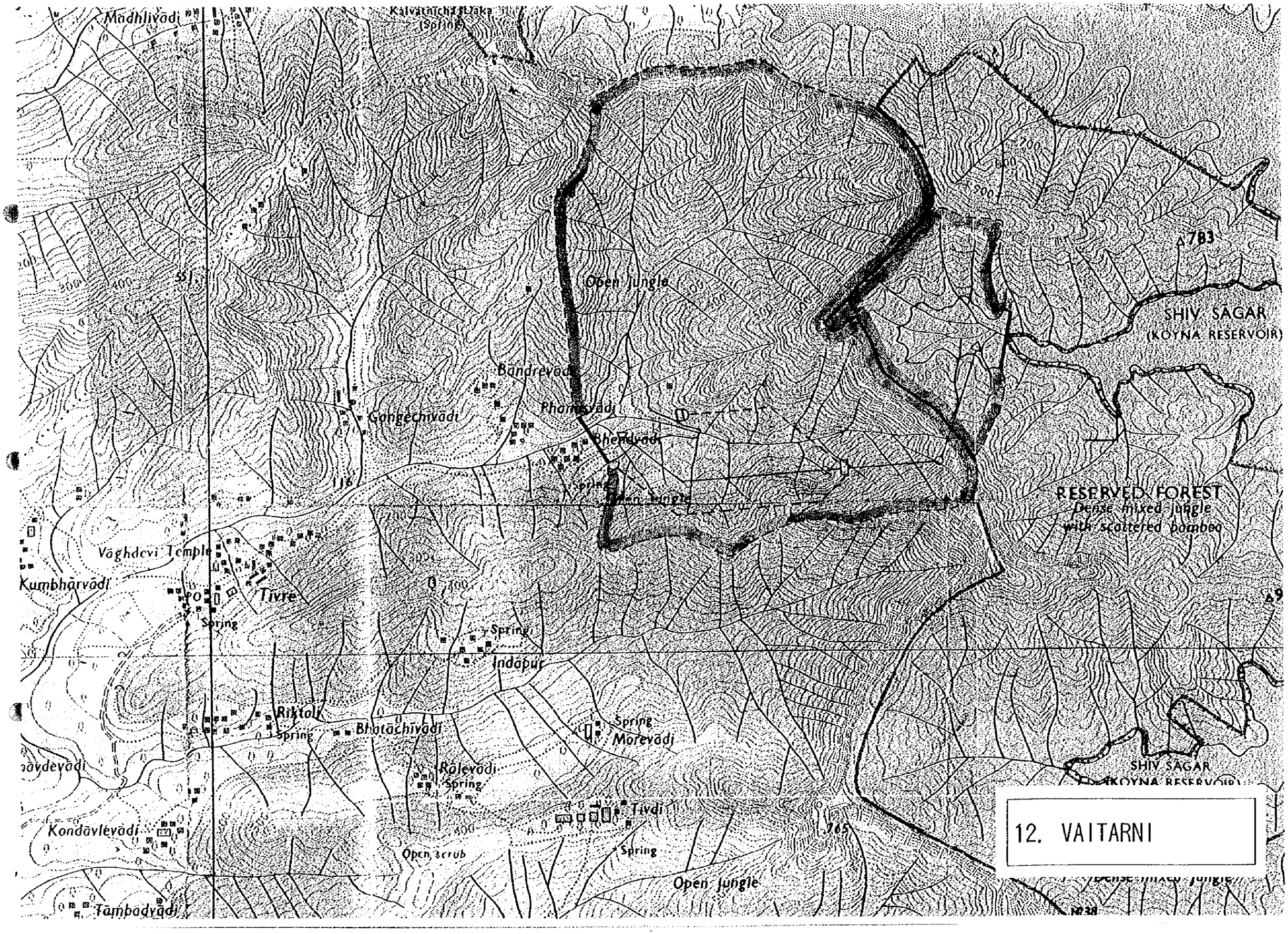
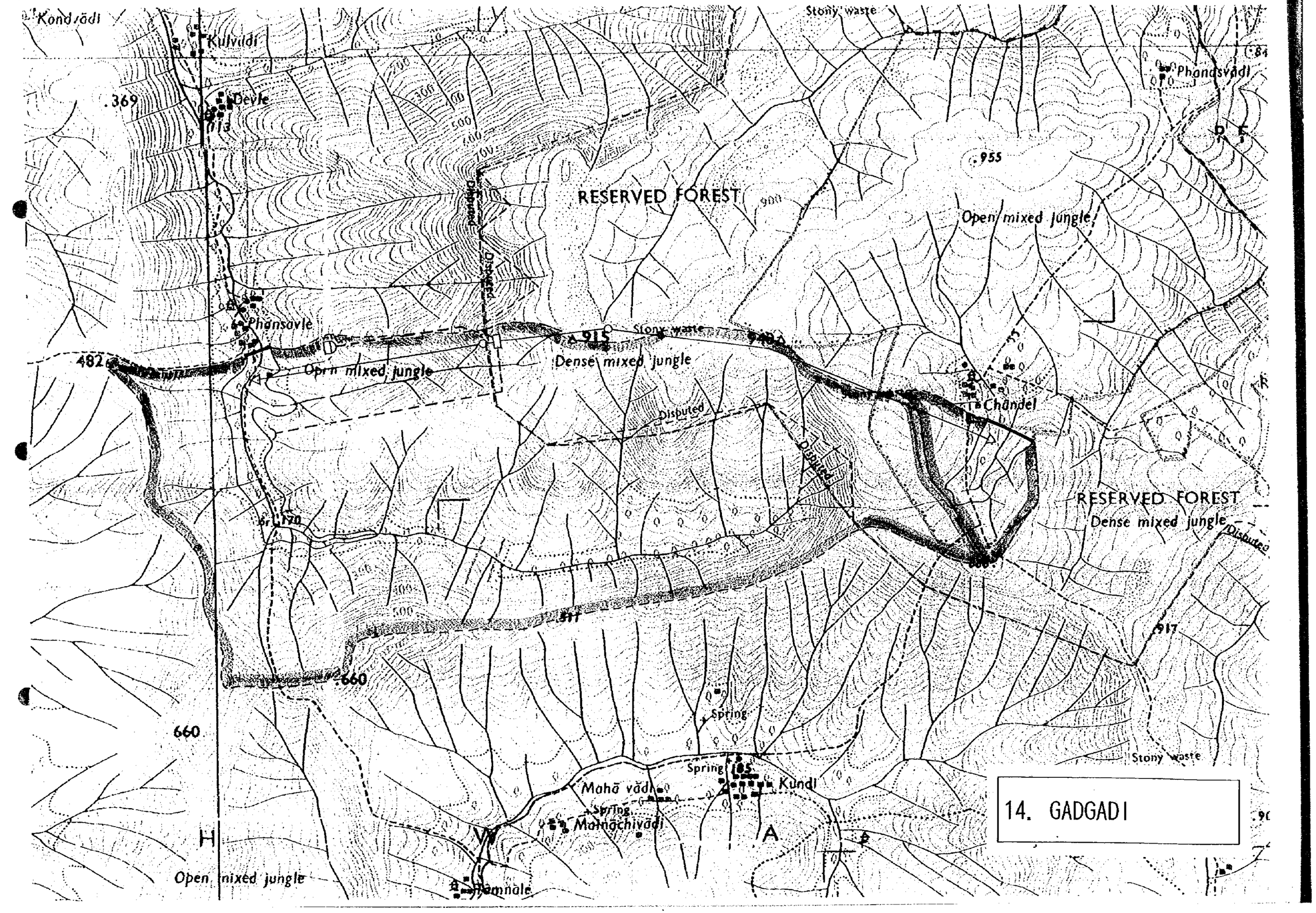
12: General Description of the VAITARNI Project Site

