assessment phase of the Environmental Impact Assessment process. This shall entail the drilling of a series of pilot holes in and adjacent the watercourse to determine the suitability of bedrock to support such a proposed structure. A Basic Assessment Process is being conducted due to the triggering of Activity 18 of Listing Notice 1 (Government Notice R.544) of the NEMA EIA Regulations of 18 June 2010. Outcomes generated from the Basic Assessment study shall be incorporated into forthcoming reports of the EIA Phase of this application.

4.4. Ecological Status

The executive summary of the Ecological Impact Assessment was available at the date of publishing of this document, hence an overview of ecological aspects has been provided for at this time. At present, the site is not known to contain any ecological systems receiving protection under South African legislation, such as National Protected Area Expansion Strategy Focus areas, or sensitive areas as identified in an environmental management framework in terms of Chapter 5 of NEMA.

As described by Ross *(2013: 6), the following ecological aspects were investigated:*

- General riparian and habitat assessment;
- Aquatic habitat assessment;
- Aquatic macro-invertebrates; and
  Fish community assemblages.

4.4.1. Terrestrial Ecological Survey

The following information was compiled using available information from the forthcoming Aquatic and Terrestrial Biodiversity Impact Survey.

Figure 4: The view of the proposed site facing upstream

4.4.1.1. Terrestrial Habitat

The following is an extract taken from Ross *(2013:7)*: *"Observations from general habitat descriptions and "walk-about" surveys at the two proposed sites and strategic points within the area that would be inundated by the construction of the in stream barriers showed that the riparian habitat had remained largely intact, with the surrounding land use locally being dominated by livestock (cattle and sheep) and game farming. Mining was noted within the area, especially at the North Site. The Orange River presents a reliable water source within an otherwise arid environment and therefore formal irrigation schemes are also common within the area that supports a thriving agricultural sector. Riparian vegetation remained largely intact. The banks of the watercourse are largely alluvial-driven coarse-grained sands. Deposition and transport of these sands is common and a natural feature of the river system. Actual soil erosion was considered low throughout the survey area."*

4.4.1.2. Flora

The following is an extract taken from Ross *(2013:10)*: "*The riparian zones of the river fall within an azonal vegetation unit of the freshwater wetlands biome, known as Upper Gariep Alluvial*

Vegetation. The conservation status of this vegetation unit is regarded as Vulnerable, largely due to limited extent of the unit and the lack of formal conservation. The upper slopes of the macro-channel and the areas surrounding the riparian zones on either side of the river are classified within the Eastern Kalahari Bushveld bioregion of the Savanna biome, known as Vaalbos Rocky Shubland. This vegetation unit is regarded as Least threatened. Both vegetation units within the survey area were well represented and considered to be in natural climax state of succession. The riparian zones are favoured for grazing of livestock and therefore some disturbance impacts were evident. This was mostly through the increase in density of Acacia mellifera, which is a response to a degree of disturbance. Overgrazing and undue trampling by livestock was not, however, considered an impacting or deleterious feature of the survey area. Grass species observed were typical of the vegetation unit and were indicative of shifting alluvial soils as well as nutrient-poor rocky soils. Pioneering species (indicative of recent disturbance features) were only noted sporadically, and were mostly limited to the dispersive aeolian and alluvial soils common throughout the survey area."

"The floral species communities observed were not impacted by encroachment of exotic invasive species, with exotic species making up a minor and insignificant proportion of the biomass and species diversity."

Protected floral species and species of conservational concern

"Noted protected tree species, as per the National Forests Act (Act 84 of 1998) included Acacia erioloba and Boscia albitrunca. As these individuals would be destroyed by the inundation of the area, a permit will be required from the DAFF (Department of Agriculture, Forestry and Fisheries) to remove (relocate) individuals of these species. Further protected species as per Schedule 2 of the Northern Cape Conservation Act (Act 9 of 2009) were also identified."

"No further RDL (Red data listed) species were noted during the field survey, but the vastness of the area meant that comprehensive site searches were not possible and therefore the possibility of RDL species occurring that may be impacted by the proposed development activities may exist."

