B. Pre-feasibility report (extracts of DPR)

1. Executive Summary

- The proposed project is a water recirculation project by pumping 400 cusecs of water in the summer months (8 months, November - June) from the storage pond near MGHE to the weir proposed to be constructed in the upstream of Sita Katte bridge and use the reversible flow in the same pipeline for generating power for 4 months (July-October).
- The water from the weir will be released to the falls in the summer months (for about 8 months from November to June). This pumped water, drops over the falls for a maximum of about 8 hours each day for 8 months. The discharged water at the upstream will have a natural distribution through cascades before the drop in the falls.
- In rainy season (June to October), the same pipeline would be used to generate power. The pump house/power house will be located in the area opposite side of Mahatma Gandhi Hydro Electric (MGHE) power house adjacent to Ambuthirtha reservoir/MGHE powerhouse tail water pond. The reservoir has sufficient storage capacity.
- The water is pumped directly from the downstream storage pond through two pipes of 1600 mm diameter, which passes through a tunnel near Bombay guest house. The total distance to be covered from the pump house to the foot of the anicut near the Sita Katte bridge shall be approximately 3210 m.
- The power house with two generators will be with an installed capacity for generation of power of 16.61 MW each in monsoon months (totalling to 47.84 million units) and the power consumed in non-monsoon months (pump mode) would be 24.74 MW each amounting to 47.80 Million units. This makes the project as a viable in terms of power generation and consumption being the same.
- The project involves generation of 33.22 MW (16.61 MW x 2) of Hydropower. Hence, the project is categorized as 'B' under EIA Notification, 2006 and its subsequent amendments. However, general conditions applicable for this project due to proximity of Sharavathi Valley Wildlife Sanctuary and therefore categorized as 'A' require Environmental Clearance from MoEF&CC, New Delhi.
- Total forest area required for tunneling is 2 ha. However, no tree cutting is envisaged in the forest area.

- Total cost of the project is 408 Crores and Government of Karnataka accorded administrative approval for the project.
- The project will bring substantial tourism development and thus creating 3000 jobs directly and 7000 jobs indirectly in the region.
- The project is Environmentally sustainable in view of following advantages;
  - ✓ Absolutely, there will be no water for 6-8 months in Sharavathi river in summer season. The re-circulation of water will have remarkable positive effect in 4 Km of river for eco-system services.
  - ✓ With the construction of a storage weir at the upstream of Jog falls, helps in riparian vegetation and water dependent fauna (especially fish) to flourish. Also it increases the flow of water (about 30%) in the river which is normally dry during non-rainy season. It can also attract birds and other animals, hence no deleterious effects are seen on flora and fauna due to the project.
  - ✓ The project acts as a source of drinking water for wild animals located in the region during summer season.
  - ✓ Though, 2 ha of forest land is required for tunneling operations, no tree cutting is envisaged in forest area.
  - ✓ The project will have substantial socio-economic and tourism development in the region and thus creating enormous job opportunities for local poor.
  - ✓ The project requires 47.80 Million units of power during non-monsoon months to pump the water for re-circulation. However, by using same infrastructure during monsoon season, 47.84 Million units will be generating and connecting to grid. This makes the project techno-economically viable in terms of power generation and consumption being the same.

2. Introduction of the Project/ Background Information

2.1 Identification of project and project proponent

Jog falls is the second highest plunge waterfall in India. It is world famous for its magnificent spectacular waterfall and the segmented falls area a major tourist attraction, which is a gift from Karnataka to the World. Falls is located on the border of Sagara taluk of Shimoga and Siddapura taluk of Uttara Kannada district in the state of Karnataka and is also known as Gerusoppa falls or Jogadagundi. It is created by the Sharavathi river in Shimoga District flowing over a rocky bed which is about 230 m wide and takes a spectacular drop from a height of 253 meters, and divides into four smaller cascades known as Majestic Raja, The Graceful Rani, Swift Rocket and Boisterous Roarer. The Raja Fall pours in one unbroken column sheer to the depth of 830 ft (250 m).

Fig - 1 Photograph showing awesome Jog Falls

Jog falls in Shivamogga district is an internationally recognized tourist destination and nearly 3 lakh tourists visiting Jog falls every year. To make Jog falls all season tourist attraction and to coordinate the development around Jog falls, Jog Management Authority (JMA) was constituted by Govt. of Karnataka vide GO no. ITY 323 TTT 99 Bangalore dt: 02.01.2002. The objectives of the JMA is to develop, promote, manage, provide, assist, establish, tourism in and around Jog Falls area. Hon'ble Minister for Tourism and Haj is the acting Chairman for JMA and Deputy Commissioner of Shivamogga district is acting as Chief Executive Officer for JMA.

2.2 Brief description of nature of the project

It is proposed to develop a water recirculation project by pumping 400 cusecs (200 cusecs x 2)

of water in the summer months and use the reversible flow in the pipeline for generating power for 8 months. The water will be pumped from the water pond (Ambutheertha reservoir) located close to Mahatma Gandhi Hydro Electric (MGHE) Powerhouse and a weir is created beyond Sita Katte bridge to store the water for release to the falls in summer months. In rainy season the same pipeline would be used to generate power for which pump house and power house would be located in the area opposite side of MG Powerhouse. The location map of the project on google earth is given and location map on toposheet is given below.

Fig - 2 Photograph showing pump house location

2.3 Need for the project and its importance to the country and or region

Jog falls was a perennial fall before construction of Linganamakki dam across Sharavathi river. Unfortunately, the glorious awesome natural splendour view is available to tourists for only a very short period of four months during rainy season in a year. Before the onset of monsoon season, when there is not much water in the Linganmakki dam, the Jog Falls are only a pair of thin streams of water trickling down the cliff, as the water collected in the dam is exclusively for generation of electricity. Hence, to make the Jog as an International tourist paradise and to attract visitors from India and abroad round the year, it is proposed to develop a water recirculation project by pumping 400 cusecs (200 cusecs x 2) of water in the summer months and use the reversible flow in the pipeline for generating power for 8 months. Such large number of inflow of tourists to the region will increase the socio economic conditions of people in the jog falls region and also surrounding area.

The project is Environmentally sustainable in view of following advantages;

- ✓ Absolutely, there will be no water for 6-8 months in Sharavathi river in summer season. The re-circulation of water will have remarkable positive effect in 4 Km of

river for eco-system services.

- ✓ With the construction of a storage weir at the upstream of Jog falls, helps in riparian vegetation and water dependent fauna (especially fish) to flourish. Also it increases the flow of water (about 30%) in the river which is normally dry during non-rainy season. It can also attract birds and other animals, hence no deleterious effects are seen on flora and fauna due to the project.
- ✓ The project acts as a source of drinking water for wild animals located in the region during summer season.
- ✓ Though, 2 ha of forest land is required for tunneling operations, no tree cutting is envisaged in forest area.
- ✓ The project will have substantial socio-economic and tourism development in the region and thus creating enormous job opportunities for local poor.
- ✓ The project requires 47.80 Million units of power during non-monsoon months to pump the water for re-circulation. However, by using same infrastructure during monsoon season, 47.84 Million units will be generating and connecting to grid. This makes the project techno-economically viable in terms of power generation and consumption being the same.