1. Environment conditions	(1) Upper reservoir			The submerged area involves 25 ha of reserved forest
	(2) Lower reservoir			The submerged area involves 15 ha of reserved forest and 13 ha of agricultural land
2. River basin conditions	(1) Upper reservoir	(1) River basin		The upper reservoir forms a narrow basin under the influence of the watershed peak consisting of an abrupt cliff of approximately 800mm elevation. From the upstream to the midstream regions the terrain has a steeply inclined relief. Further downstream, the topography dips at a gentler slope, with falling elevation toward the reservoir. The area around the reservoir presents flat topography.
		(2) Submerged dwellings		The reservoir is situated upstream of the side stream of the Koyna reservoir. There are no roads nearby, nor is there any dwelling.
		(3) River bed condition		In the upper reaches of the basin, the terrain is marked by a steep eroded topography , with no evidence of erosion. From the middle reaches the topography swiftly changes to a flat relief, emptying into the reservoir. In this basin it is estimated that there are deposits of somewhat depth.
		(4) Circum-reservoir terrain		The surrounds of the reservoir form gentle slopes believed to be covered with deposits settled on the land surface. Due to the changes in the water level of the reservoir the is sufficient reason to anticipate the possibility of the deposits sliding with the detrimental effect of causing a reduction in the reservoir's storage capacity.
	(2) Lower reservoir	(1) River basin		The basin covers a comparatively wide area. In the most upstream part it is flanked by an abrupt wall of overhanging cliff. Down to the vicinity of the reservoir, the terrain dips at a steep gradient. From the vicinity of the reservoir, the slopes dip at a gentle gradient, with the surrounds of the river bed presenting a flat topography.
		(2) Submerged dwellings		Isolated villages are present immediately downstream of the dam site. Due to the age of the topographical map available, it may well be conceivable that by now there may also be dwellings near the reservoir.
		(3) River bed condition		The basin broadly divides into three tributaries. Each of these is deep and show evidence of erosion. The eroded rock debris is believed to have deposited and settled in the vicinity of the reservoir.
		(4) Circum-reservoir terrain		Except for the right bank, the area near the reservoir dips at a gentle gradient. In this area, the debris from collapsed rocks has come from the upper parts. In the area along the tributaries, however, there are supposed to have deposits of washed-down rock debris.
	(3) Changes in river basin			The most upstream end of both the lower and the upper reservoirs forms a watershed peak of abrupt overhanging cliff. The upper reservoir is designed to take a flow course directed to the east and the lower reservoir to the west.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status		The dam site is located in a position at which the flat relief is somewhat narrow. Both banks are assumed to be covered with deposits of rock debris. Similarly, the river bed has deposits of washed-down or collapsed rock debris.
		(2) Dam		As stated above, the dam site has deposits of rock debris. On topographical evidence, it is considered that the foundation bed rock is also subject to progressive weather. It will therefore be of vital importance to conduct a geological survey in order to determine the extent and nature of the work required to finish the dam foundation rock.
	(2) Lower reservoir dam	(1) Dam site status		Except for the right bank, it is supposed on topographical evidence, that there are deposits of collapsed rock debris on the left bank and the river bed and washed-down rock debris from the basin. It is also believed that the foundation rock bed of the dam has weathered.
		(2) Dam		On the right bank of the dam site, the rock bed is exposed, and it will be necessary to make a proper assessment of the extent of the work required to finish the dam foundation rock both on the river bed and the left bank.
	(3) Waterway route	(1) Geographical profile		The waterway route has been selected by taking into account the topographical relief. The general perpendicular relief is marked by a smooth, gentle gradient. The length of the waterway is approximately 3.5km.
		(2) Layout		The waterway system has a relief inclined at a smooth dipping gradient so that the powerhouse will be positioned somewhat midway on the waterway route. The waterway does not have a large water head so that surge tank is left out to control the water pressure on the headrace.
	(4) Intake and outlet			Ordinary horizontal intake and outlet structures are used in the plan for both the intake and the outlet.
	(5) Surge tank			The headrace layout is marked by a short length of approximately only 600m. Nor is the head very high. As a result, it is possible to dispense with the need for a surge tank to control the water pressure. The tailrace, however, has a length of approximately 2km and thus requires the installation of a surge tank.
	(6) Powerhouse			The powerhouse is situated midway on the waterway system so that costs for the access and cable tunnels will need to be considered. In an effort to reduce the construction costs for the underground structures for the powerhouse it is planned to construct a single tunnel doubling as the access and cable tunnels.
4. Access road and tunnel	(1) Upper and lower reservoirs			Similarly to the Madhalivad location, there is no existing road in the vicinity of the upper reservoir. Access to the upper reservoir is there planned to take the form of an inclined type tunnel from the lower reservoir. Access to the lower reservoir, is planned to be achieved by repairing the roughly 40km long foot path road from Tivre.
	(2) Access tunnel to powerhouse			The plans for the access tunnel to the powerhouse provide the construction of an inclined tunnel on the left bank of the lower reservoir to construct a single tunnel doubling as an access and a cable tunnel.
	(3) Cable tunnel			The cable tunnel is to be installed in the upper part of the access tunnel to the powerhouse. The plan also makes provision for the installation of the switchyard on a comparatively flat part.
5. Power transmission lines				To construct the 400kV one circuit, double conductors, 45km from Vaitarni PPS to planning of New Koyna S/S along the planning of 400kV double circuits transmission line between Loniknnd S/S and planning of New Koyna S/S through Koyna I & II S/S.
6. General evaluation				In view of the fact that both at the upper and lower reservoirs, the topography of the terrain around the dam site imposes significant limitations, it will be difficult to raise the dam any further. It will consequently not be possible to secure an adequate storage capacity. A further difficulty is that construction costs will mount as a a result of the long waterway to the detriment of economic efficiency. Both in the lower and upper reservoirs, it is likely that sanctuaries will exist, and in the upper reservoir, in particular, the project calls for the river flow diversion, with a total of some 50ha of submerged forest area.