4.4.1.3. Fauna

The following is an extract taken from Ross *(2013:11)*: *"The survey areas incorporated vast expanses of largely natural habitat. The area is utilised for livestock and game farming, and therefore large areas are enclosed within fences. This largely excludes larger mammals that would have historically occurred within the region due to lack of migratory freedom. An analysis of the historical and reference distributional data for the region indicated that the survey area could support various RDL species that could potentially be impacted by the proposed development activities. The analysis of the various taxonomical groups showed a relatively poor overall diversity of species. This is largely attributed to the general aridity of the area. Of the 55 mammalian species that have distributional records that include the region, only one is regarded as being RDL, namely the Arid-ecotone Black Rhinoceros. This species does not occur within the areas that would be impacted and therefore is not applicable to the survey. Five species are regarded as Near Threatened and a further three as Data Deficient. These are limited to small and illusive species, including small carnivores. Of these species, only the Spotted-necked otter is dependent on the aquatic environment. This species will benefit from the proposed development due to the expansion of aquatic habitat and the inclusion of quieter areas for this species to inhabit."*

"There are 263 avifaunal species recorded from the region, of which 21 are regarded as being of conservational concern and nine being RDL. The RDL species are the larger raptors that are subject to poisonings by farmers of livestock, collisions with power lines and habitat destruction. The majority of these species are known to make use of large trees for nest building, which is a feature that does not occur strongly within the impact area. The remaining species are known to frequent mesic savanna and grasslands for breeding and foraging purposes and therefore could be displaced by the inundation of the habitat. None of these species were observed during the field survey, however. Part of the development is the construction of power line infrastructure, which could pose a collision and/or electrocution risk, depending on the magnitude of the overhead lines. Birds will utilise the watercourse as a navigational aid and will therefore fly parallel with the watercourses as part of migratory routes. Any overhead power lines that cross watercourses will therefore be required to be fitted with bird flappers to make the lines more visible and to abate this negative ecological impact. Power line towers could also provide a positive feature. In a landscape that is largely void of larger trees, these towers could provide valuable nesting habitat for larger raptor species. The inundation of the valley will also provide an expansion of the water habitat that is a scarce habitat unit within the area. Much of the peripheral areas will be shallow enough to invite a larger population of wading species. This will cause an unnatural shift in the species community structures, which may be positive in some aspects (provision of supporting habitat for existing species), but negative in other aspects (will invite species that would otherwise not be found in the area). This is not regarded as a significant impact as the inundation of the habitat will merely increase the extent of an existing habitat feature and not create an undue transformation of one habitat unit into another."

"Only three species of amphibians are recorded from the region. This limitation on species diversity is largely due to the overall aridity of the area as well as the watercourse being largely unsuitable to support breeding of frogs in general. The inundation of the habitat at both sites will increase suitable breeding habitat for frogs by providing quiet backwater areas and therefore it is thought to be beneficial to amphibians."

"There are 43 reptilian species recorded from the region that includes the two proposed sites, none of which are regarded as being RDL. Endemism within the area is relatively high due to habitat specialist species. Inundating the river valley will drown many of the rock faces that support reptilian species, so these species will be displaced. This is a feature that is not readily mitigated, but the vastness of the open areas throughout the region means that this impact will be largely insignificant."

"Invertebrate species of conservational concern recorded from the region (at provincial level) include a relatively high number of mygalomorph spider species (generally trapdoor and baboon spiders). Female species of this group are sedentary and inhabit burrows and excavations, only leaving them for brief periods to hunt or during mating season. Inundation of the habitat will impact these species. This is also thought to be of minor significance as the river valley floods cyclically and therefore the chance of viable populations becoming established within the areas that will be flooded out is thought to be minimal. This is also largely true for scorpion species (also a protected invertebrate taxon). It should be noted that no RDL faunal or floral species were noted during the field survey."

4.4.2. Aquatic Ecological Survey

4.4.2.1. Aquatic Habitat

The following is an extract taken from Ross *(2013:7)*: *"Both of the proposed sites fall within the Upper Orange Water Management Area (WMA-13) and within the Nama Karoo Aquatic Ecoregion. The Orange River at the survey sites is characterised by a perennial, deep, fast-flowing watercourse where the watercourse constricts to a single channel through a smooth bedrock-dominated area. Instream aquatic habitat was found to be dominated by bedrock or alluvial, coarse-grained sand deposited as sandbanks or along the edges of the watercourse. Freshets and flood-flows would shift the position of these deposition areas, depending on the severity and nature of the flood event. Aquatic submerged and emergent vegetation was largely absent, as were algal beds. The survey sites were therefore assumed to not support a great diversity of aquatic macro-invertebrates due to a habitat characteristic considered to be a limiting factor."*

4.4.2.2. In-situ Water Quality

Results generated by the in-situ water quality parameter testing found no limiting factors that could potentially limit the aquatic biota.