2.4 Demand-Supply

The Proposed storage weir is being proposed around 200 m from Sita Katte bridge upstream side to store around 3,50,000 cum of water coming from Sharavathi river and near catchment area during rainy season as well as during non rainy season by lifting of water from storage at MGHE storage. The daily flow data of Linganamakki Reservoir is enclosed as Annexure-2. The average rainfall in the Sharavathi basin is around between 5000-8000 mm.

During non-rainy season the water will be lifted at 400 cusecs for 8 to 9 hours or more to store and discharge same amount of water from the proposed storage weir at upstream side to make Jog Falls for all the remaining non-rainy season. There is enough of water is available ie., around 8 Lakh cum at Ambutheertha storage opposite to MGHE to meet the proposed demand of 400 cusecs for second water re-circulation from the falls simultaneously. The MGHE during non-seasonal of power generation uses around 10 cusecs of water for auxiliary maintenance of the existing power plant at MGHE from their existing Kargal balancing storage. This quantity of 10 cusecs will also be added to the existing at Ambutheertha. The distance of lifting of water as well as flow of water from Jog falls both are more or less same around 2km. Hence both lifting of water and the discharge from the storage at the top can simultaneously started in extreme condition of water availability.

2.5. Imports vs. Indigenous production

Not Applicable

2.6. Export possibility

Not Applicable

2.7. Domestic/ Export markets

Not Applicable

2.8. Employment Generation (Direct and Indirect) due to the project

Around 150 construction labors will be employed during construction phase of the project. Further, due to advent of tourism throughout the year 3000 direct employment and 7000 indirect employment will be expected from the project..

3. Project Description

3.1. Type of project including interlinked and interdependent project, if any.

The proposed project is a water re-circulation and hydro power project. There is no interlinked project.

3.2. Location (map showing general location, specific location, and project boundary & project site layout) with coordinates.

The project is located in Jog falls, Shivamogga district, Karnataka. The geographical coordinates of the project is given below;

- Jog Falls -$14^0 13' 46.24''$ N, $74^0 48' 44.68''$ E

Proposed Pump House - $14^0 13' 42.61''$ N, $74^0 47' 57.92''$ E

Location map of the project on toposheet and map showing alignment on google earth is given below.

