

Annual Disbursement Schedule

Year	Amount (NRs. thousand)
1993	19,023
1994	51,170
1995	402,716
1996	208,929
Total	681,839

G.3.4.5 Total Project Cost

The Project costs consist of direct construction cost, physical contingency, engineering service cost, administration cost and price contingency. The total project cost is estimated at NRs. 681,839 thousands (US\$ 13.6 million) consisting of the foreign currency portion of NRs. 312,460 thousands and the local currency portion of NRs. 369,379 thousands. The summary of the total project cost is given in Table G.3.8.

Total Project Cost

Cost Item	Foreign Currency	Local Currency	Total
1. Direct Construction Cost	194,731	209,839	404,570
2. Physical Contingency	38,946	41,968	80,914
3. Administration Cost	0	10,093	10,093
4. Engineering Service Cost	54,950	25,000	79,950
5. Price Contingency	23,833	82,479	106,312
Total	312,460	369,379	681,839

Unit : NRs. 1,000

G.3.5 Annual Operation & Maintenance Cost and Replacement Cost

Annual operation and maintenance cost comprises salary of gatemen for operation and material & labor cost for repair and maintenance of irrigation & drainage facilities. The estimated annual operation and maintenance cost at full operation stage is NRs. 2,433 thousands/year.

Some mechanical works have a shorter useful life than the project life and will require replacement. The main replacement items will be steel slide gates to be used for the proposed project facilities such as headworks, headrace, turnouts and irrigation ponds. The estimated replacement cost is NRs. 1,767 thousands for 20 years.

The breakdown of the annual operation & maintenance cost and replacement cost are given in Table G.3.9.

TABLES

Table G.1.1 Hydraulic & Structural Design Dimension of Irrigation Canal

No	Name of Canal	Discharge (m ³ /sec)	Length (m)	Canal Type	Base Width (m)	Canal Height (m)	Water Depth (m)	Hydr. Gradient	Velocity (m/sec)
1	Headrace	4.40	450	Concrete Box	2.50	1.50	1.10	1/500	1.60
2	Primary Feeder Canal	4.40	3,600	Concrete Flume	2.0 - 2.5	2.0 - 1.0	1.30 - 0.55	1/400 - 1/50	1.7 - 3.6
	"	2.00	1,700	Concrete Flume	1.8 - 2.5	1.3 - 1.0	1.0 - 0.30	1/700 - 1/65	1.1 - 2.5
	"	1.7 - 1.5	4,600	Earth Canal	1.50	1.10	1.00	1/2000	0.50
	"	0.8 - 0.5	5,600	Earth Canal	1.5 - 0.9	1.1 - 1.0	0.6 - 0.4	1/1800 - 1/800	0.6 - 0.4
3	Secondary Feeder Canal								
	To Tikker	4.40	500	Natural Stream	-	-	-	-	-
	From Tikker	1.9 - 1.7	1,500	Concrete Flume	1.80	1.30	1.10	1/1000	1.00
	To Gorusinge	0.7 - 0.5	3,200	Earth Canal	1.20	1.00	0.6 - 0.5	1/800	0.6 - 0.55
	To Badahara	0.10	100	Earth Canal	0.50	0.70	0.30	1/400	0.50
4	Main Irrigation Canal								
	From Gorusinge	0.5 - 0.2	2,600	Earth Canal	1.2 - 0.5	1.0 - 0.7	0.6 - 0.3	1/1800 - 1/400	0.6 - 0.4
	From Badahara	0.10	100	Earth Canal	0.50	0.70	0.30	1/400	0.50
	From Buddi & Dewari	0.5 - 0.2	1,800	Earth Canal	1.2 - 0.5	1.0 - 0.7	0.6 - 0.3	1/1800 - 1/400	0.6 - 0.4
5	Secondary Irrigation Canal								
	Feeder Canal Irrigation Block								
	5 number	0.07 - 0.03	1,530	Earth Canal	0.30	0.55	0.25 - 0.12	1/300 - 1/100	0.6 - 0.4
	Tikker Pond Irrigation Block								
	9 number	0.23 - 0.02	9,470	Earth Canal	0.5 - 0.3	0.7 - 0.55	0.5 - 0.1	1/1000 - 1/100	0.6 - 0.4
	Gorusinge Pond Irrigation Block								
	6 number	0.14 - 0.03	8,080	Earth Canal	0.5 - 0.3	0.7 - 0.55	0.4 - 0.1	1/1000 - 1/100	0.6 - 0.4
	Badahara Pond Irrigation Block								
	1 number	0.09	850	Earth Canal	0.5 - 0.3	0.7 - 0.55	0.3 - 0.2	1/1200 - 1/200	0.6 - 0.3
	Buddi Pond Irrigation Block								
	4 number	0.16 - 0.06	6,820	Earth Canal	0.5 - 0.3	0.7 - 0.55	0.4 - 0.2	1/1000 - 1/200	0.6 - 0.3

Table G.1.2 The Number of Structures for Supply, Irrigation and Drainage System

Description	Q m ³ /s	Irrigation Facilities					Drainage Facilities			Total (nos.)
		Supply System		Irrigation System			Drainage System			
		Primary Feeder C. (nos.)	Feeder C. (nos.)	Main Irri. C. (nos.)	Secondary Irri. C. (nos.)	Tertiary Irri. C. (nos.)	Primary Drain.C (nos.)	Secondary Drain.C (nos.)	Tertiary Drain.C (nos.)	
1. Culvert	High way, L=30m	0.6			1					1
	High way, L=30m	0.15				1				1
	Road, L=10m	4.4	8					2		10
	Road, L=10m	1.5	6	1						7
	Road, L=10m	0.6	4	1	2			11	57	75
	Road, L=10m	0.1			1	16				52
2. Syphon	High way, L=30m	0.6	1							1
	L=10m	0.05				3				3
3. Aqueduct	L=30m	4.4	2							2
	L=30m	0.6	4		1					5
	L=30m	0.1				1				1
	L=10m	0.3			1					1
	L=10m	0.1				7				7
	L=10m	0.05							30	30
4. Bridge	Road, W/L=2.5/20							1		1
	Road, W/L=2.5/10							3	2	5
	Footpath, W/L=1.0/30							5		5
	Footpath, W/L=1.0/20							4		4
	Footpath, W/L=1.0/10							2	3	5
	Footpath, W/L=1.0/5		44	11	19				10	84
	Footpath, W/L=1.0/3					64				64
5. Drop	H=1m	4.4	7							7
	H=1m	1.5	15							15
	H=1m	0.3			2					31
	H=1m	0.1				10				10
	H=1m	0.05								161
6. Protection	Curve	1.5	10	2						12
	Curve	0.6	21	1	6					28
	Curve	0.1		1		54				55
7. Cross Drain	L=10m	4.4	1							1
	L=10m	1.5		1	1					2
	L=10m	0.6	1	2						3
	L=10m	0.1	8	6						14
	L=5m	0.3				7				7
	L=5m	0.1				2			18	20
8. Drainage Culvert	Road, L=10m	1.5						1		1
	Road, L=10m	0.3						1		1
9. Turnout	Bifurcation	1.5	1							1
	Bifurcation	0.15				5				5
	Gated	0.3	1	1						2
	Gated	0.1	11	3	10					24
	APM	0.05				64				64
	Field Outlet (D)								90	90
	Field Outlet (S)								290	290
10. Confluence		1.9	1							1
11. Spring Intake		7.0/1.9	1							1
12. Drain Inlet			9	6		6				21
13. Regulating Check Gate	Duckbill	4.4	5							5
	Duckbill	2.2	1							1
	Regular	2.2		1						1
	Regular	1.5	2							2
	Regular	0.6	4	3	6					13
14. Spillway		4.4	2							2
		2.2	1							1
		1.5	1							1
		0.6	1							1
15. Wasteway		2.2	1							1
16. Stilling Basin		4.4	8							8
17. Terminal Structure		0.1				25				25
18. Washing Steps		4.4	16							16
		1.5	20	4						24
		0.6	10							10
19. Sand Excluder			4							4

