

# Geophysical Studies for Delineating Bedrock Topography and its Competance along Song Dam Axis and To Configure the Palaeochannel of Song River, District Dehradun, Uttarakhand

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## Abstract

*The water supply scheme for Dehradun town envisages construction of a 100m high concrete gravity dam across Song River near village Sondana, district Dehradun, Uttaranchal. Sondana village is situated about 10 km upstream of Song river road head near village Maldevata along a Kachcha road. In the vicinity of Song dam site, fine to medium grained grayish to greenish Nagthat quartzites with quartz veins at places are exposed on both the banks of the river and the valley is filled with river borne material.*

*Geophysical surveys were conducted employing electrical resistivity and shallow seismic refraction techniques along the proposed dam axis with an objective to delineate the bedrock topography and the palaeo-channel of Song River.*

*Vertical electrical resistivity soundings (VES) were conducted using Schlumberger electrode configuration and seismic refraction survey was carried out using hammer source single channel refraction seismograph with a maximum spread of 100m.*

*VES have shown resistivity of the bedrock varying between 650 and 800 Ohm-m. Four to five layered subsurface configurations was depicted along dam axis. The thickness of the overburden varies between 12.5 and 25m bgl.*

*The P-wave velocity of the bedrock (Quartzites) was recorded in the range of 4500-5000 m/s, which is suggestive of the competent bedrock. The depth to the bedrock deciphered by geophysical surveys is in corroboration with the test drilling results.*

*The result shows that the bedrock is deeper along left bank than the right bank which suggests that the river was flowing through left bank in the past which presently flows through right bank.*

## Introduction

The water supply scheme in Dehradun envisages the construction of a 100m high concrete gravity dam on the Song river near village Sondana, district Dehradun, Uttaranchal (Fig. 1). The proposed Song dam is situated in Sondana village, which is about 10 km upstream of the Song river from the road-head near the village Mal Dewata. The dam site is approachable only in dry season because of the kachcha road. Electrical resistivity and shallow seismic refraction surveys have been carried out to delineate the bedrock topography and to determine the subsurface layer parameters.

## Geology

Fine to medium grained grayish to greenish Nagthat quartzites with quartz veins at places are exposed on both the banks of the Song river and the valley is filled with river borne material.

## Instrumentation

Electrical resistivity survey has been conducted using a ScIntrex made A.C. resistivity meter (5Hz) (RAC-8). Seismic refraction survey has been conducted using a FS-3 Hunttec seismograph with a hammer source.

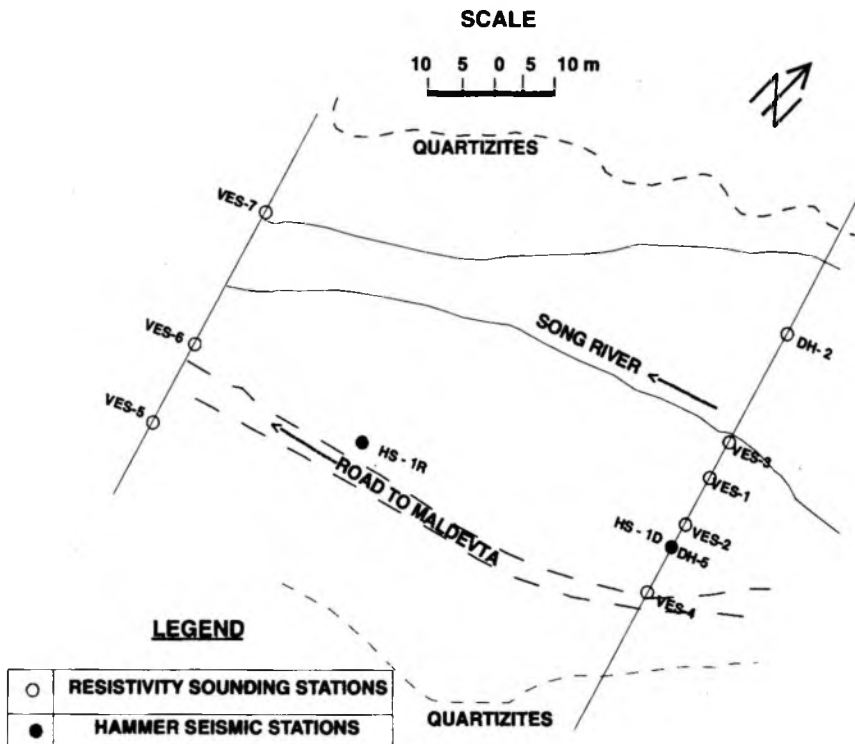


Fig. 1 : Geophysical layout at Sondana Dam Site over song river, Dehradun, Uttaranchal

### Survey design, execution and data collection

Vertical electrical soundings (VES) have been conducted using Schlumberger electrode array at the proposed dam axis and along an axis 80 m downstream of the proposed dam axis. Maximum spread length has been 150m (AB/2) and sampling has been done at 8 points per cycle.

Shallow seismic refraction survey has been planned at the proposed dam axis in such a way that one shot of every profile has been taken at dam axis. Reverse shot has been kept at 80m downstream with best possible spread. Profiles were laid along the river valley following the minimum elevation difference.