Madhlivadi
Kalvatnichi Vaka
(Spring)
Open Jungle
783
SHIV SAGAR
(KOYNA RESERVOIR)
Bandrevadi
Phonsvadi
Gangechivadi
Bhendvadi
Spring
Open Jungle
RESERVED FOREST
Dense mixed jungle
with scattered bamboo
Vaghdevi Temple
Kumbharvadi
Tivre
Spring
Spring
Indapur
Rixtoli
Spring
Bhatachivadi
Spring
Morevadi
Kolevadi
Spring
Tivdi
Spring
Kondavlevadi
Open Scrub
Open Jungle
Tambadyadi
SHIV SAGAR
(KOYNA RESERVOIR)
12. VAITARNI

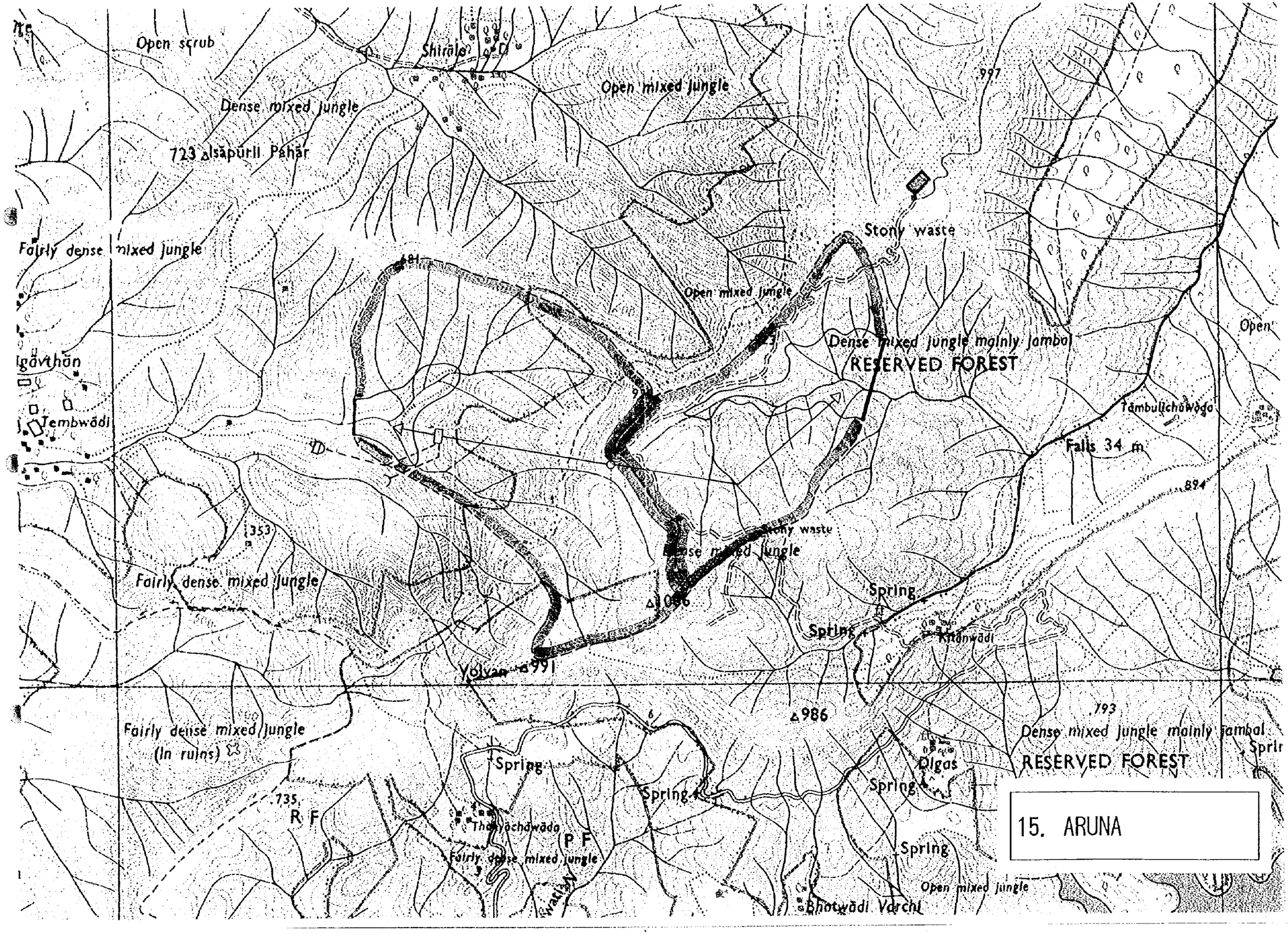
14: General Description of the GADGADI Project Site

1. Environment conditions	(1) Upper reservoir			The subjerged area involves 17 ha of forest including 2 ha of reserved forest as well as 15 ha of agricultural land
	(2) Lower reservoir			The submerged area involves 5 ha of agricultural land
2. River basin conditions	(1) Upper reservoir	(1) River basin		This is a small basin with a surface short a 1 square km, presenting a generally gently dipped topography. It is inferred that a tick layer of top soil is supposed to spread throughout the basin.
		(2) Submerged dwellings		Downstream of the dam site, there are some villages or hamlets. As the map is old it seems likely that there are some dwellings in the reservoir.
		(3) River bed condition		In the basin of one stream, it can be assumed that the river bed has deposits of rock debris or sand.
		(4) Circum-reservoir terrain		The terrain surrounding the reservoir has a gently sloping topography. Due to variation in the water level of the reservoir, however, the sand deposits in the vicinity of the reservoir may be considered liable to sliding.
	(2) Lower reservoir	(1) River basin		The basin is long and narrow in the east-west direction. The upstream end and the right bank form a smooth tableland and elevation of the steep slopes falls toward the river side to assume a gently inclined topography near the river. The left bank presents a steep-gradient mountain ridge subsiding into the river.
		(2) Submerged dwellings		There are some villages or hamlets in the lower reaches of the dam site. Some dwellings can also be spotted in the upper reaches and in some cases it also seems likely that the number of dwellings has increased.
		(3) River bed condition		The left bank is steeply inclined with little evidence of erosion. In contrast, the right bank has a gently inclined relief. The map suggests that some streams have been formed by the water flow washing out a river bed. The main stream has a gentle gradient and it appears likely that rock debris has been washed down and settled with the formation of deposits.
		(4) Circum-reservoir terrain		The area surrounding the reservoir present a gently inclined topography, with the surface covered with rock debris. As a result of the variation in the reservoir water level, there is sufficient reason to anticipate the risk of this rock debris deposits sliding.
	(3) Changes in river basin			The most upstream end of the lower reservoir basin is a tableland plain, forming a watershed ridge dividing it from the upper reservoir.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status		The dam site has a flat topography, with deposits of rock debris and sand on both the river bed and the banks on both sides. It is estimated that erosion has also taken place at the dam foundation rock bed.
		(2) Dam		The banks on both sides represent gentle slopes, and considering the height of the dam it would appear that work on the foundation rock bed of the river bed, and especially on the abutment area, might create problems.
	(2) Lower reservoir dam	(1) Dam site status		The base of the dam site has a large width and gentle slopes are seen to flank the banks on both sides. The river bed is believed to be covered with deposits of rock debris washed down from the upper reaches and the banks on both sides is supposed to have deposits of collapsed rock debris. There is also evidence to suggest that the dam foundation rock bed has progressively weathered.
		(2) Dam		Due to the geological conditions present in the basin, there is reason to fear that the work on the river bed foundation as well as on the banks of the dam will present problems. A precise geological survey is therefore considered essential.
	(3) Waterway route	(1) Geographical profile		The waterway has a straight route. Yet, two thirds of the upstream area has a flat perpendicular profile with an elevation of approximately 800m. Further downstream, however, the gradient suddenly falls and the elevation then decreases in passing toward the outlet.
		(2) Layout		The lower reaches of the basin have a long and narrow shape proceeding in the east-west direction. As a result, the waterway system has a considerable length of some 6km. The headrace, in particular, reaches a length of 3km and it will be necessary to change the layout for the headrace on the basis of a geological survey on the waterway route.
	(4) Intake and outlet			The intake and outlet use both the standard horizontal types of construction.
	(5) Surge tank			In view of the considerable length of the waterway, it will be necessary to provide surge tanks both on the headrace and the tailrace sides.
	(6) Powerhouse			For topological reasons, the powerhouse has been sited at a location roughly 2km from the outlet. Since the powerhouse itself is located deep underground, it will not give rise to any problems provided that the geological conditions are satisfactory.
4. Access road and tunnel	(1) Upper and lower reservoirs			For access to the upper reservoir, the existing, approximately 80km long foot path road from Gathna should be repaired. For access to the lower reservoir, the plan is to repair the existing, approximately 40km long road from Kinjale.
	(2) Access tunnel to powerhouse			The plan is to construct an access tunnel to the powerhouse parallel to the tailrace from the right bank of the lower reservoir.
	(3) Cable tunnel			The switchyard is to be construct on a flat topography at an elevation of approximately 450m on the right bank of the tailrace. The cable tunnel is to link to the transformer room adjacent to the powerhouse, using the inclined tunnel.
5. Power transmission lines				The construct the 220 kV one circuit, one conductor, 45 km from Gadgadi PPS to planning of New Koyna S/S
6. General evaluation				Since the capacity of both the upper and lower reservoirs will be subject to the limitations imposed by the topography. Another disadvantage is the comparatively long extension of the waterway compared with other sites it is clear that the project offers poor economic efficiency. It is possibility that both the lower and upper reservoirs may have sanctuaries. There is also a total of 50ha of agricultural land will be submerged, with the diversion of the river flow.