4.4.2.3. Macro-invertebrate sampling and integrity

The following is an extract taken from Ross *(2013: 9): "Interpretative SASS5 reference data for the Nama Karoo (lower) Ecoregion (Dallas, 2007) show that overall relatively low scores can be expected. This is largely due to the physical nature of the watercourse, being dominated by bedrock with a general lack of vegetation. The macro-invertebrate community structures from the SASS5 sampling showed the system to fall generally within a C/D Present Ecological State (PES) category, which falls in line with the reference data (SANBI, 2009) for the system. This biological integrity class was noted for both the North and the South Sites, which is largely due to the close proximity of the two sites, the general lack of isolated impacting features between the two sites as well as the general similarity in habitat types."*

4.4.2.4. Fish sampling and species community integrity

The following is an extract taken from Ross *(2013:9): "Sampling for fish was limited due to the nature of the watercourse that did not suit the standard collection methodologies (electronarcosis in wadeable depth). Fish were sampled within the peripheral zones, but these represented juveniles and sedentary species. Reference and historical data were therefore utilised for impact evaluations on the fish community structures. Two reference sites (DWA, 2007) are located within the same quaternary catchment areas as the two proposed sites. The fish sampled during the survey only represented four of the possible 11 species expected at the sites. This was also applicable to both the North and the South Sites."*

"The reference data sourced through DWA include species regarded as obligatory migratory species. These are species that require migratory freedom in order to complete a portion of their life cycle. These species include Labeobarbus kimberleyensis, Labeobarbus aeneus, Labeo capensis and Labeo

umbratus. These species typically migrate upstream annually in order to locate suitable spawning grounds. The proposed development activities at both sites include the construction of 20m (approximate) instream weirs, which will pose as an absolute migratory barrier at each site and exclude a considerable extent of the river system to recruitment of species from downstream. This will have a significant impact on the overall ecological integrity of the aquatic ecosystem and will require mitigation."

"The provision of fishways (or a fish bypass facility) at each site must be implemented in order to abate this impacting feature. Various fishway designs and concepts will suit the site – the choice of which is dependent on the geomorphological features particular to the site as well as the design considerations of the weirs, hydro power infrastructure, intake chambers (design and locality) and other technical feasibility aspects. Further consultation with the design engineers will be required to refine the designs, but fishways have been shown to be highly effective in allowing migrating fish to overcome barriers with little to no physiological impacts. Design concepts to explore are the possible provision of a bypass natural rock-ramp fishway at each site. This would, however, be dependent on detailed surveys of the surrounding topographies and other technical features. If this is found to be an impracticable solution, then a vertical slot design incorporated into a series of pre-barrages, rock ramps and slopes could mitigate a water level difference of 20 m. These aspects do, however, require consultation with the design engineers when more detailed site information becomes available."

4.5. Heritage Status

4.5.1. Archaeological

Archaeologist, Ms. Karen van Ryneveld of Archaeomaps CC conducted a Phase 1 Archaeological Impact Assessment in September 2013. A brief discussion of the outcomes thereof are as follows: Based on the outcomes of the a pre-feasibility assessment (including review of the SAHRA 2009 database, Cultural Resource Management (CRM) projects, the SAHRA Built Environment Database – Northern Cape and the McGregor Museum Archaeological Database) and a field assessment, the following resources were determined:

- Site NH-S1 – Livestock enclosures (Colonial Period) – S29°17'00.5''; E23°51'52.5'';
- Site NH-S2 – Stone Age occurrence (MSA and LTA) – S29°17'12.8''; E23°52'04.8''

At the time of the study, heritage resources were not investigated within the proposed access roads, a rock art survey must be conducted and an investigation for heritage resources across the extent of the expected inundation levels must be conducted.

4.5.2. Palaeontological

Palaeontologist, Dr. Lloyd Rossouw of Paleo Field Services, conducted a Phase 1 Palaeontological Impact Assessment in September 2013. A succinct discussion of the outcomes thereof is as follows:

A pedestrian survey indicated that the proposed hydroelectric site footprint shall fall primarily over Ventersdorp Supergroup lavas, whilst the power line options would traverse unfossiliferous glacial

tillites and a variety of surface gravels, reworked calcretes and windblown sands. No fossil remains or localities were observed within the surface deposits during the field survey.

