

qualitatively based on the data and information made available so far. The environmental impact assessment was performed in compliance to EIA form, which was formulated through a number of discussions among the MOLG, NES and Study Team.

There are two areas to be objective of the environmental impact assessment. One is the sites of both Njoro and Town STWs, where the actual construction works take place for installation of sewage treatment facilities, and the other is Lake Nakuru, being beneficiary of the Project. The environmental impact assessment was conducted for two conditions: one is the construction period and the other is the operation period.

8.2 Environmental Impact Assessment

The summary of environmental impact assessment are shown in Table 8-1. The contemplated Project greatly contributes not only to alleviate pollution loads into Lake Nakuru but also make it possible to commence the additional water supply of 13,300 m³/day to the Nakuru Municipality. It is foreseeable that adverse environmental impacts resulting from the installation of a waste stabilization pond system will be kept minimum, and the positive impacts, alleviation of water pollution in particular, will greatly outweigh any potential negative impacts such as odour nuisance or sludge generation. Some aspects are forecast to be subjected to minor impact. The mitigation measures are studied and proposed for the respective item as also shown in Table 8-1.

9 FINANCIAL AND ECONOMIC EVALUATION

9.1 Financial Evaluation

The investment capital of the project construction costs (KShs. 1,427 million) was assumed to be procured as follows:

Case 1: A loan under the interest rate of 7% per annum and a repayment period of 30 years without a grace period; and

Case 2: A grant.

The O&M costs was estimated at KShs. 6.4 million per annum after the completion of the construction works. These costs were assumed to escalate annually at 4.2% for local currency portion and 2.3% for foreign currency portion. Incidentally, the physical life of the facility is assumed at 30 years.

The revenue through sewage treatment services is estimated at KShs. 12.9 million by NMC in the fiscal year 1992/93. The revenue increases to KShs. 25.4 million at 1993 constant prices after the completion of the construction works. The total annual income is calculated as a product of the annual sewage volume and the unit price which is arranged with price escalation.

Financial internal rate of return (FIRR) for gross capital was 1.8%. This rate is far smaller than the interest rates of 7% to 13%, which Local Government Loans Authority (LGLA) applies to local authorities. From the financial point of view, this Project might be not viable as far as the NMC procure the investment capital through LGLA. In order to make the project feasible, it would be necessary to introduce special funds and/or grants for relieve the burden of repayment and interest of loan.

Table 9-1 shows a financial stream of Case 1 and Table 9-2 of Case 2. The negative cash balance will continue to 23rd year. By the end of the physical facility life, the accumulated deficit will become KShs. 1,006.2 million. Accordingly, to manage the sewage service soundly, the NMC must employ the following two countermeasures: (1) to receive subsidies from the municipal finance and/or the central government finance; and (2) to increase sewage unit price to around 40% more than the present level. In Case 2, the cash balances can keep sound financial condition until the end of the facility life.

9.2 Economic Evaluation

In economic evaluation, the costs and benefits must be estimated in economic terms. The economic values are converted from financial values through conversion procedure. The economic costs were estimated at KShs. 1,257 million for construction works and KShs. 5.9 million for O&M after the completion of the Project.

This sewage works aim not only to conserve sanitary condition of the municipal area but also to maintain very delicate ecology of Lake Nakuru. Because, Nakuru Municipality is deemed as the major source of pollution load for Lake Nakuru. At the same time, Lake Nakuru is one of the most important tourist spots in Kenya. Accordingly, from the point of view of the national economy, it is important to keep the natural environment of Lake Nakuru. Taking this background of the Project into consideration, the two benefits could be selected as tangible benefits: 1) benefit on direct beneficiaries, i.e., residents and establishments such as factories, stores and other facilities covered by sewage treatment services and 2) benefit on conservation of tourism resources, i.e., nature of Lake Nakuru.

