



BATOKA GORGE HYDRO - ELECTRIC SCHEME

International Investor Conference - 30 March 2017



ZESA Holdings



Zambezi River Authority



ZESCO
ZESCO Limited

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Agenda

Overview of the Batoka Gorge Hydro-Electric Scheme

Project Description and Engineering Feasibility Studies

Environmental & Social Impact Assessment (ESIA) Studies

Project Commercial and Finance Structure

Legal & Regulatory Framework

Project Packaging and Procurement Process

Past, current and planned World Bank Project Development Support

Past, current and planned AfDB Project Development Support

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Project Description & Engineering Feasibility Studies



Project Description & Engineering Feasibility Studies - Project Participants

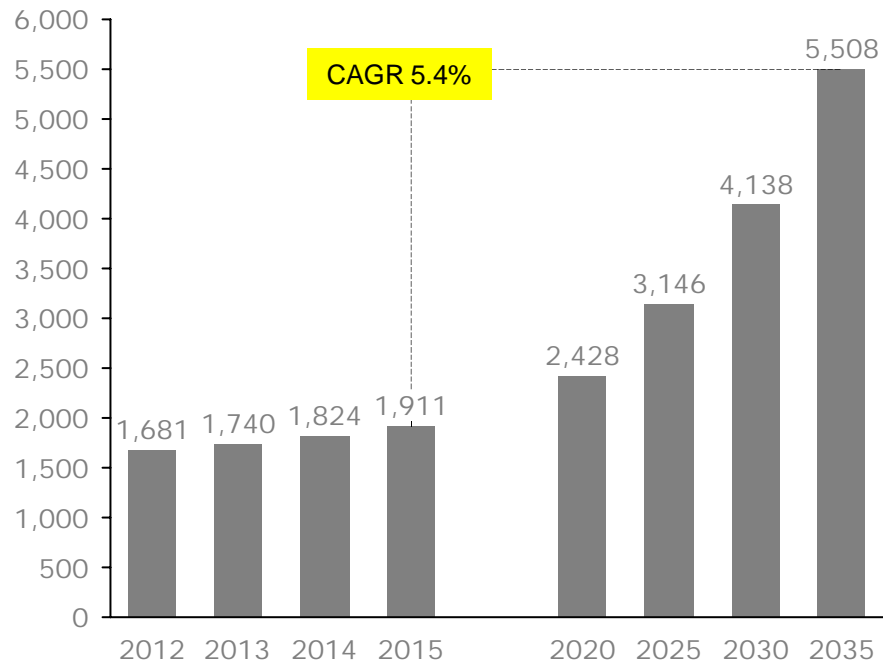
- ▶ The Zambezi River Authority (the Authority), a statutory body jointly owned by the Governments of the Republics of Zambia and Zimbabwe, has been mandated by the two Governments to develop the Batoka Gorge Hydro-Electric Scheme (Project).
- ▶ The Authority in collaboration with ZESCO and ZESA/ZETDC/ZPC have been expediting project preparatory activities leading to a detailed feasibility study.
- ▶ Project Advisors :
 - ▶ Transaction: Ernst & Young
 - ▶ Technical: Studio Pietrangeli (SP)
 - ▶ Environmental: Environmental Resources Management (ERM)

Project Description & Engineering Feasibility Studies

- Local demand

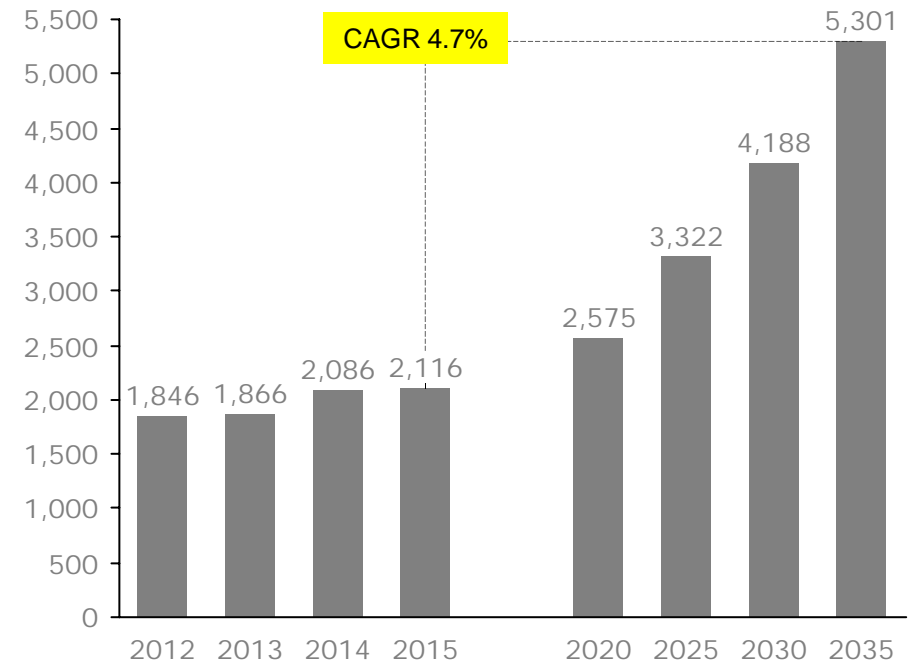
Zambia

- ▶ Current installed generation capacity of c.2350 MW, predominately hydroelectric.
- ▶ Peak demand forecast to grow from 1,911MW in 2015 to 5,508MW in 2035



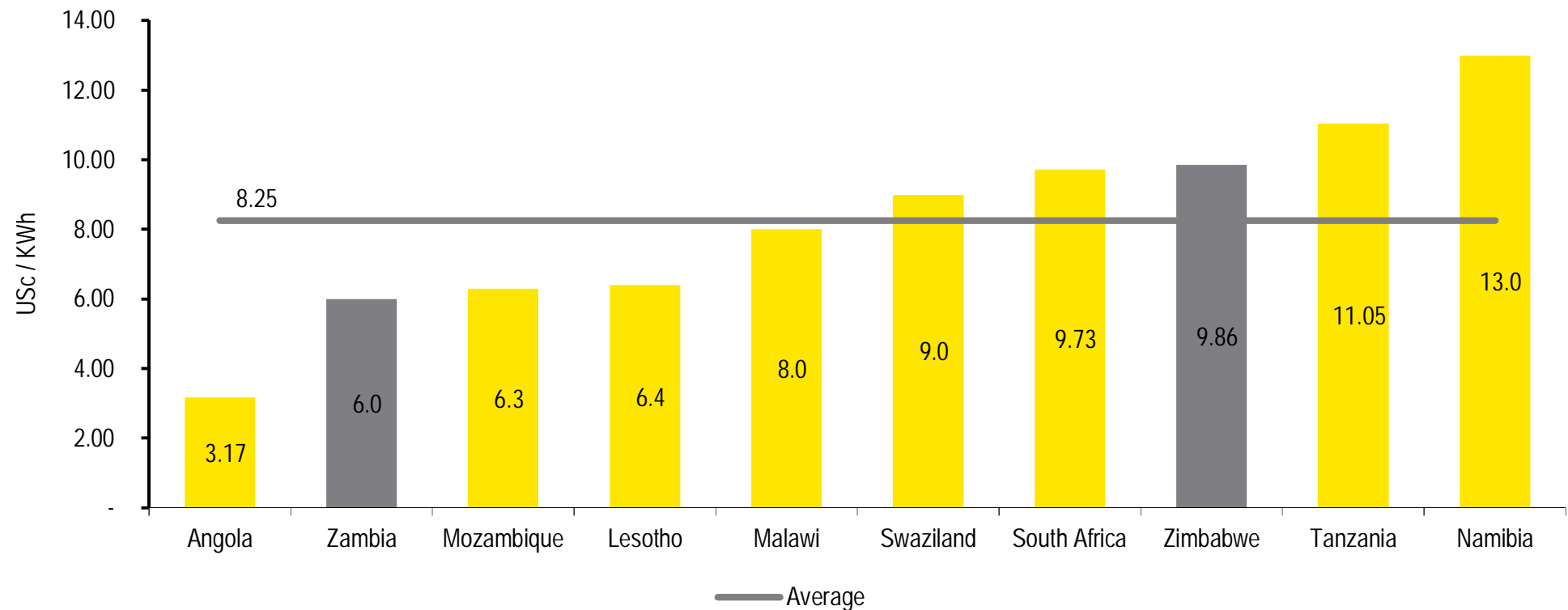
Zimbabwe

- ▶ Current installed generation capacity of c.1960 MW made up by a range of generation.
- ▶ Peak demand forecast to grow from 2,116MW in 2015 to 5,301MW in 2035



Project Description & Engineering Feasibility Studies - SAPP Power Pricing

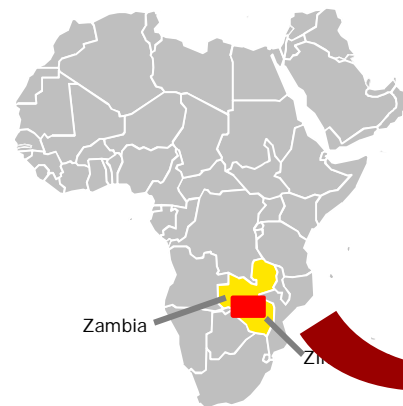
- ▶ The average bulk exchange tariff in the SAPP during 2014 was 8.25 US\$/Kwh



Project Description & Engineering Feasibility Studies - Location

- ▶ The proposed Batoka Gorge Hydro-electric Scheme (BGHES or Project) is located on the Zambezi River approximately 54km downstream of the Victoria Falls on the border between Zambia and Zimbabwe.

