4.2.5 Selection of Priority Pumped Storage Sites

(1) Selection of Priority Pumped Storage Sites

Based on the results of the second site survey, the main issue of each project site was abstracted and further actions for each issue were clarified as shown in the Table 4-2-11.

As a result, the P5 project site has a significant situation in the geological conditions and was removed from the priority projects. Three other projects (JN3, JN5, JS6) remained as priority projects.

(2) Reviews of Project Design based on the Second Site Survey

Study team reviewed the design of promising three project sites based on the results of the second site survey.

Throughout the review study, layout of the project structures such as dam type, route of waterway, location of underground powerhouse and approach route have been adjusted considering the features of each project.

Main features of the reviewed projects are shown in Table 4-2-12, and layout of the projects are shown in Fig 4-2-7～4-2-9.

Additionally, Study team renamed the three selected projects tentatively, which is derived from the district name.

Table 4-2-11 Main Issues and Further Actions of Each Project

Site		Main issues to be considered	Further actions	Evaluation
JN3	Geology / Design	➢ River inflow at the lower dam site is little. First pooling of the reservoir may take a long time.	➢ Monitoring and evaluation of the river inflow.	○
	Environment	**Social environment** ➢ One village (37 households, 140 persons) at the lower dam / reservoir site will incur significant impacts because the houses and the agricultural lands will be submerged. ➢ One village at lower dam and another at upper dam are expected to incur significant impacts because of their proximity to the sites. **Natural environment** ➢ One tributary with small basin on the Mua river will disappear by the lower dam. ➢ Relatively good forest around the upper dam / reservoir site is expected to incur secondary impacts.	**Social environment** ➢ Social environment investigation to clarify impacts **Natural environment** ➢ Natural environment investigation to clarify impacts	
JN5	Geology / Design	➢ Since there is a highly weathered col in the left side of the upper reservoir, measures for stop the leakage, such as saddle dam/curtain grouting, will be required.	➢ Up-grade of the topographic maps and review design of the countermeasures	○
	Environment	**Social environment** ➢ At the lower dam / reservoir site, four villages (306 households, 1680 persons in total) will incur significant impacts because the houses and the agricultural lands will be submerged. One of the villages moved to the current site when Hoa Binh dam project was implemented. ➢ Four villages along the planned approach road to the lower dam are expected to incur significant impacts. **Natural environment** ➢ It is likely that the aquatic ecosystem of Sapriver incurs significant impacts by the lower dam / reservoir.	**Social environment** ➢ Social environment investigation to clarify impacts ➢ Design review taking mitigation measures into consideration, such as road layout separate from houses/fields **Natural environment** ➢ Natural environment investigation to clarify impacts	
P5	Geology / Design	➢ Since permeability around the underground powerhouse is high, construction/maintenance is incredibly difficult. ➢ There exists thick, huge secondary sediment around the planned outlet area. It is technically impossible to construct the outlet in this area.	➢ **Give-up on the current plan. Drastic change of the layout plan**	×
	Environment	**Social environment** ➢ One village (15 households, 60 persons) at the upper dam / reservoir site will incur significant impacts because the houses and the agricultural lands will be submerged. They moved to the current site at the time of the Hoa Binh dam project. ➢ Two villages along the planned approach road to the outlet are expected to incur significant impacts.	**Social environment** ➢ Social environment investigation to clarify impacts	
JS6	Geology / Design	➢ An irrigation dam project is planned and is scheduled to be completed at the conclusion of this study.	➢ Coordination with irrigation dam project.	○
	Environment	**Social environment** ➢ One village (63 households, 330 persons) at the lower dam / reservoir site will incur significant impacts because the houses and the agricultural lands will be submerged. **Natural environment** ➢ Internationally recognized important terrestrial ecosystem will incur direct (limited scale) and secondary impacts. ➢ The aquatic ecosystem of Cai River will incur significant impacts. The impacts may reach to the downstream of the river.	**Social environment** ➢ Social environment investigation to clarify impacts **Natural environment** ➢ Natural environment investigation to clarify impacts	

○: It is possible to go on to the next stage. ×: There are fatal issues.