Table G.1.3 Quantity of Major Works (1/2)

Description	Quantity of Major Items														
	Concrete A,B,C,D (m3)	Rein. Bar (kg)	Form (m2)	Gate (nos.)	RC Pipe ø 200 (m)	RC Pipe ø 300 (m)	RC Pipe ø 600 (m)	Wet Masonry (m3)	Gabion (m3)	Clear Cutting (m2)	Stripping (m2)	Excavation (m3)	Embankment (m3)	Sod Facing (m2)	Gravel Metalling (m3)
1. Headworks	2,663	43,835	2,387	3			231	726			975	6,708	2,353	832	
2. Headrace	1,520	94,000	4,600	3			850					7,900	6,300		
3. Supply System (1) Primary Feeder Canal Canals (2) Secondary Feeder Canal Canals	3,700	128,747	27,551								105,129	25,918	49,962	45,398	
	1,167	23,108	8,436								43,732	6,557	16,642	11,939	
4. Irrigation System (1) Main Irrigation Canal Canals (2) Secondary Irrigation Canal Canals (3) Tertiary Irrigation Canal Canals															
											36,212	5,804	13,016	10,309	
											103,284	16,588	36,049	39,868	
											216,950	8,988	58,844		
5. Drainage System (1) Primary Drainage Canal Canals (2) Secondary Drainage Canal Canals (3) Tertiary Drainage Canal Canals															
											223,708	312,854	11,066	14,751	
											129,078	130,583		48,965	
												66,090			
6. Supply, Irrigation and Drainage System Related Structures	6,007	227,642	27,880	55	377	1,510	6,407								
Sub-Total	15,057	517,331	70,854	61	377	1,510	6,638	1,576			859,068	587,990	194,233	172,063	

Table G.1.3 Quantity of Major Works (2/2)

Description	Quantity of Major Items															
	Concrete A,B,C,D (m3)	Rein. Bar (kg)	Form (m2)	Gate (nos.)	RC Pipe ø 200 (m)	RC Pipe ø 300 (m)	RC Pipe ø 600 (m)	Masonry (m3)	Wet Ghabion (m3)	Ghabion (m3)	Clear Cutting (m2)	Stripping (m2)	Excavation (m3)	Embankment (m3)	Sod Facing (m2)	Gravel Metalling (m3)
7. Irrigation Ponds																
(1) Tikker																
2) Earth Works	215	11,200	305	1				297		505,000			24,422	159,060	23,530	
2) Structures																
(2) Badahara																
1) Earth Works	37	1,159	83	1				111		28,000			8,612	6,852	4,147	
2) Structures																
(3) Gorusinge																
1) Earth Works	35	1,159	83	1				95		106,000			10,047	16,000	4,683	
2) Structures																
(4) Dewari																
1) Earth Works																
2) Structures	20							248		23,000			34,687	27,736	6,608	
(5) Buddi																
1) Earth Works	64	2,800	200	1				330		199,000			60,845	52,608	13,717	
2) Structures																
8. Village cum Service Roads																
1) Earth Works												127,710	14,850	36,630	89,249	18,563
2) Structures	88	1,610	323			545	66			861,000			153,463	298,887	141,934	18,563
Sub-Total	459	17,928	994	4	4	545	66	1,081		861,000		127,710	153,463	298,887	141,934	18,563
Grand-Total	15,515	535,259	71,848	65	65	377	2,055	66	7,719	1,576	861,000	986,778	741,453	493,120	313,997	18,563

Note : Concrete A : 150kg/cm2
Concrete B : 200kg/cm2
Concrete C : 300kg/cm2
Concrete D : 300kg/cm2 with Steelfiber

Table G.3.1 Price List of Construction Material & Labour (1/4)

Market Price List of Construction Material

(Unit : NRs)

Description	Unit	Price
1. Concrete		
Portland Cement	bag	249
Sand	m ³	353
Gravel	m ³	670
Crushed Coarse Aggregate	m ³	1,295
Reinforced Concrete Pipe NP-3		
ϕ 400mm	m	1,092
ϕ 500mm	m	1,338
ϕ 600mm	m	1,557
ϕ 800mm	m	2,412
ϕ 1,000mm	m	3,002
ϕ 1,200mm	m	3,482
Concrete Pipe NP-2		
ϕ 200mm	m	257
ϕ 300mm	m	366
ϕ 400mm	m	511
ϕ 500mm	m	633
2. Masonry and Brick		
Boulder	m ³	516
Cobble	m ³	645
Rubble	m ³	491
Fired Brick	pce	2.3
3. Steel		
Reinforcement Bar		
ϕ 6.35mm	kg	26
ϕ 9.35mm	kg	25
ϕ 12.7mm	kg	25
ϕ 15.9mm	kg	25
ϕ 19.1mm	kg	25
ϕ 22.2mm	kg	26
ϕ 25.4mm	kg	26
ϕ 28.6mm	kg	26
Sheet Steel		
t=1.6mm	kg	38
t=2.3mm	kg	38
t=2.8mm	kg	38
t=3.2mm	kg	38
t=4.5mm	kg	38
t=6.0mm	kg	38
t=8.0mm	kg	38
t=9.0mm	kg	38
t=12.0mm	kg	38
Shape Steel		
L-Shape	kg	32
I-Shape	kg	36

Note : Above prices mean market prices in March, 1993 based on hearing survey through Department of Irrigation of Nepal

Table G.3.1 Price List of Construction Material & Labour (2/4)

Market Price List of Construction Material

(Unit : NRs)

Description	Unit	Price
Sluice Gate with Frame, Spindle and Handle		
300 x 300mm	nos	25,000
600 x 600mm	nos	40,000
800 x 800mm	nos	50,000
1,000 x 1,000mm	nos	60,000
Galvanized Wire		
ø 1.0mm	kg	38
ø 2.0mm	kg	38
ø 4.0mm	kg	38
ø 6.0mm	kg	38
Barbed Wire		
ø 1.0mm	kg	40
ø 2.0mm	kg	42
Nail	kg	35
4. Timber		
Log	m ³	21,210
Rectangular Lumber	m ³	28,280
Plywood (900 x 1,800mm Sheet)		
t=4.0mm	sheet	200
t=6.0mm	sheet	225
t=12.0mm	sheet	425
5. Glass (300 x 300 x 5mm Sheet)		
Frosted	sheet	32
Ordinary	sheet	40
6. Fuel and Oil		
Gasoline	lit.	29
Kerosine	lit.	9.8
Diesel	lit.	12
Engine Oil	lit.	130
Gear Oil	lit.	165
Hydraulic Oil	lit.	175
Grease	kg	120
7. Asphalt		
Asphalt Emulsion	kg	15
Cutback Asphalt	kg	13
8. Galvanized Steel Pipe		
ø 50mm	m	267
ø 75mm	m	440
ø 100mm	m	633

