

### 13.1.3 Sensitivity Analysis

The sensitivity analysis of the project was implemented for the cases based on conditions stated below;

- (1) Increase of Construction Cost
- (2) Fluctuation of Fuel Prices
- (3) Suspension of Implementation of the Upper Kihansi Project

The results of the sensitivity analysis on the increase of the construction costs are shown in Fig. 13-2. On the basis of these results, it can be concluded that the Project is feasible and superior to the alternative thermal power plant as long as the ratio of the increase of the construction costs does not exceed 75%.

Judging from the cost flow and the benefit flow in Table 13-2 in the case that the benefit from the fuel cost is zero, the project is feasible (EIRR: 23.29%) regardless of the fluctuation of fuel prices.

The cost flow and the benefit flow for the above case (3) are presented in Table 13-4, and it can be also concluded that the project is feasible in the case that the Upper Kihansi Project is suspended.

Furthermore, EIRR calculated from the cost and the benefit of the Upper Kihansi Project is 11.26% as shown in Table 13-3, and it can be understood that the benefit of the project mainly comes from the Lower Kihansi Project.

Table 13-1 Cost and Benefit Flow of Kihansi Project (Upper and Lower)

Unit: 1,000us\$

Serial Number	No. after Completion	Cost			Total (N.P.V.)	Benefit			Total (N.P.V.)	B - C	
		Investment Cost	O&M Cost	Total		Investment Cost	O&M Cost	Total			
0		0.0		0.0	0.0			0.0	0.0	0.0	
1	(92)	13303.0		13303.0	12093.6			3.0	0.0	-13303.0	
2	(93)	13974.0		13974.0	11548.8			0.0	0.0	-13974.0	
3	(94)	17644.0		17644.0	13256.2	19049.4		19049.4	14312.1	1405.4	
4	(95)	42252.0		42252.0	28858.7	38098.8		38098.8	26022.0	-4153.2	
5	(96)	54784.0		54784.0	34016.6	96791.4		96791.4	60099.8	12007.4	
6	1	34506.0	1141.1	35647.1	20121.9	81153.9		7590.0	38743.9	50093.6	
7	2	69225.0	1190.4	70415.4	36134.3	42964.0	4706.3	12420.0	60090.4	30835.9	
8	3	53950.0	1190.4	55140.4	25723.4	16111.5	4706.3	12420.0	33237.9	15505.7	
9	4		2211.9	2211.9	938.1		7928.6	19987.0	27915.7	11839.0	
10	5		2211.9	2211.9	852.8		7928.6	19987.0	27915.7	10762.7	
11	6		2211.9	2211.9	775.3		7928.6	19987.0	27915.7	9784.3	
12	7		2211.9	2211.9	704.8		7928.6	19987.0	27915.7	8894.8	
13	8		2211.9	2211.9	640.7		7928.6	19987.0	27915.7	8086.2	
14	9		2211.9	2211.9	582.5		7928.6	19987.0	27915.7	7351.1	
15	10		2211.9	2211.9	529.5		7928.6	19987.0	27915.7	6682.8	
16	11		2211.9	2211.9	481.4		7928.6	19987.0	27915.7	6075.3	
17	12		2211.9	2211.9	437.6		7928.6	19987.0	27915.7	5523.0	
18	13		2211.9	2211.9	397.8		7928.6	19987.0	27915.7	5020.9	
19	14		2211.9	2211.9	361.7		7928.6	19987.0	27915.7	4564.4	
20	15		2211.9	2211.9	328.8		7928.6	19987.0	27915.7	4149.5	
21	16		2211.9	2211.9	298.9		7928.6	19987.0	27915.7	3772.3	
22	17		2211.9	2211.9	271.7		7928.6	19987.0	27915.7	3429.3	
23	18		2211.9	2211.9	247.0		7928.6	19987.0	27915.7	3117.6	
24	19		2211.9	2211.9	224.6		7928.6	19987.0	27915.7	2834.2	
25	20		2211.9	2211.9	204.1		7928.6	19987.0	27915.7	2576.5	
26	21		2211.9	2211.9	186.6		7928.6	19987.0	27915.7	2342.3	
27	22		2211.9	2211.9	168.7		7928.6	19987.0	27915.7	2129.3	
28	23		2211.9	2211.9	153.4	19049.4	7928.6	19987.0	46965.1	3256.7	
29	24		2211.9	2211.9	139.4	38098.8	7928.6	19987.0	66014.5	4161.5	
30	25		2211.9	2211.9	126.8	66909.9	7928.6	19987.0	94825.6	5434.3	
31	26		2211.9	2211.9	115.2	51272.4	7928.6	19987.0	79188.1	4125.6	
32	27		2211.9	2211.9	104.8	42964.0	7928.6	19987.0	70879.7	3357.0	
33	28		2211.9	2211.9	95.2		7928.6	19987.0	44027.2	1895.7	
34	29		2211.9	2211.9	86.6		7928.6	19987.0	27915.7	1092.7	
35	30		2211.9	2211.9	78.7		7928.6	19987.0	27915.7	993.4	
36	31		2211.9	2211.9	71.6		7928.6	19987.0	27915.7	903.0	
37	32		2211.9	2211.9	65.0		7928.6	19987.0	27915.7	821.0	
38	33		2211.9	2211.9	59.1		7928.6	19987.0	27915.7	746.3	
39	34	18261.0	2211.9	20472.9	497.6		7928.6	19987.0	27915.7	678.5	
40	35	34810.0	2211.9	37021.9	818.0	29881.5	7928.6	19987.0	57797.2	1277.0	
41	36	3289.0	2211.9	5500.9	110.5	29881.5	7928.6	19987.0	57797.2	1160.9	
42	37	5184.0	2211.9	7395.9	135.1		7928.6	19987.0	27915.7	509.7	
43	38	9824.0	2211.9	12035.9	199.8		7928.6	19987.0	27915.7	463.4	
44	39		2211.9	2211.9	33.4		7928.6	19987.0	27915.7	421.3	
45	40		2211.9	2211.9	30.3		7928.6	19987.0	27915.7	383.0	
46	41		2211.9	2211.9	27.6		7928.6	19987.0	27915.7	348.2	
47	42		2211.9	2211.9	25.1		7928.6	19987.0	27915.7	316.5	
48	43		2211.9	2211.9	22.8		7928.6	19987.0	27915.7	287.7	
49	44		2211.9	2211.9	20.7		7928.6	19987.0	27915.7	261.6	
50	45		2211.9	2211.9	18.8		7928.6	19987.0	27915.7	237.8	
51	46		2211.9	2211.9	17.1		7928.6	19987.0	27915.7	216.2	
52	47		2211.9	2211.9	15.6		7928.6	19987.0	27915.7	196.5	
53	48		2211.9	2211.9	14.2		7928.6	19987.0	27915.7	178.7	
54	49		2211.9	2211.9	12.9		7928.6	19987.0	27915.7	162.4	
55	50		2211.9	2211.9	11.7		7928.6	19987.0	27915.7	147.7	
56											
		371006.0	107481.3	478487.3	193491.8	588338.0	382058.0	971820.6	1942216.6	339838.6	1463729.3