Table 4-2-12 Outline of the Promising PSPP

Project Site Name		Phu Yen East (JN3)	Phu Yen West (JN5)	Bac Ai (JS6)
Project Specifica - tion	Installed Capacity P (MW)	1000	1000	1000
	Designed Discharge Qd (m^3/s)	230	240	350
	Effective Head Hd (m)	560	520	360
	Peak Duration Hours	7	7	7
Upper Reservoir	Type	Full Faced Pond (Asphalt)	Concrete Gravity	Rockfill
	Height H (m)	35	85	30+30+30
	Crest Length L (m)	2000	340	410+270+200
	Dam (Bank) Volume V ($1000m^3$)	3400	530	670+200+250
	Excavation Volume Ve($1000m^3$)	4200	150	400
	Reservoir Area Ra (km^2)	0.3	0.6	0.7
	Catchment's Area Ca (km^2)	0.6	3.5	3.4
	H.W.L (m)	880	720	600
	L.W.L (m)	850	705	580
	Usable Water Depth (m)	30	15	20
	Effective Reserve Capacity (mln m^3)	6	6	9
Lower Reservoir	Type	Concrete Gravity	Concrete Gravity	Concrete Gravity
	Height H (m)	75	95	55
	Crest Length L (m)	150	220	500
	Dam Volume V ($1000m^3$)	200	670	860
	Reservoir Area Ra (km^2)	1.1	2.5	3.2
	Catchment's Area Ca (km^2)	16.0	420	720
	H.W.L (m)	280	160	210
	L.W.L (m)	270	157	206
	Usable Water Depth (m)	10	3	4
	Effective Reserve Capacity (mln m^3)	6	6	9
Water Way	Head Race L (m) x n	6.7 x 500 x 1	6.9 x 1400 x 1	8.3 x 1000 x 1
	Penstock L (m) x n	5.4 x 1600 x 1	5.4 x 1000 x 1	6.7 x 800 x 1
	Tail Race L (m) x n	6.7 x 2200 x 1	6.9 x 400 x 1	8.3 x 600 x 1
	Total Length Lt (m)	4300	2800	2400
Power House	Type	Underground	Underground	Underground
	Cavern Volume ($1000m^3$)	200	200	200
	Overburden (m)	400	400	250
Lt / Hd		7.7	5.4	7.3
Total Project Cost (mln US$)		630	700	660
	Power Station	(627)	(688)	(657)
	Land Compensation / Resettlement	(3)	(12)	(3)
Construction Period (years)		6	6	6
Construction Unit Cost (US$/kW)		630	700	660
Economic Efficiency (B/C)		1.29	1.17	1.24
Distance from 500kV Substation (km)		70	80	90