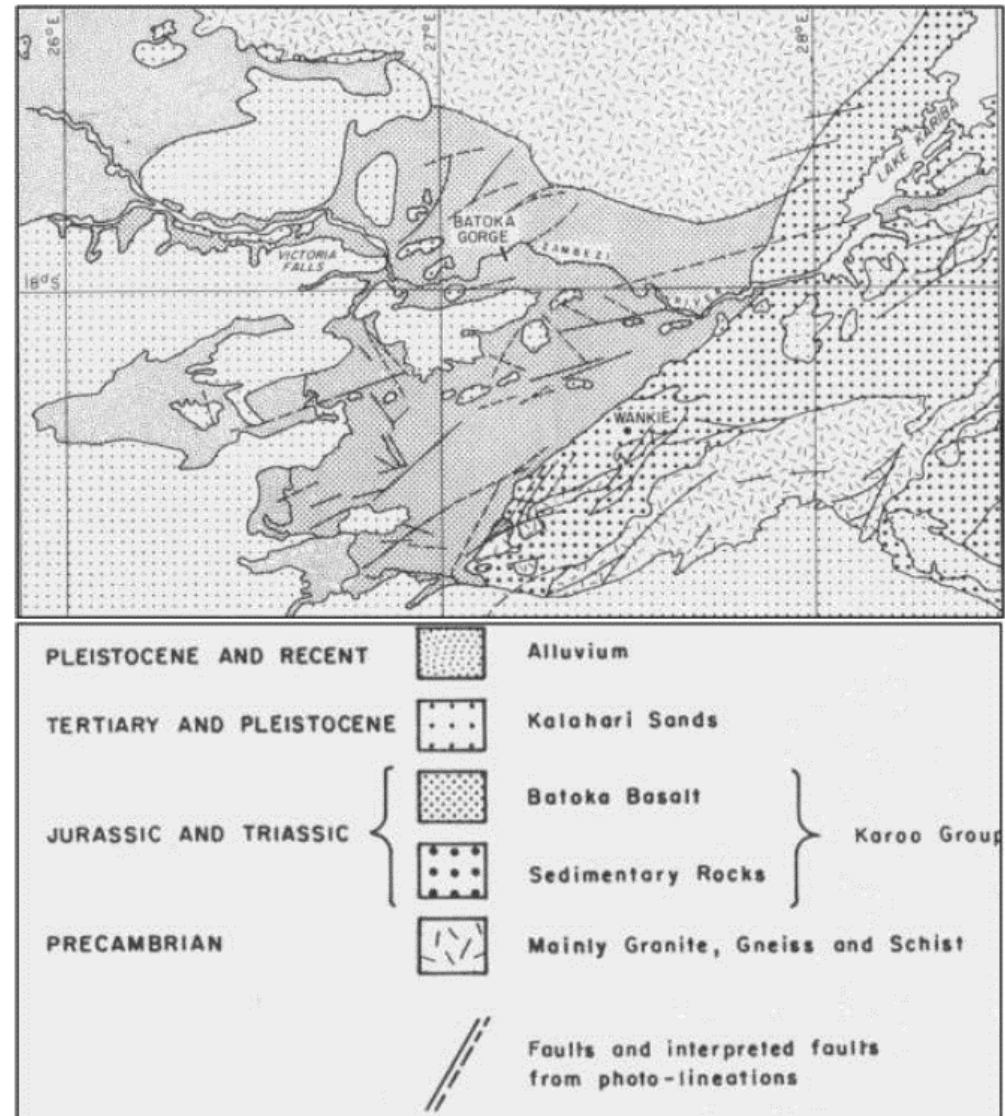
Project Location



Source: SP

Project Description & Engineering Feasibility Studies - Regional Geology

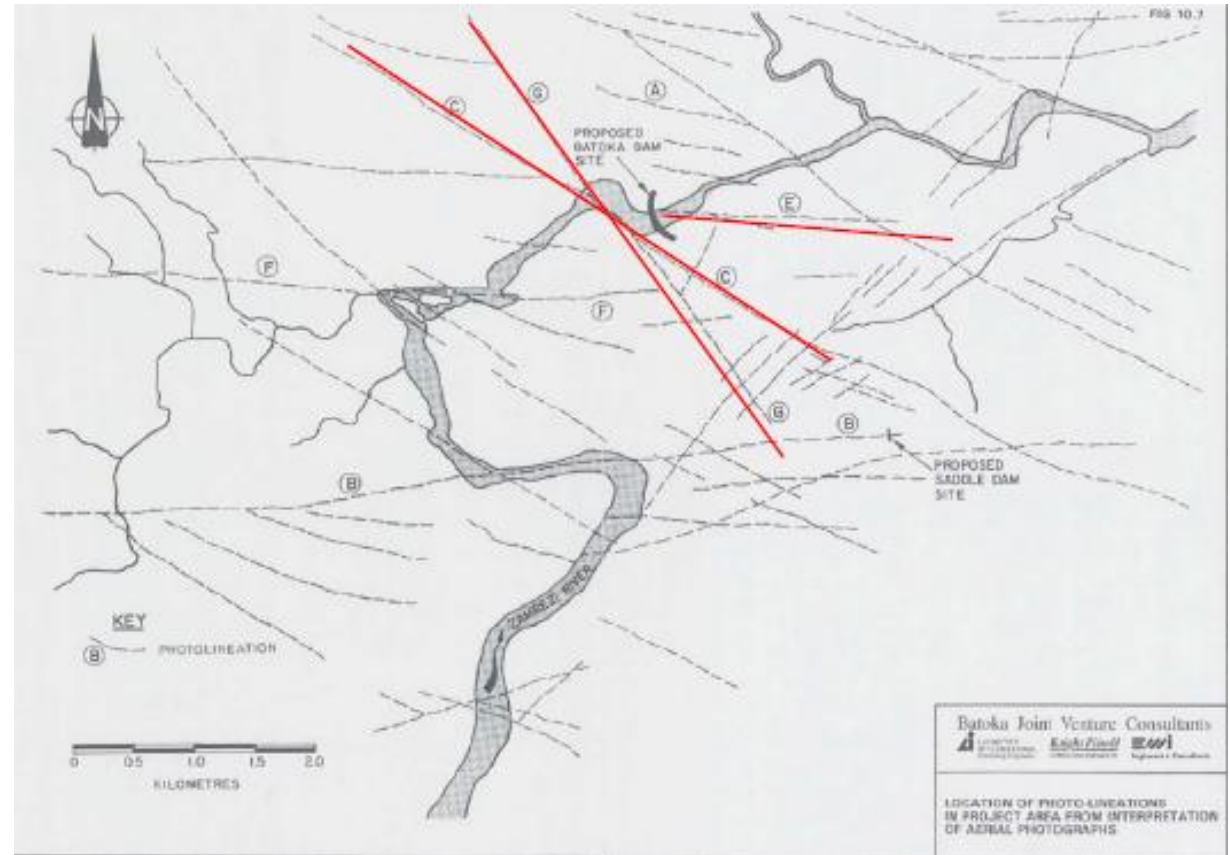
- ▶ The region where the project is located is within a wide area of plateau basalt belonging to the Karoo Group of Jurassic age (about 170 million years old).