4.6. Visual and Aesthetic Status

The proposed development would be located in the Orange River watercourse, which is surrounded by steep slopes. The nature of the surrounding topography as undulating would shield the presence of such a facility unless when in immediate proximity to the structure. Furthermore, the undulating state of the river would lessen the conspicuousness of the facility to upstream or downstream uses.

A Visual Impact Assessment was conducted by Ms. Emmerentia Marais of Enviroworks and is to be externally reviewed by Professor Francois Retief of the Centre for Environmental Management, Potchefstroom University. The study identified two visual receptors in the vicinity of the proposed facility, namely:

- Farm Stead, 3.3km from the development site in an Easterly direction;
- Secondary Road, 6.4km from the development site in a North-Easterly direction.

4.7. Land Use

The precise land uses underway on properties adjacent to the site are not currently verified, whilst those underway on properties nearby include:

- Livestock farming;
- Conservation;
- Hunting;
- Safaris and tourism;
- Mining;
- Agriculture;
- Cultural; and
- Water abstraction.

It is anticipated that through further engagement with surrounding landowners and stakeholders, land use information will be refined. Therefore, a detailed description of such features will be described in forthcoming stages of this assessment process.

4.8. Socio-Economic Structure of the Area

4.8.1. Economic Issues

The Siyancuma Local Municipality places one of the themes in the Integrated Development Plan of 2012-2013 as increasing economic growth. The IDP recognises budget spending for Douglas (the closest town to the proposed development site) as being centred on providing basic infrastructure within poor areas to address service backlogs. This plan also recognises an in-migration of unskilled people from farms as an ongoing phenomenon. Furthermore, the agriculture sector, community, social and personal service sectors are primary job-providing economic entities.

Land use within the local municipal boundaries of the Siyancuma Local Municipality comprises towns and settlements (<5%), farms and agricultural land (>90%) and other forms like mining and resorts (<5%). Within the local municipal boundaries, employment levels decreased between 2001 and 2007 to the region of 7000 persons, whilst unemployment increased from approximately 3000 persons in 2001 to 3500 persons in 2007 respectively. Not economically active persons (including scholars, housewives, pensioners and disabled) were recorded at approximately 10 000 individuals in 2007 (*Siyancuma Local Municipality Integrated Development Plan 2012: 2*4).

The level of education in Douglas maintains the highest percentage at secondary school (35%) whilst the lowest for tertiary education (2%). At a municipal level the majority of household income in 2001 was recorded at between R4 801 – R9 600 for approximately 2100 households, whilst no income was reported for approximately 1400 households (*Siyancuma Local Municipality Integrated Development Plan 2012: 25*).

4.8.2. Social Context

The population of Siyancuma Local Municipality was recorded as 35 790 people in 2007. The density ratios of 2011 determined that the largest age component within the residing community was of the 20 – 65 year old age bracket. A housing survey found that 6970 dwellings within the municipality were formal structures constructed of brick on a separate stand or yard, whilst second to this 1232 dwellings comprised informal structures in a squatter settlement. The Siyancuma Local Municipality Local Economic Development Strategy recognised a population growth trend which peaked in 2003 at approximately 41 100 individuals and declined to approximately 38500 individuals in 2010. Of the same year, the Siyancuma Local Municipality recognised an HIV/AIDS Prevalence Rates of 6.8% in the population, which is below the national average of 12.6% of that year.

5. IDENTIFICATION, DESCRIPTION AND METHODOLOGY OF THE ENVIRONMENTAL IMPACTS

The following section describes the identification, description and methodology to be used in the assessment of environmental impacts, to be undertaken in the Environmental Impact Assessment Phase, following approval of the Plan of Study (PoS) by the DEA.

5.1. Identification of Environmental Impacts

Several factors have been used to compile this section in determination of environmental impacts to date. These include the conducting of an initial site visit on the 23rd July 2013, the use of available information provided in the Draft Inception Report from engineering investigations (BKS 2012), detail gathered on the impacts of such facilities from former projects conducted by Enviroworks (*Fouche 2011*) and a degree of technical and site information from Sidala Energy Solutions (Pty) Ltd.

5.1.1. Methodology for Assessment of Potential Impacts

The impacts will be evaluated by applying the methodology as described below. The impact is defined and the significance is rated from Low to High as indicated in the table below, with an explanation of the impact magnitude and a guide that reflects the extent of the proposed mitigation measures deemed necessary.