Table 9-1 Financial Stream of Income and Expenditure: Case 1

(Unit: Shs. million)																
Year	Capital Balance					Revenue Balance					Cash Accumulated					
	Income	Expenditure		Total	Balance	Sewage Charge	Income		Total	Operation & Maintenance	Depreciation #2	Interest of Loan	Total	Balance	Cash Balance #1	Cash Balance
		LGLA Loan	Construc- tion Cost				Repayment of Loan	Other Income								
1	316.4	316.4	0.0	316.4	0.0	18.1	0.1	18.2	6.2	0.0	22.1	28.3	-10.1	-10.1	-10.1	-10.1
2	957.3	957.3	10.5	967.9	-10.5	18.9	0.1	19.0	6.4	0.0	38.4	94.8	-75.8	-86.4	-96.4	-96.4
3	153.6	153.6	42.5	196.1	-42.5	19.7	0.1	19.8	6.7	0.0	96.2	102.9	-83.1	-125.5	-222.0	-222.0
4			47.6	47.6	-47.6	40.5	0.2	40.7	7.6	47.6	92.9	148.0	-107.3	-107.3	-329.3	-329.3
5			47.6	47.6	-47.6	42.2	0.2	42.4	7.9	47.6	89.5	145.0	-102.6	-102.6	-431.9	-431.9
6			47.6	47.6	-47.6	44.0	0.2	44.2	8.2	47.6	86.2	142.0	-97.8	-97.8	-529.7	-529.7
7			47.6	47.6	-47.6	45.8	0.2	46.0	8.5	47.6	82.9	139.0	-92.9	-92.9	-622.6	-622.6
8			47.6	47.6	-47.6	47.7	0.2	48.0	8.9	47.6	79.6	136.0	-88.0	-88.0	-710.6	-710.6
9			47.6	47.6	-47.6	49.7	0.3	50.0	9.2	47.6	76.2	133.0	-83.0	-83.0	-793.7	-793.7
10			47.6	47.6	-47.6	51.8	0.3	52.1	9.6	47.6	72.9	130.1	-78.0	-78.0	-871.7	-871.7
11			47.6	47.6	-47.6	54.0	0.3	54.3	10.0	47.6	69.6	127.1	-72.8	-72.8	-944.5	-944.5
12			47.6	47.6	-47.6	56.3	0.3	56.5	10.4	47.6	66.2	124.2	-67.6	-67.6	-1012.1	-1012.1
13			47.6	47.6	-47.6	58.6	0.3	58.9	10.8	47.6	62.9	121.3	-62.4	-62.4	-1074.5	-1074.5
14			47.6	47.6	-47.6	61.1	0.3	61.4	11.2	47.6	59.6	118.4	-57.0	-57.0	-1131.5	-1131.5
15			47.6	47.6	-47.6	63.7	0.3	64.0	11.7	47.6	56.2	115.5	-51.5	-51.5	-1183.0	-1183.0
16			47.6	47.6	-47.6	66.3	0.3	66.7	12.2	47.6	52.9	112.7	-46.0	-46.0	-1229.0	-1229.0
17			47.6	47.6	-47.6	69.1	0.4	69.5	12.7	47.6	49.6	109.8	-40.3	-40.3	-1269.3	-1269.3
18			47.6	47.6	-47.6	72.0	0.4	72.4	13.2	47.6	46.2	107.0	-34.6	-34.6	-1304.0	-1304.0
19			47.6	47.6	-47.6	75.0	0.4	75.4	13.7	47.6	42.9	104.2	-28.8	-28.8	-1332.7	-1332.7
20			47.6	47.6	-47.6	78.2	0.4	78.6	14.3	47.6	39.6	101.4	-22.8	-22.8	-1355.6	-1355.6
21			47.6	47.6	-47.6	81.5	0.4	81.9	14.8	47.6	36.3	98.7	-16.8	-16.8	-1372.4	-1372.4
22			47.6	47.6	-47.6	84.9	0.4	85.3	15.4	47.6	32.9	96.0	-10.6	-10.6	-1383.0	-1383.0
23			47.6	47.6	-47.6	88.5	0.5	88.9	16.1	47.6	29.6	93.2	-4.3	-4.3	-1387.3	-1387.3
24			47.6	47.6	-47.6	92.2	0.5	92.6	16.7	47.6	26.3	90.6	2.1	2.1	-1385.2	-1385.2
25			47.6	47.6	-47.6	96.0	0.5	96.5	17.4	47.6	22.9	87.9	8.6	8.6	-1376.6	-1376.6
26			47.6	47.6	-47.6	100.1	0.5	100.6	18.1	47.6	19.6	85.3	15.3	15.3	-1361.3	-1361.3
27			47.6	47.6	-47.6	104.3	0.5	104.8	18.9	47.6	16.3	82.7	22.1	22.1	-1339.2	-1339.2
28			47.6	47.6	-47.6	108.7	0.6	109.2	19.6	47.6	12.9	80.2	29.1	29.1	-1310.2	-1310.2
29			47.6	47.6	-47.6	113.2	0.6	113.8	20.4	47.6	9.6	77.6	36.2	36.2	-1274.0	-1274.0
30			47.6	47.6	-47.6	118.0	0.6	118.6	21.3	47.6	6.3	75.1	43.5	43.5	-1230.5	-1230.5
31			47.6	47.6	-47.6	122.9	0.6	123.6	22.1	47.6	3.0	72.7	50.9	50.9	-1179.6	-1179.6
32			37.0	37.0	-37.0	128.1	0.7	128.8	23.0	47.6	0.4	71.0	57.8	57.8	-1111.3	-1111.3
33			5.1	5.1	-5.1	133.5	0.7	134.2	24.0	47.6	0.0	71.6	62.6	105.1	-1006.2	-1006.2

Remark: *1 (Capital Balance)+(Revenue Balance)+(Depreciation)

*2 Loan charges of Kf64.053 is assumed to be included in the O&M cost till the 26th year.