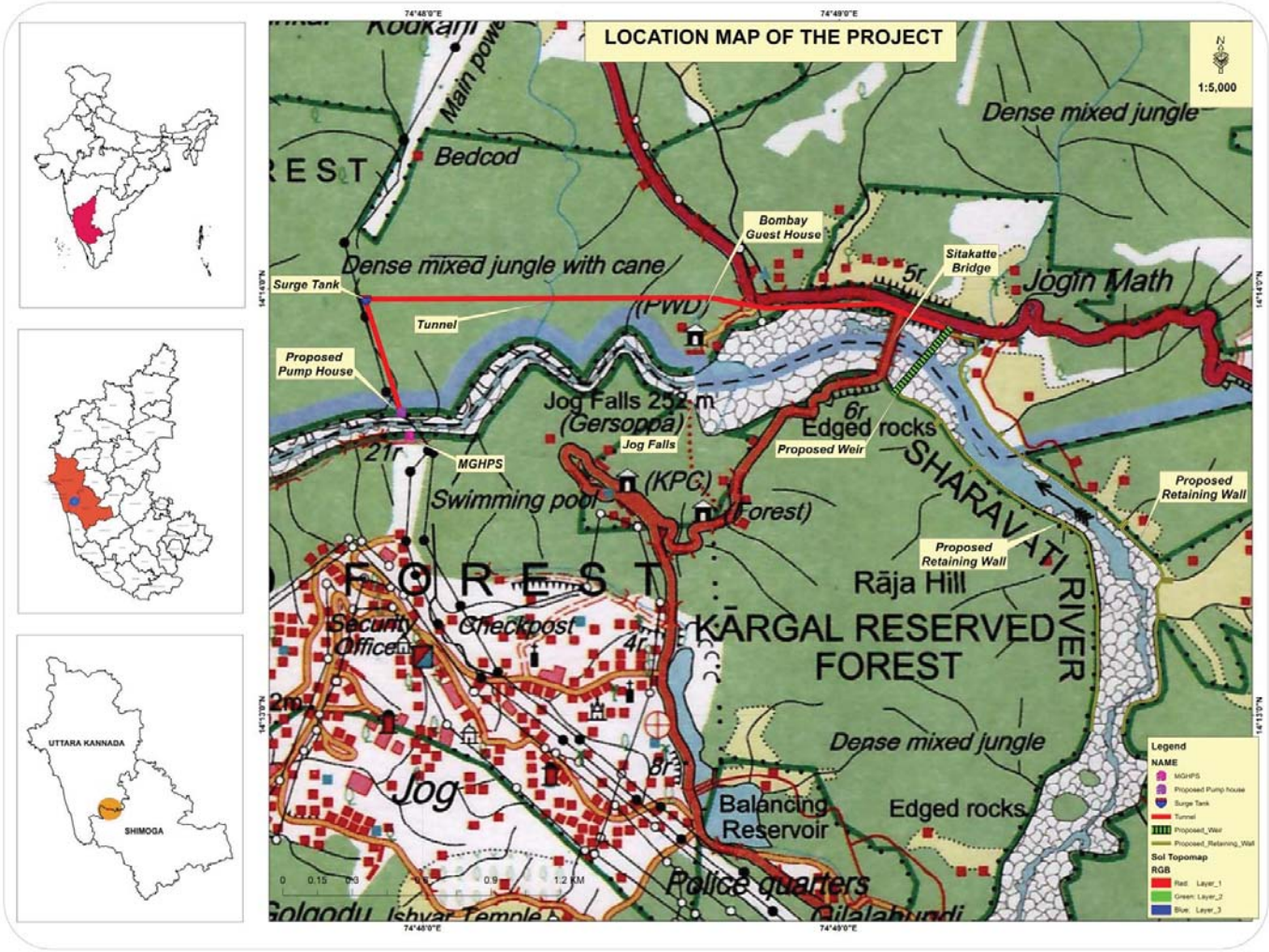


Fig - 3 Location map of the project on Toposheet

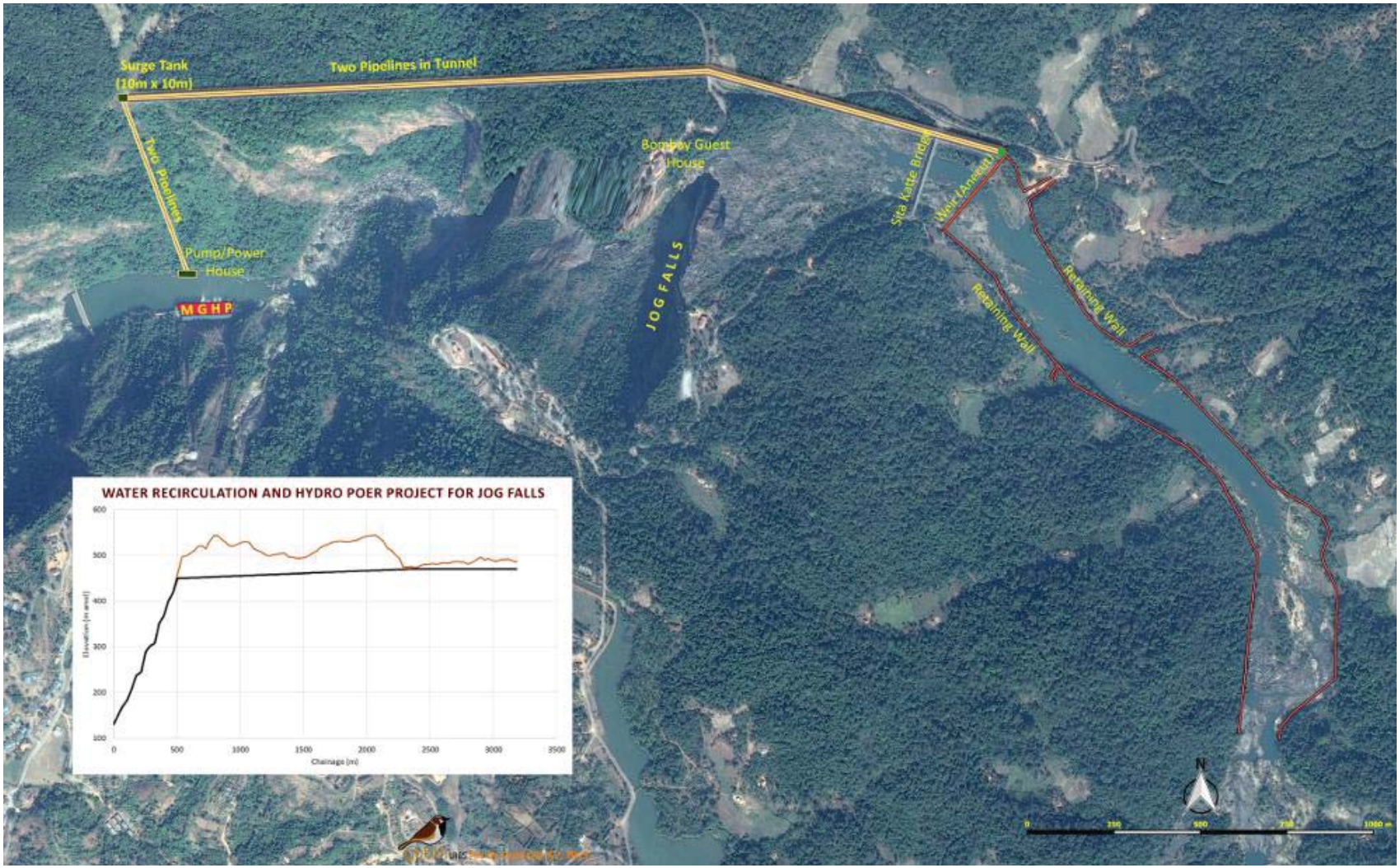


Fig - 4 Location map of the project on Google Earth

3.3. Details of alternative sites, considered and the basis of selecting the proposed site particularly the environmental considerations gone into should be highlighted

Detail survey was conducted during DPR preparation to find out for gravity flow of water from upstream to downstream on the right hand side of river as left hand side of the river from Kargal to MGHE is a gravity flow of water for power generation at MGHE. The detail survey shows that the gravity flow of water from upstream side to downstream side is not possible because the ground level is high with hillocks.

Hence it is proposed to make a tunnel for pipe line to pass the water from upstream to downstream till penstock alignment for the proposed project. RCC structure is proposed for the storage weir including retaining wall (within the river course). Control regulator is proposed for the water flow from reservoir. To take out the water from reservoir to pump house vice-versa 1.6 m diameter MS pipe is proposed for the power generation and lifting.

Two additional alignments also studied in which the length of the tunnel is more and subsequently the forest area. Hence, environmentally sustainable option with minimum tunnel length is considered for implementation. Map showing alternative alignments are enclosed as Annexure-1.

3.4. Size & magnitude of operation

It is proposed to develop a water recirculation project by pumping 400 cusecs (200 cusecs x 2) of water in the summer months and use the reversible flow in the pipeline for generating power for 8 months. The water will be pumped from the water pond (Ambutheertha reservoir) located close to Mahatma Gandhi Hydro Electric (MGHE) Powerhouse and a weir is created beyond Sita Katte bridge to store the water for release to the falls in summer months. In rainy season the same pipeline would be used to generate power for which pump house and power house would be located in the area opposite side of MG Powerhouse.

3.5. Project description with process details (a schematic diagram/flow chart showing the project layout, components of the project etc) should be given.

3.5.1 Construction of Pump house / Power house

Power generation will be carried out in the monsoon months from June to September. Conventional H.E. Schemes are adapted. The power will be consumed from 110 kV grid of MGHE for pumping mode of operation. The total maximum storage during lean and non-lean period is same ie., 3,50,000 cum. As it is a single pipe line of discharge and lifting mode of works it is being considered for maximum discharge level only for generation of power ie., 400 cusecs. The power house with two generators will be with an installed capacity for generation of power of 16.61 MW each in monsoon months (totalling to 47.84 million units per each unit) and the power consumed in non-monsoon months (pump mode) would be 24.74 MW each amounting to 47.80 Million units. This makes the project as a viable in terms of power generation and consumption being the same.

Power generation and utilization will happen through same pipeline. The optimization of storage capacity at the upstream side of the reservoir for a RL of 471.00m 90000cum. The

maximum drawn down level for RL of is about 2,50,000 cum. The FRL level for the above storage is about 475.00m and over above that will be flood level for a maximum discharge capacity of more than 3,50,000 cum. The upper side Kargal storage diversion reservoir RL is 500.00 at MSL. The downstream existing Ambutheertha storage top RL is 125.00m at MSL and 105.00m bottom RL. The proposed project is envisaged to make Jog falls perennial, by discharging 400 cusecs of water as checked. The project is envisaged for the purpose of tourist attraction, by re-circulation of water from down to up and also generating power using same pipe line. To meet the above demand of power supply for lifting of water it requires 48 MU during non-rainy season for 8 hours a day. So it is being decided to make power generation during rainy season using the same pipe line.