Kondvādi
Kulvādi
369
Devle
Phansavle
482
Open mixed jungle
Disputed
RESERVED FOREST
Stony waste
915
Dense mixed jungle
Phandsvādi
955
Open mixed jungle
Chāndel
RESERVED FOREST
Dense mixed jungle
Disputed
917
660
Spring
Stony waste
Spring
185
Kundl
Mahā vādi
Spring
Malnāchivādi
H
A
Open mixed jungle
Hamnale
14. GADGADI

15: General Description of the ARUNA Project Site

1. Environment conditions	(1) Upper reservoir		The submered area involves 27 ha of reserved forest
	(2) Lower reservoir		The submerged area involves 23 ha of reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin	This basin consists of gentle slopes , with the watershed peak at an elevation of about 900m. Near the reservoir, the land surface slopes at a fairly gentle gradient.
		(2) Submerged dwellings	The basin is one of the tributaries, and in the lower reaches there is a waterfall, with no dwelling in the basin.
		(3) River bed condition	The topography is marked by a gentle gradient. Both the main and subsidiary flows present evidence suggesting that the beds have been gouged out. Downstream of the dam site, the banks and the rivers are somewhat narrow so that it is assumed that there are deposits of rock debris or sand.
		(4) Circum-reservoir terrain	The terrain surrounding the reservoir dips at a gentle gradient so that the areas around the reservoir are likely to have progressively developed deposits of rock debris or sand. There is ground for fear that the land surface layer may slide as a result of variations in the water level of the reservoir
	(2) Lower reservoir	(1) River basin	In the most upstream part, the basin forms a gently inclined plateau. Further downstream, the terrain then changes to slopes inclined at a steep gradient toward the scheduled site for the lower reservoir. In the vicinity of the reservoir, the relief is inclined at a somewhat gentle gradient and the rivers also dip at a gentle gradient.
		(2) Submerged dwellings	There are large village communities near a point some 3km downstream of the dam site. Near the reservoir, the banks on either side come close so that it may be concluded that there is no dwelling there.
		(3) River bed condition	Upstream of the dam site there are mainly two rapidly flowing streams forking off from the river. The two streams have gouged out the terrain more extensively than any of the other small streams. On the gentle slopes flanking the reservoir from these streams, it is believed that rock debris or similar has washed down and settled.
		(4) Circum-reservoir terrain	The terrain around the reservoir presents a gently inclined topography. It is inferred that the surface soil forms a thin layer.
	(3) Changes in river basin		The rivers feed the upper and lower reservoirs flow in opposite directions in the east-west site, divided by the watershed peak formed by a plateau of 900m elevation.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	Both banks of the dam site are situated in a gently inclined location. It is estimated that the rock debris deposit and weathered soil layers are deep. The river bed has accumulated sand or rock debris deposits washed down from the upper reaches. There is also probability that the dam foundation rock bed has also been subject to progressive weathering.
		(2) Dam	As has already been stated in connection with the river bed condition, it will be necessary to select the type of dam and decide on the foundation work procedures on the basis of the results obtained from detailed geological survey. For topological reasons, it would be difficult to raise the dam height any further.
	(2) Lower reservoir dam	(1) Dam site status	Rock debris and sand washed down from the upper reaches is likely to have deposited on the river bed. The surface soil on both banks forms a thin layer. Yet, in terms of raising the dam height, it appears that the geological conditions present problems, as seen that the left bank consists of gently inclined slopes.
		(2) Dam	With the present dam height, it is though that there are no problems that might hamper the construction of the dam. Yet, even when the dam height is raised, storage efficiency will remain poor and the project will not be economic because of the steep mountain near the reservoir.
	(3) Waterway route	(1) Geographical profile	The longitudinal relief near the waterway route presents a flat topography up to the watershed peak. Further downstream the relief slopes more gently after the precipitous cliffs have been crossed and steadily falls toward the lower reservoir.
		(2) Layout	The waterway has a total length of approximately 4km. The terrain presents a very favorable topography for the layout of the waterway system. The headrace has a length of 2.5km, and the merit of the arrangement is that the powerhouse is close to the outlet.
	(4) Intake and outlet		The ordinary horizontal type structures may be used for both the intake and outlet.
	(5) Surge tank		As stated above, the headrace is long so that it required the construction of a surge tank to control water pressure. On the tailrace, however, it will not be necessary to construct a surge tank.
	(6) Powerhouse		The powerhouse is situated in the vicinity of the outlet. All ancillary structures related to the powerhouse are amenable to an economically advantageous layout.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to the upper reservoir, there are existing roads in the vicinity so that there is practically no need to provide any new access roads. To gain access to the lower reservoir, the situation is quite similar in that an existing road already leads to the villages 3.5km downstream. It is also easy to construct new roads.
	(2) Access tunnel to powerhouse		The switchyard is situated at the left downstream of the dam site of the lower reservoir. According to the plan, this forms the starting point for the construction of the access tunnel to the powerhouse.
	(3) Cable tunnel		The cable tunnel is layouted running parallel to the access tunnel to the powerhouse and connecting to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 60km from Aruna PPS to Kolhapur II S/S along the 110kV one circuit transmission line between Kankavli S/S and Kolhapur II S/S.
6. General evaluation			While the head is comparatively high, the fact is that because of the limited water storage capacity of both the upper and lower reservoirs, the effective water volume is small so that economic performance is somewhat poor. The submerged forest area in the upper reservoir is close to 60ha and the project site requires the river flow diversion.