Note : Above prices mean market prices in March, 1993 based on hearing survey through Department of Irrigation of Nepal

Table G.3.1 Price List of Construction Material & Labour (3/4)

Market Price List of Construction Material

(Unit : NRs)

Description	Unit	Price
9. PVC Pipe		
ø 42.4mm		
Class D	m	42
Class E	m	50
ø 48.4mm		
Class D	m	54
Class E	m	66
ø 60.5mm		
Class C	m	68
Class D	m	83
Class E	m	100
ø 89.1mm		
Class C	m	138
Class D	m	176
Class E	m	213
ø 114.5mm		
Class C	m	225
Class D	m	290
Class E	m	349
ø 140.4mm		
Class C	m	335
Class D	m	434
Class E	m	521
ø 168.5mm		
Class C	m	478
Class D	m	622
Class E	m	749
ø 219.4mm		
Class C	m	734
Class D	m	955
Class E	m	1,146
10. Joint Filer		
Solvent Cement	lit.	250

Note : Above prices mean market prices in March, 1993 based on hearing survey through Department of Irrigation of Nepal

Table G.3.1 Price List of Construction Material & Labour (4/4)

Wage List of Construction Workers

(Unit : NRs)

Description	Unit	Price
1. Engineer		
Civil Engineer	month	15,000
Irrigation Engineer	month	15,000
Mechanical Engineer	month	15,000
Engineering Geologist	month	15,000
Boring Engineer	month	15,000
Concrete Engineer	month	15,000
Construction Engineer	month	15,000
Design Engineer	month	15,000
Survey Engineer	month	15,000
2. Overseer/Technician		
Construction Inspector	month	8,000
Mechanic	month	8,000
Electrician	month	8,000
Surveyor	month	8,000
Draftsman	month	8,000
3. Skilled Worker		
Foreman (Earth Works)	day	80
Foreman (Concrete Works)	day	80
Foreman (Steel Works)	day	80
Foreman (Carpentry Works)	day	80
Concrete Worker	day	80
Mason	day	80
Steel Worker	day	80
Welder	day	80
Carpenter	day	80
Operator(Large Equipment)	month	5,000
Operator(Small Equipment)	month	4,000
Driver (Dump Truck)	month	4,000
Driver (Truck)	month	3,000
Driver (Jeep/Pick-Up/Sedan)	month	3,000
Repairman	month	4,000
4. Laborer		
Earth Works	day	50
Concrete Works	day	60
Masonry Works	day	60
Steel Works	day	60
Mechanical Works	day	60
Electrical Works	day	60
Carpentry Works	day	60
Survey Works	day	50
Boring Works	day	50
5. Office Worker		
Office Manager	month	8,000
Translator	month	6,000
Bilingual Secretary	month	5,000
Bilingual Computer Operator	month	4,000
Bilingual Typist	month	3,000
Bilingual Accountant	month	4,000
Clark	month	2,500
Office Boy	month	1,800
Sweeper	month	1,500
Watchman	month	1,800

Note : Above prices mean market prices in March, 1993 based on hearing survey through Department of Irrigation of Nepal

Table G.3.2 Unit Price of Civil Works (1/4)

(Unit : NRs)

Description	Unit	Unit Price		
		Total	F.C.	L.C.
1. Irrigation and Drainage Facilities				
(1) Headworks				
1) Earth Works				
1.1) Stripping of Top Soil	m2	35	16	19
1.2) Excavation of Gravel with Cobble	m3	270	121	149
1.3) Excavation of Fresh Rock	m3	1,200	540	660
1.4) Excavation of Weathered Rock	m3	780	351	429
1.5) Backfill by Excavated Materials	m3	50	22	28
1.6) Backfill by Borrow Materials	m3	114	51	63
1.7) Embankment by Borrow Materials	m3	156	70	86
1.8) Sod Facing	m2	10	4	6
2) Concrete Works				
2.1) Concrete A (150kgf/cm2)	m3	4,000	2,697	1,303
2.2) Concrete C (300kgf/cm2)	m3	5,045	3,593	1,452
2.3) Concrete D (300kgf/cm2 with Steelfibre)	m3	13,409	11,957	1,452
2.4) Form	m2	480	22	458
2.5) Reinforcement Bar	kg	50	47	3
3) Stone Works				
3.1) Wet Masonry with Concrete A	m3	3,131	2,003	1,128
3.2) Gabion Mattress	m3	1,800	1,140	660
4) Steel Works				
4.1) Bar Screen	m	555	355	200
4.2) Sluice Gate (1,700mm x 1,700mm)	nos	1,300,000	1,170,000	130,000
4.3) Sluice Gate (D=500mm)	nos	360,000	324,000	36,000
4.4) Hand Rail	m	138	127	11
4.5) Steel Pipe (D=600mm)	m	26,000	23,400	2,600
5) Other Works				
5.1) Weephole Works	nos	117	105	12
5.2) Water Stop Works	m2	1,208	1,078	130
5.3) PVC Pipe Works	m	312	250	62
5.4) Steel Materials Works	kg	115	106	9
(2) Headrace				
1) Earth Works				
1.1) Excavation	m3	60	27	33
1.2) Embankment	m3	90	40	50
2) Concrete Works				
2.1) Concrete A (150kgf/cm2)	m3	4,000	2,697	1,303
2.2) Concrete B (200kgf/cm2)	m3	4,400	3,133	1,267
2.3) Reinforcement Bar	m	50	47	3
2.4) Form	m2	480	22	458
2.5) Joint Filer	m2	1,312	1,113	199
3) Stone Works				
3.1) Gabion Mattress	m3	1,800	1,140	660
4) Steel Works				
4.1) Gates	kg	120	111	9

F.C. : Foreign Currency Portion

L.C. : Local Currency Portion

Table G.3.2 Unit Price of Civil Works (2/4)

(Unit : NRs)