The power generation for a rainy season ie., 4 months is equal to 48 MU. Considering water availability in the river basin on the proposed alignment it is being proposed to make the above mention volume of power generation only during rainy season. No other alternatives were considered as there are existing power houses to generate power. The specifications of power generation is as follows;

i. Type

- Reversible Francis Turbine (Vertical)

ii.Operating heads& outputs

- Net head at 352.00m for generation of 16.61 mw in the monsoon
- Net head at 375.00m for pumping mode at 24.87mw consumption in non-monsoon period

iii. Specific speed and synchronous speed

- Specific speed (Ns)=103rpm
- Synchronous speed (Nn)=1000rpm

iv. Setting of turbine/pump turbine

- Setting level of turbine =RL 114.00 m

v. Speed &pressure rise

- Speed rise = 35 to 55% of its rated speed
- Pressure rise= 32 to 35% of its rated head.

vi. Type of generator/motor

- Umbrella/ semi umbrella type

vii. Outputs, power factor, Generation Voltage

- As a generator, output = 16.61MW
- As a Motor power required = 24.87 MW
- Thermal Voltage = 11kV
- Power Factor= 0.8pf (lag)
- No of Phases =3 AC
- Operating Frequency = 50 Hz

viii. Class of insulation

- Class F insulation (Manufacturing)
- Operation = class B insulation level

ix. Type of cooling

- Water / Air cooling system.

x. Generator inertia

- Manufacture will be provided

xi. Starting method (pumped storage schemes)

- Generator Mode of starting using water potential
- Pumping Mode of starting using grid potential

xii. Generator-transformer connections

- Star connected Generator with neutral grounding transformer
- Delta Start connected transformer of 11/110 kV
- Primary Delta winding transformer to be connected to generator terminals through XLPE cable. Two numbers of Generator breakers (GCB)in parallel are connected between generator and transformer. One breaker used for Generator Mode of operation when power is generating. Other breaker will be used when the generator using for pumping mode of operation.

xiii. Main step –up transformer

- Star delta transformer of 11kv/110kv, 32 MVA 3 phase, 50 Hz
- The Primary Delta Winding transformer of 11kV.
- Start winding transformer of 110 kV.
- ONAN cooling system.

xiv. Switchyard equipment

- Single Bus-Bar system of 110kv.
- Current Transformers for protection & metering purpose.
- Potential Transformers for protection metering & synchronizing.
- Isolators
- Earth Switches.
- Lightening arresters.
- Line Breakers and Transformer breakers (GIS can be used if the Switchyard space is not enough.

xv. Single line scheme

Single line diagram containing all electrical equipment of NGT , CT's & PT's of 11kv, generator ,XLPE Cable connection, Unit Auxiliary Transformer, Generator Transformer, LA's Earth Switches, Isolators, breakers, 110kv Single Bus systems are connected for the functioning of generators motor mode.

xvi. Control &protection equipment

- AVR (Automatic Voltage Regulator) is used for generator mode of operation
- Governing System is used for Turbine Operation, both in Turbine / Pump mode
- Control and protection is used to run the unit and give a protection to the unit while it is in run condition

3.5.2 Laying pipeline

From the pump house / power house, it is proposed to lay 2 rows of pipeline above ground and

under the KPCL power lines with a diameter of 1600 mm up to surge tank and from there again 2 rows of pipeline will be laying inside the tunnel upto a exit of tunnel. The details are given below;

- The proposed 1600 mm diameter pipeline to carry 5.66 m3/sec discharge can be operated in both pumping gravity modes.
- Based on the head requirements for pumping mode, the pipeline specifications as are follows:
  - Ch. 0 m to Ch. 300 m on slope - E410 grade steel with 20 mm thickness
  - Ch. 300 m to Ch. 540 m on slope - E350 grade steel with 20 mm thickness
  - Ch. 540 m to Ch. 3234 m in tunnel- E250 grade steel with 12 mm thickness
- The surge pressure in pumping mode on power failure is 766 m without protection and with provision of surge shaft of 1200 mm diameter and about 40 m height at Ch. 540 m, the surge pressure reduces to 492 m.
- The surge pressure in gravity mode with valve closure in 10 sec at delivery end with surge shaft is 483 m, which is less than the pumping operation mode.

3.5.3 Tunnel

It is proposed to construction a tunnel of 2630 m length for accommodating a pair of pipe lines as a water conducting system at the RL of 470m. The tunnel alignment is shown in Figure 1. The terrain of tunnel alignment is sharply bent at the middle. The tunnel starts from surge pool and ends near the Sitakatte bridge. The surface and sub surface geological investigations have been carried out along entire length of tunnel. The project area is covered by rocks of the granite, which is very hard in nature. Based on the physical observations and Geological investigations the rock mass is characterised as below:

- The rock is granitic gneiss with density of 2.8 gm/cc
- The rock is weathered and highly jointed at the tunnel locations and overburden with poor to fair RQD.
- The Rock Mass Rating (RMR) of exposed rock profiles indicate the rock is classified as " FAIR“ (**RMR=50**).
- The laboratory P & S-wave velocities of rock samples are 3200-3300 m/s and 400 - 850 m/s respectively
- There are mostly two sets of joints with joint orientation w.r.t tunnel alignment is 25-60^0

Drilling and blasting is the most common and economic technique of rock excavation from the earliest days of invention of explosives to even in these days of modernization. Although there have been numerous developments took place in blasting technology, application of this technology for rock excavations results in number of safety and stability problems to the remaining rock mass as an offshoot by inducing damage. Drilling and blasting is the most common and versatile method of rock excavation for tunneling. Tunnel boring machines (TBM) are used to excavate tunnels with a circular cross section through a variety of geologies. They can be used to bore through hard rock or sand and almost anything in between. Tunnel diameters can range from a meter (done with micro-TBMs) to 15 meters.

Tunnel boring machines are used as an alternative to drilling and blasting (D&B) methods. TBM has the advantages of not disturbing surrounding soil and producing a smooth tunnel wall. This significantly reduces the cost of lining the tunnel, and makes them suitable to use in built-up areas. The key disadvantage is cost and geology. TBMs are expensive to construct, difficult to transport and require significant infrastructure. There are advantages and disadvantages with TBM applications.

The following specifications are proposed as per the requirements of water recirculation system:

- Shape of tunnel = D-shape to accommodate circular pipeline of 1.6 m diameter
- Diameter of tunnel= 4.5m (to accommodate 2.5 m pipeline and clearance of 1m on either sides)
- Length of tunnel= 2630 m
- Tentative support system requirement is cement grouting, rock bolting and shotcreting and rib erection as per rock conditions and requirement
- Thickness of lining/shotcreting = 25 to 30 cm (as per site requirements

The elevation and plan view of the proposed Jog tunnel is shown in Figures below. The overburden above the tunnel level is varying from 20 to 80m. It is also proposed to go for cut and cover method of rock excavation when the overburden is less than twice the diameter of the tunnel. It is also found that intermediate access to the tunnel, adit is difficult for the proposed alignment without touching reserved forest land. And no adit may increase the time period of excavation by 30% more, which as to be overcome by adopting effective and efficient rock excavation techniques.