Open scrub
Shirale
Dense mixed jungle
Open mixed jungle
997
723 Alsāpūrli Pahār
Fairly dense mixed jungle
Stony waste
481
Open mixed jungle
Dense mixed jungle mainly jambul
RESERVED FOREST
Open
Tembwādi
Tambulichowdo
Falls 34 m
894
353
Fairly dense mixed jungle
Stony waste
Dense mixed jungle
Spring
Spring
Khānwādi
Volvan 991
793
Dense mixed jungle mainly jambul
RESERVED FOREST
Fairly dense mixed jungle
(In ruins)
Spring
Spring
Dīgas
Spring
735
R F
Thakurachāwāda
P F
Fairly dense mixed jungle
Spring
Open mixed jungle
Bhatwādi Varchi

15. ARUNA

16: General Description of the KHARARI Project Site

1. Environment conditions	(1) Upper reservoir		The submerged area involves 52 ha of non-reserved forest
	(2) Lower reservoir		The submerged area involves 25 ha of reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin	At the most upstream part of the stream emptying into the Chandvad Nadi river on the right river bank, the topography presents a watershed peak in the form of a plateau at an elevation of around 800m. The river basin as a whole is dipped at a gentle gradient. In the vicinity of the reservoir, the terrain is flat. In the upper reaches of the basin, there are some villages or hamlets.
		(2) Submerged dwellings	The map suggest that there is no submerged dwelling. As the map is quite old, however, there may now be some villages.
		(3) River bed condition	In the upstream part, the river dips at a steep gradient. In the vicinity of the reservoir, the terrain has a flat topography with the river dipping at a gentle gradient. It is estimated that sand or rock debris has deposited.
		(4) Circum-reservoir terrain	In the vicinity of the reservoir there are some hilly elevations taking the shape of tableland type plateaus. The slopes have a gentle gradient of dip. It is thus clear that with the changes in the reservoir water level, there is a possible risk of the slope surface sliding.
	(2) Lower reservoir	(1) River basin	The basin is located on the stream flowing into the Kharal Nadi on the right bank. The upstream part of the basin is marked by mountainous terrain with cliffs dipping at a steep gradient. Towards the reservoir, the terrain assumes a somewhat gentler gradient of dip. There are some villages or hamlets in the upper reaches.
		(2) Submerged dwellings	The surrounds of the reservoir form the terminal rim of a steeply inclined topography, with no dwelling in evidence.
		(3) River bed condition	The upper reaches are marked by a steep river gradient which become less steep as the flow approaches the lower reaches. The river shows signs of erosion from about the middle reaches. From the vicinity of the reservoir to the lower reaches there is evidence to suggest the presence of deposits of washed-down rock debris.
		(4) Circum-reservoir terrain	The reservoir is situated in a topographical relief abruptly changing from a steep inclination to a gentle dip. The terrain around the reservoir has a generally gentle gradient, and on the left bank in particular, the terrain forms a plateau. The surface of the land is assumed to be covered by a top soil layer, with the risk of subsidence due to movements in the reservoir water level.
	(3) Changes in river basin		The watershed peak in the form of a plateau at an elevation of approximately 800m divides the basin into a northern and southern flow pattern.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	The dam site is situated in a gently dipped location forming a tableland plateau. It is believed that the river bed and both banks are covered with rock debris deposits and that the foundation rock bed has progressively weathered.
		(2) Dam	The dam height is topographically limited to a maximum corresponding to an elevation of approximately 800m. It would be difficult to raise the dam beyond this in order to increase the reservoir at storage capacity. No further increase in output can therefore be reasonably expected at this site.
	(2) Lower reservoir dam	(1) Dam site status	There are no particular problems on the right bank of the river. Yet, the left bank of dam site consists of gentle slope so that it may be assumed that deposits have settled on the river bed and that progressive weathering has taken place on the foundation rock bed.
		(2) Dam	On the left bank of the dam site, the terrain is gently dipped. It is thus absolutely essential to conduct a geological survey on the dam foundations, including the river bed. The results of such a survey should form the basis for formulating the approach to be adopted for finishing the dam foundations.
	(3) Waterway route	(1) Geographical profile	The waterways system has a flat extension of 4km and thus present a topographical shape with the characteristics of an area qualifying for a water flow diversion. From the upper reservoir to the watershed peak, the terrain maintains a gentle dip, with the lower reaches showing a similarly gentle incline.
		(2) Layout	From the upper reservoir to the watershed peak, the terrain has a gentle topography so that the layout for the headrace needs some considerations. In view of the gentle longitudinal profile, the tailrace takes a long course and the powerhouse will have to be positioned on the upstream end of the waterway system.
	(4) Intake and outlet		For both the intake and outlet, the ordinary horizontal type structures are planned.
	(5) Surge tank		If the headrace tunnel and the penstock line are included, the total length will be approximately 1.9km so that a surge tank will be needed to control the water pressure. Similarly, the need for a surge tank also arises on the tailrace side as the tailrace tunnel has a considerable length of 2.4km.
	(6) Powerhouse		The powerhouse will have to be sited underground at a point 2.4km from the outlet. This will make the layout economically unfavorable.
4. Access road and tunnel	(1) Upper and lower reservoirs		The existing road goes as far as Umgaon in the direction toward the upper reservoir, and a new road of approximately 4km length should therefore be constructed from this point to gain access to the upper reservoir. To reach the lower reservoir, an approximately 1.5km road needs to be newly constructed.
	(2) Access tunnel to powerhouse		It will be necessary to construct an approximately 1.5km long access tunnel from the lower reservoir.
	(3) Cable tunnel		A new approximately 2km long road is to be extended to gain access to the right bank of the lower reservoir. It will also be necessary to construct a switchyard and an approximately 1.5km long inclined tunnel to connect to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 105km from Kharari PPS to Kolhapur II S/S along the 220kV double circuits transmission line between Ponda S/S and Kolhapur II S/S.
6. General evaluation			The upper reservoir has a topographically limited water storage capacity and the waterway system is long. The basin also makes it necessary to locate the powerhouse on the upstream end of the waterway system. For these reasons, the economic effectiveness of the layout is somewhat adversely affected. In the upper reservoir there is a considerable area of submerged forest reaching 50ha. The basin qualifies for the river flow diversion.