Table 4: Methodology for Assessment of Potential Impacts

Significance	**Low**	**Low-Medium**	**Medium**	**Medium-High**	**High**
Impact Magnitude	Impact is of very low order and therefore likely to have very little real effect. Acceptable.	Impact is of low order and therefore likely to have little real effect. Acceptable.	Impact is real, and potentially substantial in relation to other impacts. Can pose a risk to the environment.	Impact is real and substantial in relation to other impacts. Pose a risk to the environment. Unacceptable.	Impact is of the highest order possible. Unacceptable. Fatal flaw.

Action Required	Maintain current management measures. Where possible improve.	Maintain current management measures. Implement monitoring and evaluate potential increase in risk. Where possible improve.	Implement monitoring. Investigate mitigation measures and improve management measures, toreduce risk, where possible.	Improve management measures to reduce risk.	Implement significant mitigation measures or implement alternatives.

The following is a short description of the assessment criteria as mentioned above:

The **Nature of impact** is a broad indication of what is being affected and how it is being affected. **Severity** relates to the nature of the event, aspect or impact to the environment and describes how severe the aspects or impacts on the biophysical and socio-economic environment may be.

Table 5 : Nature of Impact Assessment Criteria

Type of criteria	**1 - Low**	**2 Low-Medium**	**3 Medium**	**4 Medium-High**	**5 High**
Quantitative	0-20%	21-40%	41-60%	61-80%	81-100%
Qualitative	Insignificant / Non-harmful	Small / Potentially harmful	Significant/ Harmful	Great/ Very harmful	Disastrous Extremely harmful
Social/ Community response	Acceptable / I&AP satisfied	Slightly tolerable / Possible objections	Intolerable/ Sporadic complaints	Unacceptable / Widespread complaints	Totally unacceptable / Possible legal action
Irreversibility	Very low cost to mitigate/	Low cost to mitigate	Substantial cost to	High cost to mitigate	Prohibitive cost to

	High potential to mitigate impacts to level of insignificance/ Easily reversible		mitigate/ Potential to mitigate impacts/ Potential to reverse impact		mitigate/ Little or no mechanism to mitigate impact Irreversible
Biophysical (Air quality, water quantity and quality, waste production, fauna and flora)	Insignificant change / deterioration or disturbance	Moderate change / deterioration or disturbance	Significant change / deterioration or disturbance	Very significant change / deterioration or disturbance	Disastrous change / deterioration or disturbance

Extent refer to the spatial influence of an impact be local (extending only as far as the activity, or will be limited to the site and its immediate surroundings), regional (will have an impact on the region), national (will have an impact on a national scale) or international (impact across international borders).

Table 6: Extent of Impact Assessment Criteria

Rating	Description
1: Low	Immediate, fully contained area
2: Low-Medium	Surrounding area
3: Medium	Within the affected property boundary
4: Medium-High	Beyond the affected property boundary
5: High	Regional, National, International

Frequency refers to how often the specific activity, related to the event, aspect or impact, is undertaken.

Table 7: Frequency of Impact Assessment Criteria	
Rating	**Description**
1: Low	Once a year or once/more during operation
2: Low-Medium	Once/more in 6 Months
3: Medium	Once/more a Month
4: Medium-High	Once/more a Week
5: High	Daily

Probability considers the likelihood of an impact/incident occurring over time.

Table 8: Probability of Impact Assessment Criteria	
Rating	**Description**
1: Low	Almost never / almost impossible
2: Low-Medium	Very seldom / highly unlikely
3: Medium	Infrequent / unlikely / seldom
4: Medium-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

Duration: Duration refers to the amount of time that the environment will be affected by the event, risk or impact, if no intervention e.g. remedial action takes place.

Table 9: Duration of Impact Assessment Criteria	
Rating	**Description**
1: Low	Almost never / almost impossible
2: Low-	Very seldom / highly unlikely

Medium	
3: Medium	Infrequent / unlikely / seldom
4: Medium-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

5.1.2. Environmental Impacts identified to date

5.1.2.1. Ambient Air Quality

Construction activities as well as vehicle movement normally associated with construction will result in an increase in the dust level. The quantity of dust generated would be dependent on, in which season the construction takes place and the prevailing wind directions. Appropriate measures to minimise the generation of nuisance dust from the works, operations and activities shall be taken. Such measures shall include regular and effective treatment of access roads and working areas, etc.