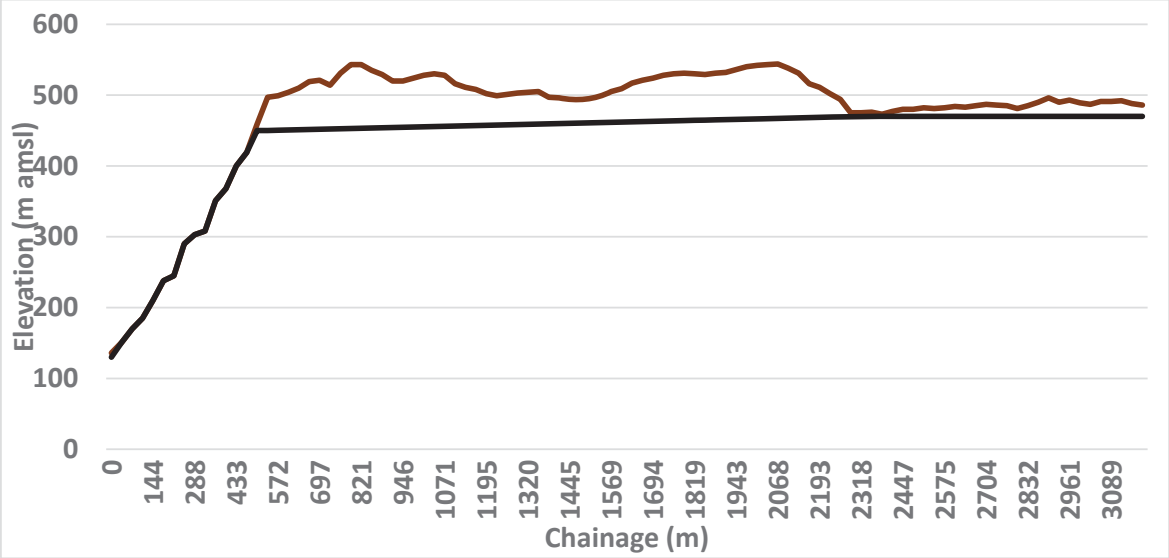


Fig 5. Elevation view of the proposed Jog tunnel

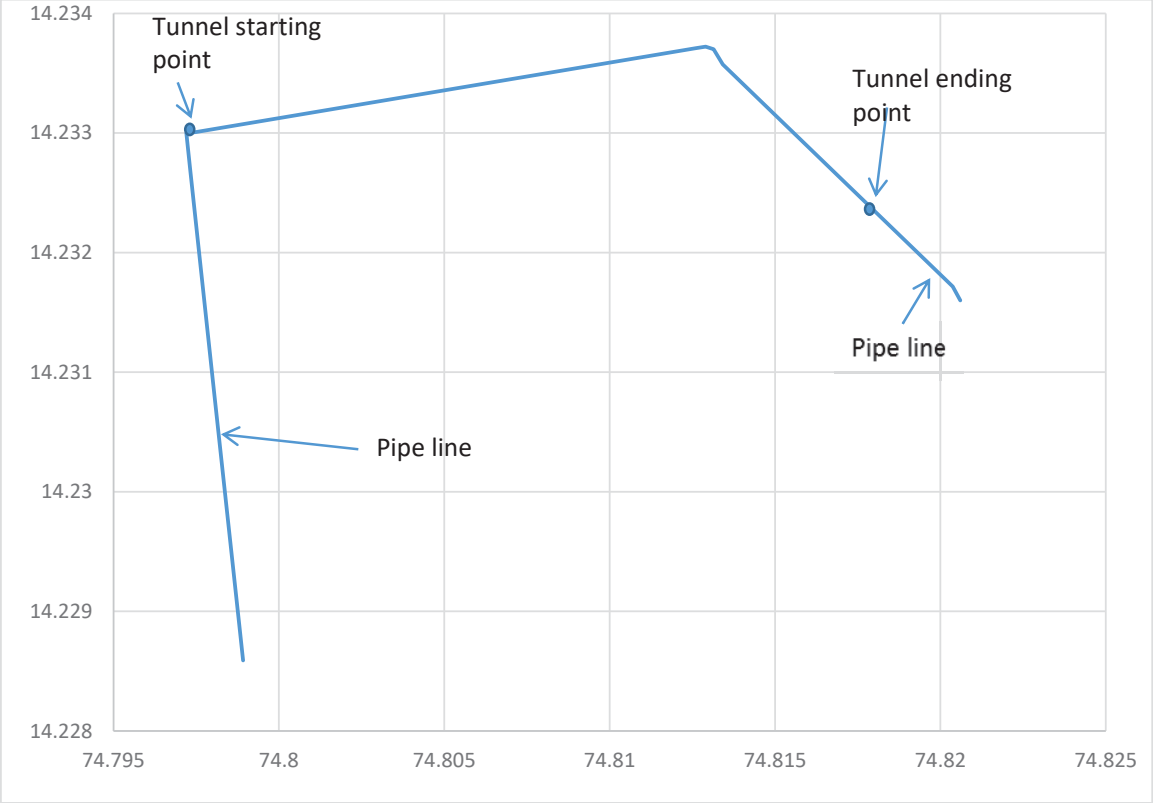


Fig 6. Plan view of the proposed Jog tunnel

3.5.4 Construction of Weir and a retaining wall (within the river course)

The catchment area for the proposed reservoir is about 25 km^2 and it further receives a runoff from the reservoirs existing upstream of the river Sharavathi. The runoff co-efficient of 0.9 (58.07 Mcum) of rainfall is considered while designing the maximum flow of 2,50,000 cusecs from the upstream side. The submergence area due to the construction of storage reservoir near Sita Katte bridge at a height of 5m is approximately 3,47,000 m^2, only along river bed as there will be a retaining wall (within the river course) on either side of the river to avoid any submergence on forest land.

Table - Storage capacity and area submergence details along different RL

Sl. No	RL in m for Storage Water level Tank	Capacity in Cum	Length of Submerge (m)	Remarks
1	470.00	7003.50	1330.00	MWL
2	470.50	45348.50	1370.00	MWL
3	471.00	112248.20	1405.00	MDDL
4	471.50	161446.20	1445.00	
5	472.00	204189.10	1455.00	
6	472.50	228887.30	1480.00	
7	473.00	251568.80	1505.00	Around 8 lakhs Cum at Ambuteertha
8	473.50	278509.60	1655.00	
9	474.00	302056.20	1680.00	

Sl. No	RL in m for Storage Water level Tank	Capacity in Cum	Length of Submerge (m)	Remarks
10	474.50	323458.00	1705.00	Flood Cushion Level
11	475.00	347813.00	1730.00	Full Reservoir Level
12	475.50	377813.00	1780.00	Maximum water level
13	476.00	408623.68	1830.00	
14	476.50	433549.99	1835.00	
15	477.00	468930.22	2055.00	
16	477.50	501108.27	2105.00	
17	478.00	529701.50	2130.00	
18	478.50	591212.50	2180.00	

The proposed reservoir is a small structure and holds less quantity of water for a height of 5m, in addition, water is drawn from the storage to minimum storage in the dam, the accumulation of sedimentation in the proposed structure is very minimal and can be desilted/de-sedimented from the reservoir whenever required.