Project Description & Engineering Feasibility Studies

- Project Geology

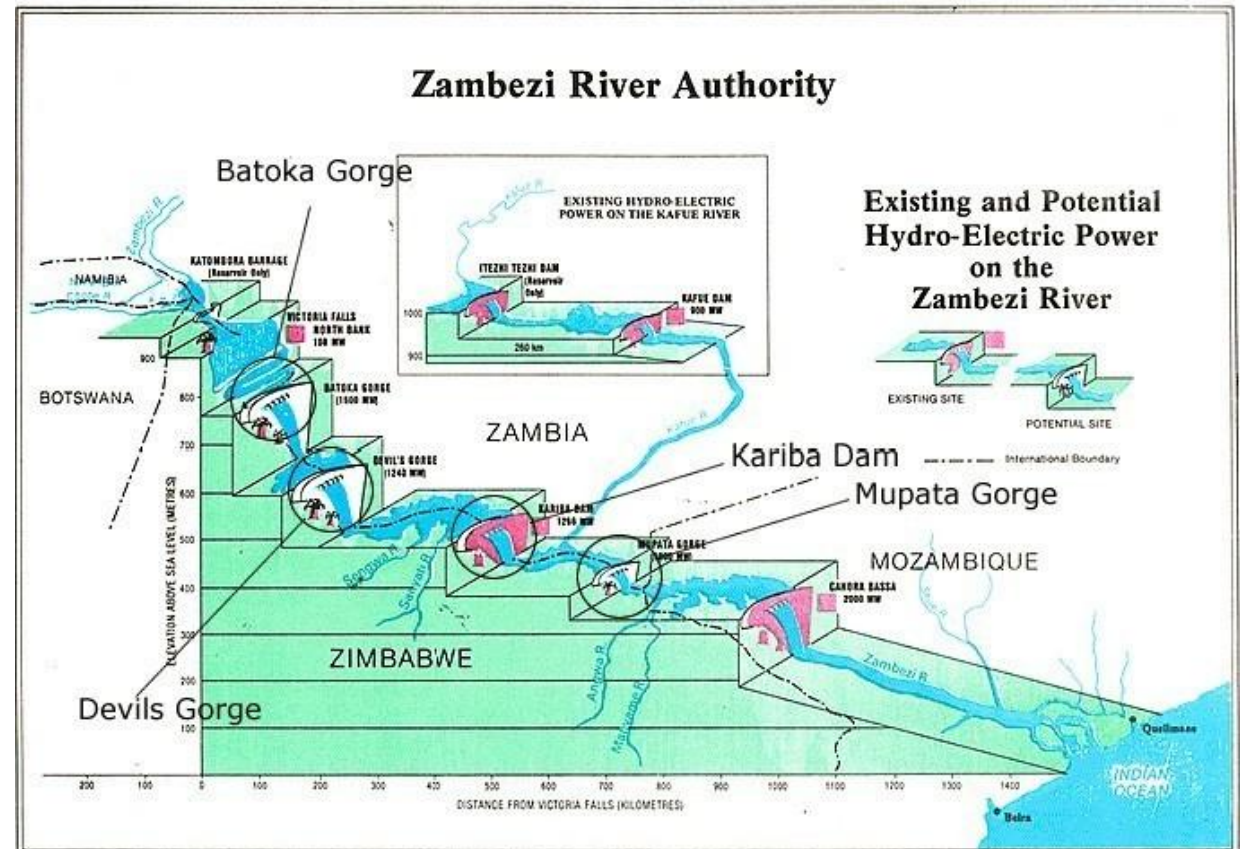
- ▶ Basalt outcrops cover both abutments with the overburden thickness less than 5 m.
- ▶ The overburden consists of blocky and gravelly talus material.
- ▶ The river bed exposes basalt outcrops and there are no alluvial deposits at or around the site.



Project Description & Engineering Feasibility Studies - Location

- ▶ The proposed Project was conceived in 1972 out of a study instituted by the predecessor of the Zambezi River Authority, the Central African Power Corporation.
- ▶ Through a number of subsequent studies and analysis (1981, 1992-93, 1998 and 2015) the current technical configuration has been refined.

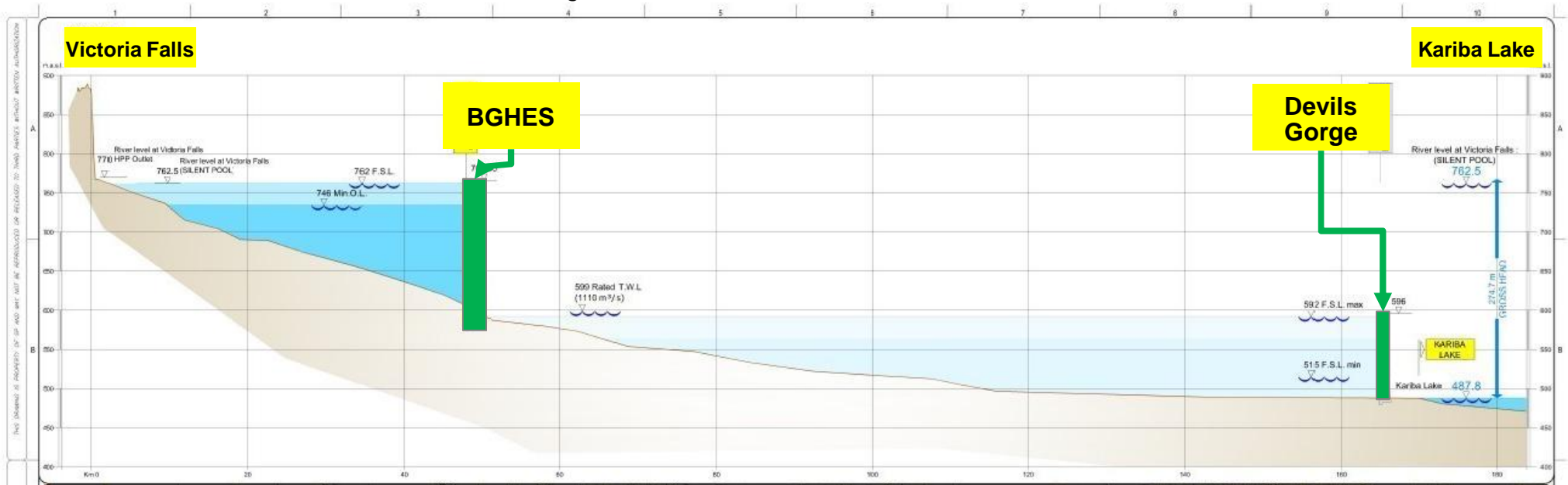
Zambezi River Hydro Facility Summary



Source: ZRA

Project Description & Engineering Feasibility Studies - Location

BGHES Location vs Victoria Falls and Devils Gorge



Source: SP

- ▶ Location maximises hydro power potential of the Zambezi River between the base of the falls and the Kariba Lake taking into account future development of the Devils Gorge Hydro Electric Scheme.

Project Description & Engineering Feasibility Studies - Proposed Layout

The selection of the layout has been carried out considering a multi-criteria analysis including the following:

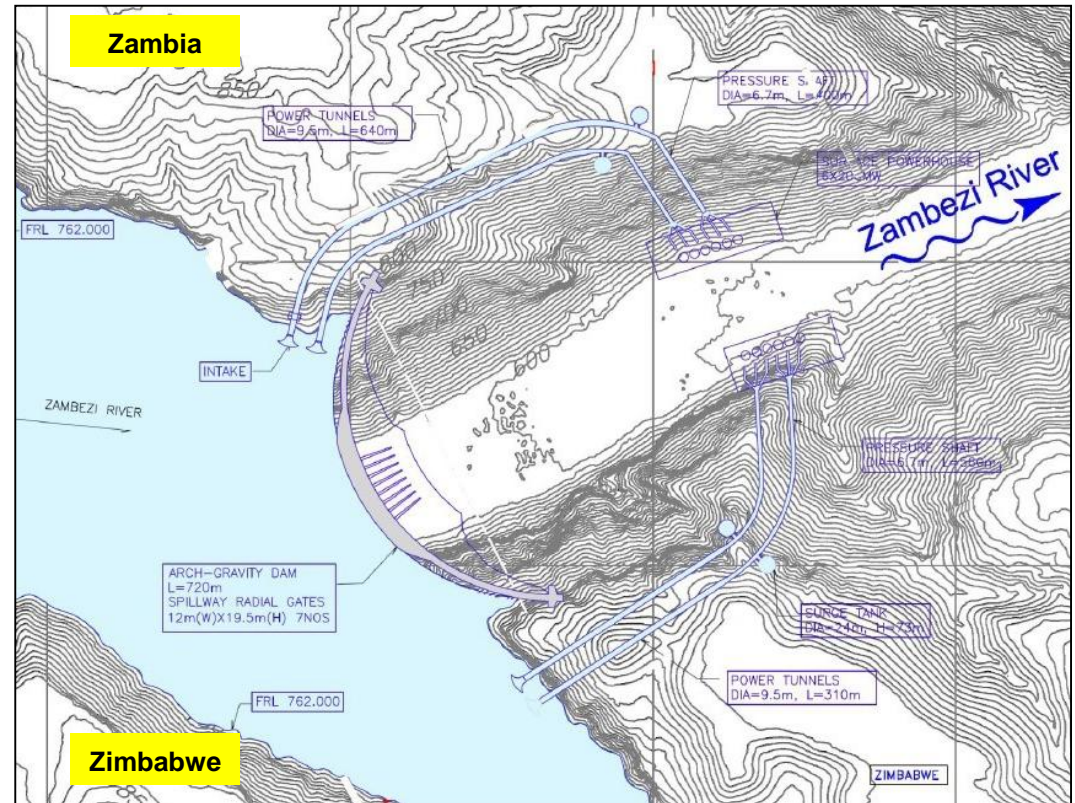
- ▶ Evaluation of ESIA inputs
- ▶ Time of construction (expressed in costs)
- ▶ Risks (qualitatively described, including geological, floods, construction, etc.)
- ▶ Least cost of the works,
- ▶ Flexibility for project implementation and operation (independent power lines, etc.)
- ▶ Institutional arrangements (power lines separated from the dam)

Project Description & Engineering Feasibility Studies - Proposed Layout

Arch gravity dam + outdoor PHs

- ▶ 181m high, 720m long, roller compacted concrete gravity arch dam;
- ▶ Radial gated crest type spillway;
- ▶ 4 intakes each connected to tunnels c.1km
- ▶ Two surface power plants of 1,200MW each, with a combined capacity of 2,400MW;
- ▶ 6 x 200MW turbines in each powerhouse; and
- ▶ Transmission lines: 330kV in Zambia and 400kV in Zimbabwe.