Description	Unit	Unit Price		
		Total	F.C.	L.C.
5) Other Works				
5.1) Water Stop Works	m2	1,208	1,078	130
(3) Supply System				
1) Earth Works				
1.1) Stripping	m2	35	16	19
1.2) Excavation	m3	60	27	33
1.3) Embankment	m3	90	40	50
1.4) Sod Facing	m2	10	4	6
2) Concrete Works				
2.1) Concrete A (150kgf/cm2)	m3	4,000	2,697	1,303
2.2) Concrete B (200kgf/cm2)	m3	4,400	3,133	1,267
2.3) Reinforcement Bar	m	50	47	3
2.4) Form	m2	480	22	458
2.5) Joint Filer	m2	1,312	1,113	199
3) Stone Works				
3.1) Dry Masonry	m3	1,014	455	559
4) Other Works				
4.1) Water Stop Works	m2	1,208	1,078	130
4.2) Safety Rope Works	kg	350	50	300
(4) Main and Secondary Irrigation System				
1) Earth Works				
1.1) Stripping	m2	35	16	19
1.2) Excavation	m3	60	27	33
1.3) Embankment	m3	90	40	50
1.4) Sod Facing	m2	10	4	6
(5) Tertiary Irrigation System				
1) Earth Works				
1.1) Stripping	m2	35	0	35
1.2) Excavation	m3	30	0	30
1.3) Embankment	m3	50	0	50
(6) Primary and Secondary Drainage System				
1) Earth Works				
1.1) Stripping	m2	35	16	19
1.2) Excavation	m3	70	31	39
1.3) Embankment	m3	90	40	50
1.4) Sod Facing	m2	10	4	6
(7) Tertiary Drainage System				
1) Earth Works				
1.1) Excavation	m2	30	0	30
(8) Supply System, Irrigation System and Drainage System Structures				
1) Earth Works				
1.1) Sand Placing	m3	790	412	378

F.C. : Foreign Currency Portion

L.C. : Local Currency Portion

Table G.3.2 Unit Price of Civil Works (3/4)

(Unit : NRs)

Description	Unit	Unit Price		
		Total	F.C.	L.C.
2) Concrete Works				
2.1) Concrete A (150kgf/cm ²)	m ³	4,000	2,697	1,303
2.2) Concrete B (200kgf/cm ²)	m ³	4,400	3,133	1,267
2.3) Concrete C (300kgf/cm ²)	m ³	5,045	3,593	1,452
2.4) Reinforcement Bar	m	50	47	3
2.5) Form	m ²	480	22	458
2.6) Concrete Pipe D=200mm	m	640	305	335
2.7) Concrete Pipe D=300mm	m	950	457	493
3) Stone Works				
3.1) Wet Stone Masonry	m ³	3,500	1,130	2,370
4) Steel Works				
4.1) Gate	kg	120	111	9
(9) Irrigation Pond				
1) Earth Works				
1.1) Cutting, Grubbing and Clearing	m ²	20	9	11
1.2) Excavation	m ³	70	31	39
1.3) Embankment	m ³	110	49	61
1.4) Sod Facing	m ²	10	4	6
2) Concrete Works				
2.1) Concrete A (150kgf/cm ²)	m ³	4,000	2,697	1,303
2.2) Concrete C (300kgf/cm ²)	m ³	5,045	3,593	1,452
2.3) Form	m ²	480	22	458
2.4) Reinforcement Bar	m	50	47	3
3) Stone Works				
3.1) Wet Masonry	m ³	3,500	1,130	2,370
4) Steel Works				
4.1) Trash Rack	kg	176	100	76
4.2) Sluice Gate (1,700mm x 1,700mm)	nos	1,300,000	1,170,000	130,000
4.3) Sluice Gate D=400mm	nos	175,450	159,500	15,950
4.4) Sluice Gate D=1,000mm	nos	484,000	440,000	44,000
4.5) Hand Rail	m	138	127	11
4.6) Manhole	nos	26,000	23,400	2,600
5) Other Works				
5.1) Stoplog Works	m ³	24,783	24,771	12
5.2) Air Pipe	m	644	307	337
(10) Village Cum Service Roads				
1) Earth Works				
1.1) Stripping	m ²	35	16	19
1.2) Excavation	m ³	70	31	39
1.3) Embankment	m ³	110	49	61
1.4) Sod Facing	m ²	10	4	6
1.5) Gravel Metaling	m ³	1,100	495	605
2) Concrete Works				
2.1) Concrete A (150kgf/cm ²)	m ³	4,000	2,697	1,303
2.2) Concrete B (200kgf/cm ²)	m ³	4,400	3,133	1,267
2.3) Form	m ²	480	22	458

F.C. : Foreign Currency Portion

L.C. : Local Currency Portion

Table G.3.2 Unit Price of Civil Works (4/4)

(Unit : NRs)

Description	Unit	Unit Price		
		Total	F.C.	L.C.
2.4) Reinforcement Bar	m	50	47	3
2.5) Concrete Pipe D=300mm	m	950	457	493
2.6) Concrete Pipe D=600mm	m	2,000	1,206	794
(11) Project Office	nos	1,570,000	518,000	1,052,000
2. Farmers' Cooperative Offices				
(1) Farmers' Cooperative Offices	nos	3,584,000	1,183,000	2,401,000
(2) VDC Farmer's Cooperative Center	nos	2,131,400	703,400	1,428,000

F.C. : Foreign Currency Portion

L.C. : Local Currency Portion

Table G.3.3 Summary of Direct Construction Cost

(Unit : NRs. Thousand)

Description	Unit	Q'ty	Amount		
			F.C.	L.C.	Total
Direct Construction Cost					
(1) Irrigation and Drainage Facilities					
1) Headworks	nos.	1	23,280	11,537	34,817
2) Headrace	km	0.45	12,733	6,120	18,853
3) Supply System	km	20.8	51,655	51,741	103,396
4) Irrigation System	km	88.3	19,289	34,107	53,396
5) Drainage System	km	69.2	32,655	38,245	70,900
6) Irrigation Pond	nos.	5	33,928	38,196	72,124
7) Village cum Service Roads	km	49.5	15,973	19,300	35,273
8) Project Office	nos.	1	518	1,052	1,570
Sub-total (Item (1))			190,031	200,298	390,329
(2) Farmers' Cooperative Offices					
1) Farmers' Cooperative Center	nos.	1	1,183	2,401	3,584
2) VDC farmers' cooperative office	nos.	5	3,517	7,140	10,657
Sub-total (Item (2))			4,700	9,541	14,241
Total of Direct Construction Cost			194,731	209,839	404,570