During operational phase, the potential emissions will be from of a few project vehicles and is not considered to be of any significance. The proposed project will also have a positive impact on the ambient air quality during the operational phase as the hydro-power generation will help save greenhouse gas emissions of approximately 23 000 tons of equivalent of carbon dioxide per annum.

Anticipated impacts include:

- Windblown dust due to construction activities;
- Reduction of carbon dioxide emissions (Positive Impact)

5.1.2.2. Geology and Soils

Investigations into the impact of the South Hydroelectric Power facility on erosion of the Orange River would evaluate:

- The likelihood of impact of the facility on erosion;
- Recommendations to negate any local hydraulic effects that may have resulted in erosion.

Anticipated impacts include:

- Loss of topsoil during the construction period;
- Erosion due to the unmanaged increase of activity along the river during the construction phase;
- Scouring of river beds and loss of riverbanks due to the erroneous release of water back in the river.

5.1.2.3. River Characteristics

The proposed hydroelectric power facility, due to the proposed extent of the facility, may cause a high level of impact on the river system, affecting the levels of the river both upstream and downstream. No water will however be taken out of the system on a permanent basis and neither will it be stored in any way. Flooding of upstream areas will occur due to the permanent inundation of land adjacent to the watercourse, which could affect the ecology of the river, riparian area and banks.

Anticipated impacts include:

- The flooding of upstream areas due to inundation of land adjacent to the river;
- The contamination of ground or surface water during the construction and operational phases of the proposed development**;**
- The increase in water temperature as a result of the proposed project;
- The increase of sedimentation levels of the water;
- Impeding the flow of the river;
- Negative impact on the hydroelectric power generation infrastructure due to rubble in the river;
- Impact of changed oxygen levels of the water released back into the river;
- Obstruction of migratory paths of fish.

5.1.2.4. Fauna, Flora and Habitat

The potential impact on fauna and flora were assessed by Mathew Ross of Enviross CC.

The following impacts are anticipated and include:

- The loss of habitat to accommodate the construction of infrastructure;
- Destruction of terrestrial habitat leading to transformation of biodiversity species and community structures;
- Contamination of surface water features leading to loss of sensitive biota;
- Biodiversity impacts due to riparian vegetation loss;
- Decreased flood attenuation capacity from removal of riparian vegetation;
- Depletion of a water source, effectively reducing the water volume available for the ecological reserve;
- Aquatic faunal impacts, due to the weirs being migratory barriers, leading to species isolation or inaccessibility to suitable breeding or foraging habitat;
- Construction of weirs leading to inundation of productive aquatic habitat;
- Inundation will transform a lotic (flowing) system to resemble the characteristics of a lentic (still-standing) system and therefore transform the aquatic species community structures;
- Depletion of a water source due to damming of the water, effectively reducing the water volume available for the maintenance of the volumes required to satisfy the ecological reserve;
- The inundation of the riparian and valley area will displace terrestrial species;
- Inundation leading to the destruction of protected species;
- The development of overhead power line infrastructure that could pose a collision and/or electrocution risk to birds;
- Exotic vegetation encroachment following soil disturbances;

- Disturbance of fauna during the construction phase;
- Safety risk posed to fauna by the hydroelectric power generation plant infrastructure; and
- Obstruction to movement of fauna caused by the dam wall (both in-stream and on the banks of the river).

5.1.2.5. Aesthetics

Engineering design ensures compatibility with the natural area in terms of style, layout and colour. As this area is situated in a scenic environment in the vicinity of an important tourist attraction the importance of a development that blends into the surrounding area will not be underestimated. Due to the extent of the proposed structure as illustrated in figure 2, the visual impact will be an important impact area for further assessment.

Anticipated impacts include:

- Potential visual impact that stems from the height hydroelectric power generation facility and associated infrastructure to surrounding land users and recreational activities associated with the river;
- Visual impact of proposed power line.

5.1.2.6. Land Use

5.1.2.6.1. Increase in traffic volumes

Construction vehicles would have to make use of the exiting farm access roads, which could impact negatively on the traffic flow and safety of the area. The traffic volumes on the road will increase by ±10 trucks per day for the duration of the construction phase. Impacts on traffic flow during construction could be mitigated by ensuring that all regulations relating to traffic management are followed. Adequate and appropriate traffic warning signs with appropriate speed limits for construction vehicles should be present and adhered to.