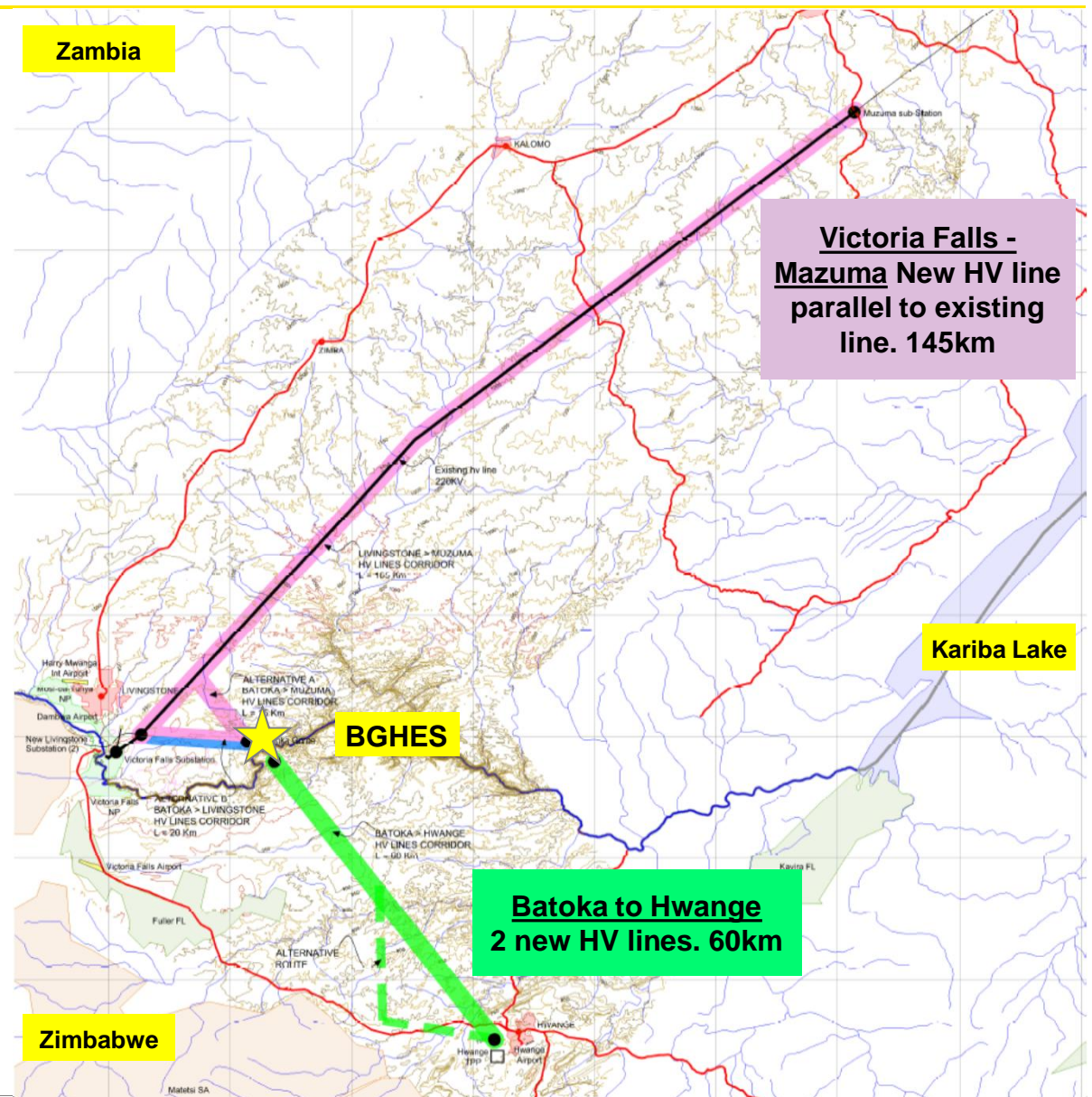
Zambezi River Hydro Facility Summary



Source: Tata Consulting Engineers

Project Description & Engineering Feasibility Studies - Transmission

- ▶ Zimbabwe: 400kV line from the Project to Hwange thermal power station.
- ▶ Zambia: 330kV lines from the Project to a future station at Livingstone.
- ▶ The two 330kV overhead lines will run in parallel, sharing a common right of way, for c.18km up to the location of the new Livingstone station.
- ▶ The line to Muzuma will follow the same route of the existing 220kV line, ending at the Muzuma station.



Project Description & Engineering Feasibility Studies - Hydrology

- ▶ There is a considerable amount of historical flow data available for the BGHES.
- ▶ Monitoring of water levels and discharge of the Zambezi River at Victoria Falls station, has been done since the beginning of the last century.
- ▶ Victoria Falls gauge is not only close to the Batoka dam site, but also has the longest data series.

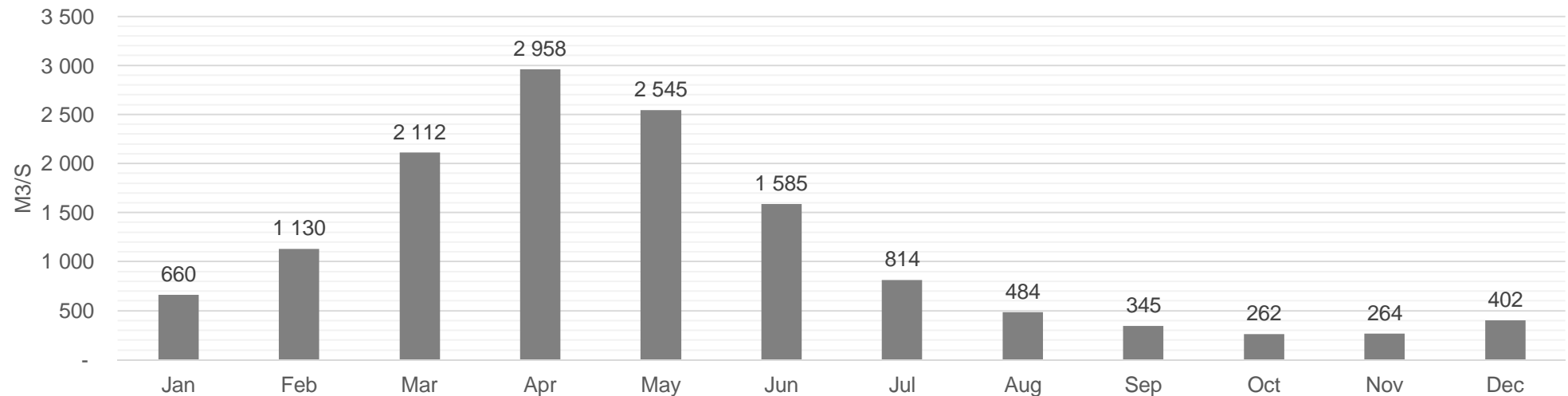
Zambezi River Flow Data

Station	Catchment (km ²)	Monthly Data	Daily data
Chavuma Falls			Water Level only (1962-1975)
Zambezi PH	82 275	Flows (1950-1992)	Water Level only (1957-1975)
Lukulu	206 531	Flows (1950-1992)	Water Level only (1957-1975)
Senanga	278 298	Flows (1950-1992)	Water Level only (1957-1975)
Ngonye	318 948		Flows (2005-2014)
Katima Mulilo	334 730		Flows (1943-1954, 1965-2013)
Sesheke	336 051		Water Level only (1960-1975)
Victoria Falls Livingstone PH Big Tree	507 200	Flows (1907-1924)	Flows (1925-2014)
Kariba dam Lake Kariba	663 800	Flows (1961-1994)	
Feira Boma	844 044		Water Level only (1962-1975)

Source: SP

Project Description & Engineering Feasibility Studies - Hydrology and Energy

Average monthly flows at Victoria Falls



Source: SP

- ▶ The graph above illustrates the average monthly flows from the Victoria Falls measuring station from 1925 to 2014.
- ▶ The mean monthly flow rate over this period is 1,130 m³/s.