F.C. : Foreign Currency Portion

L.C. : Local Currency Portion

Table G.3.4 Breakdown of Direct Construction Cost

Description	Unit	Qty	(Unit: NRs. Thousand)		
			Amount		Total
			F.C.	L.C.	
Direct Construction Cost					
1. Irrigation and Drainage Facilities					
(1) <u>Headworks</u>			23,280	11,537	34,817
Earthworks	L.S		(3,968)	(4,850)	(8,818)
Closed conduit & Structures	L.S		(19,312)	(6,687)	(25,999)
(2) <u>Headrace</u>			12,733	6,120	18,853
Earthworks	km	0.45	(515)	(630)	(1,145)
Structures	km	0.45	(12,218)	(5,490)	(17,708)
(3) <u>Supply System</u>			51,655	51,741	103,396
1) <u>Primary Feeder Canal</u>			42,411	41,429	83,840
Earthworks	km	15.5	(5,042)	(6,162)	(11,204)
Concrete flume works	km	4.6	(21,297)	(20,761)	(42,058)
Structures	L.S		(16,072)	(14,506)	(30,578)
2) <u>Secondary Feeder Canal</u>			9,244	10,312	19,556
Earthworks	km	5.3	(1,753)	(2,142)	(3,895)
Concrete flume works	km	1.5	(5,782)	(6,340)	(12,122)
Structures	L.S		(1,709)	(1,830)	(3,539)
(4) <u>Irrigation System</u>			19,289	34,107	53,396
1) <u>Main Irrigation Canal</u>			4,000	3,917	7,917
Earthworks	km	4.5	(1,431)	(1,748)	(3,179)
Structures	L.S		(2,569)	(2,169)	(4,738)
2) <u>Secondary Irrigation Canal</u>			8,631	10,546	19,177
Earthworks	km	26.8	(4,085)	(4,993)	(9,078)
Structures	L.S		(4,546)	(5,553)	(10,099)
3) <u>Tertiary Irrigation Canal</u>			6,658	19,644	26,302
Earthworks	km	57.0	(0)	(11,907)	(11,907)
Structures	L.S		(6,658)	(7,737)	(14,395)
(5) <u>Drainage System</u>			32,655	38,245	70,900
1) <u>Primary Drainage Canal</u>			17,349	20,158	37,507
Earthworks	km	18.6	(15,282)	(18,678)	(33,960)
Structures	L.S		(2,067)	(1,480)	(3,547)
2) <u>Secondary Drainage Canal</u>			9,875	10,813	20,688
Earthworks	km	24.2	(7,005)	(8,562)	(15,567)
Structures	L.S		(2,870)	(2,251)	(5,121)
3) <u>Tertiary Drainage Canal</u>			5,431	7,274	12,705
Earthworks	km	26.4	(0)	(2,181)	(2,181)
Structures	L.S		(5,431)	(5,093)	(10,524)
(6) <u>Irrigation Pond</u>			33,928	38,196	72,124
1) <u>Tikker (new construction)</u>			17,827	19,409	37,236
Earthworks	L.S		(14,623)	(17,872)	(32,495)
Structures	L.S		(3,204)	(1,537)	(4,741)
2) <u>Badahara</u>			1,448	1,585	3,033
Earthworks	L.S		(969)	(1,185)	(2,154)
Structures	L.S		(479)	(400)	(879)
3) <u>Gonusinge</u>			3,029	3,184	6,213
Earthworks	L.S		(2,292)	(2,801)	(5,093)
Structures	L.S		(737)	(383)	(1,120)
4) <u>Dewari</u>			3,341	4,309	7,650
Earthworks	L.S		(2,973)	(3,633)	(6,606)
Structures	L.S		(368)	(676)	(1,044)
5) <u>Buddi</u>			8,283	9,709	17,992
Earthworks	L.S		(7,011)	(8,569)	(15,580)
Structures	L.S		(1,272)	(1,140)	(2,412)
(7) <u>Village cum Service Roads</u>			15,973	19,300	35,273
Earthworks	km	49.5	(15,271)	(18,664)	(33,935)
Structures			(702)	(636)	(1,338)
(8) <u>Project Office</u>	nos.	1	518	1,052	1,570
Sub-total (Item 1.)			190,031	200,298	390,329
2. Farmers' Cooperative Offices					
(1) <u>Farmers' Cooperative Center</u>	nos.	1	1,183	2,401	3,584
(2) <u>YDC Farmers' Cooperative Offices</u>	nos.	5	3,517	7,140	10,657
Sub-total (Item 2.)			4,700	9,541	14,241
Total of Direct Construction Cost:			194,731	209,839	404,570

Table G.3.5 Administration Cost during Construction Period

(Unit : NRs. thousand)

Description	Amount
1. Administration	
(1) Personnel	3,708
(2) Electricity and Water Rate	825
(3) Stationery and Consumable	165
(4) Survey and Design Materials	750
(5) Quality Test	1,000
(6) Vehicle	2,625
Sub-Total	9,073
2. Agriculture Extension Services	
(1) Personnel Cost	240
(2) Vehicle	270
Sub-Total	510
3. Compensation for Crops and Houses	510
Total of Administration Cost	10,093

Table G.3.6 Engineering Service Cost

(Unit : US\$)

Description	Detailed Design				Construction Supervision			
	F.C.		L.C.		F.C.		L.C.	
	M/M	Cost	M/M	Cost	M/M	Cost	M/M	Cost
1. Remuneration	26	468,000	60	120,000	33	594,000	60	120,000
2. International Traveling Expenses		16,000				16,000		
3. Topographic Survey				15,000				
4. Geological Survey				40,000				
5. Vehicle				75,000				130,000
6. Overseas Training						5,000		
Total	26	484,000	60	250,000	33	615,000	60	250,000

Amount of Engineering Service			
F.C.		L.C.	
M/M	Amount	M/M	Amount
59	1,099,000 (NRs. 54,950 thousand)	120	500,000 (NRs.25,000 thousand)

F.C. : Foreign Currency Portion
L.C. : Local Currency Portion

Table G.3.7 Breakdown of Annual Disbursement Schedule

(Unit NRs. Thousand)

Description	Total Project Cost		1993		1994		1995		1996	
	F.C.	L.C. Total	F.C.	L.C. Total	F.C.	L.C. Total	F.C.	L.C. Total	F.C.	L.C. Total
1. Construction Works										
(1) Irrigation and Drainage Facilities										
1) Headworks	23,280	11,537	0	0	3,259	1,615	4,874	20,021	9,922	29,943
2) Headrace	12,733	6,120	0	0	0	0	0	12,733	6,120	18,853
3) Supply System	51,655	51,741	0	0	0	0	0	51,655	51,741	103,396
4) Irrigation System	19,289	34,107	0	0	0	0	0	9,645	17,053	26,698
5) Drainage System	32,655	38,245	0	0	0	0	0	10,776	12,621	23,397
6) Irrigation Ponds	33,928	38,196	0	0	0	0	0	22,731	25,591	48,323
7) Village cum Service Roads	15,973	19,300	0	0	0	0	0	6,389	7,720	14,109
8) Project Office	518	1,052	26	53	492	999	1,492	0	0	0
(2) Farmers' Cooperative Offices										
1) Agricultural cooperative center	1,183	2,401	0	0	0	0	0	1,183	2,401	3,584
2) VDC farmers' cooperative offices	3,517	7,140	0	0	0	0	0	1,161	2,356	3,517
Sub-total (Item 1.)	194,731	209,839	26	53	3,751	2,615	6,366	136,294	135,526	271,820
2. Physical Contingency	38,946	41,968	5	11	16	523	1,273	27,259	27,105	54,364
3. Administration	0	10,093	0	606	606	0	3,633	0	3,633	3,633
4. Engineering Services	54,950	25,000	12,216	6,107	18,324	24,899	36,541	11,070	4,500	15,570
Sub-total (Item 1.-4.)	288,627	286,900	12,248	6,776	19,023	29,400	47,814	174,622	170,765	345,388
5. Price contingency	23,833	82,479	0	0	0	1,147	3,356	13,886	43,443	57,329
Grand Total	312,460	369,379	12,248	6,776	19,023	30,547	51,170	188,508	214,208	402,716
Total	81,157	127,772	81,157	127,772	208,929					

Note
 Price level: 1993
 Price escalation rate: Foreign Currency: 3.9%
 Local Currency: 12.0%