B - C 146346.80  
 B / C 1.7563462  
 E D R 0.3930919

Table 13-2 Cost and Benefit Flow of Sensitivity Analysis of Kihansi Project (Upper and Lower)  
(Benefit from Fuel Cost is zero)

Unit:1,000us\$

Serial Number	No. after Completion	Cost			Benefit			B - C	
		Investment Cost	O&M Cost	Total	Investment Cost	O&M Cost	Total		
0		0.0		0.0		0.0		0.0	
1	(92)	13303.0		13303.0	12093.6	0.0	12093.6	-13303.0	
2	(93)	13974.0		13974.0	11548.8	0.0	11548.8	-13974.0	
3	(94)	17644.0		17644.0	13256.2	19049.4	32005.6	14361.6	
4	(95)	42252.0		42252.0	28858.7	38098.8	66957.5	24705.5	
5	(96)	54784.0		54784.0	34016.6	96791.4	130808.0	76024.0	
6	1	34506.0	1141.1	35647.1	20121.9	81153.9	101275.8	65628.7	
7	2	69225.0	1190.4	70415.4	36134.3	42964.0	79398.3	9353.9	
8	3	53950.0	1190.4	55140.4	25723.4	16111.5	41834.9	-13305.5	
9	4		2211.9	2211.9	938.1		7928.6	5716.7	
10	5		2211.9	2211.9	852.8		7928.6	5716.7	
11	6		2211.9	2211.9	775.3		7928.6	5716.7	
12	7		2211.9	2211.9	704.8		7928.6	5716.7	
13	8		2211.9	2211.9	640.7		7928.6	5716.7	
14	9		2211.9	2211.9	582.5		7928.6	5716.7	
15	10		2211.9	2211.9	529.5		7928.6	5716.7	
16	11		2211.9	2211.9	481.4		7928.6	5716.7	
17	12		2211.9	2211.9	437.6		7928.6	5716.7	
18	13		2211.9	2211.9	397.8		7928.6	5716.7	
19	14		2211.9	2211.9	361.7		7928.6	5716.7	
20	15		2211.9	2211.9	328.8		7928.6	5716.7	
21	16		2211.9	2211.9	298.9		7928.6	5716.7	
22	17		2211.9	2211.9	271.7		7928.6	5716.7	
23	18		2211.9	2211.9	247.0		7928.6	5716.7	
24	19		2211.9	2211.9	224.6		7928.6	5716.7	
25	20		2211.9	2211.9	204.1		7928.6	5716.7	
26	21		2211.9	2211.9	185.6		7928.6	5716.7	
27	22		2211.9	2211.9	168.7		7928.6	5716.7	
28	23		2211.9	2211.9	153.4	19049.4	26978.0	24766.1	
29	24		2211.9	2211.9	139.4	38098.8	46027.4	43815.5	
30	25		2211.9	2211.9	126.8	66909.9	74838.5	72626.6	
31	26		2211.9	2211.9	115.2	51272.4	59201.0	56983.1	
32	27		2211.9	2211.9	104.8	42964.0	50892.6	48580.7	
33	28		2211.9	2211.9	95.2	16111.5	24040.1	21828.2	
34	29		2211.9	2211.9	86.6		7928.6	5716.7	
35	30		2211.9	2211.9	78.7		7928.6	5716.7	
36	31		2211.9	2211.9	71.6		7928.6	5716.7	
37	32		2211.9	2211.9	65.0		7928.6	5716.7	
38	33		2211.9	2211.9	59.1		7928.6	5716.7	
39	34	18261.0	2211.9	20472.9	497.6		7928.6	192.7	
40	35	34810.0	2211.9	37021.9	818.0	29881.5	37810.1	-12544.3	
41	36	3289.0	2211.9	5500.9	110.5	29881.5	37810.1	788.2	
42	37	5184.0	2211.9	7395.9	135.1		7928.6	32309.2	
43	38	9824.0	2211.9	12035.9	199.8		7928.6	144.8	
44	39		2211.9	2211.9	33.4		7928.6	131.6	
45	40		2211.9	2211.9	30.3		7928.6	119.7	
46	41		2211.9	2211.9	27.6		7928.6	108.8	
47	42		2211.9	2211.9	25.1		7928.6	98.9	
48	43		2211.9	2211.9	22.8		7928.6	89.9	
49	44		2211.9	2211.9	20.7		7928.6	81.7	
50	45		2211.9	2211.9	18.8		7928.6	74.3	
51	46		2211.9	2211.9	17.1		7928.6	67.5	
52	47		2211.9	2211.9	15.6		7928.6	61.4	
53	48		2211.9	2211.9	14.2		7928.6	55.8	
54	49		2211.9	2211.9	12.9		7928.6	50.7	
55	50		2211.9	2211.9	11.7		7928.6	46.1	
56		371006.0	107481.3	478487.3	193491.8	588338.0	382058.0	970396.0	231203.0