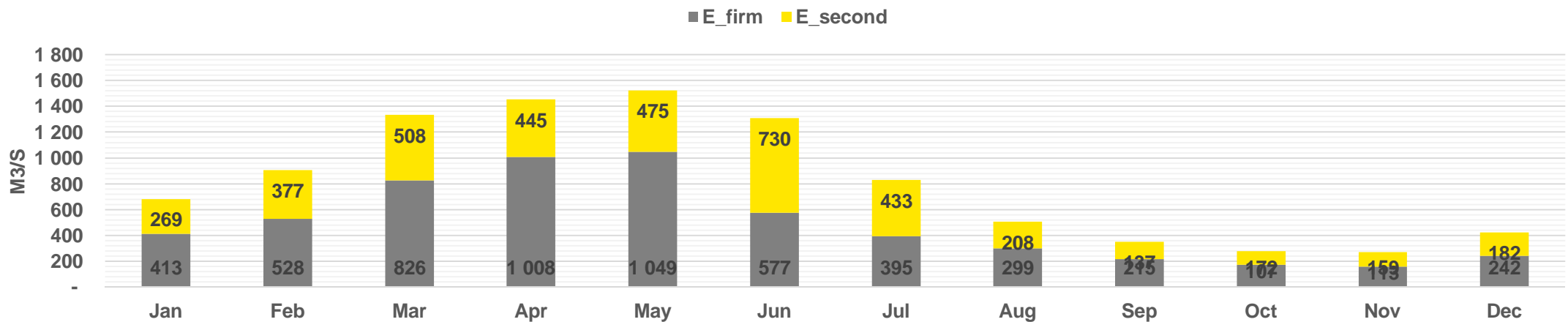
Project Description & Engineering Feasibility Studies - Climate Change

- ▶ The potential effect of climate change on the hydrological regime has been estimated using a range of tools. Since the results of the analysis might vary substantially, changing the global circulation model, emission scenario or baseline scenario, a complete sensitivity analysis was carried out calculating:
 - ▶ Three emission scenarios (RCP, Representative Concentration Pathway):
 - ▶ Five GCMs (Global Circulation Models):
 - ▶ Two Baselines.
- ▶ Results are in line with the numerous studies already carried out in the region
- ▶ Considering the most probable emission scenario (RCP 4.5), the reduction of the energy production varies between -1% and - 20%, depending on the baseline scenario adopted.
- ▶ Studies and the exploration of potential mitigants are continuing.

Project Description & Engineering Feasibility Studies - Energy Production

- ▶ BGHES has a small reservoir and will largely operate as a run-off-the-river plant. The energy production studies were carried out simulating a historical series of more than 100 years, evaluating:
 - ▶ Average energy production;
 - ▶ Firm and secondary energy, using a monthly time step; and
 - ▶ The effect of possible ESIA constraints on the operation.

- ▶ Monthly firm energy, available for 95% of the time. (Calculated over 89 years)



9867	GWh/y	Average energy production	Average energy produced (firm + secondary)
5883	GWh/y	Firm energy	Energy produced guaranteed with a reliability of 95%
3984	GWh/y	Secondary energy	Energy produced in excess of the firm energy (i.e. during high flows)

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Environmental & Social Impact Assessment



Environmental & Social Impact Assessment - Summary

- ▶ The ESIA is currently being completed by Environmental Resources Management with assistance from Kaizen Consulting International in Zambia and Black Crystal in Zimbabwe.
- ▶ A significant public engagement process is being undertaken as part of the ESIA and will continue until completion of this study.
- ▶ Expected to be completed by mid 2017.

Environmental & Social Impact Assessment

- Hydrology

Basin Wide Abstractions

- ▶ The Upper Catchment of the Zambezi above Victoria Falls is predominantly rural and the largest abstractions from the river and its tributaries are for irrigated agriculture.
- ▶ Total estimated direct abstractions in 2010 in the Upper Catchment (around 86 million m³ per year) represent approximately 0.3 % of the annual average runoff at Victoria Falls.

Water Quality

- ▶ Recent studies of the water quality show there has been no significant change in the chemical constitution of the water above Victoria Falls in recent decades and that water conditions are generally indicative of a largely unpolluted, undeveloped catchment.
- ▶ Effective mitigation will be to minimise and control upstream pollution sources wherever possible.

Environmental & Social Impact Assessment

- Hydrology

Water Environmental Flows

- ▶ As a result of the relatively small impoundment and storage capacity relative to its inflow, the proposed BGHES will be operated primarily as a run-of river scheme.
- ▶ There is an option of daily peaking, with the majority of its power generation capacity in the high flow season. The efficiency of the proposed scheme increases if the peak load could be generated and exported at a premium to the SAPP.
- ▶ Daily peaking may, however result in significant impacts on the riverine ecosystem due to flow disturbance, but this will depend ultimately on the final peaking and minimum flow conditions adopted.
- ▶ Such operating rules are under consideration, and will need to balance operational efficiencies and downstream ecological and social impacts.

Environmental & Social Impact Assessment - Ecological

Avifauna (Taita Falcon & Rock Pratincole)

- ▶ Habitats of Avifauna such as the Taita Falcon and the Rock Pratincole are expected to be impacted, but through a number of mitigation measures the impact is planned to be minimized

Proposed mitigation measures

- § Monitoring of Taita Falcons and Habitat Management
- § Minimise Disturbance to Nesting Sites
- § Artificial Falcon Nest Creation
- § Captive Falcon Breeding Programme

Taita Falcon



Source: Internet

Environmental & Social Impact Assessment

- Ecological

Fish Communities

- ▶ Fish communities within the Batoka Gorge are considered to be in a natural state with minimal utilisation due to the inaccessibility of the habitat.
- ▶ No unique fish species are known to occur within the gorge.

Crocodiles and Other Fauna

- ▶ A large Nile crocodile population is present, breeding and refuge habitats within the Batoka reservoir may be limited but crocodiles are expected to adapt to the new conditions and their populations should persist there.
- ▶ Large numbers of bats migrate into the Batoka Gorge on a seasonal basis, and are attracted to midges emerging from the rapids of the Zambezi River, ERM is assessing the impact.
- ▶ Other sensitive receptors include the broad diversity of lesser fauna at risk by increased activity through general disturbance, road kills and displacement by construction activities. These species include a wide diversity of small mammals, birds, reptiles, amphibians and other fauna.

Environmental & Social Impact Assessment

- Social

Social Economic Benefits

- ▶ Benefits of the project include increased employment, purchase of local goods and services and social investment and community development.
- ▶ Both the Hwange Rural District Council in Zimbabwe and Chief Mukuni's chiefdom in Zambia are compiling plans to maximise and enhance local tourism economic benefits wherever possible.

Resettlement in the Project Area

- ▶ The reservoir will be fully contained in the gorge, no resettlement is required for the dam, but may be required for the transmission aspects of the Project.
- ▶ The BGHES RAP will be compiled to meet international good practice and will ensure that negotiated compensation/replacement packages are provided.