The reservoir created is restricted to the width of the river course. On either side of the river course a retaining wall of height 5.5m has been proposed to contain the reservoir within in the river course. Geotechnical report highlights clearly that the hard rock without any joints is present continuously below the river course. This will make impermeable base to the reservoir, indicating the water tightness of the reservoir.

The proposed structural construction for the project is being designed considering the maximum discharge in the river basin. Hence the maximum height considered for the structure about 5 m height. The over flow during rainy season can be observed flood flow also.

The area under backwater of the reservoir storage is considered as submergence area. The total river bed area submerged is around 35 ha and proposed retaining wall on either side of river bed (within the river course) makes the area under submergence retained within the river bed to avoid any forest land submergence.

3.6. Raw material required along with estimated quantity, likely source, marketing area of final products, mode of transport of raw material and finished products.

Raw materials required for the project is given below and sourced from Government authorized suppliers.

- Aggregates - 22,525 Cum
- Sand - 10,510 Cum
- Steel - 1485 Tonnes
- Excavated soil from tunnel - 43,000 Cum

3.7. Resource optimization/recycling and reuse envisaged in the project, if any, should be briefly outlined

It is proposed to develop a water recirculation project by pumping 400 cusecs (200 cusecs x 2) of water in the summer months and use the reversible flow in the pipeline for generating power for 8 months. In rainy season the same pipeline would be used to generate power for which

pump house and power house would be located in the area opposite side of MG Powerhouse.

3.8. Availability of water its source, Energy/power requirement and sources should be given.

Water Requirement: During construction phase, 11 KLD of water is required for construction labors and during operation phase 400 cusecs of water is required for re-circulation which is sourced from Sharavathi river.

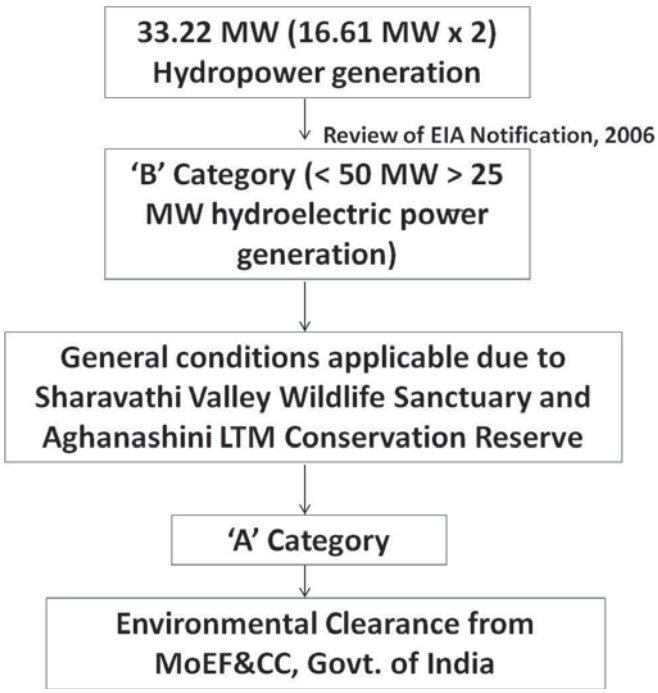
Power Requirement: The total power required for re-circulation is 47.80 Million Units during non-monsoon months. During monsoon months, 47.84 Million Units of power will be generating by utilizing same infrastructure of the project.

3.9. Quantity of wastes to be generated (liquid and solid) and scheme for their Management/disposal.

Sewage generated from the labour camps will be connected to existing sewer line of Jog-Kargal Town Panchayath.

Domestic solid wastes (38 Kg/Day) will be generating from labor camps will be handed over to Jog-Kargal Town Panchayath.

3.10. Schematic representations of the feasibility drawing which give information of EIA purpose



4. Site Analysis

4.1. Connectivity

The Proposed Project site is located along the Sharavathi river at Jog falls area, Sagara taluk in Shivamogga District and partly in Uttar Kannada district of Karnataka State.

Access by air at proposed airport in Shivamogga town, which is nearly 95 Km from the proposed project and by Hubli airport, which is 165 Km away by road and 400 Km from Bengaluru international airport.

The proposed project is well connected by National Highway (NH 207) and State Highways and also the nearest ports are located at Karwar and Mangalore.

4.2. Land form, land use and land ownership

The land use in the proposed project area is completely covered under forest and agricultural plantations.