### Data reduction processing

Vertical electrical sounding data is plotted on a double log scale of 62.5 mm modulus and are interpreted using two layer master curves by Orellana & Mooney. VES curves

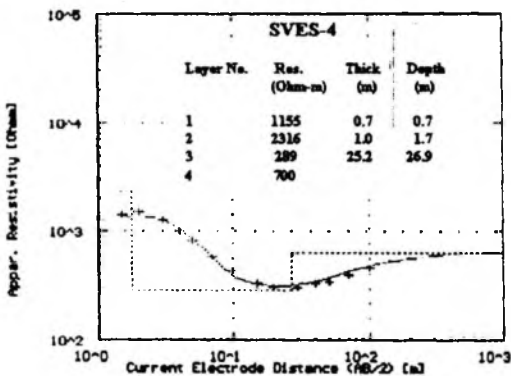
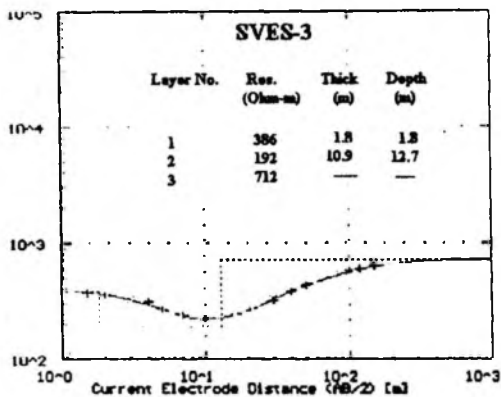
have been modeled using the computer software 'RESIST'. Typical vertical electrical sounding curves are presented in Fig-2. A depth-section has been prepared along proposed dam axis using layer parameters derived from the VES results.

Seismic refraction data was processed by plotting the arrival time against the distance (position of the observation points). Intercept-time technique was used for computing the layer parameters (thickness & velocity).

### Discussion of Results

#### Vertical electrical resistivity soundings:

Vertical electrical resistivity soundings in the vicinity of the dam alignment have shown four to five-layered subsurface. The top layer comprising dry sand and silt is very thin and is not registered its presence in all the soundings. Second layer constitutes dry boulder bed. The third layer is the boulder bed saturated with water whose resistivity is



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Fig 2 : Representative vertical electrical resistivity sounding curves

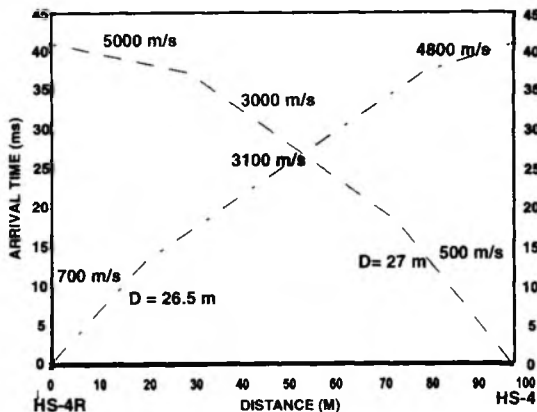


Fig 3 : Time-distance Plot, Hammer Seismic Profile-sp 4, Dam Site Area, Song Dam, Dehradun, Uttaraanchal

less than that of the dry boulders. The fourth layer is interpreted as another saturated boulder bed with larger size boulders (semi-weathered bedrock?). The underlain bedrock

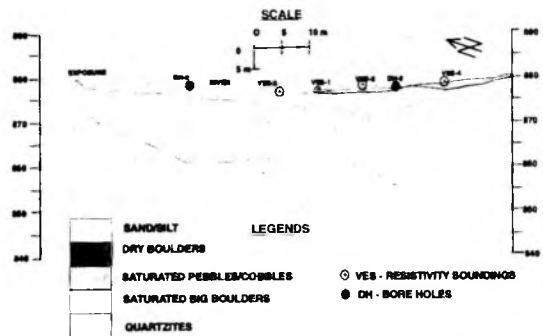


Fig. 4. Geoelectric section and bedrock profile, song dam axis, dehradun, uttaranchal

(quartzite) is resistive and quite competent for the dam construction. The depth to the bedrock observed in four VES conducted at the dam axis varies between 12.5 m and 27 m. The geo-electric section (Fig-4) along the dam axis suggests that the bedrock is deeper at the left bank than the right and the river was flowing along left bank in the past. This indicates the possibility of the buried channel through left abutment.

**Seismic refraction survey**

Seismic refraction survey with hammer source has been carried out at 12 locations along six profiles each of 80 m lengths. Direct shots are located over the dam axis and the reverse one on the axis 80 m down stream. The P-wave velocity for the bedrock is recorded between 4500 m/s and 5000 m/s. The depth to the bedrock has been estimated between 12 m and 27 m which corroborate with the electrical resistivity results.

**Conclusions**

From the results of the geophysical surveys it has been concluded that:

1. The vertical electrical resistivity soundings have brought out a four to five-layered subsurface configuration with the bedrock resistivity of the order of 800 Ohm-m.
2. The depth to the bedrock (thickness of the overburden) varies between 12 m and 27m.

3. Seismic P-wave velocity of the bedrock varies between 4500m/s and 5000 m/s.
4. The results of electrical resistivity and seismic surveys are in good corroboration.
5. The bedrock at the dam site is competent.
6. Palaeo-channel of the Song river was delineated through left abutment.

### **Reference**

Mooney, M. and Orellana, H M. (1966) : A resistivity computation method for layered-earth model; Geophysics, pp-33.