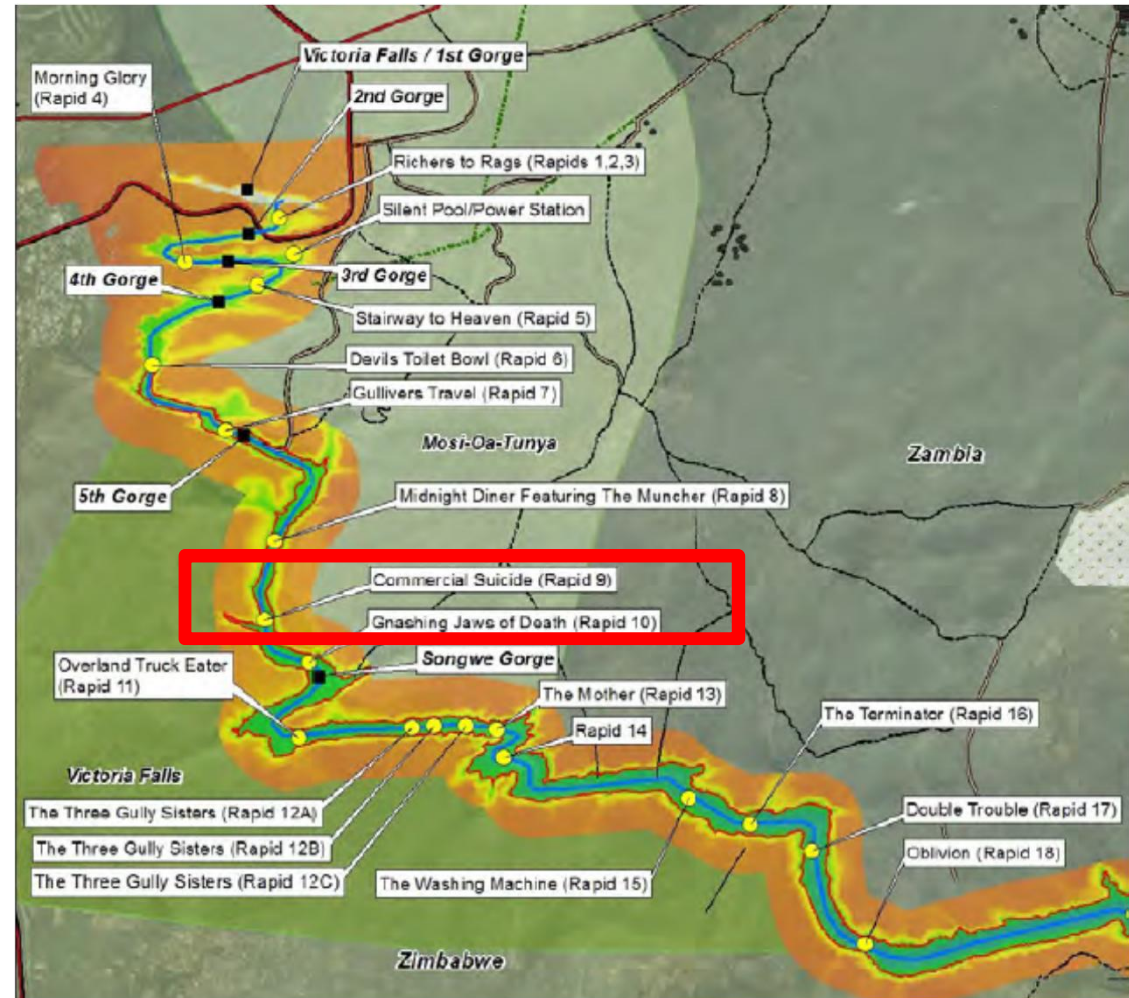
Environmental & Social Impact Assessment

- Social: Rafting

Rafting

- ▶ The dam tailwater is expected to flood a number of rapids which are currently used for tourism purposes by both Zambia and Zimbabwe during low flows.
- ▶ A proposal is currently being considered whereby the full supply level is reduced in the low flow season which would uncover a section of the rapids from the Victoria Falls downstream to around rapids 9 and 10, which is the current limit of half-day rafting trips on the river.

Zambezi River Rapids - 1 to 18



Source: ERM

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Project Commercial and Finance Structure

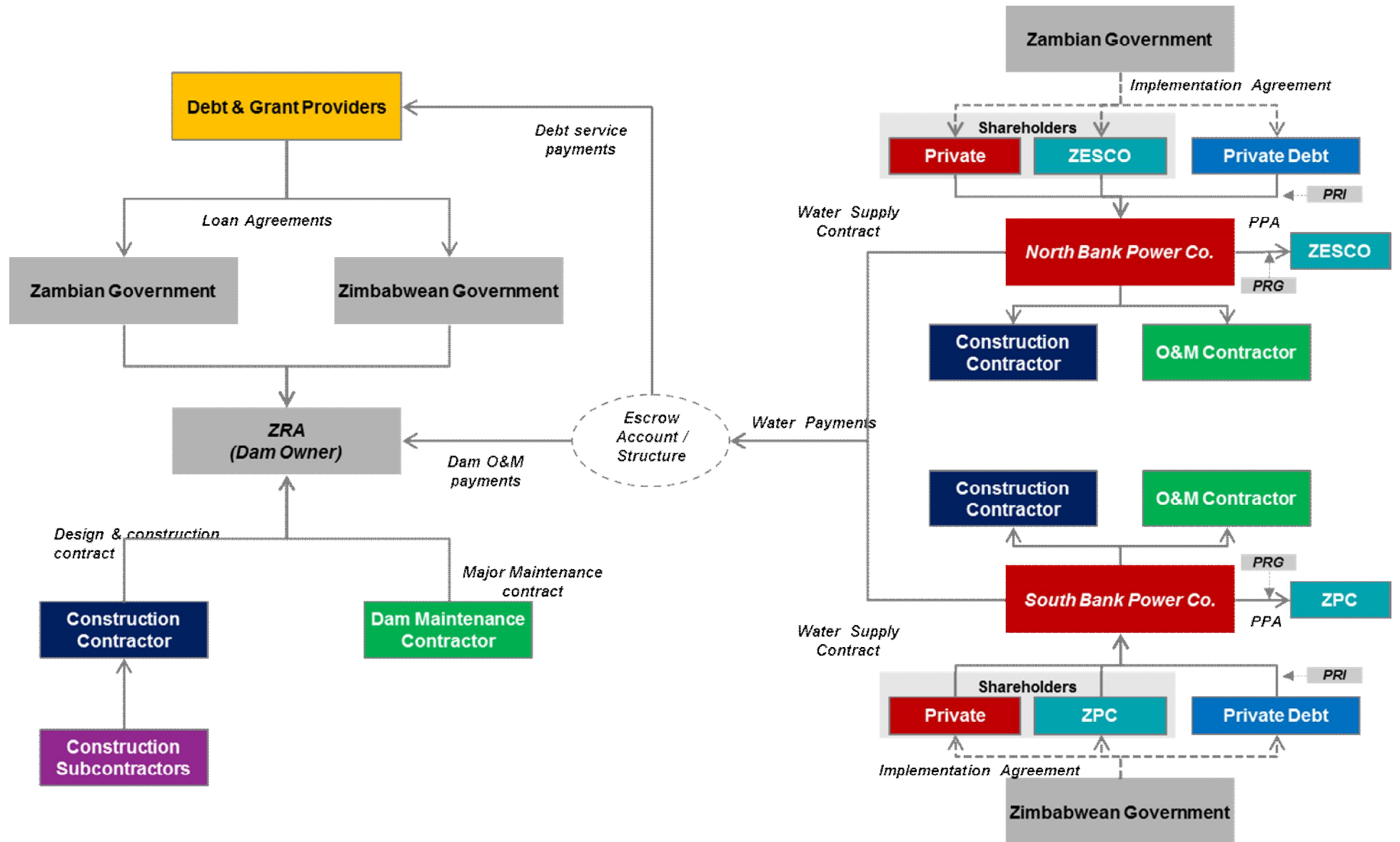


Project Commercial and Finance Structure

- Process

- ▶ A number of commercial structures, ranging from privately owned, operated and financed to publicly owned, operated and financed and combinations thereof were evaluated.
- ▶ In an extensive options analysis, a structure whereby the dam would be owned by the ZRA, and the power plants would be developed under a project finance structure and owned by a Special Purpose Vehicle ("SPV") scored the highest when assessed against key evaluation criteria (financeability, risk management, whole of life costing, innovation capacity, economies of scale and competitive tension)
- ▶ The dam would be financed by debt and grants raised by the respective countries, and then on-lent to the ZRA through subsidiary agreements between the Authority and the governments of Zambia and Zimbabwe.
- ▶ Market sounding indicated a strong interest for private sector sources to finance the power plants with debt and equity under an SPV (IPP/PPP) structure. Private finance reduces the amount of debt that the two governments need to raise for the project.

Project Commercial Structure



Project Commercial and Finance Structure

- *Funding Approach*

Batoka Dam

Funders:

- ▶ Government of Zambia and Zimbabwe
- ▶ International Donors
- ▶ Development Finance Institutions; Acting as MLA
- ▶ Export Credit Agencies and Commercial Lenders

Ownership:

- ▶ Zambezi River Authority

Batoka North and South Power SPVs

Funders:

- ▶ Export Credit Agencies and Commercial Lenders (Project Finance)
- ▶ Development Finance Institutions

Ownership:

- ▶ Public, Private, or a combination

Project Commercial and Finance Structure

- Debt financing plan objectives

- ▶ Utilise lowest cost forms of debt finance;
- ▶ Limit restrictive covenants placed on ZRA/Dam entity and power plant Companies by debt providers;
- ▶ Limit onerous government commitments;
- ▶ Minimise currency mismatches between power sales and financing sources; and
- ▶ Maximise competition amongst the various sources of finance so as to enhance procurement efficiency and value for money.

Project Commercial and Finance Structure

- Risk management

Risk Management measures will be vital to project success:

- ▶ Risk management Insurance products could be procured from MIGA, AfDB and through ECA cover for procurement.