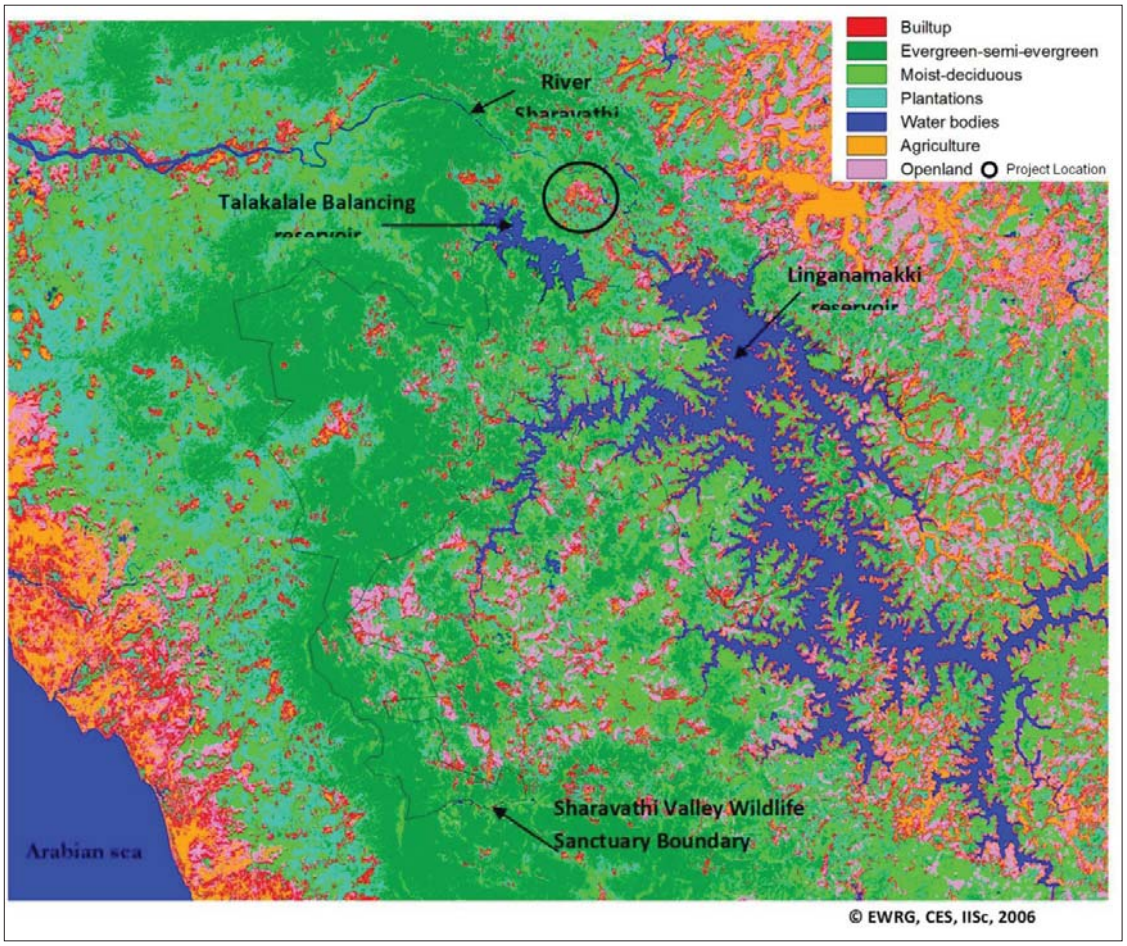


Fig 7. Land use land cover map showing project location (Source: Ramachandra et.al, 2013)

4.3. Topography (along with map)

The project area forms part of Western Ghats comprising of valleys and hill ranges. Toposheet of the project area is enclosed.

4.4. Existing land use pattern (agriculture, non agriculture, forest, water bodies (including area under CRZ), shortest distances from the periphery of the project to periphery of the forest, national parks, wild life sanctuary, eco sensitive areas, water bodies (distance from, the HFL of the river)). In case of notified industrial area a copy of the Gazette notification should be given.

The land use in the proposed project area is completely covered under forest and agricultural plantations. Sharavathi Valley Wildlife Sanctuary is located at a distance of 6.69 Km from power house and 7.14 Km from Tunnel and Aghanashini LTM Conservation Reserve is located at a distance of 3.6 Km. Map showing project location and protected areas is enclosed as Annexure-3.

Linganamakki Reservoir is close to the project vicinity with a live storage capacity of 4276 Mcum, its MWL is 555.04 m, FRL is at 554.43 m and the MDDL is 522.73 m.

The project has a proposal of construction of weir at RL 470 m and FRL for this weir in 475 m and an MWL of 475.50 m.

4.5. Existing Infrastructure

Jog falls is well connected with National and State Highways. The region has high tourism potential and hence Karnataka Tourism Dept., has already constructed and developed area around Jog falls for tourist attraction. Further, Karnataka Power Corporation has well developed infrastructure for their employees which includes schools and colleges.

For transportation of construction materials to the site, trolley of KPCL shall be utilised thereby reducing the travel distance of 14 km. There is no proposal of electrical substation for the project. Existing MGHS grid system will be upgraded and connecting to the same grid.

4.6. Soil Classification

Ramachandra et.al (2013) reported that, Sagar Taluk soil is classified under Sandy loam and clay loam. Horticultural plantation such as Areca nut and Rubber are the major crops. Paddy cultivation is prevailing in the region. Agro-sylvicultural is being practiced in the region.

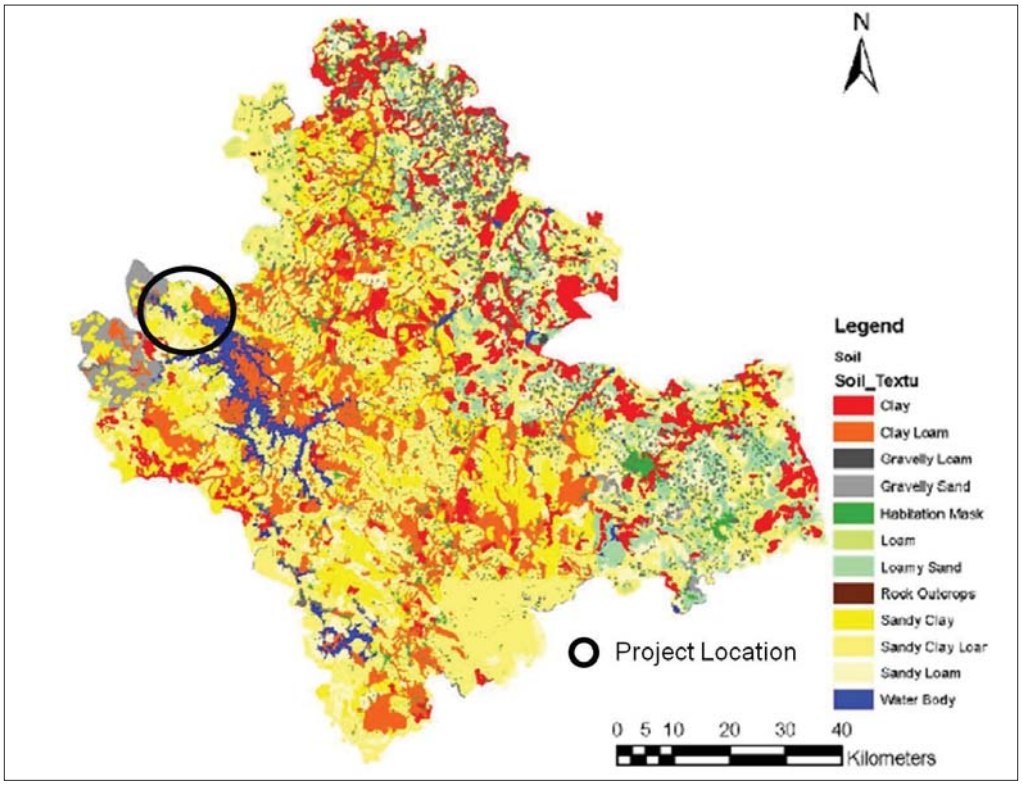


Fig 8. Soil map of Shivamogga district showing project location (Source: Ramachandra et.al, 2013)

4.7. Climatic data from secondary sources

The proposed project location is in the Western Ghats and receiving annual average rainfall of 2400 mm. River Sharavathi receive an annual rainfall of about 5000-8000 mm between to June - September. Annual average Minimum and Maximum Temperature are 15^0C and 38^0C respectively. Map showing annual rainfall distribution of the region is given below;

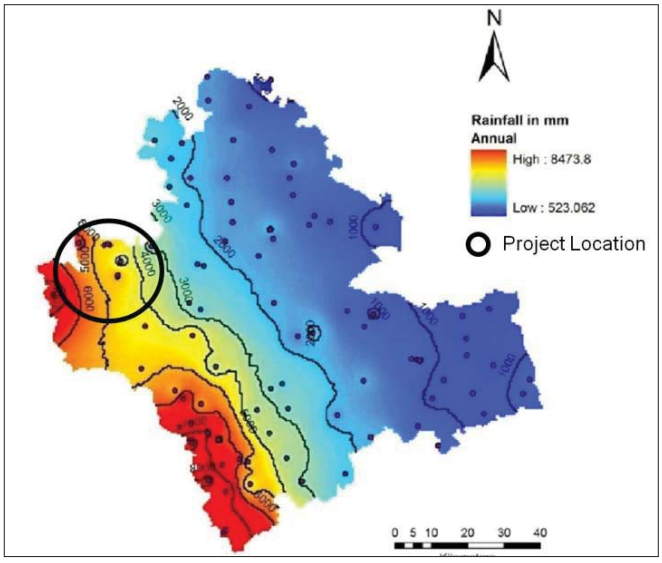


Fig 9. Rainfall map of Shivamogga showing project location (Source: Ramachandra et.al, 2013)

4.8. Social Infrastructure available

In the close proximity of the project site, educational, religious and transportation facilities are available at Jog and Kargal village. The habitants have a good transportation facility as these are accessible easily. Overall it is clearly seen that the social infrastructure in and around the project site is fairly good.