B - C 37711.147  
B / C 1.1948978  
E D R 0.2328895

Fig. 13-2 Sensitivity Analysis - Construction Cost

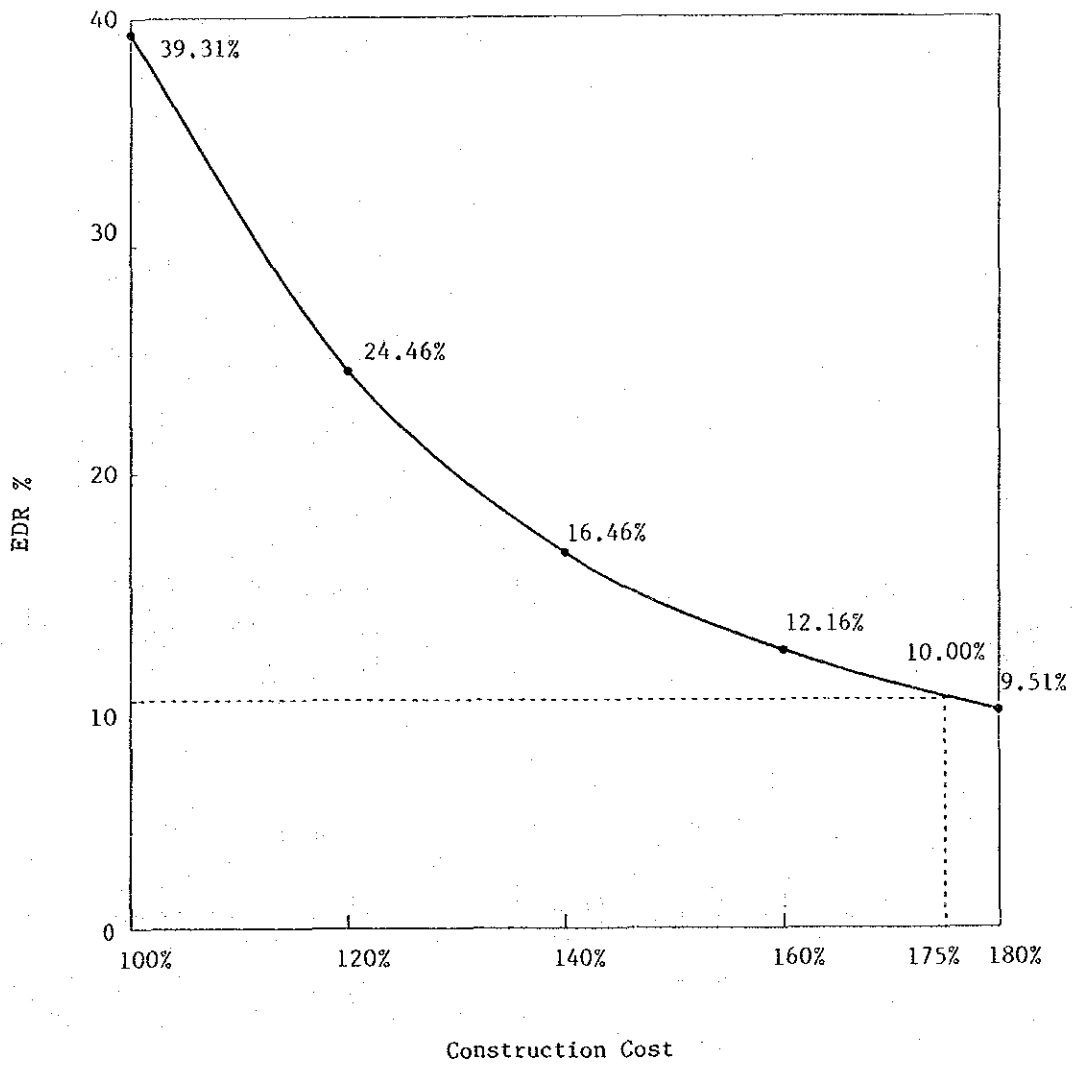


Table 13-3 Cost and Benefit Flow of Upper Kihansi Project

Unit:1,000us\$

Serial Number	No. after Completion	Cost			Benefit				B - C		
		Investment Cost	O&M Cost	Total (N.P.V.)	Investment Cost	O&M Cost	Fuel Cost	Total (N.P.V.)			
0		0.0		0.0	0.0			0.0	0.0		
1	(95)	3936.0		3936.0	3578.2			0.0	-3936.0		
2	(96)	15729.0		15729.0	12999.2			0.0	-15729.0		
3	(97)	31217.0		31217.0	23453.8			16111.5	-15105.5		
4	(98)	69225.0		69225.0	47281.6			32223.0	-37002.0		
5	(99)	53950.0		53950.0	33498.7			42964.0	-10986.0		
6	1		1021.5	1021.5	576.6	16111.5		16111.5	15090.0		
7	2		1021.5	1021.5	524.2		3222.3	7567.0	5836.6		
8	3		1021.5	1021.5	476.5		3222.3	7567.0	5033.3		
9	4		1021.5	1021.5	433.2		3222.3	7567.0	4575.7		
10	5		1021.5	1021.5	393.8		3222.3	7567.0	4159.7		
11	6		1021.5	1021.5	358.0		3222.3	7567.0	3781.6		
12	7		1021.5	1021.5	325.5		3222.3	7567.0	3437.8		
13	8		1021.5	1021.5	295.9		3222.3	7567.0	3125.3		
14	9		1021.5	1021.5	269.0		3222.3	7567.0	2841.2		
15	10		1021.5	1021.5	244.5		3222.3	7567.0	2582.9		
16	11		1021.5	1021.5	222.3		3222.3	7567.0	2348.1		
17	12		1021.5	1021.5	202.1		3222.3	7567.0	2134.6		
18	13		1021.5	1021.5	183.7		3222.3	7567.0	1940.5		
19	14		1021.5	1021.5	167.0		3222.3	7567.0	1784.1		
20	15		1021.5	1021.5	151.8		3222.3	7567.0	1603.8		
21	16		1021.5	1021.5	138.0		3222.3	7567.0	1458.0		
22	17		1021.5	1021.5	125.5		3222.3	7567.0	1325.4		
23	18		1021.5	1021.5	114.1		3222.3	7567.0	1204.9		
24	19		1021.5	1021.5	103.7		3222.3	7567.0	1095.4		
25	20		1021.5	1021.5	94.3		3222.3	7567.0	995.8		
26	21		1021.5	1021.5	85.7		3222.3	7567.0	905.3		
27	22		1021.5	1021.5	77.9		3222.3	7567.0	823.0		
28	23		1021.5	1021.5	70.8	16111.5	3222.3	7567.0	26900.8		
29	24		1021.5	1021.5	64.4	32223.0	3222.3	7567.0	43012.3		
30	25		1021.5	1021.5	58.5	42964.0	3222.3	7567.0	53753.3		
31	26		1021.5	1021.5	53.2	16111.5	3222.3	7567.0	26900.8		
32	27		1021.5	1021.5	48.4		3222.3	7567.0	10789.3		
33	28		1021.5	1021.5	44.0		3222.3	7567.0	10789.3		
34	29		1021.5	1021.5	40.0		3222.3	7567.0	10789.3		
35	30		1021.5	1021.5	36.3		3222.3	7567.0	10789.3		
36	31		1021.5	1021.5	33.0		3222.3	7567.0	10789.3		
37	32	106.0	1021.5	1127.5	33.2		3222.3	7567.0	10789.3		
38	33		1021.5	1021.5	27.3		3222.3	7567.0	10789.3		
39	34	5184.0	1021.5	6205.5	150.8		3222.3	7567.0	10789.3		
40	35	9824.0	1021.5	10845.5	239.6		3222.3	7567.0	10789.3		
41	36		1021.5	1021.5	20.5		3222.3	7567.0	10789.3		
42	37		1021.5	1021.5	18.7		3222.3	7567.0	10789.3		
43	38		1021.5	1021.5	17.0		3222.3	7567.0	10789.3		
44	39		1021.5	1021.5	15.4		3222.3	7567.0	10789.3		
45	40		1021.5	1021.5	14.0		3222.3	7567.0	10789.3		
46	41		1021.5	1021.5	12.7		3222.3	7567.0	10789.3		
47	42		1021.5	1021.5	11.6		3222.3	7567.0	10789.3		
48	43		1021.5	1021.5	10.5		3222.3	7567.0	10789.3		
49	44		1021.5	1021.5	9.6		3222.3	7567.0	10789.3		
50	45		1021.5	1021.5	8.7		3222.3	7567.0	10789.3		
51	46		1021.5	1021.5	7.9		3222.3	7567.0	10789.3		
52	47		1021.5	1021.5	7.2		3222.3	7567.0	10789.3		
53	48		1021.5	1021.5	6.5		3222.3	7567.0	10789.3		
54	49		1021.5	1021.5	5.9		3222.3	7567.0	10789.3		
55	50		1021.5	1021.5	5.4		3222.3	7567.0	10789.3		
56		189171.0	51072.8	240243.8	127446.0	214820.0	157892.7	370782.3	743495.0	136667.5	503251.3