- ▶ Risk management structural provisions include the following:
 - ▶ ZRA – single entity with twin government authority for focused decision making
 - ▶ Competitive procurement enabling the transfer of risk to contractors and providers of services and finance
 - ▶ Robust PPAs and back-to-back PPAs to support revenue projections
 - ▶ Complete Project perspective, including transmission investments
 - ▶ Presence of Commercial Lenders and Experienced Developers to bring considerable risk management expertise.

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Legal & Regulatory Framework



Legal & Regulatory Framework

We have concluded a due diligence review to establish whether the Project can be implemented within the present regulatory / legislative environments of Zambia and Zimbabwe.

Procurement

Established that, subject to:

- ▶ complying with all the permits, consents and proper processes and receiving the appropriate approvals and licenses within the current regulatory frameworks and imminent legislative enactments:
- ▶ the procurement of the construction of the envisaged dam and ancillary infrastructure on the Zambezi River is allowed for; and
- ▶ there are no explicit legislative prohibitions which prevent the establishment and/or implementation of the Project

Legal & Regulatory Framework

Financing

- ▶ The Zambian Ministry of Finance is in the process of drafting the new Loans and Guarantees (Maximum Amounts) (Amendment) Order 2016 and is considering the relevant amendments that would be required to be included within the Act to ensure that it is adequate for the purposes of the Zambian Government of securing financing and underwriting the Project.
- ▶ The Zimbabwean Government is considering what relevant amendments may be required in respect of the Public Finance Management Act for purposes of securing funding and/or underwriting of the Project.

Legal & Regulatory Framework

Further considerations

Indigenisation requirements under Zimbabwean dispensation

- ▶ Under Zimbabwean law, the Project will need to:
- ▶ provide support measures for the indigenisation of the Zimbabwean economy and for the economic empowerment of indigenous Zimbabwean nationals;
- ▶ submit an indigenisation implementation plan for approval;
- ▶ exhibit desirable strategic objectives that contribute towards the socio-economic transformation of the economy.

Legal & Regulatory Framework

Land ownership security under Zimbabwean law

- ▶ The necessary land rights will be secured prior to any project documents being executed.
- ▶ Granting of National Project Status to the Project will be sought due to its importance to the Government of Zimbabwe as a national power project.
- ▶ A specific undertaking will be sought from the Government of Zimbabwe undertaking to recognise and uphold the land rights for the Project.

Legal & Regulatory Framework

Conclusion

- ▶ We are satisfied that the regulatory frameworks for Zambia and Zimbabwe enable the Project to proceed and we do not discern materially insurmountable obstacles to its successful implementation.

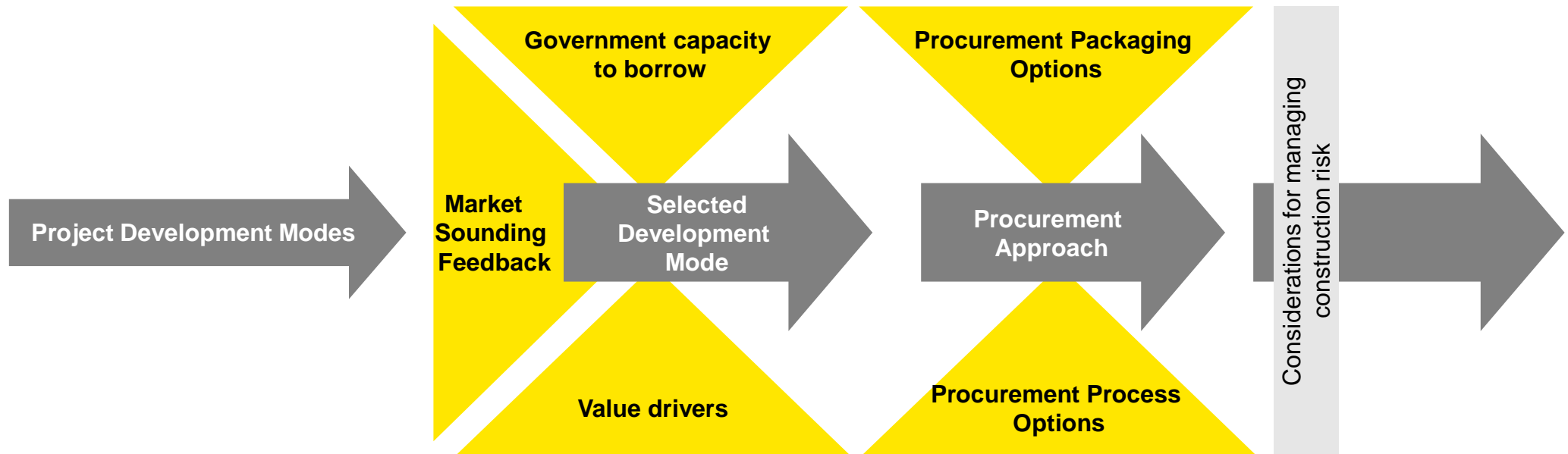
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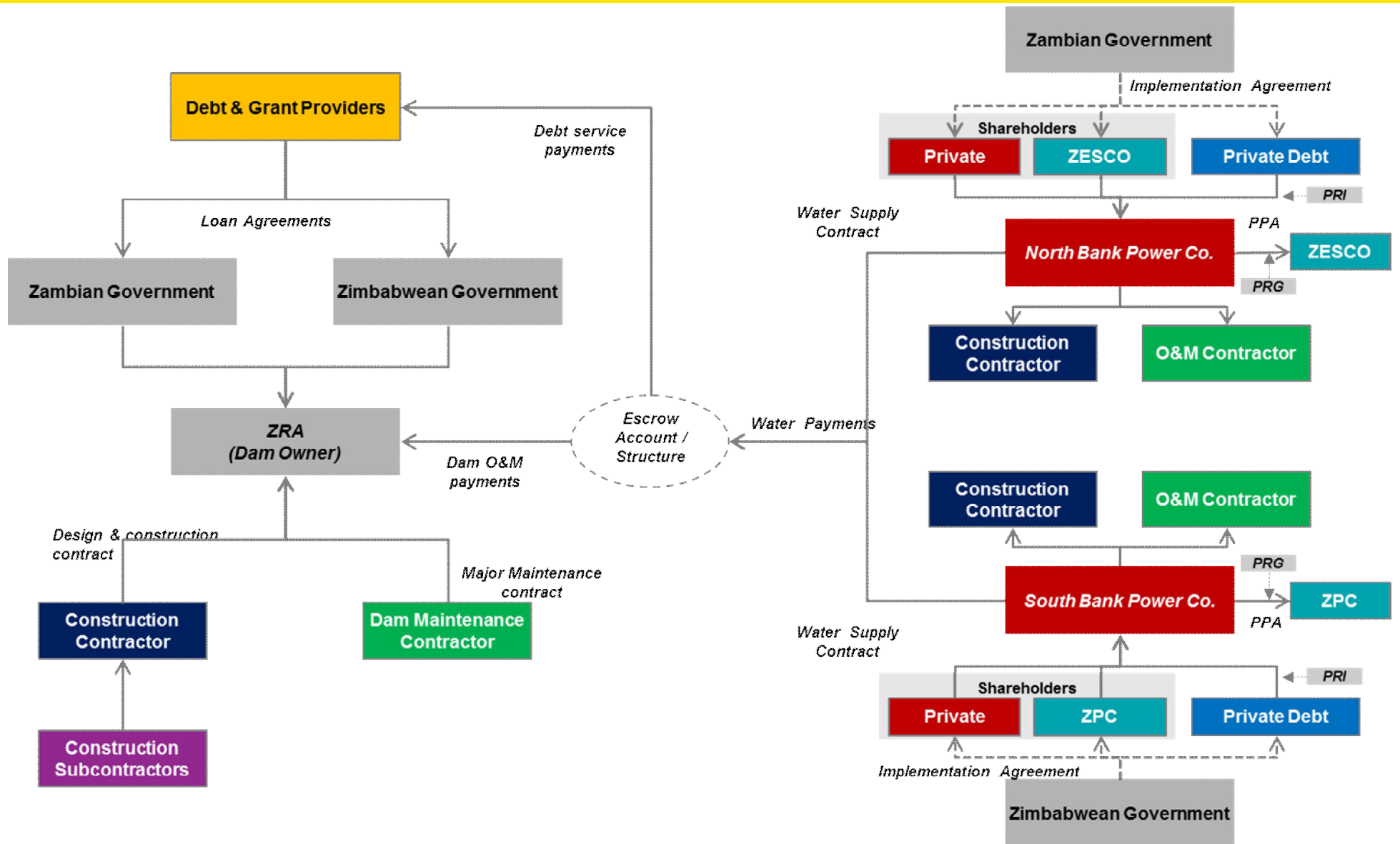
Project Packaging and Procurement