During the operation phase of the hydroelectric power generation plant the traffic volumes will be considerably less, as the plant is automated and will have few personnel on site during normal operation. Maintenance vehicles will only visit the site when necessary.

Anticipated impacts include:

- Impact on the traffic volume of the area;
- Deterioration of access roads during the construction phase.

5.1.2.6.2. Impacts of inundation on increased flood levels

Due to the construction of the hydropower facility in the river the flood level will rise, causing permanent inundation. The increased flood line will have potentially high levels of impact on the various land uses adjacent to or on the banks of the Orange River. The precise land use to be affected will be verified through consultation with affected landowners, in discussions with stakeholders and through engagement of authorities. Known land uses with the potential of being

affected include mining, recreational use, irrigation infrastructure and cultural. These will be described in the FSR

Anticipated impacts include:

- Impacts to infrastructure in and/or adjacent to the river;
- Impacts to agricultural and grazing land use directly adjacent to the river;
- Impacts to agricultural activity which sources water from infrastructure in the and/or adjacent to the river;
- Impacts to recreational users of the river

5.1.2.7. Waste Handling

Solid waste produced during the construction phase of the activity may require frequent removal from the site to nearby waste dump facility in Douglas. The municipality will be contacted in this regard and approval will be obtained from the municipality prior to any dumping of waste at the dumping site.

All hazardous substances e.g. diesel, oil etc. required by the contractors shall be stored in dedicated areas, outside the flood line of the river, developed to minimize spills and to protect the environment. Any spillage of hazardous substances will be cleaned according to the guidelines in the EMP and the area will be rehabilitated. No hazardous substances will be dumped at the local waste dump site, but will be transported to a hazardous waste disposal facility. Portable toilet facilities would need to be regularly cleaned in accordance with the number of personnel operating on site during the construction period.

Anticipated impacts include:

- Litter or waste pollution of the area;
- Spills of hazardous materials from machinery and vehicles operating on site during construction.

5.1.2.8. Socio-economic structure of the area

The proposed development is anticipated to have some positive impacts on the local socio-economic sectors. Indirect impacts caused by the hydroelectric power facility and inundation must be adequately investigated as these remain an important implication of the facility to surrounding land uses.

Anticipated impacts include:

- Potential economic implications of permanent inundation on upstream users adjacent to the river;
- Potential economic implications of permanent inundation to agricultural activities which source water from infrastructure in the river;
- Potential economic implications of permanent inundation to recreational users and businesses operating tourism-related activities in and adjacent to the river;

- Potential economic implications of barricading of the river to recreational users and businesses operating tourism-related activities in and adjacent to the river;
- Increase in the security risk of the area due to the construction activities;
- Potential impact of the development in generating jobs during the construction phase and skilled positions during the operational phase.

5.1.2.9. Existing Infrastructure

Various forms of infrastructure exist in support of land uses being undertaken in or adjacent to the Orange River, which may be affected by inundation of upstream areas. An inventory of infrastructure including location, type and other information shall be prepared once all infrastructures are made known during forthcoming assessment periods.

Anticipated impacts include:

- Impact of permanent inundation to known infrastructure include mining-related infrastructure and structures, central irrigation pivot pumps, weirs, access roads and camping facilities;
- Impact of permanent inundation to planned infrastructure.

6. PLAN OF STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT

The following Plan of Study for EIA sets out the proposed approach to the Environmental Impact Assessment phase of the EIA process.

6.1. Description of the tasks to be undertaken during the Environmental Impact Assessment

- The potential environmental impacts will be inspected and discussed further through the methodology described in this Scoping Report.
- Mitigation and management measures for incorporation during the construction- and operational phases will be proposed.
- Parallel with the above mentioned activities, the following public participation process will be followed:
    - Continued discussions with the client and engineer;
    - Consultation will be done with:
        - Surrounding Landowners;
        - Department of Environmental Affairs;
        - Department of Water Affairs;
        - Department of Agriculture, Forestry and Fisheries;
        - Provincial Department of Agriculture, Land Reform and Rural Development;
        - Department of Mineral Resources;
        - South African Heritage Resources Agency;
        - South African National Biodiversity Institute;
        - Northern Cape Department of Roads and Public Works;
        - Northern Cape Department of Environment and Nature Conservation;
        - Pixley Ka Seme District Municipality;
        - Siyancuma Local Municipality;
        - Eskom;
        - National Energy Regulator of South Africa;
        - Municipal Ward Councillors;
        - The Fly Guides;
        - Kakamus Hydro;
        - Aurecon;
        - Oranje Vaal Water Use Association;
        - Vanderkloof Water Use Association;
        - Douglas Agricultural Association;
        - Hopetown Agricultural Association;
        - Fly Fishing Interest Groups and Organisations;
        - Freshwater Fish Interest Groups and Organisations;
        - Rafting and Canoe Interest Groups and Organisations;
        - Additional stakeholders and Interested and Affected Parties which may be determined during the course of the EIA process.