B - C 9221.4591  
 B / C 1.0723567  
 E D R 0.1126488

Table 13-4 Cost and Benefit Flow of Lower Kihansi Project

Unit:1,000us\$

Serial Number	No. after Completion	Investment Cost	Cost			Investment Cost	O&M Cost	Benefit			B - C
			O&M Cost	Total	Total (N.P.V.)			Fuel Cost	Total	Total (N.P.V.)	
0		0.0		0.0	0.0	0.0			0.0	0.0	0.0
1	(92)	13303.0		13303.0	12093.6	0.0			0.0	0.0	-13303.0
2	(93)	13974.0		13974.0	11548.8	0.0			0.0	0.0	-13974.0
3	(94)	17644.0		17644.0	13256.2	19049.4		19049.4	14312.1	1405.4	
4	(95)	38316.0		38316.0	26170.3	38098.8		38098.8	26022.0	-217.2	
5	(96)	39055.0		39055.0	24250.1	80679.9		80679.9	50095.9	41624.9	
6	1	3289.0	1141.1	4430.1	2500.7	48930.9		7590.0	56520.9	31904.6	52090.8
7	2		1190.4	1190.4	610.9		4706.3	12420.0	17126.4	8788.5	15935.9
8	3		1190.4	1190.4	555.4		4706.3	12420.0	17126.4	7989.6	15935.9
9	4		1190.4	1190.4	504.9		4706.3	12420.0	17126.4	7263.3	15935.9
10	5		1190.4	1190.4	459.0		4706.3	12420.0	17126.4	6603.0	15935.9
11	6		1190.4	1190.4	417.2		4706.3	12420.0	17126.4	6002.7	15935.9
12	7		1190.4	1190.4	379.3		4706.3	12420.0	17126.4	5457.0	15935.9
13	8		1190.4	1190.4	344.8		4706.3	12420.0	17126.4	4960.9	15935.9
14	9		1190.4	1190.4	313.5		4706.3	12420.0	17126.4	4509.9	15935.9
15	10		1190.4	1190.4	285.0		4706.3	12420.0	17126.4	4099.9	15935.9
16	11		1190.4	1190.4	259.1		4706.3	12420.0	17126.4	3727.2	15935.9
17	12		1190.4	1190.4	235.5		4706.3	12420.0	17126.4	3388.4	15935.9
18	13		1190.4	1190.4	214.1		4706.3	12420.0	17126.4	3080.3	15935.9
19	14		1190.4	1190.4	194.6		4706.3	12420.0	17126.4	2800.3	15935.9
20	15		1190.4	1190.4	177.0		4706.3	12420.0	17126.4	2545.7	15935.9
21	16		1190.4	1190.4	160.9		4706.3	12420.0	17126.4	2314.3	15935.9
22	17		1190.4	1190.4	146.2		4706.3	12420.0	17126.4	2103.9	15935.9
23	18		1190.4	1190.4	132.0		4706.3	12420.0	17126.4	1912.6	15935.9
24	19		1190.4	1190.4	120.9		4706.3	12420.0	17126.4	1738.8	15935.9
25	20		1190.4	1190.4	109.9		4706.3	12420.0	17126.4	1580.7	15935.9
26	21		1190.4	1190.4	99.9		4706.3	12420.0	17126.4	1437.0	15935.9
27	22		1190.4	1190.4	90.8		4706.3	12420.0	17126.4	1306.4	15935.9
28	23		1190.4	1190.4	82.5	19049.4	4706.3	12420.0	36175.8	2508.5	34985.3
29	24		1190.4	1190.4	75.0	38098.8	4706.3	12420.0	55225.2	3481.4	64034.7
30	25		1190.4	1190.4	68.2	50798.4	4706.3	12420.0	67924.8	3892.7	66734.3
31	26		1190.4	1190.4	62.0	19049.4	4706.3	12420.0	36175.8	1884.7	34985.3
32	27		1190.4	1190.4	56.4		4706.3	12420.0	17126.4	811.1	15935.9
33	28		1190.4	1190.4	51.3		4706.3	12420.0	17126.4	737.4	15935.9
34	29		1190.4	1190.4	46.6		4706.3	12420.0	17126.4	670.4	15935.9
35	30		1190.4	1190.4	42.4		4706.3	12420.0	17126.4	609.4	15935.9
36	31		1190.4	1190.4	38.5		4706.3	12420.0	17126.4	554.0	15935.9
37	32		1190.4	1190.4	35.0		4706.3	12420.0	17126.4	503.7	15935.9
38	33		1190.4	1190.4	31.8		4706.3	12420.0	17126.4	457.9	15935.9
39	34	18261.0	1190.4	19451.4	472.8		4706.3	12420.0	17126.4	416.2	-2925.1
40	35	31704.0	1190.4	35894.4	793.1	29881.5	4706.3	12420.0	47007.9	1038.6	11113.4
41	36	3289.0	1190.4	4479.4	90.0	29881.5	4706.3	12420.0	47007.9	944.2	42528.4
42	37		1190.4	1190.4	21.7		4706.3	12420.0	17126.4	312.7	15935.9
43	38		1190.4	1190.4	19.8		4706.3	12420.0	17126.4	284.3	15935.9
44	39		1190.4	1190.4	18.0		4706.3	12420.0	17126.4	258.5	15935.9
45	40		1190.4	1190.4	16.3		4706.3	12420.0	17126.4	235.0	15935.9
46	41		1190.4	1190.4	14.8		4706.3	12420.0	17126.4	213.6	15935.9
47	42		1190.4	1190.4	13.5		4706.3	12420.0	17126.4	194.2	15935.9
48	43		1190.4	1190.4	12.3		4706.3	12420.0	17126.4	176.5	15935.9
49	44		1190.4	1190.4	11.2		4706.3	12420.0	17126.4	160.5	15935.9
50	45		1190.4	1190.4	10.1		4706.3	12420.0	17126.4	145.9	15935.9
51	46		1190.4	1190.4	9.2		4706.3	12420.0	17126.4	132.6	15935.9
52	47		1190.4	1190.4	8.4		4706.3	12420.0	17126.4	120.6	15935.9
53	48		1190.4	1190.4	7.6		4706.3	12420.0	17126.4	109.6	15935.9
54	49		1190.4	1190.4	6.9		4706.3	12420.0	17126.4	99.6	15935.9
55	50		1190.4	1190.4	6.3		4706.3	12420.0	17126.4	90.6	15935.9
56		181836.0	69472.9	241307.9	97753.2	373518.0	230609.9	616172.2	1220300.2	226989.3	978992.3