Table G.3.8 Summary of Total Project Cost

(Unit: NRs. Thousand)

Description	Amount		
	F.C.	L.C.	Total
1. Direct Construction Cost	194,731	209,839	404,570
2. Physical Contingency	38,946	41,968	80,914
3. Administration Cost	0	10,093	10,093
4. Engineering Service Cost	54,950	25,000	79,950
5. Price Contingency	23,833	82,479	106,312
Total	312,460	369,379	681,839

F.C. : Foreign Currency Portion

L.C. : Local Currency Portion

Table G.3.9 Annual O&M Cost and Replacement Cost

Annual Operation & Maintenance Cost at Full Operation Stage

(Unit : NRs)

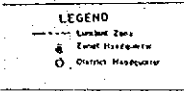
Description	Amount/year	Amount/ha/year
1. Maintenance		
(1) Headworks, Headrace, Canals, Roads and Pond:	1,019,000	566.1
(2) Gates	132,000	73.3
(3) Related Structures	886,000	492.2
2. Operation		
Gates	396,000	220.0
Total of O&M Cost	2,433,000	1,351.7
Direct Construction Cost / Total of O&M Cost	0.60%	

Replacement Cost at Full Operation Stage

(Unit : NRs)

Description	Amount/ 20 year interval	Amount/ha 20 year interval
Replacement Cost		
Gates	1,767,000	981.7

FIGURES



LEGEND

- Project Area
- Headworks
- Primary Feeder Canal
- Secondary Feeder Canal
- Main Irrigation Canal
- Secondary Irrigation Canal
- Irrigation Pond