R E S E R V E D F O R E S T

mixed jungle

RF

Open scrub

757

950

Beradvadi

705

Dhongarvadi

776

Open scrub

Changvad Nadi

Dense scrub

Dense mixed jungle

831

Bamboo Plantation

Dhongarvadi

Bamboo Plantation

Kunda Tekadi

915

Dense mixed jung

Ishvarling Temple

R E S E R V E D F O

Vaghotre

Ambrashivadi

Causeway

Ramghat

endravadi

Dense scrub

Open scrub

643

658

Rocky knob

729

608

504

593

Dense mixed jungle

Dense mixed jungle

Dense mixed jung

Kharal Nadi

16. KHARARI

17: General Description of the KUNDI Project Site

1. Environment conditions	(1) Upper reservoir			The submerged area involves 65 ha of non-reserved forest
	(2) Lower reservoir			The submerged area involves 40 ha of non-reserved forest and 37 ha of agricultural land
2. River basin conditions	(1) Upper reservoir	(1) River basin		The basin is situated in a plateau topography at the most upstream part of the Varna Nadi river. It is a small basin with a catchment area of only 1.7 km^2. There are stony waste in the vicinity and the land is deserted. Toward the river, the terrain is gently inclined.
		(2) Submerged dwellings		Located at the most upstream part of the Varna Nadi river, the surrounds of the reservoir are deserted land with no evidence of any dwelling.
		(3) River bed condition		Sandy waste forming a plateau of approximately 900m elevation constitutes the water source area. On the left bank of the reservoir, the terrain consists of stony waste dipped at a gentle gradient towards the reservoir. It is therefore likely to anticipate no sliding problems in this part due to the variations in the reservoir water level.
		(4) Circum-reservoir terrain		The left bank of the reservoir area has deposits of weathered rock. In view of the stony waste terrain on the left bank and because of the gentle gradient of the relief toward the reservoir there is substantial ground to anticipate no sliding problems as a result of variation in the reservoir water level.
	(2) Lower reservoir	(1) River basin		The basin is situated at the most upstream part of the stream emptying into the Bav Nadi river on the right bank. From the watershed peak at an elevation in the order of 800m towards the river, the terrain dips at a steep gradient. Immediately upstream of the dam site there are two streams forking off from the river, and the terrain assumes a gentle inclination in the direction towards these streams.
		(2) Submerged dwellings		There is a temple in the reservoir and the village of Kundi is located downstream of the dam site.
		(3) River bed condition		The basin as a whole is a mountainous zone with cliffs dipping at a steep gradient. Immediately upstream of the dam site there are two streams forking off from the river, and the main stream, including these two streams, dip at a gentle gradient. There is ample reason to suppose that rock debris has formed the deposits.
		(4) Circum-reservoir terrain		On the left bank by the reservoir the terrain dips at a sharp gradient. On the right bank, however, it dips at a gentle gradient. It is believed that there are deposits of rock waste on this bank and in the river bed. There is a possibility that these rock debris deposits may collapse with the variations in the reservoir water level.
	(3) Changes in river basin			The basin qualifies as the river flow diversion. It also offers sufficient potential for a scheme to construct the upper reservoir as an excavated and embanked pondage.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status		The terrain has a gentle relief and reports stony waste in the basin. The rock debris are believed to be little. The dam foundation rock forms a plateau table so that it is most likely to have progressively weathered.
		(2) Dam		With the present layout, a saddle dam will be required on the upstream end of the reservoir. It would be difficult, however, to raise the dam height beyond this. On topographical and geological grounds, the basin therefore qualifies for a scheme envisaging the creation of a pondage based on the excavated and embanked method.
	(2) Lower reservoir dam	(1) Dam site status		The basin represents a topography dipped at a steep gradient, with a river bed sloping at a gentle gradient. The river bed itself is supposed to have deposits of somewhat depth. The terrain adjoining the right bank of the dam site slopes at a gentle gradient, with deposits.
		(2) Dam		There are supposed to have deposits on the river bed and also on the right bank it is reasonable to assume that the dam foundation rock has no progressively weathered.
	(3) Waterway route	(1) Geographical profile		The longitudinal profile of the waterway system has an ideal pattern for a river flow diversion scheme.
		(2) Layout		The waterway system has a short overall length, thus permitting an economically favorable layout.
	(4) Intake and outlet			The headrace has a shallow overburden and the intake takes the form of inclined type. The outlet can be constructed using ordinary horizontal type structures.
	(5) Surge tank			As the waterway system has a short overall length, there will be no need to provide the surge tank to control water pressure either on the headrace or the tailrace.
	(6) Powerhouse			Given the topographical features of the terrain and the nature of the waterway layout, the powerhouse is planned to be positioned roughly midway on the waterway system.
4. Access road and tunnel	(1) Upper and lower reservoirs			For access to the upper reservoir, a new approximately 3km long road is to be constructed forking off from the existing road leading to Gathna. For access to the lower reservoir, it is proposed that an approximately 10km long road should be newly constructed or repaired from Kadowvadi downstream of the dam site.
	(2) Access tunnel to powerhouse			On the right bank of the lower reservoir, a new access road of approximately 3km length should be constructed along the reservoir. To gain access to the powerhouse, it is proposed that an access tunnel be constructed connecting to the powerhouse at a length of approximately 1km.
	(3) Cable tunnel			The switchyard is layouted on the left bank of the lower reservoir and an approximately 1km long inclined tunnel to gain access to the underground transformer room.
5. Power transmission lines				To construct the 400kV one circuit, double conductors, 55km from Kundi PPS to planning of New Koyna S/S.
6. General evaluation				The site offers favorable economic prospects in view of the large storage capacity of the reservoir and the short overall length of the waterway system. The findings of the site survey have also shown that the upper reservoir qualifies as a pondage by excavated and embanked method. The upper reservoir has a total of 65ha of submerged forest area and the project includes the river flow diversion.

RESERVED FOREST

Dense mixed jungle

Disputed

Dense mixed jungle

Spring

Vādi

Dhangarvādi

Spring

908

Open mixed

Open scrub

Dhakāle

RESERV

Stony waste

Spring

Spring

105

Kundl

Mahā vādi

Spring

Mahāchivādi

A

R

901

Dense mixed jungle

1044

Hamnale

726

mnāle

Spring

Belāri Khurd

Dense mixed jungle

Open scrub

Gothno

Stony waste

808

Mahipatgarh Fort

(in ruins)

Stony waste

924

368

Open scrub

Stony waste

Falls 180 m

901

623

Nigudvādi

Marleshwar Temple

(in cave)

Annual fair (Jan)