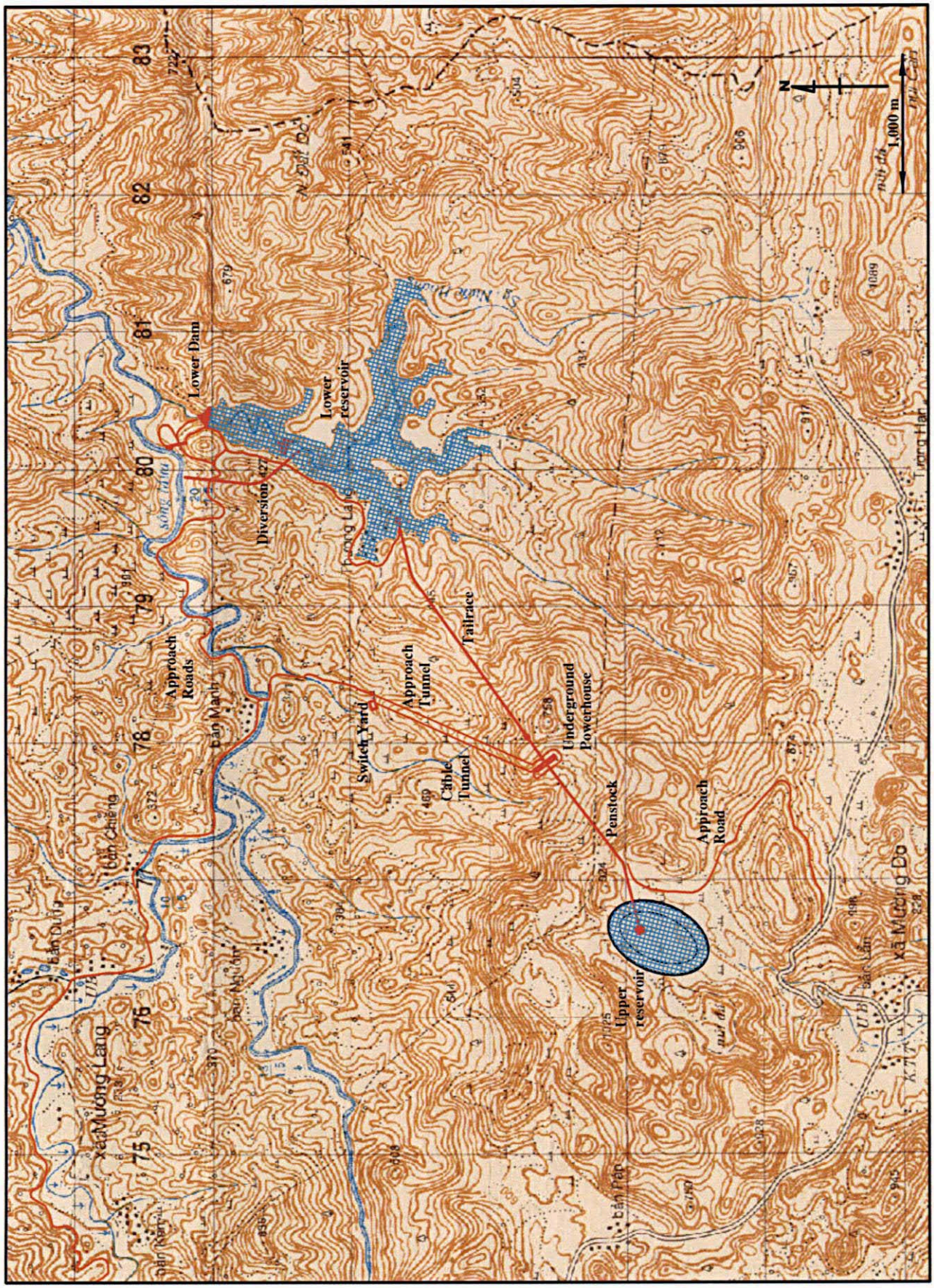

Figure 4-2-7 Layout of Phu Yen East (JN3) project

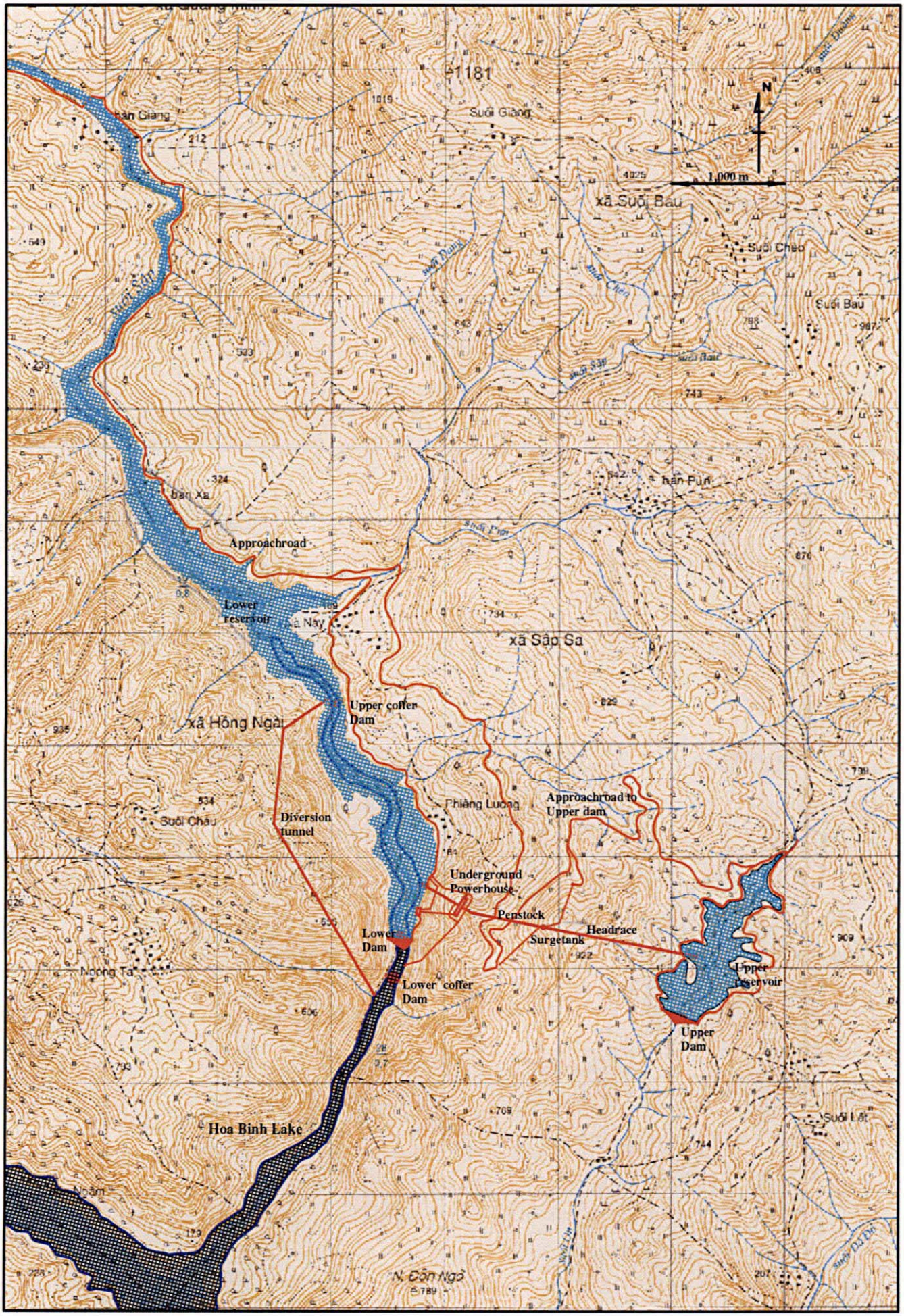

Figure 4-2-8 Layout of Phu Yen West (JN5) project