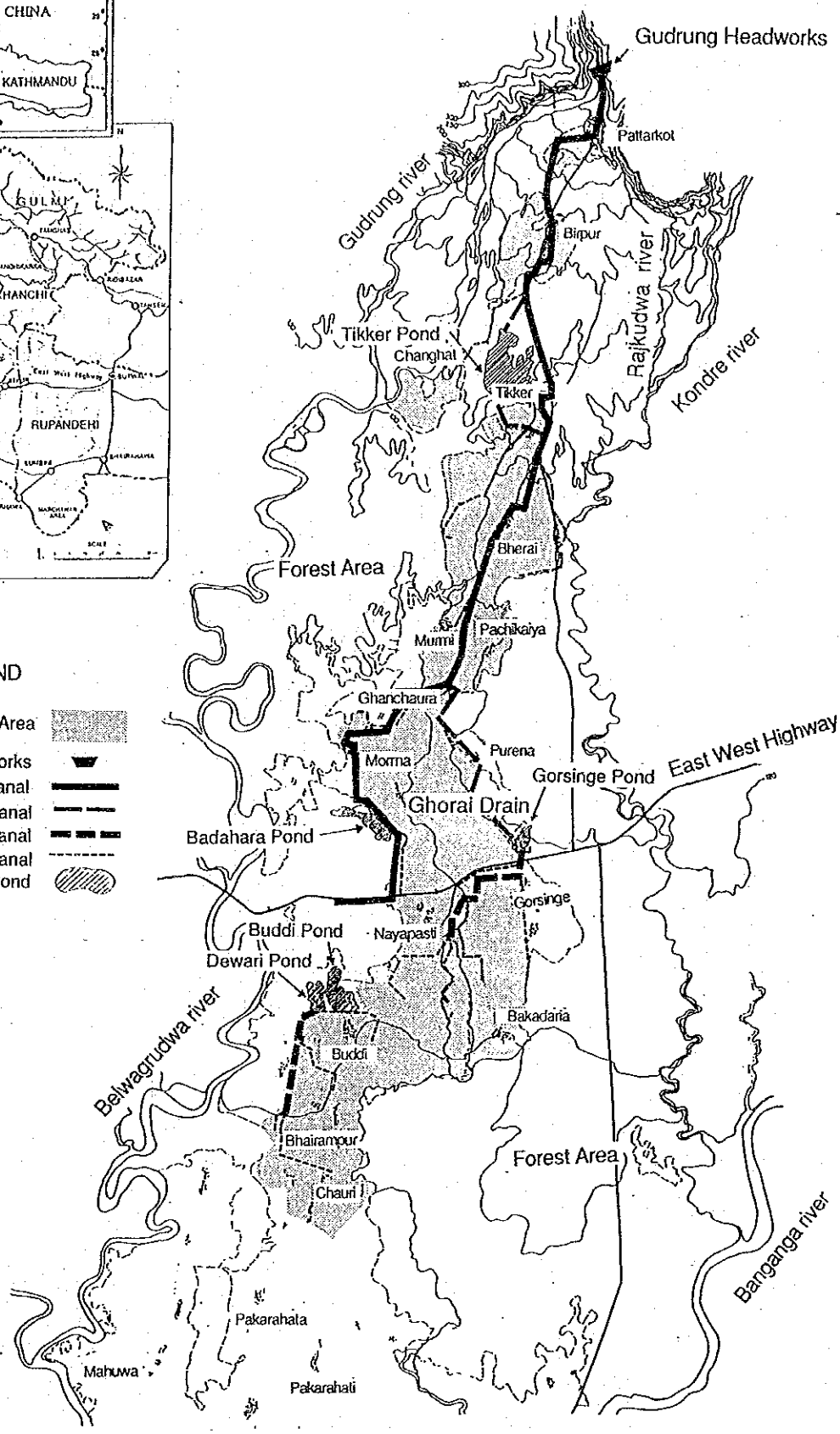
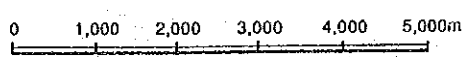
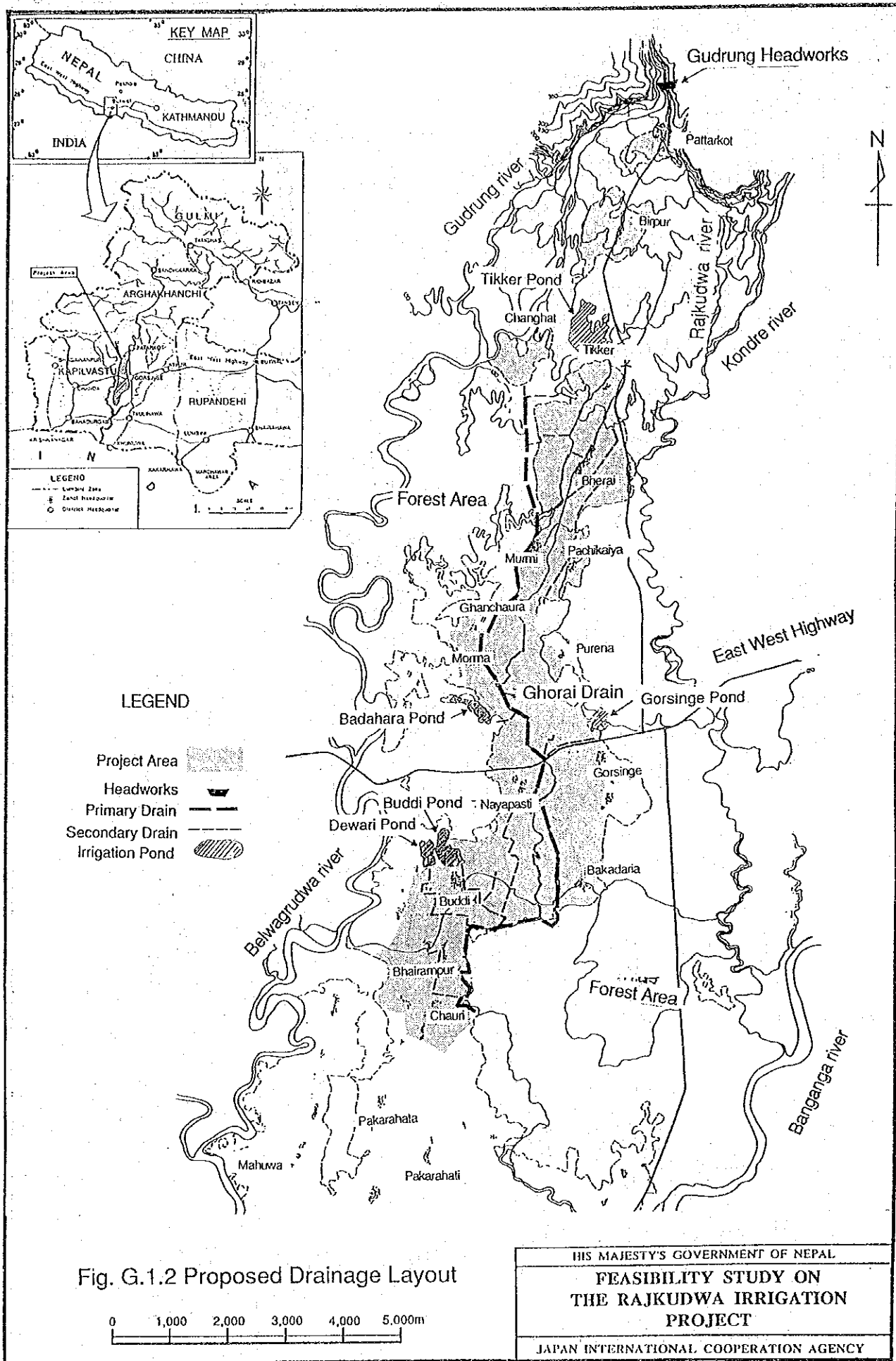
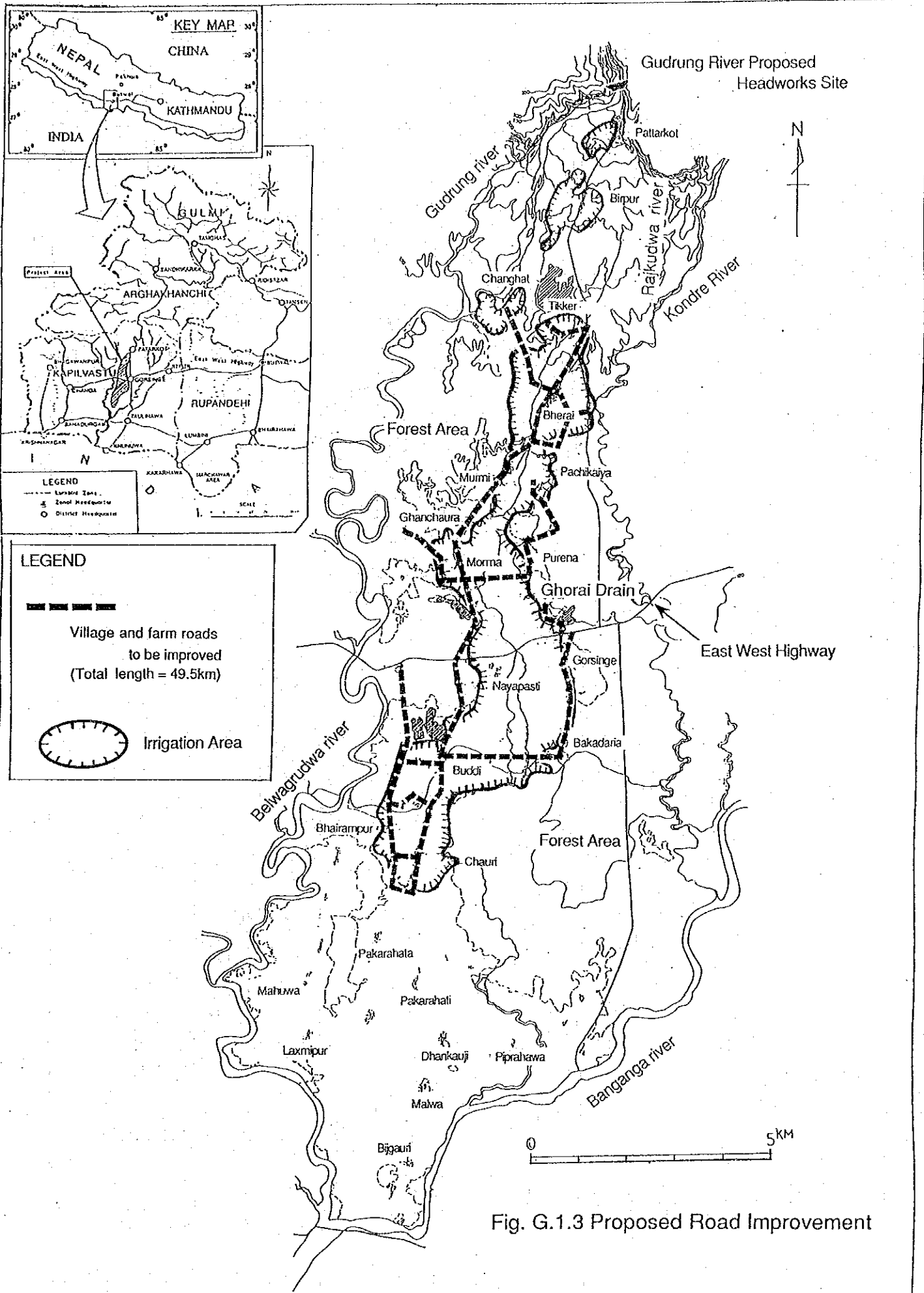


Fig. G.1.1 Proposed Irrigation Layout



HIS MAJESTY'S GOVERNMENT OF NEPAL
**FEASIBILITY STUDY ON
 THE RAJKUDWA IRRIGATION
 PROJECT**
 JAPAN INTERNATIONAL COOPERATION AGENCY