B - C 129236.15  
 B / C 2.3220663  
 B D R 0.4593853

## 13.2 Financial Analysis

### 13.2.1 Methodology and basic Conditions

#### (1) Methodology

For the financial analysis of this Project, the financial internal rate of return (FIRR), in which the present value of the revenue from business (revenue from power sold) equals the present value of the total cost, will be calculated. And the profitability of this project will be judged by comparing the EDR with the discount rate that reflects the capital opportunity cost.

The cost applicable to this evaluation will include the total investment (construction cost with the import duty and the interest during construction) without consideration of the financing conditions, such as interest excluding the interest during construction, repayment of principal, repayment period, etc., and the operation and maintenance cost.

In this evaluation, the profitability of the investment for the project will be judged regardless of financing conditions.

#### (2) Basic Conditions

The basic conditions for implementing the financial evaluation of this project will be as follows:

##### i) Financing Conditions

###### (a) Foreign Currency Portion

Interest : 8.5%

Commitment fee: Not considered

(b) Local Currency Portion

Interest: 12%

ii) Electric Sales Revenue

The electric sales revenue will be estimated using the weighted average tariff of the TANESCO.

iii) Construction Cost

The construction cost including the import duty and interest during construction will be used.

iv) Depreciation

The straight line method is adopted.

v) Operation and Maintenance Costs

Civil Structure: 0.5% of the construction cost

Hydraulic

Equipment : 1.5% of the construction cost

Electro-Mechanical

Equipment : 1.5% of the construction cost

### 13.2.2 Financial Analysis

#### (1) Construction Cost

The construction cost adopted for calculation of FIRR is as follows:

Upper Kihansi Project: 261,000 x 10<sup>3</sup> US\$

Lower Kihansi Project: 206,000 x 10<sup>3</sup> US\$

Total 476,000 x 10<sup>3</sup> US\$



(2) Operation and Maintenance Cost

The operation and maintenance cost based on the above construction cost is as follows:

Upper Kihansi Project

Civil Structure

(Construction Cost x 0.5%):  $1,200 \times 10^3$  US\$/year

Other Facilities

(Construction Cost x 1.5%):  $315 \times 10^3$  US\$/year

Lower Kihansi Project

Civil Structure

(Construction Cost x 0.5%):  $611 \times 10^3$  US\$/year

Other Facilities

(Construction Cost x 1.5%):  $1,258 \times 10^3$  US\$/year

---

Total  $3,384 \times 10^3$  US\$/year

(3) Revenue

The annual energy production which can be sold to consumers considering the station service rate and the transmission lose rate of the project is as follows:

Upper Kihansi Project:  $269.3 \times 10^6$  KWh

Lower Kihansi Project:  $850.7 \times 10^6$  KWh

Total  $1,120.0 \times 10^6$  KWh

For calculation of the revenue from the project, 0.0616 US\$/KWh (3.958 Tsh/KWh) is used as the weighted average tariff of TANESCO. This average tariff is calculated based on "TANESCO-Report of the Auditors" dated 29th December, 1988.

(4) Financial Internal Rate of Return (FIRR)

The cost flow and the flow of the revenue are presented in Table 13-5 based on the above calculation, and FIRR is evaluated as 12.07%.

Judging from this FIRR, it can be concluded that this project is sound from the financial point of view.

FIRRs of the Upper Kihansi Project and the Lower Kihansi Project are 6.49% and 12.74% respectively as presented in Table 13-6 and Table 13-7, and it can be understood that total financial feasibility of the project owes to the Lower Kihansi Project.

Table 13-5 Cost Flow and Flow of Revenue of Kihansi Project (Upper and Lower)

Unit:1,000us\$

Serial Number	Year	Cost			Revenue	B - C
		Investment Cost	O&M Cost	Total		
0	1991	0.0		0.0		0.0
1	1992	17493.0		17493.0		-17493.0
2	1993	20438.0		20438.0		-20438.0
3	1994	27808.0		27808.0		-27808.0
4	1995	64030.0		64030.0		-64030.0
5	1996	86701.0		86701.0		-86701.0
6	1997	64921.0	1575.9	66496.9	20742.1	-45754.8
7	1998	99160.0	1869.0	101029.0	33941.6	-67087.4
8	1999	86449.0	1869.0	88318.0	33941.6	-54376.4
9	2000		3384.0	3384.0	68992.0	65608.0
10	2001		3384.0	3384.0	68992.0	65608.0
11	2002		3384.0	3384.0	68992.0	65608.0
12	2003		3384.0	3384.0	68992.0	65608.0
13	2004		3384.0	3384.0	68992.0	65608.0
14	2005		3384.0	3384.0	68992.0	65608.0
15	2006		3384.0	3384.0	68992.0	65608.0
16	2007		3384.0	3384.0	68992.0	65608.0
17	2008		3384.0	3384.0	68992.0	65608.0
18	2009		3384.0	3384.0	68992.0	65608.0
19	2010		3384.0	3384.0	68992.0	65608.0
20	2011		3384.0	3384.0	68992.0	65608.0
21	2012		3384.0	3384.0	68992.0	65608.0
22	2013		3384.0	3384.0	68992.0	65608.0
23	2014		3384.0	3384.0	68992.0	65608.0
24	2015		3384.0	3384.0	68992.0	65608.0
25	2016		3384.0	3384.0	68992.0	65608.0
26	2017		3384.0	3384.0	68992.0	65608.0
27	2018		3384.0	3384.0	68992.0	65608.0
28	2019		3384.0	3384.0	68992.0	65608.0
29	2020		3384.0	3384.0	68992.0	65608.0
30	2021		3384.0	3384.0	68992.0	65608.0
31	2022		3384.0	3384.0	68992.0	65608.0
32	2023		3384.0	3384.0	68992.0	65608.0
33	2024		3384.0	3384.0	68992.0	65608.0
34	2025		3384.0	3384.0	68992.0	65608.0
35	2026		3384.0	3384.0	68992.0	65608.0
36	2027		3384.0	3384.0	68992.0	65608.0
37	2028		3384.0	3384.0	68992.0	65608.0
38	2029		3384.0	3384.0	68992.0	65608.0
39	2030	24849.8	3384.0	28233.8	68992.0	40758.3
40	2031	49151.8	3384.0	52535.8	68992.0	16456.3
41	2032	10003.0	3384.0	13387.0	68992.0	55605.0
42	2033	7010.8	3384.0	10394.8	68992.0	58597.3
43	2034	13824.3	3384.0	17208.3	68992.0	51783.8
44	2035		3384.0	3384.0	68992.0	65608.0
45	2036		3384.0	3384.0	68992.0	65608.0
46	2037		3384.0	3384.0	68992.0	65608.0
47	2038		3384.0	3384.0	68992.0	65608.0
48	2039		3384.0	3384.0	68992.0	65608.0
49	2040		3384.0	3384.0	68992.0	65608.0
50	2041		3384.0	3384.0	68992.0	65608.0
51	2042		3384.0	3384.0	68992.0	65608.0
52	2043		3384.0	3384.0	68992.0	65608.0
53	2044		3384.0	3384.0	68992.0	65608.0
54	2045		3384.0	3384.0	68992.0	65608.0
55	2046		3384.0	3384.0	68992.0	65608.0
		571839.5	164361.9	736201.4	3331249.3	2595047.9

