

Allain stream joins Beas near village Aleo in Manali while Duhangan stream joins Beas near village Jagatsukh located on the outskirts of Manali. The Allain stream is formed by Hamtal and Patroi streams which originate at an elevation of 4680 m amsl and 4800 m amsl respectively in the Himalayan ranges and traverses a distance of 18.5km before it joins Beas at an elevation of about 1800 m. A comprehensive relief and drainage map of the state is shown in *Figure 4.1* and of the project area in *Figure 4.2*. The Duhangan stream originates at an elevation of 5229m amsl from Chandratat glacier in the Himalayan ranges and traverses a distance of 19.1 km before it joins Beas River. Both streams have a number of vertical falls, joined by several streams before emptying into Beas River. On an average these streams have a steep gradient of 1:7 indicating of suitability for hydropower generation, however, such areas are prone to soil erosions.

4.4.2 Geology

The regional geological studies carried out by Geological Survey of India (GSI) have established that the rock formations in the area belong to the unfoliated Paleozoic Group of rock having thrust contact with older rocks. Three well-defined structural units characterize the region, viz.:

- Central Crystallines;
- Kullu formation; and
- Dabinala granites.

Each structural unit/formation has a thrust contact with the other. In the project area, the rock units exposed belong to central crystallines. The general trend of the foliation of the rocks in the area varies from NNE-SWW to NW-SE. The area has undergone intense folding which is manifested by megascopic and mesoscopic folds observed in the rock. The folds are asymmetrical and are of plunge type drag folds, mostly seen in gneissic rocks. The stratigraphic succession of lithological units is given in the Table - below.

Table 4.1: Stratigraphic Sequence of Rocks

Age	Formation	Lithology
Recent to Sub-Recent	-	Fluvial and Fluvio-Glacial unconsolidated sediments.
Post Cambrian	Dabinala	Intrusive foliated granite biotite granite, pegmatite and aplites.
Upper Pre Cambrian	Kully Formation	Micaceous quartzites, quartz mica-schists.
Pre Cambrian	Central	Garnetiferous mica schists Crystalline banded and streaky gneisses and migmatites

Central crystalline are the oldest formations in the area which consist of garnetiferous mica schist, Kyanite schist, staurolite schist, banded and streaky gneiss and migmatites. The gneiss and schist bands vary in thickness from a few cm to over 50m. These bands grade into each other unperceptibly both along and across their foliation. Micaceous quartzites, quartz – mica schist, garnetiferous mica – schist are exposed in the upper reaches of Allain Duhangan streams. The gneisses and schist show intense folding. Later granites, pegmatite's and quartz veins intrude these. The geological map of the region showed in *Figure 4.3*. Geological map of the state showing soil types is shown in *Figure 4.4* highlighting the soil type of the project area.

Local Geological Setting of Project Components

Allain Barrage Site

The proposed barrage site is at an elevation of about 2740-m and the valley base at the site is about 50 m wide with steep banks. The entire river section is filled with 15 to 20 m thick river fill material while highly jointed and massive gneisses are well exposed on right abutment. The left abutment is covered by hill out wash. The strike of foliation generally varies from N 50° W – S 50° E to N 60° S to N 60° E and dip is of the order of 20° to 25° towards Southwest direction. At the barrage axis, the steep abutment slopes in massive gneisses are generally stable. The desilting basin is located on the left bank of Allain stream where space for locating the surface structure is available.

Dunagan Weir Site

The Duhangan weir site is proposed at about 5.5 km upstream of its confluence with river Beas. At this site the valley has very steep banks. Fluvioglacial deposits occupy almost the entire valley section, while porphyritic granitic gneiss with occasional schist bands are exposed on the banks. The strike of foliation here generally varies from N 70° E – S 70° W to N 85° W – S 85° E and the dip towards Southwest direction. The weir axis has been selected mainly from topographic considerations and slide prone zones are encountered downstream of the chosen site. In terms of geology, gneisses are well exposed on steep abutments where rock slopes appear to be stable. In view of fresh and hard nature of rock the desilting chamber has been designed as an underground structure on the Right Bank of Duhangan stream.

Allain Head Race Tunnel

The Allain head Race tunnel portal is located on the left bank of Allain stream where bed rock is generally covered by overburden comprising of hill out wash barring exposures of gneisses and mica schist near RD 730 of tunnel alignment approximately at the cross drainage location. The tunnel alignment passes mainly through granitic gneisses and micaceous quartzites with occasional schist bands. The strike of foliation of rock varies from N 50° W – S 50° W to N 60° W – S 60° E and dip is of the order of 5° to 25° towards Southwest direction.