(1) Benefit of residents and establishments

The benefit of residents is based on willingness-to-pay of the beneficiaries in the target areas. According to the questionnaire survey, the average willingness-to-pay was estimated at KShs. 36.42 per household in financial terms in 1993. The benefit of urban establishments was estimated a product of sewage volume from them and unit value of sewage which was calculated in the resident's benefit. The total benefit of both residents and establishments was KShs. 21.7 million in economic terms in 4th year.

(2) Conservation benefit of tourism resources

This benefit is estimated as a national revenue through tourism, i.e., the expenditure of tourists. Applying the results of the questionnaire survey, the total amount of tourists' expenditure in Lake Nakuru National Park was estimated at KShs. 434.6 million in 4th year in economic terms. Of course, this benefit does not always accrue from the effect of sewage system. However, if the sewage system does not exist and does not function to keep better environment for tourism resources in Lake Nakuru, this national revenue would decrease in the future because of water pollution of the lake. In this study, thus, the tourism benefit for the project is assumed to be a half of the total revenue.

Table 9-3 Economic Cost and Benefit Stream of Proposed Project

(Unit: KShs. million)

Year	Cost			Benefit			Balance
	Initial Construction Works	O&M Works	Total	Residents & Estab- lishments	Tourism	Total	
1	255.7		255.7			0.0	-255.7
2	743.7		743.7			0.0	-743.7
3	116.7		116.7			0.0	-116.7
4		5.9	5.9	21.7	217.3	239.0	233.1
5		5.9	5.9	22.4	221.6	244.1	238.2
6		5.9	5.9	23.2	226.1	249.3	243.4
7		5.9	5.9	24.1	230.6	254.7	248.8
8		5.9	5.9	24.7	233.8	258.4	252.6
9		5.9	5.9	25.3	237.0	262.3	256.4
10		5.9	5.9	25.9	240.2	266.2	260.3
11		5.9	5.9	26.6	243.5	270.1	264.2
12		5.9	5.9	27.3	246.9	274.1	268.3
13		5.9	5.9	28.0	250.4	278.4	272.6
14		5.9	5.9	28.8	254.0	282.8	276.9
15		5.9	5.9	29.6	257.7	287.2	281.4
16		5.9	5.9	30.4	261.4	291.8	285.9
17		5.9	5.9	31.2	265.1	296.4	290.5
18		5.9	5.9	31.2	265.1	296.4	290.5
19		5.9	5.9	31.2	265.1	296.4	290.5
20		5.9	5.9	31.2	265.1	296.4	290.5
21		5.9	5.9	31.2	265.1	296.4	290.5
22		5.9	5.9	31.2	265.1	296.4	290.5
23		5.9	5.9	31.2	265.1	296.4	290.5
24		5.9	5.9	31.2	265.1	296.4	290.5
25		5.9	5.9	31.2	265.1	296.4	290.5
26		5.9	5.9	31.2	265.1	296.4	290.5
27		5.9	5.9	31.2	265.1	296.4	290.5
28		5.9	5.9	31.2	265.1	296.4	290.5
29		5.9	5.9	31.2	265.1	296.4	290.5
30		5.9	5.9	31.2	265.1	296.4	290.5
31		5.9	5.9	31.2	265.1	296.4	290.5
32		5.9	5.9	31.2	265.1	296.4	290.5
33		5.9	5.9	31.2	265.1	296.4	290.5