17. KUNDI

Rocky knob

18: General Description of the JALWARA Project Site

1. Environment conditions	(1) Upper reservoir		The submerted area involves 34 ha of reserved forest
	(2) Lower reservoir		The submerged area involves 25 ha of non-reserved forest and 3 ha of agricultural land
2. River basin conditions	(1) Upper reservoir	(1) River basin	The basin is situated in the most upstream part of the Halatar Nadi river. It has an uncertain topography with a vaguely outlined boundary formed by a plateau table at an elevation of 800m.
		(2) Submerged dwellings	As the basin forms a plateau of 800m elevation there is no dwellings in the area.
		(3) River bed condition	The main and streams dips at a gentle gradient and both banks are flanked by a gently inclined terrain. It is believed that rock debris or sand deposits have settled here and on the river beds.
		(4) Circum-reservoir terrain	The reservoir is flanked by gently dipping terrain . There is the conceivable danger of sliding as a result of the variations in the reservoir water level.
	(2) Lower reservoir	(1) River basin	At the most upstream end of the Jalwara Nadi river, a mountain ridge stretches around the watershed peak, with the terrain forming sharp overhanging cliffs and running out at a sharp gradient into steep slopes whose angle of dip becomes somewhat more moderate only in the vicinity of the reservoir.
		(2) Submerged dwellings	There is no dwelling on the reservoir, but there are villages or hamlets spread in the area spanning the elevation levels from 200m to about 300m on the left bank of the dam site.
		(3) River bed condition	The river has two streams forking off somewhere 500m upstream of the dam site. These streams terminate in a multiplicity of mountain streams. At the most upstream end, there is little evidence of erosion. Yet, in the lower reaches, erosion is very much in evidence as the river flow into the reservoir.
		(4) Circum-reservoir terrain	The mountainous terrain around the reservoir presents a fairly gentle gradient, and rock debris has been washed down from the streams and innumerable mountain streams to form no deposits. With the changes in the reservoir water level these deposits are liable to collapse.
	(3) Changes in river basin		The Halatar Nadi river basin goes over into the Jalwara river basin. The project location is situated at the most upstream part where the basin is small. There are no particular factors likely to cause any problems.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	Both banks form a dam site dipped at a gentle gradient. There are supposed to have deposits on the banks and the river bed itself. The dam foundation rock is considered to show signs of progressive weathering.
		(2) Dam	It appears difficult to raise the dam height beyond the height envisaged under the present plans. This means that the reservoir will have a limited storage capacity, offering no prospect for increasing output.
	(2) Lower reservoir dam	(1) Dam site status	The dam site is situated at a location in which the steep river gradient suddenly eases. The terrain in the lower reaches is also gentle. The river bed is believed to be covered with rock debris deposits. Both banks have relatively gentle slopes, with evidence to suggest that the deposits of rock waste have formed.
		(2) Dam	The dam is relatively long and the position of the dam poses no great problem. On the left bank, however, there are small mountain ridges. The basin offers an economically unfavorable storage effect. Nor would this effect be improved by raising the dam height.
	(3) Waterway route	(1) Geographical profile	The waterway route has been selected by taking into account the topographical conditions. The headrace tunnel reaches a length of approximately 3km, and as it passes underneath a plateau of some 800m elevation it needs to ensure about 100m overburden.
		(2) Layout	The distance between the intake and outlet is very long at over approximately 5km. The system does have the advantage, however, that the powerhouse, can be provided near the outlet.
	(4) Intake and outlet		Ordinary horizontal structures are used for the intake and outlet.
	(5) Surge tank		The headrace has a considerable length of approximately 3km so that a surge tank will be required on the headrace to control the water pressure. It is concluded that there will be no need to provide a surge tank on the tailrace.
	(6) Powerhouse		The powerhouse is layouted at the deep underground approximately 1.5km from the outlet.
4. Access road and tunnel	(1) Upper and lower reservoirs		The existing road can be used to gain access to the upper reservoir. For access to the lower reservoir, however, it will be necessary to construct a new road of some 10km length from Usap.
	(2) Access tunnel to powerhouse		The plan is to excavate an approximately 1km long access tunnel from the left bank of the lower reservoir to connect to the powerhouse.
	(3) Cable tunnel		The layout is to construct the switchyard on the left bank of the lower reservoir and an inclined tunnel to connect to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 110km from Jalware PPS to Kolhapur II S/S along the 220kV double circuits transmission line between Ponda S/S and Kolhapur II S/S.
6. General evaluation			In view of the limited reservoir capacity and the significant length of the waterway due to the natural features of the relief, the project offers poor economic effectiveness. The upper reservoir has a considerable area of submerged forest reaching 70ha and the project area is subject to the river flow diversion.