Table 13-6 Cost Flow and Flow of Revenue of Upper Kihansi Project

Unit:1,000us\$

Serial Number	Year	Cost			Revenue	B - C
		Investment Cost	O&M Cost	Total		
0	1994	0.0		0.0		0.0
1	1995	6454.0		6454.0		-6454.0
2	1996	23556.0		23556.0		-23556.0
3	1997	45381.0		45381.0		-45381.0
4	1998	99160.0		99160.0		-99160.0
5	1999	86449.0		86449.0		-86449.0
6	2000		1515.0	1515.0	20679.1	19164.1
7	2001		1515.0	1515.0	20679.1	19164.1
8	2002		1515.0	1515.0	20679.1	19164.1
9	2003		1515.0	1515.0	20679.1	19164.1
10	2004		1515.0	1515.0	20679.1	19164.1
11	2005		1515.0	1515.0	20679.1	19164.1
12	2006		1515.0	1515.0	20679.1	19164.1
13	2007		1515.0	1515.0	20679.1	19164.1
14	2008		1515.0	1515.0	20679.1	19164.1
15	2009		1515.0	1515.0	20679.1	19164.1
16	2010		1515.0	1515.0	20679.1	19164.1
17	2011		1515.0	1515.0	20679.1	19164.1
18	2012		1515.0	1515.0	20679.1	19164.1
19	2013		1515.0	1515.0	20679.1	19164.1
20	2014		1515.0	1515.0	20679.1	19164.1
21	2015		1515.0	1515.0	20679.1	19164.1
22	2016		1515.0	1515.0	20679.1	19164.1
23	2017		1515.0	1515.0	20679.1	19164.1
24	2018		1515.0	1515.0	20679.1	19164.1
25	2019		1515.0	1515.0	20679.1	19164.1
26	2020		1515.0	1515.0	20679.1	19164.1
27	2021		1515.0	1515.0	20679.1	19164.1
28	2022		1515.0	1515.0	20679.1	19164.1
29	2023		1515.0	1515.0	20679.1	19164.1
30	2024		1515.0	1515.0	20679.1	19164.1
31	2025		1515.0	1515.0	20679.1	19164.1
32	2026		1515.0	1515.0	20679.1	19164.1
33	2027		1515.0	1515.0	20679.1	19164.1
34	2028		1515.0	1515.0	20679.1	19164.1
35	2029		1515.0	1515.0	20679.1	19164.1
36	2030		1515.0	1515.0	20679.1	19164.1
37	2031	146.0	1515.0	1661.0	20679.1	19018.1
38	2032	12.0	1515.0	1527.0	20679.1	19152.1
39	2033	7010.8	1515.0	8525.8	20679.1	12153.4
40	2034	13824.3	1515.0	15339.3	20679.1	5339.9
41	2035		1515.0	1515.0	20679.1	19164.1
42	2036		1515.0	1515.0	20679.1	19164.1
43	2037		1515.0	1515.0	20679.1	19164.1
44	2038		1515.0	1515.0	20679.1	19164.1
45	2039		1515.0	1515.0	20679.1	19164.1
46	2040		1515.0	1515.0	20679.1	19164.1
47	2041		1515.0	1515.0	20679.1	19164.1
48	2042		1515.0	1515.0	20679.1	19164.1
49	2043		1515.0	1515.0	20679.1	19164.1
50	2044		1515.0	1515.0	20679.1	19164.1
51	2045		1515.0	1515.0	20679.1	19164.1
52	2046		1515.0	1515.0	20679.1	19164.1
53	2047		1515.0	1515.0	20679.1	19164.1
54	2048		1515.0	1515.0	20679.1	19164.1
55	2049		1515.0	1515.0	20679.1	19164.1
		281993.0	75750.0	357743.0	1033956.0	676213.0