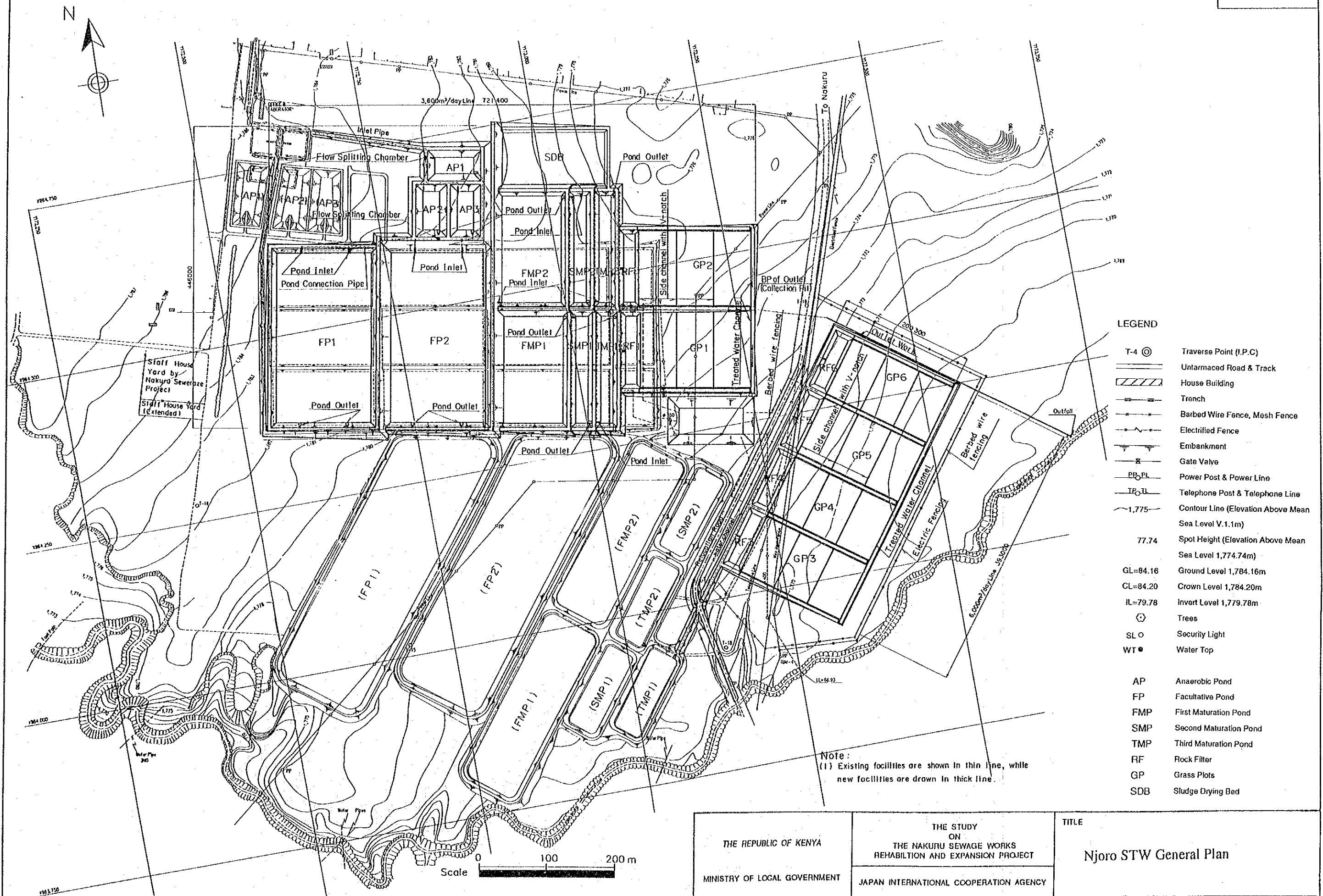
EIRR

18.6%

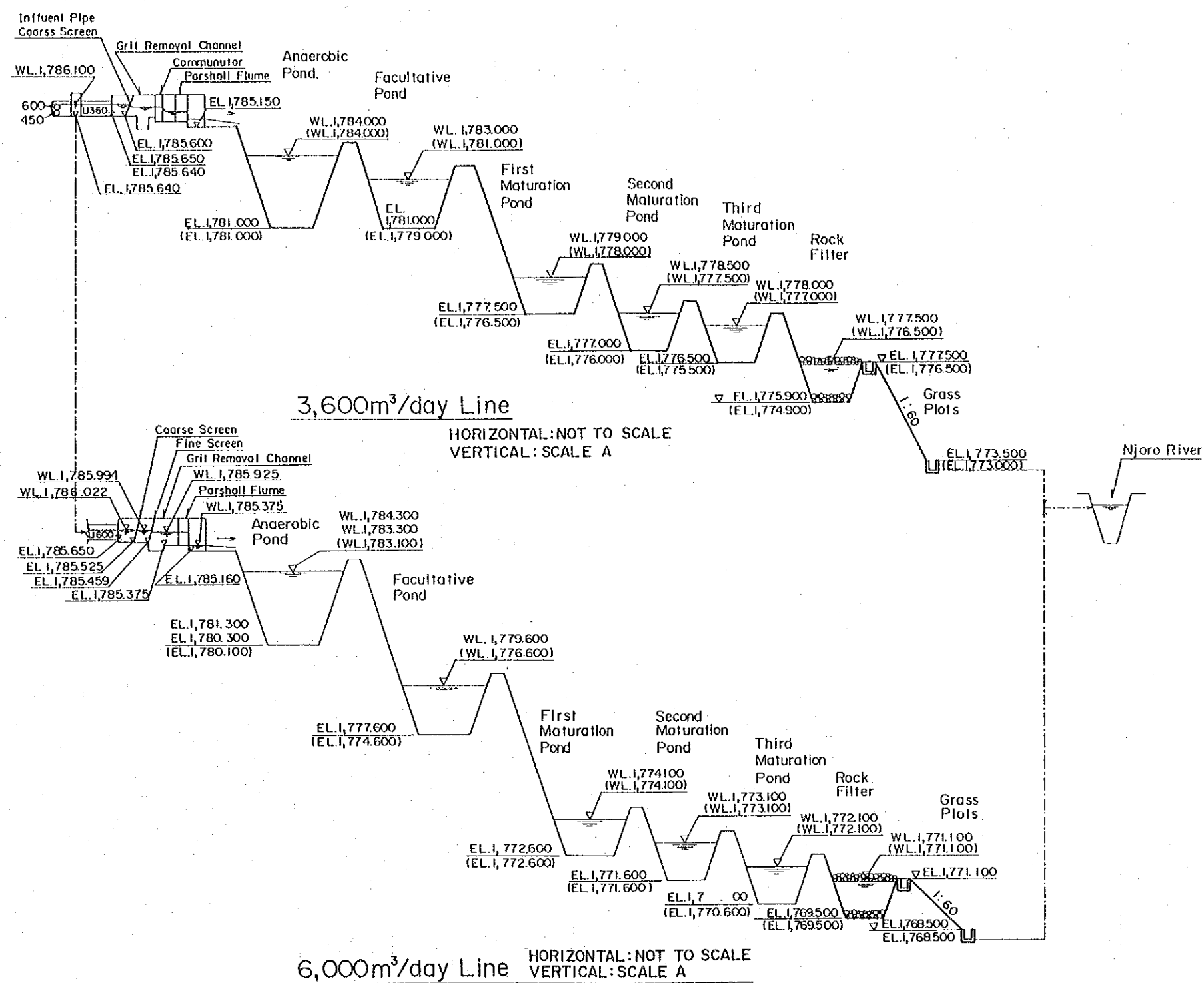
The proposed project was examined in economic efficiency through Economic internal rate of return (EIRR). Table 9-3 shows the stream of economic costs and benefits and the results of the examination. The project resulted in 18.6%, exceeding the opportunity cost of capital of 10%. Therefore, the proposed project is viable from economic point of view.