Dense mixed jungle mainly bamboo

R E S E R

Gurkhi N

Spring

601 Kamarla Dongar

Kārla Temb 788

Ford

Māni

Kusgarhivādi

Mangali

Fanasvādi

Falls 26 m

Yarandekarvādi

Stony waste

Dense mixed jungle

Talevādi

852 Sukmi Temb

Ford 765

Sada

Stony waste

Open jungle

Savalvādi

Chavlā

Spring

Falls 6 m

Vaira Sakkal Falls 143 m

466 △ Mūk Dongar

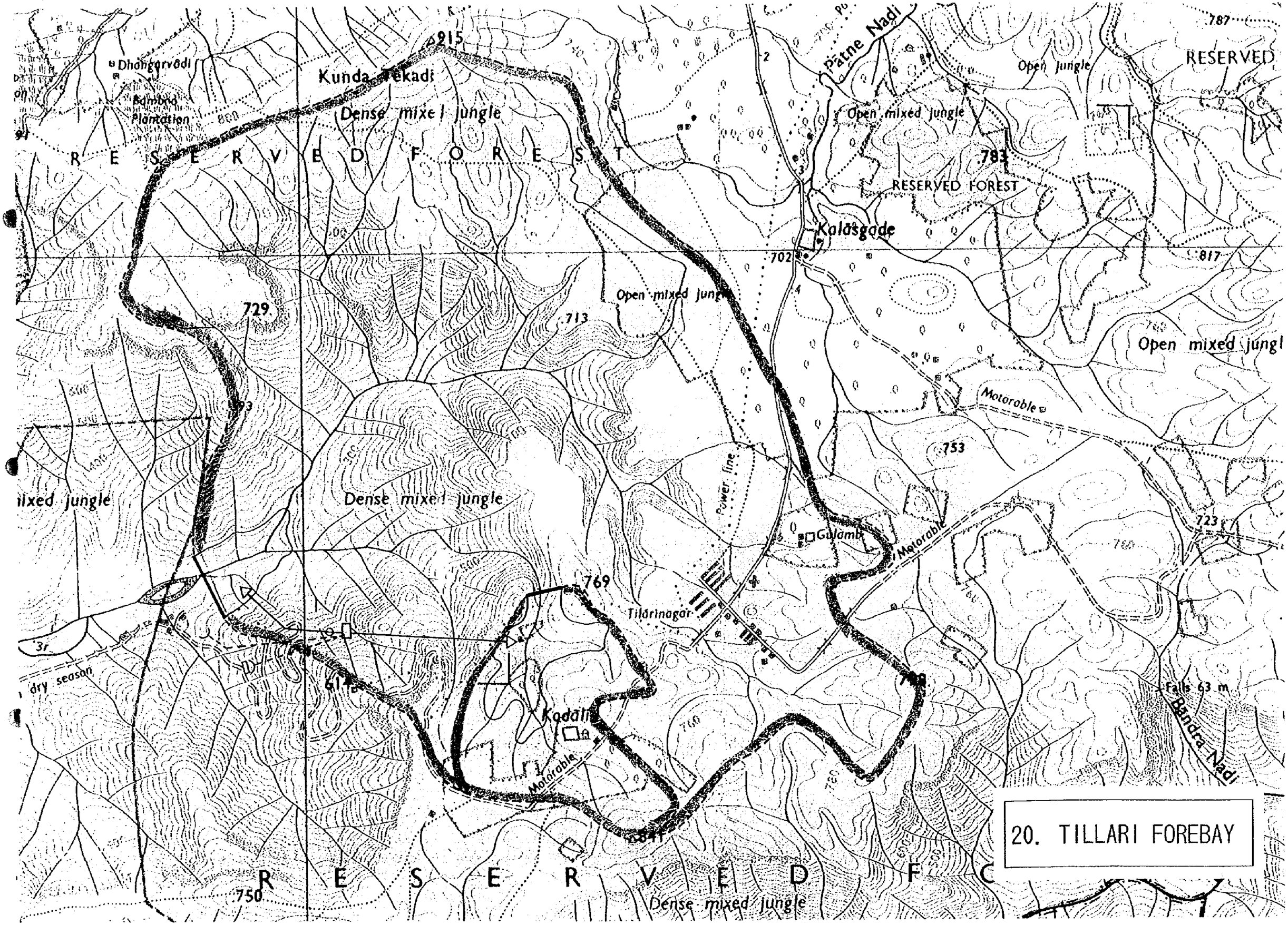
806 △ Lāsni Temb

RH

18. JALWARE

20: General Description of the TILLARI FORBAY Project Site

1. Environment conditions	(1) Upper reservoir			The submerged area involves 32 ha of forest including 24 ha of reserved forest as well as 8 ha of agricultural land
	(2) Lower reservoir			The submerged area involves 50 ha of reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin		This basin is situated in the most upstream part of the river Kharal Nadi, a tributary of the Tillari Forebay river. The basin topography consists of a tableland plateau, with no ups and downs. Similarly, the river also exhibits a gentle gradient.
		(2) Submerged dwellings		There are some villages and temples in the upper reaches of the basin. In the reservoir, however, there is no the evidence of any dwelling.
		(3) River bed condition		The basin forms a tableland, with the river also flowing at a gentle gradient. It is likely that weathered rock debris and sand may have deposited.
		(4) Circum-reservoir terrain		The terrain surrounding the reservoir forms a plain. Towards the dam site, however, the river suddenly increases its gradient of flow. Around the reservoir, the terrain is dipped at a gentle gradient so that it appears likely for rock debris and sand to have deposited.
	(2) Lower reservoir	(1) River basin		The river basin is located upstream of the Kharal Nadi and the most upstream part of this river forms a hilly plateau of over 700m elevation. Past this plateau, the relief is one of steep mountains with overhanging cliffs in some parts. From the skirting areas of the reservoir, the terrain marks a drop in elevation toward the river with its gentle gradient of flow.
		(2) Submerged dwellings		There is no submerged dwellins in the reservoir, as the reservoir is planned, at a location which the steep mountain terrain becomes somewhat gentler.
		(3) River bed condition		At a position approximately 0.5km upstream of the dam site, the river branches off into two streams extending to the plateau which forms the watershed peak of the basin. These streams divide into innumerable mountain streams and the signs of erosion are in evidence. Near the dam site there are rock debris layers which are not thought to be of any considerable depth.
		(4) Circum-reservoir terrain		In the terrain around the reservoir on the left bank in the upper reaches, the topography is relatively gentle and there are somewhat deposits of rock debris. Apart from this, the surrounds of the reservoir present a gentle topography. The rock bed is exposed with the thin depsit.
	(3) Changes in river basin			There will be no need to change the flow of the river which takes a meandering course from the upper reservoir. This make the site ideal for the project.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status		The dam site is located on the boundary of the plateau and the gorge or valley. Yet, the rock debris and washed down from the plateau is deposited and on the both banks the terrain is marked by a small mountain ridge so that the foundation rock bed at the both sides of the dam site has weathered.
		(2) Dam		There is an existing masonry dam with a main dam of which dams are connected with an open canal, the plan for the upper reservoir is to raise the existing dam height to secure the necessary reservoir capacity for the pumped storage power project. The result of the reconnaissance study carried out at the second survey in India is found out the dam height raising is difficult and costly because it is necessary to reconstruct the open canal with approximately 15km length and other reasons. An original plan is however described in this table.
	(2) Lower reservoir dam	(1) Dam site status		On both banks of the dam site, the relief has a steep gradient and the rock bed is not deep. Near the river bed the gradient eases to a gentle slope, with evidence that there are somewhat deposits at the both banks of the river.
		(2) Dam		On both banks of the dam site, the rellief has a steep gradient, and the dam basement has a relatively width. Great increase of the storage capacity by raising the dam height is not an economically tenable proposition, as the water storage efficiency is poor because of the steep relief on both banks around the reservoir.
	(3) Waterway route	(1) Geographical profile		The layout for the waterway system has been selected by taking into account the natural relief of the basin. The topography is marked by a gentle gradient from the upper to the lower reservoirs. The powerhouse is to be positioned roughly in the middle of the waterway system.
		(2) Layout		The waterway system has a total extended length of only approximately 2.5km so that it is an economically favorable waterway system. Yet, the layout cannot avoid locating the powerhouse somewhere midway on the waterway system.
	(4) Intake and outlet			For the intake and outlet, it is possible to use the ordinary horizontal type structures.
	(5) Surge tank			In view of the short length of the waterway, it is not necessary to provide a surge tank on the headrace. The tailrace, however, needs a surge tank to control the water pressure.
	(6) Powerhouse			The powerhouse needs to be situated somewhere midway in the waterway system.
4. Access road and tunnel	(1) Upper and lower reservoirs			For access to the upper reservoir, no new road is needed because the existing road is passing through the dam site. For access to the lower reservoir, there is already an existing road passing along the left bank to the site, however some road repair is necessary.
	(2) Access tunnel to powerhouse			The plan is to be constructed 1.5km long access tunnel from the left bank of the dam site on the lower reservoir to grain access to the underground powerhouse.
	(3) Cable tunnel			The switchyard is to be layouted on the dam site of the lower reservoir and an inclined tunnel to link to the underground transformer room.
5. Power transmission lines				To construct the 400kV one circuit, double conductors, 95km from Tillari Forebay PPS to Kolhapur II S/S along the 220kV double circuits transmission line between Ponda S/S and Kolhapur II S/S.
6. General evaluation				While both the upper and lower reservoirs have limited water storage capacity, this capacity is large and the waterway system is very short. These two advantages combine to make this an economically very favorable and attractive project. There will be no need for river flow diversion and the submerged forest is relatively small.


Dhongarvadi
Bamboo Plantation
Kunda Tekadi
Dense mixed jungle
RESERVED FOREST
Patne Nadi
Open jungle
Open mixed jungle
RESERVED
783
RESERVED FOREST
Kalasgade
702
817
729
713
Open mixed jungle
Open mixed jungl
Motorable
753
Power line
Gulamb
723
Motorable
769
Tilarinagar
Falls 63 m
Bandra Nadi
Kadali
Motorable
841
750
Dense mixed jungle
20. TILLARI FOREBAY