Table 13-7 Cost Flow and Flow of Revenue of Lower Kihansi Project

Unit:1,000us\$

Serial Number	Year	Cost			Revenue	B - C
		Investment Cost	O&M Cost	Total		
0	1991	0.0		0.0		0.0
1	1992	17493.0		17493.0		-17493.0
2	1993	20438.0		20438.0		-20438.0
3	1994	27808.0		27808.0		-27808.0
4	1995	57576.0		57576.0		-57576.0
5	1996	63145.0		63145.0		-63145.0
6	1997	19540.0	1575.9	21115.9	20742.1	-373.8
7	1998		1869.0	1869.0	33941.6	32072.6
8	1999		1869.0	1869.0	33941.6	32072.6
9	2000		1869.0	1869.0	33941.6	32072.6
10	2001		1869.0	1869.0	33941.6	32072.6
11	2002		1869.0	1869.0	33941.6	32072.6
12	2003		1869.0	1869.0	33941.6	32072.6
13	2004		1869.0	1869.0	33941.6	32072.6
14	2005		1869.0	1869.0	33941.6	32072.6
15	2006		1869.0	1869.0	33941.6	32072.6
16	2007		1869.0	1869.0	33941.6	32072.6
17	2008		1869.0	1869.0	33941.6	32072.6
18	2009		1869.0	1869.0	33941.6	32072.6
19	2010		1869.0	1869.0	33941.6	32072.6
20	2011		1869.0	1869.0	33941.6	32072.6
21	2012		1869.0	1869.0	33941.6	32072.6
22	2013		1869.0	1869.0	33941.6	32072.6
23	2014		1869.0	1869.0	33941.6	32072.6
24	2015		1869.0	1869.0	33941.6	32072.6
25	2016		1869.0	1869.0	33941.6	32072.6
26	2017		1869.0	1869.0	33941.6	32072.6
27	2018		1869.0	1869.0	33941.6	32072.6
28	2019		1869.0	1869.0	33941.6	32072.6
29	2020		1869.0	1869.0	33941.6	32072.6
30	2021		1869.0	1869.0	33941.6	32072.6
31	2022		1869.0	1869.0	33941.6	32072.6
32	2023		1869.0	1869.0	33941.6	32072.6
33	2024		1869.0	1869.0	33941.6	32072.6
34	2025		1869.0	1869.0	33941.6	32072.6
35	2026		1869.0	1869.0	33941.6	32072.6
36	2027		1869.0	1869.0	33941.6	32072.6
37	2028		1869.0	1869.0	33941.6	32072.6
38	2029		1869.0	1869.0	33941.6	32072.6
39	2030	24849.8	1869.0	26718.8	33941.6	7222.9
40	2031	49005.8	1869.0	50874.8	33941.6	-16933.2
41	2032	9991.0	1869.0	11860.0	33941.6	22081.6
42	2033		1869.0	1869.0	33941.6	32072.6
43	2034		1869.0	1869.0	33941.6	32072.6
44	2035		1869.0	1869.0	33941.6	32072.6
45	2036		1869.0	1869.0	33941.6	32072.6
46	2037		1869.0	1869.0	33941.6	32072.6
47	2038		1869.0	1869.0	33941.6	32072.6
48	2039		1869.0	1869.0	33941.6	32072.6
49	2040		1869.0	1869.0	33941.6	32072.6
50	2041		1869.0	1869.0	33941.6	32072.6
51	2042		1869.0	1869.0	33941.6	32072.6
52	2043		1869.0	1869.0	33941.6	32072.6
53	2044		1869.0	1869.0	33941.6	32072.6
54	2045		1869.0	1869.0	33941.6	32072.6
55	2046		1869.0	1869.0	33941.6	32072.6
		289846.5	93156.9	383003.4	1683880.5	1300877.1

## **Chapter 14 Future Investigation Works**



Chapter 14

FUTURE INVESTIGATION WORKS

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**Fig. 14-1 Location Map of Future Investigation Works**



## Chapter 14 FUTURE INVESTIGATION WORKS

The following investigations are necessary to be executed for the definite design on the Lower Kihansi Project from now on.

### 14.1 Topographic Surveyings

- Area of Access Road

Supplemental surveying of the existing topographic map (scale 1 : 5,000)

- Areas of Aggregate Quarry Site and Temporary Construction Facilities Site

Topographic surveying (scale 1 : 1,000)

- Areas of Dam, Powerhouse, Switchyard and Outlet Sites

Topographic surveying (scale 1 : 500)

The areas of topographic surveying mentioned above are presented on Fig. 14-1.

### 14.2 Geologic Investigations

- Dam Site

Drilling investigation including permeability test to grasp the detailed geologic conditions at the upper part of both bank slopes nearby the dam abutment and the deep part of the river-bed.

Drilling	Left bank of dam	50 m x 1 hole
	River-bed	30 m x 1 hole
	Right bank of dam	50 m x 1 hole

- Headrace Tunnel Site

Drilling and adit investigations to confirm the geologic characteristics along the route of headrace and penstock tunnels.

Drilling	80 m x 2 holes
Adit	200 m x 1 adit

- Powerhouse and Outlet Sites

Drilling, adit, trench and seismic prospecting investigations to confirm the powerhouse foundation, depth to the rock foundation at the outlet site and lineament pattern.

Drilling	Powerhouse site	30 m x 2 holes
		80 m x 1 hole
	Outlet site	30 m x 1 hole
Adit		50 m x 1 adit
Trench		30 m x 2 trenches
Seismic prospecting		3 lines (1.8 km)

- Aggregate Quarry Site

Drilling investigation to grasp the geologic characteristics

Drilling	50 m x 1 hole
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The geologic investigation sites above mentioned are shown in Fig. 14-1.

### 14.3 Material Tests

Rock material at the upstream right bank of the lower dam and the adit sites which are promising as for concrete aggregate quarries is necessary to be performed the following tests.

- Crushing test
- Dam concrete mix proportion test using the crushed aggregate

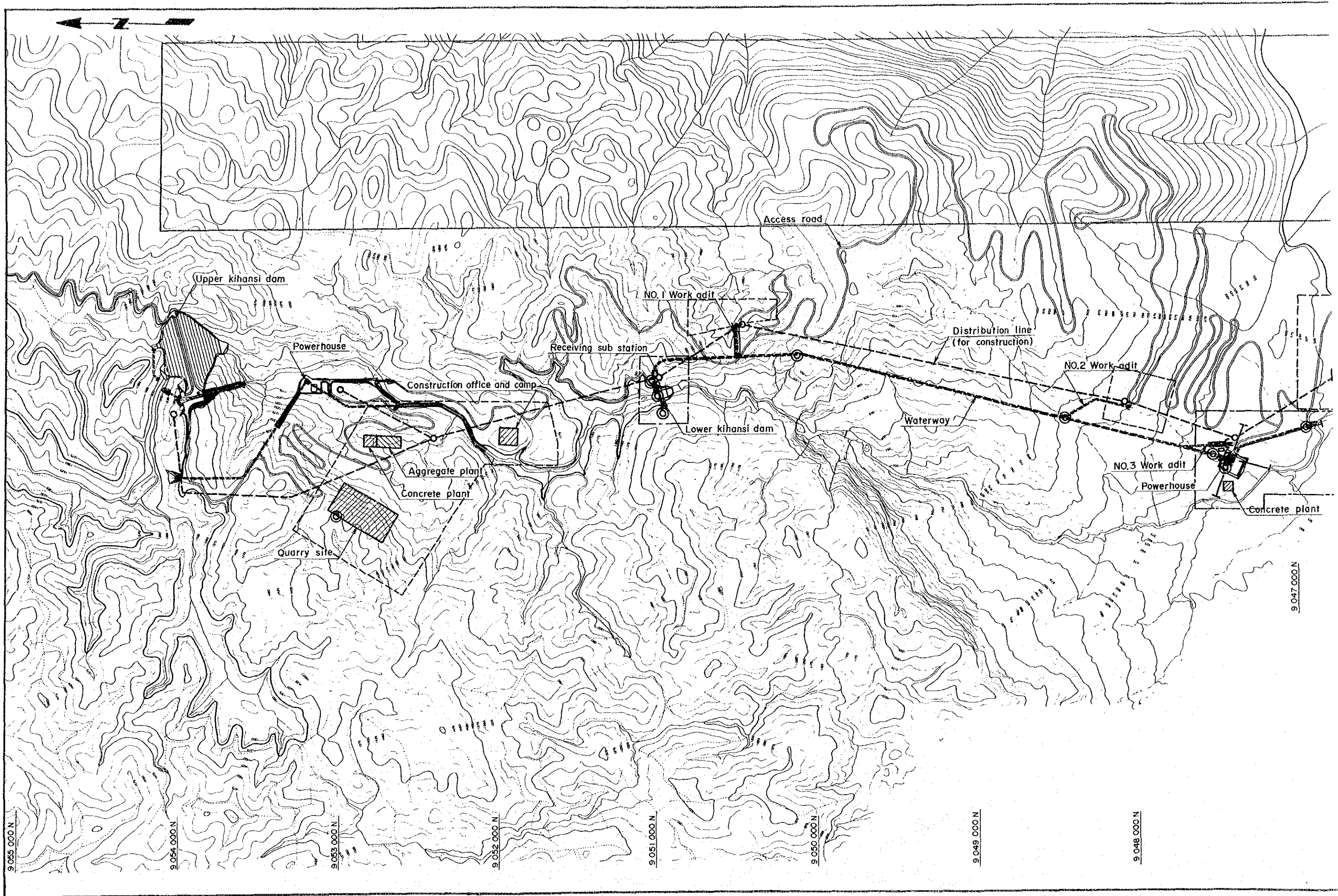
#### 14.4 Water Level and Discharge Measurement