Yet, the quantification of the tourism benefit seems to be controversial. Then, the sensitivity of this benefit was tested in the case that the benefit for the project was reduced to a quarter of the national revenue. In this case, EIRR was 10.8%, which is still higher than the opportunity cost of capital of 10%. Then, the project is concluded as feasible even under this condition.

DRAWINGS



THE REPUBLIC OF KENYA MINISTRY OF LOCAL GOVERNMENT	THE STUDY ON THE NAKURU SEWAGE WORKS REHABILITATION AND EXPANSION PROJECT	TITLE
	JAPAN INTERNATIONAL COOPERATION AGENCY	Njoro STW General Plan

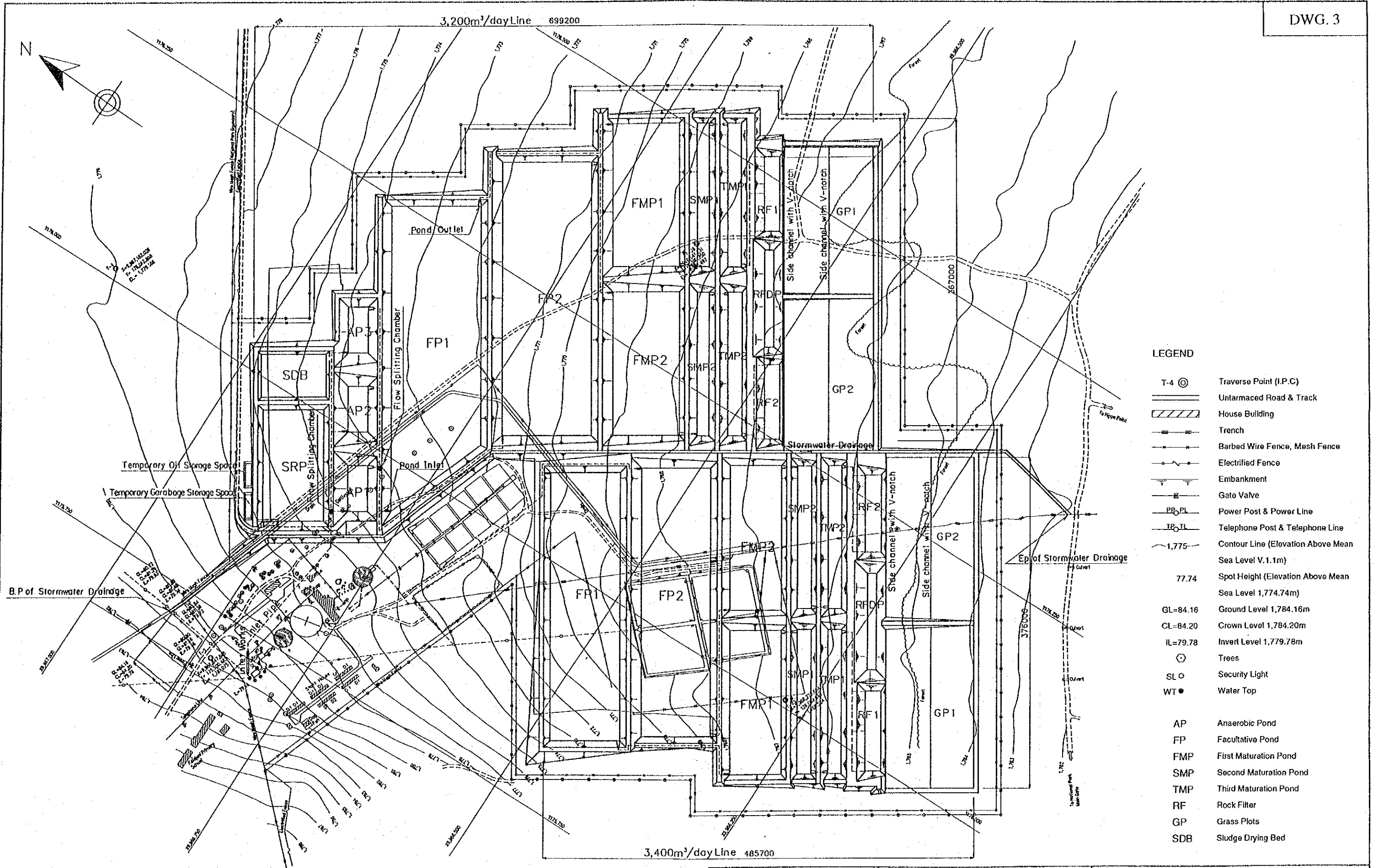


Note:

- (1) In case two elevations are shown, the upper figure is of the 1st pond and the lower figure of the 2nd pond.
- (2) Existing facility is shown in a thin line and rehabilitation / additional facility in thicker line.



<p>THE REPUBLIC OF KENYA</p> <p>MINISTRY OF LOCAL GOVERNMENT</p>	<p>THE STUDY ON THE NAKURU SEWAGE WORKS REHABILITATION AND EXPANSION PROJECT</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>Njoro STW Hydraulic Profile</p>
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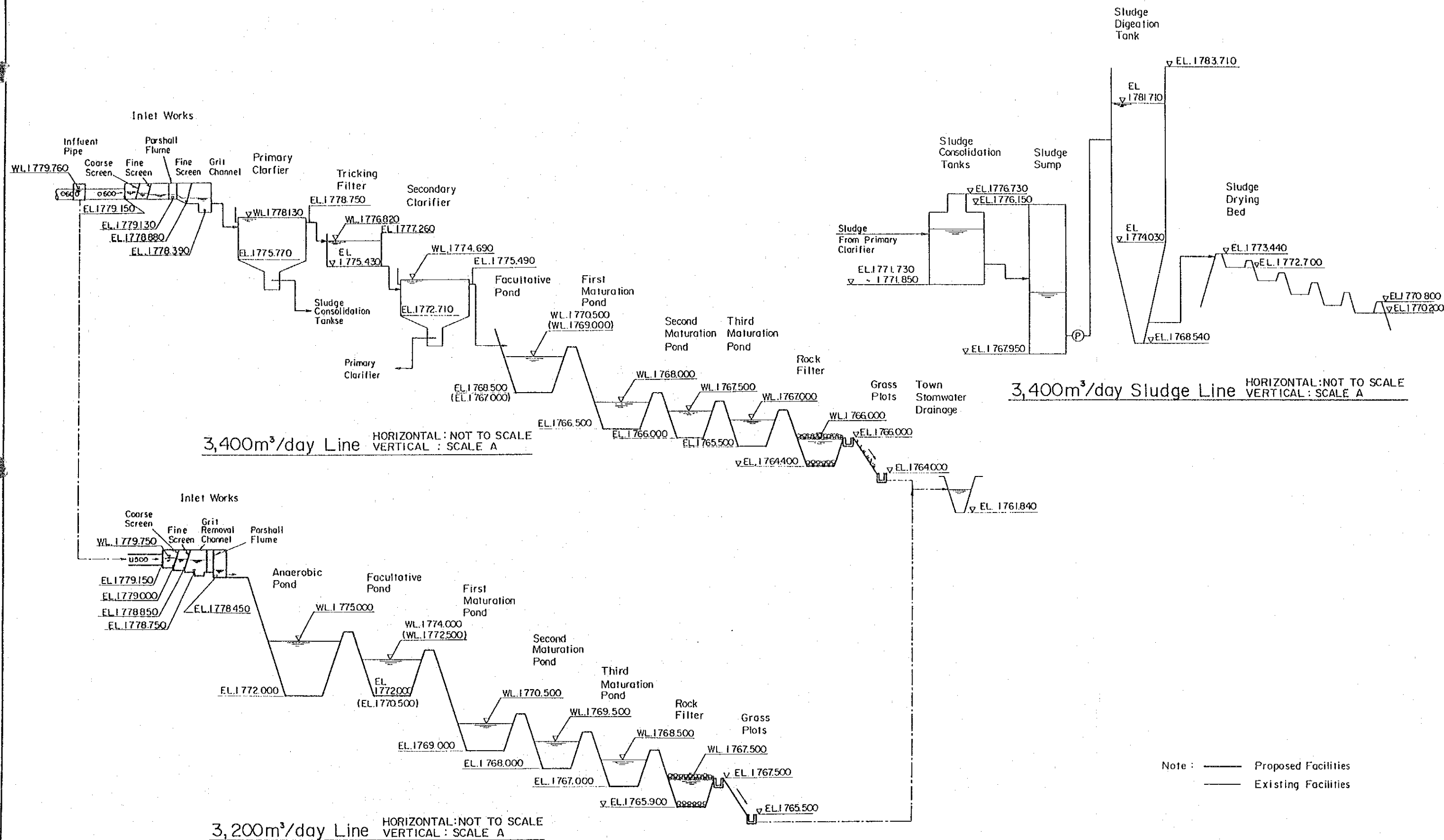