This Final Scoping Report was made available for comment to all Interested and Affected Parties and Stakeholders for a 21 calendar day period. Comments on the FSR will be incorporated into a Comments and Responses Report that will be submitted to the DEA for their review. This FSR and its

appendices shall be made available to the Department of Environmental Affairs and published on the website, www.enviroworks.co.za/projectdownloads.php, for I&APs to download

6.2. Assessing method to be used

The impacts will be evaluated by applying the methodology as described in the Scoping Report. The impact is defined and the **significance** is rated from Low to High with an explanation of the impact magnitude and a guide that reflects the extent of the proposed mitigation measures deemed necessary.

- The **Nature** of impact is a broad indication of what is being affected and how.
- **Severity** relates to the nature of the event, aspect or impact to the environment and describes how severe the aspects impact on the biophysical and socio-economic environment.
- **Extent** refer to the spatial influence of an impact be local (extending only as far as the activity, or will be limited to the site and its immediate surroundings), regional (will have an impact on the region), national (will have an impact on a national scale) or international (impact across international borders);
- **Frequency** refers to how often the specific activity, related to the event, aspect or impact, is undertaken.
- **Probability** considers the likelihood of an impact/incident occurring over time
- **Duration** refers to the amount of time that the environment will be affected by the event, risk or impact, if no intervention e.g. remedial action takes place.

6.4. Specialist Investigations

In order to adequately assess the probable impacts on areas that may be caused by the proposed development, the appointment of qualified and experienced specialists is to be undertaken. To fulfil this commitment, the following specialist investigations are to be conducted:

- Phase 1 Archaeological Impact Assessment;
- Phase 1 Paleontological Impact Assessment;
- Aquatic and Terrestrial Biodiversity Impact Survey;
- Engineering Pre-feasibility / Hydrological Study;
- Visual Impact Assessment.

Where additional studies are identified to be beneficial towards assessment of impacts, these shall be conducted during the EIA phase.

6.4. Particulars of the Public Participation Process to be followed

The following particular PP activities shall be undertaken:

- Continued discussions with the Client and other contributing parties;
- A copy of the Final Scoping Report will be available to I&APs/ Stakeholders for comment;
- The preparation of a resource inventory will be done in collaboration with landowners, stakeholder, authorities, land users and interested parties.

- A copy of the archaeological and cultural heritage investigation will be send to the South African Heritage Resources Agency for comment and decision;
- A hard copy and CDs shall be provided to DAFF as requested;
- A hard copy and CDs shall be provided to DEANC for comment;
- DAFF shall be engaged with regarding any protected species, and their removal or destruction;
- Further engagement with DWA shall be undertaken to ensure provision of the National Water Act are complied with;
- Where there is a demand for direct consultation, a public meeting shall be considered.

The comments received on the Final Scoping Report will be incorporated into the Draft Environmental Impact Report.

7. WAY FORWARD

The abovementioned Plan of Study for EIA sets out the proposed approach to the Impact Assessment phase of the EIA process.

Key dates associated with the remaining scoping phase milestones are as follows:

September 2013	Publication of DSR + accompanying 40 day comment period
October 2013	Publication of FSR + 21 day comment period
November 2013	DEA reviews the FSR and PoS for EIA
December 2013/ January 2014	DEA reviews FSR and PoS

Following the completion of the Final Scoping Report's 21 day commenting period, Enviroworks shall submit this Plan of Study for Environmental Impact Assessment for the proposed development of a hydroelectric power generation scheme (North Hydropower facility) to the Department of Environmental Affairs for review and decision as to whether approval of the Plan of Study shall be granted. If accepted, the EIA phase of the project shall commence thereafter.

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APPENDICES

Appendix A: CVs
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