Project Packaging and Procurement Process



Project Commercial Structure



Procurement Packages

Package 1

- ▶ Dam Finance

Package 2

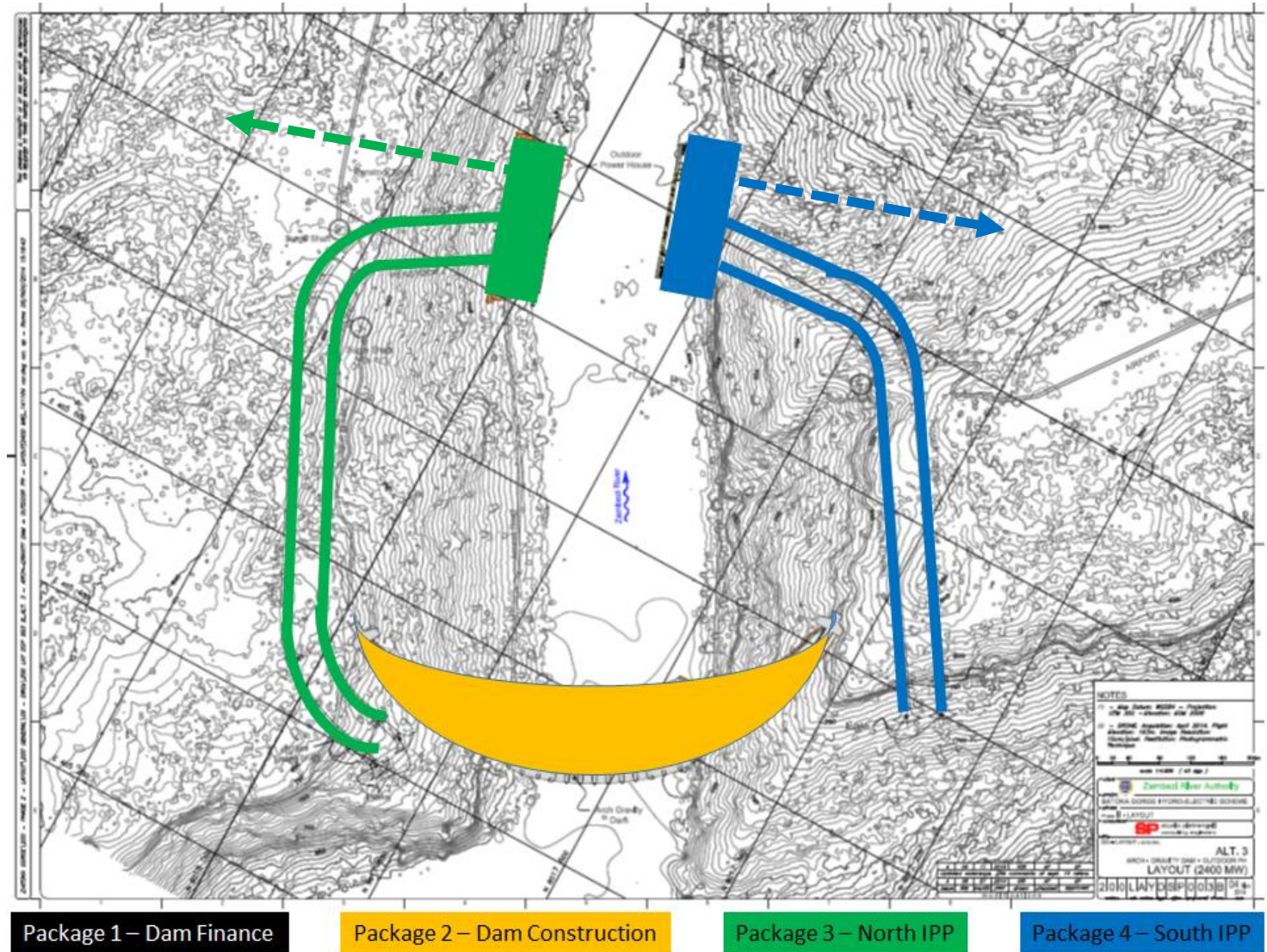
- ▶ Dam Construction

Package 3

- ▶ North Bank Power Co

Package 4

- ▶ South Bank Power Co



Procurement objectives

Fair and transparent

- ▶ Procurement and tendering should be conducted in a fair and transparent manner.

Open competition

- ▶ Unrestricted, universal access to the procurement market.

Value for Money

- ▶ Bids that provide the best overall value for money, taking into account quality, cost, risk and other factors should be preferred over the lowest cost, compliant bid.

Procurement Packaging & Procurement - Conclusion

Procurement Packaging

- ▶ All four packages are procured separately maximising competition but allowing bidders to bid across multiple packages.
- ▶ Water transfer tunnels and transmission included under Powerhouse contracts.
- ▶ Construction interface to be managed contractually.

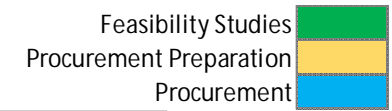
Procurement Process

- ▶ Two phase open tender process with shortlisting (RFQ and RFP phases) for construction of the dam and powerhouse SPVs (including transmission) should best meet the procurement objectives (VFM, competition, fairness, transparency).

Managing construction interface risks

- ▶ In order to achieve the benefits and flexibility that individual procurement of the various construction contracts bring, it is necessary to deal with construction interface risks contractually.
- ▶ Key construction interface risks (amongst others) include:
 - ▶ Failure to achieve minimum performance guarantees by an agreed longstop date (performance risk); and
 - ▶ Failure to deliver project on time, due to delay of one or more works packages (programme risk).
- ▶ Two “Contractual Options” have been developed, each of which allocates a varying amount of construction interface risk to project parties.
 - ▶ Umbrella Wrap
 - ▶ Co-ordination and Interface
- ▶ The Contractual Options are designed to ensure interface risks between the various contractors procured through the bidding process are addressed and allocated with varying degrees of risk sharing between the Contractors.

Project Implementation Phases



ZRA / Government of Zambia and Zimbabwe

Draft Business Case / Feasibility study



Dam Financing

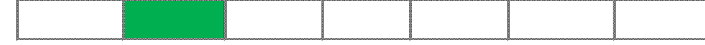


Enviromental Studies

Complete ESIA



Complete required ESIA studies



Publish ESIA

Technical Studies

Complete Technical Studies



Complete required Technical studies



Updated Fesibility Study complete

Prepare tender documents

Draft technical tender documents - Dam & Power Plant SPVs



Transaction Implementation

Implementation Agreement



Prepare tender documents - Dam - D&C

RFQ, RFP



Prepare tender documents - Power Plant SPVs

RFQ, RFP, PPA



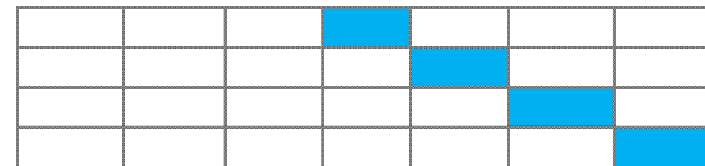
Dam Tender

RFQ

Evaluate RFQ & Shortlist

RFP

Evaluate RFP and negotiate (BAFO etc)



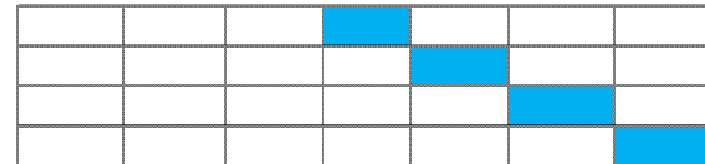
Power Plant SPVs Tender

RFQ

Evaluate RFQ & Shortlist

RFP

Evaluate RFP and negotiate (BAFO etc)



Project financing

Total Project Financing Requirements (including inflation and financing costs)

Item	Financing amount (US\$ million)	Financed by	Comments
Dam (including spillway and intakes)	\$2,139m	Government of Zambia & Government of Zimbabwe	DFI/MDB debt, grants and other sources of debt
North Bank Power Plant (including transmission & waterways on North bank)	\$732m	Equity \$220m (30%) Debt \$512m (70%)	Financing arranged by North Bank Power Company
South Bank Power Plant (including transmission & waterways on South bank)	\$732m	Equity \$220m (30%) Debt \$512m (70%)	Financing arranged by South Bank Power Company
Total	\$3,603m		

Indicative cost of energy

Item	Average real tariff (\$c/kWh)
Power plant (North)	3.2
Power plant (South)	3.2

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Summary



Why Invest in the BGHES ?

- ▶ Strong regional demand for power
- ▶ Competitive power tariff (c. US\$3.2c/kWh excl. impacts of climate change)
- ▶ Excellent hydrology data at the dam site (more than a century of data)
- ▶ Uniquely attractive physical location
- ▶ Project Sponsor (ZRA) has a strong track record of owning and operating hydroelectric facilities
- ▶ Enabling legal environment
- ▶ Low environmental footprint (reservoir confined to the gorge with no resettlement required the dam)
- ▶ Strong political support for the development of the project