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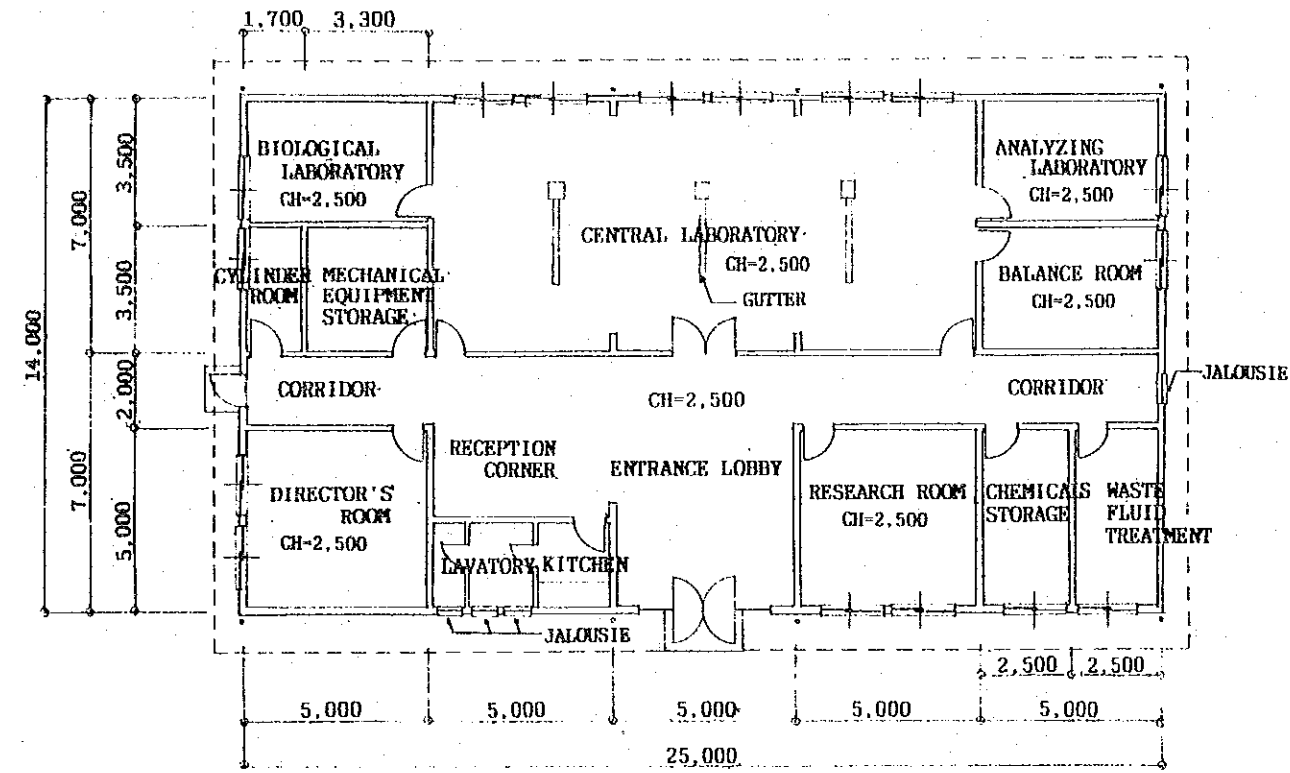
THE REPUBLIC OF KENYA
MINISTRY OF LOCAL GOVERNMENT