5. Planning

5.1. Planning concept (type of industries, facilities, transportation, etc.,) Town and Country Planning Development authority classification

Jog Management Authority is responsible for implementation of the project through BRS Re-creations Pvt. Ltd.

5.2. Population Projection

Approximately 10 Lakh tourists round the year will be expected to Jog Falls with the implementation of this project.

5.3. Land use planning (breakup along with green belt etc.)

The construction of pump house, laying pipeline upto tunnel, weir and retaining wall (within the river course) are the structures proposed on ground. Tunnel is underground, 2 ha of forest land is required for tunnel construction and doesn't envisages tree cutting in forest area. However, compensatory afforestation will be undertaken in consultation with Karnataka Forest Dept.,

5.4. Assessment of Infrastructure Demand (Physical & Social)

Upon implementation of the project, no. of tourists visiting the project area will be substantially increased. To meet the requirements of tourists necessary infrastructure will be developed at later stages.

5.5. Amenities/facilities

Existing amenities / facilities will be utilised and to meet the requirements of tourists necessary infrastructure will be developed at later stages.

6. Proposed Infrastructure

6.1. Industrial Area (Processing area)

Not applicable

6.2. Residential Area (non processing area)

Not applicable

6.3. Green Belt

As such, the project doesn't envisage cutting of trees. However, compensatory plantation will be undertaken in due consultation with Karnataka Forest Dept., in an area of 2 Ha.

6.4. Social Infrastructure

Karnataka Tourism Dept., has constructed hotels, dormitories, accommodation facilites, commercial complexes, etc at Jog. Further, Karnataka Power Corporation has developed infrastructure for KPCL employees including a Pre-University college.

6.5. Connectivity Traffic and Transportation Road/Rail/Metro/Water ways etc.,

The Proposed Project site is located along the Sharavathi river at Jog falls area, Sagara taluk in Shivamogga District and partly in Uttar Kannada district of Karnataka State.

Access by air at proposed airport in Shivamogga town, which is nearly 95 Km from the proposed project and by Hubli airport, which is 165 Km away by road and 400 Km from Bengaluru international airport.

The proposed project is well connected by National Highway (NH 207) and State Highways and also the nearest ports are located at Karwar and Mangalore.

6.6. Drinking water management (Source & Supply of water)

11 KLD of fresh water is required for construction labors and the same will be sourced from Jog-Kargal Town Panchayath.

6.7. Sewerage System

Existing sewer lines will be make use for labor camps. Hence, there is no additional sewage will be generated due to the project.

6.8. Industrial waste management

Not Applicable

6.9. Solid waste management

150 construction labors will be engaged for construction activities. 38 Kg of Domestic Solid waste will be generated from labors. The solid waste will be handed over to the Jog-Kargal Town Panchayath. The excavated earth of 43,000 cum will be generated due to tunneling operations and the same will be properly managed by identifying suitable locations.

6.10. Power requirement & Supply/Source

The power house with two generators will be with an installed capacity for generation of power of 16.61 MW each in monsoon months (totaling to 47.84 million units) and the power consumed in non-monsoon months (pump mode) would be 24.74 MW each amounting to 47.80 Million units. This makes the project as a viable in terms of power generation and consumption being the same.

7. Rehabilitation and Resettlement (R&R) Plan

7.1. Policy to be adopted (Central/State) in respect of the project affected persons including home oustees, land oustees, and landless laborers (a brief outline to be given).

The proposed project does not involve displacement of the families/houses for the project activities. The total land required for the project is 1 Ha for Power house, tunnel construction & muck disposal and 35 ha of river portion for weir construction.

8. Project Schedule & Cost Estimation

8.1. Cost Estimates

The total estimated cost for the proposed project is 408 Crores.

8.2. Project Schedule

The project will be completed in 18 months. Bar chart showing time line required for each activity is given below;

CONSTRUCTION PLAN

Sl No	Description	No of Days Required	1st Year in Months												2nd Year in Months					
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
	Total Duration Of Project	**540**																		
1	**Survey Work and Preliminary works**	30																		
2	**Weir and Retaining wall Works**	390																		
	Excavation & PCC works	180																		
	Steel reinforcement Works	320																		
	Shuttering Works	345																		
	Weir and Retaining wall concrete works	330																		
	Construction of Cicuit House	120																		
3	**Tunnel Works**	460																		
	Tunnel Lining Drilling & Blasting	450																		
	Shotcreting/SFRS	400																		
	Concrete lining & base concreting	370																		
	Miscellaneous tunneling items	30																		
4	**Pipe line Works**	360																		
	Laying and Aligning of pipe works	270																		
	Civil works for surge tank and other civil works , retaining walls etc	240																		
5	**Pump House and Service Bay**	380																		
	Foundation works	120																		
	Construction of foundation for Electro mechanical works	150																		
	Erection of Gantry cranes commissioning et	30																		
	Flooring,Roofing and finishing works	180																		
	Construction of switch yard and distribution	150																		

9. Analysis of proposal (Final recommendation)

9.1. Financial and social benefits with special emphasis on the benefit to the local people including tribal population, if any, in the area

Detail survey was conducted during DPR preparation to find out for gravity flow of water from upstream to downstream on the right hand side of river as left hand side of the river from Kargal to MGHE is a gravity flow of water for power generation at MGHE. The detail survey shows that the gravity flow of water from upstream side to downstream side is not possible because the ground level is high with hillocks.

Hence it is proposed to make a tunnel for pipe line to pass the water from upstream to downstream till penstock alignment for the proposed project. RCC structure is proposed for the storage weir including retaining wall (within the river course). Control regulator is proposed for the water flow from reservoir. To take out the water from reservoir to pump house vice-versa 1.6 m diameter MS pipe is proposed for the power generation and lifting. Two additional alignments studied are enclosed as Annexure-1.

It is leant that at present the number of tourists who visit jog falls is around 3 lakhs including foreigners. This total number of tourist inflow is more during rainy season compared to non-monsoon season. Falls become perennial (throughout the year), if the project is implemented and it will attract large number of tourists during non-rainy season also. Such large number of inflow of tourists to the region will increase the socio economic conditions of people in the jog falls region and also surrounding area. The area does not have any tribal people and it is in the region of heavy rainfall.