- The Upper Dam Site (NC3 Runoff Gauging Station)  
Continuation of water level and discharge measurement
- The Lower Powerhouse Site (1KB28 - Runoff Gauging Stations)  
Continuation of water level and discharge measurement

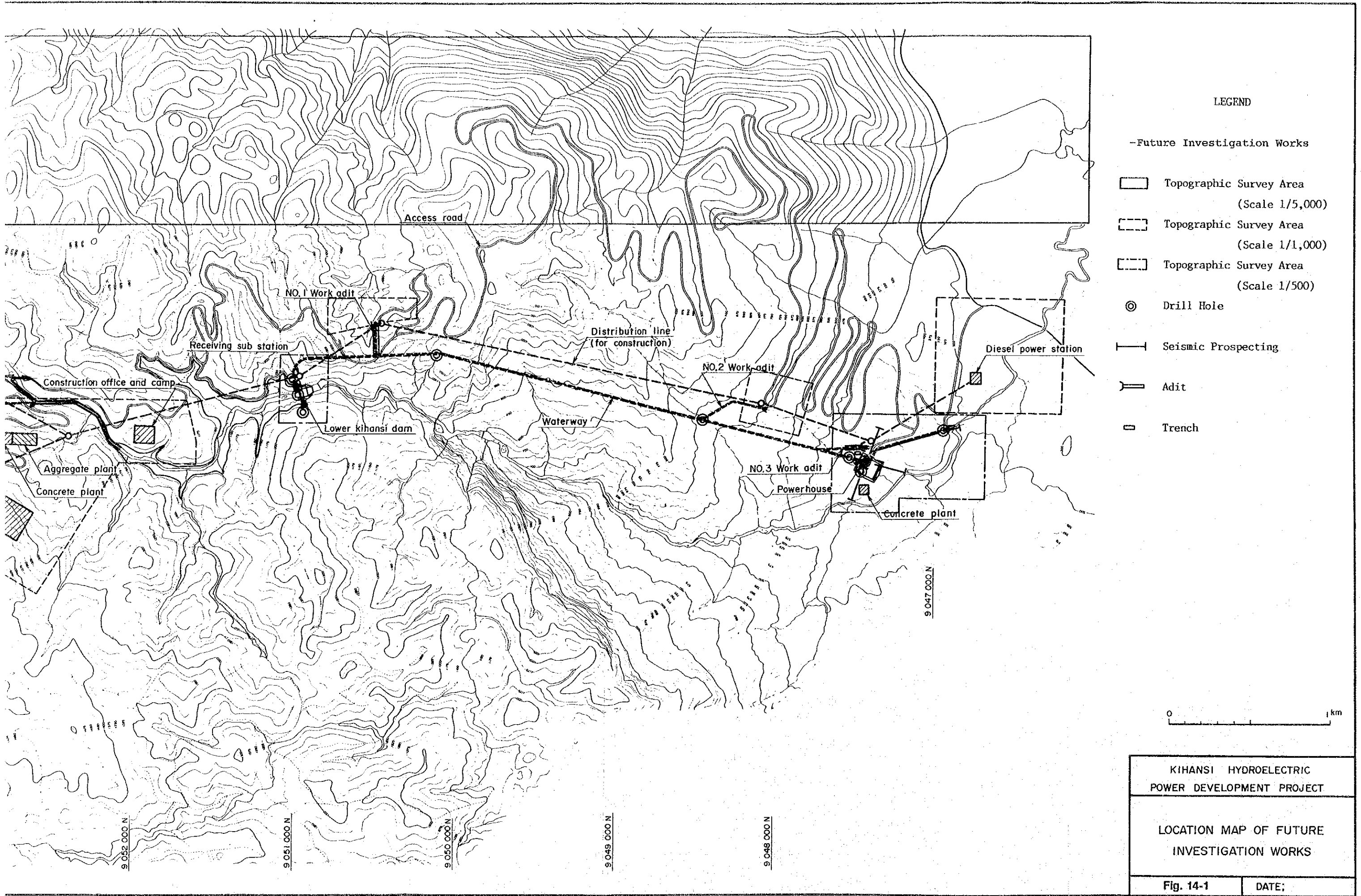
#### 14.5 Environmental Survey

- Survey of Influence on Social Environment  
Countermeasures to moderate the influence of the power generation plan on social environment should be studied by surveying the influence of submerged farmland on social environment in the region, substitute farmland, new residents, employment opportunity, etc.
- Public Health Survey  
The power generation plan should be designed to prevent new public health problems in the region from occurring by surveying and considering harmful animals and plants regarded as the media of diseases and the health of residents.
- Natural Environment Survey  
The power generation plan should be designed by surveying and considering animals and plants, especially

precious animals and plants, and existences of cultural assets, ruins and so on in the project area.







LEGEND

- Future Investigation Works
- Topographic Survey Area (Scale 1/5,000)
- Topographic Survey Area (Scale 1/1,000)
- Topographic Survey Area (Scale 1/500)
- Drill Hole
- Seismic Prospecting
- Adit
- Trench

KIHANSI HYDROELECTRIC  
POWER DEVELOPMENT PROJECT

LOCATION MAP OF FUTURE  
INVESTIGATION WORKS

Fig. 14-1      DATE:





