THE STUDY
ON
THE NAKURU SEWAGE WORKS
REHABILITATION AND EXPANSION PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

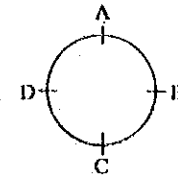
TITLE
Town STW General Plan



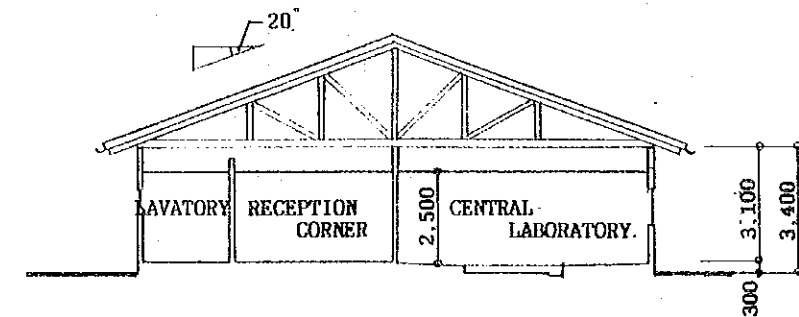
THE REPUBLIC OF KENYA MINISTRY OF LOCAL GOVERNMENT	THE STUDY ON THE NAKURU SEWAGE WORKS REHABILITATION AND EXPANSION PROJECT	TITLE Town STW Hydraulic Profile
	JAPAN INTERNATIONAL COOPERATION AGENCY	



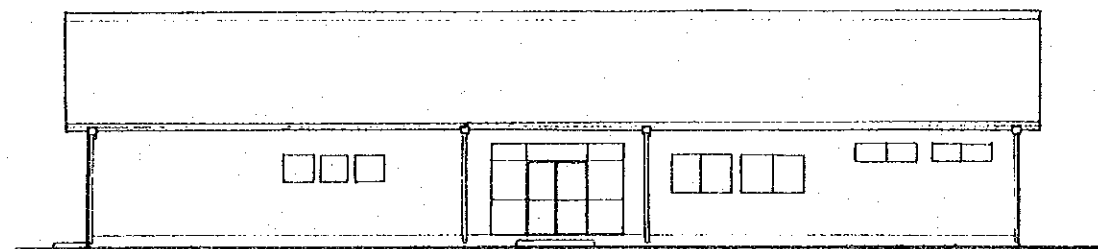
PLAN
FLOOR AREA: 350SQ. METERS



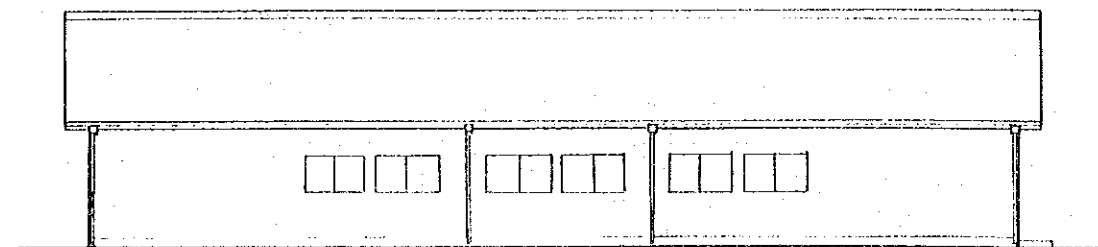
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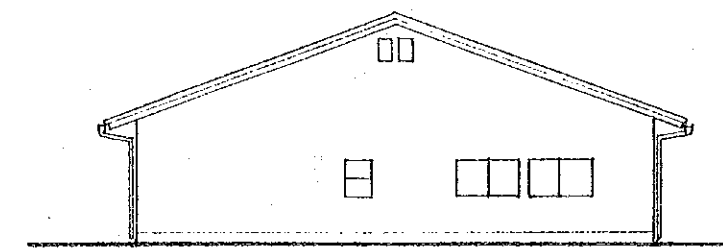
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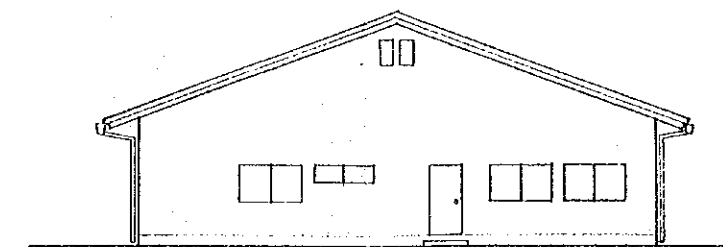
ELEVATION C



ELEVATION A



ELEVATION B



ELEVATION D

<p>THE REPUBLIC OF KENYA</p> <p>MINISTRY OF LOCAL GOVERNMENT</p>	<p>THE STUDY ON THE NAKURU SEWAGE WORKS REHABILITATION AND EXPANSION PROJECT</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>Building Works Water Quality Testing Laboratory, Plan and Elevation</p>
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JICA