Duhangan Head Race Tunnel

The Duhangan headrace tunnel would pass through micaceous quartzite, granitic – gneiss and micaschist with occasional pegmatite veins and shear seams. The strike of foliation of rock varies from N 60° E – S 60° W to E – W with a dip of the order of 20° to 30° towards North direction.

Surge shaft Site

The area around the proposed Surge shaft site is occupied by quaternary deposits in the form of glacial moraines, fluvio-glacial deposits and outwash materials. No rocky exposures are present close to this site and its vicinity.

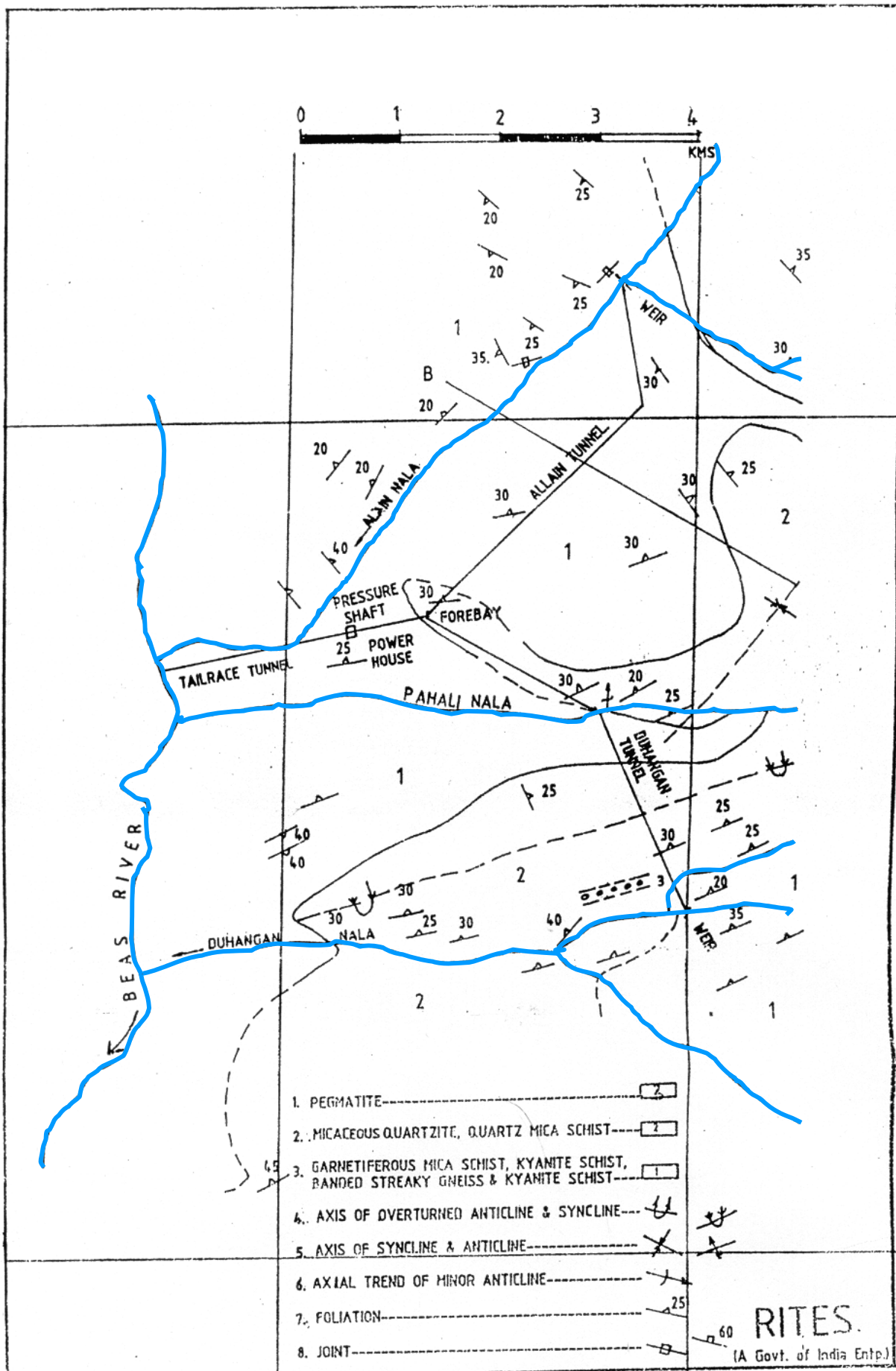


Figure 4.3: Geological Map of the Project Area