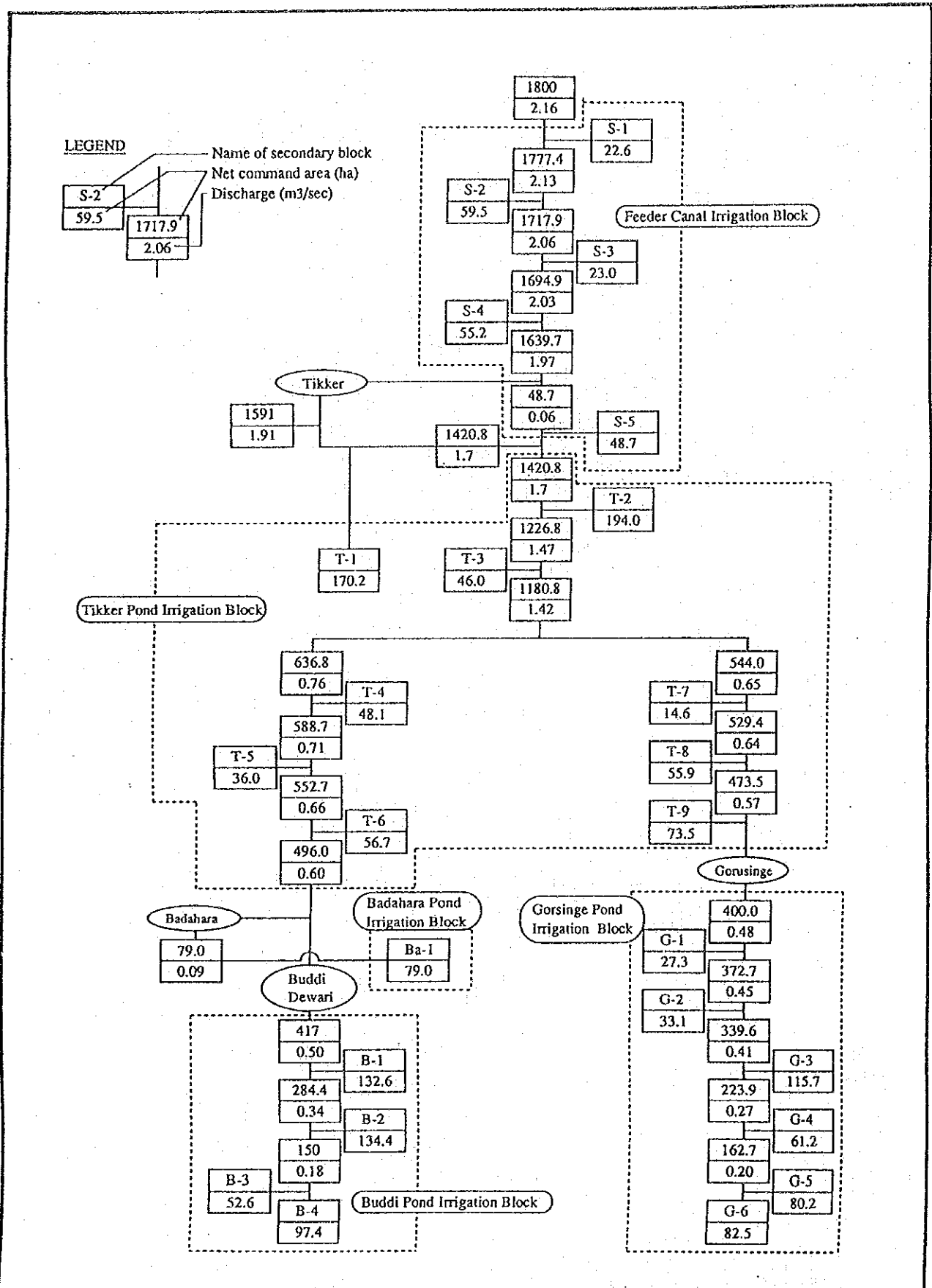


Fig. G.1.4 Proposed Irrigation Diagram

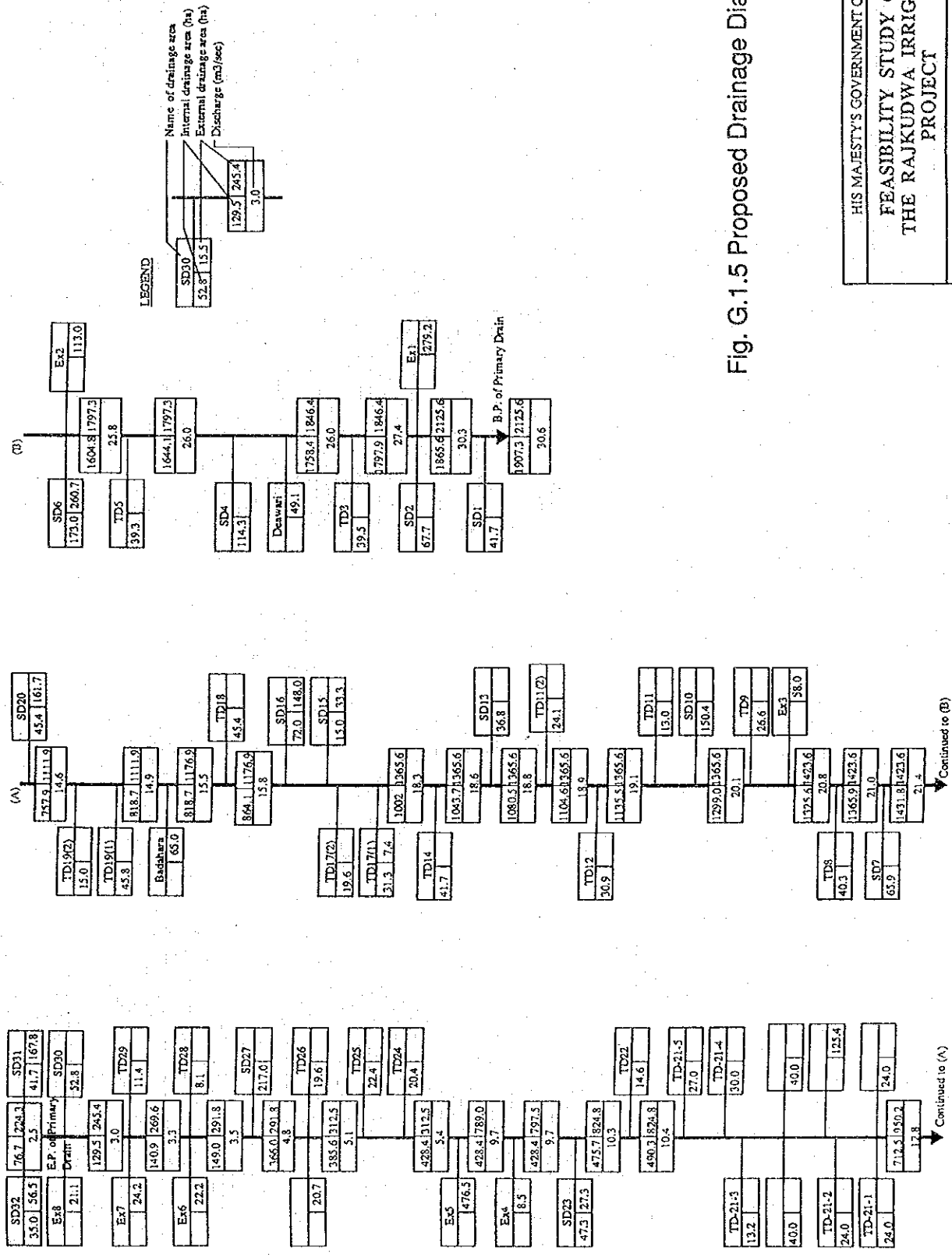


Fig. G.1.5 Proposed Drainage Diagram

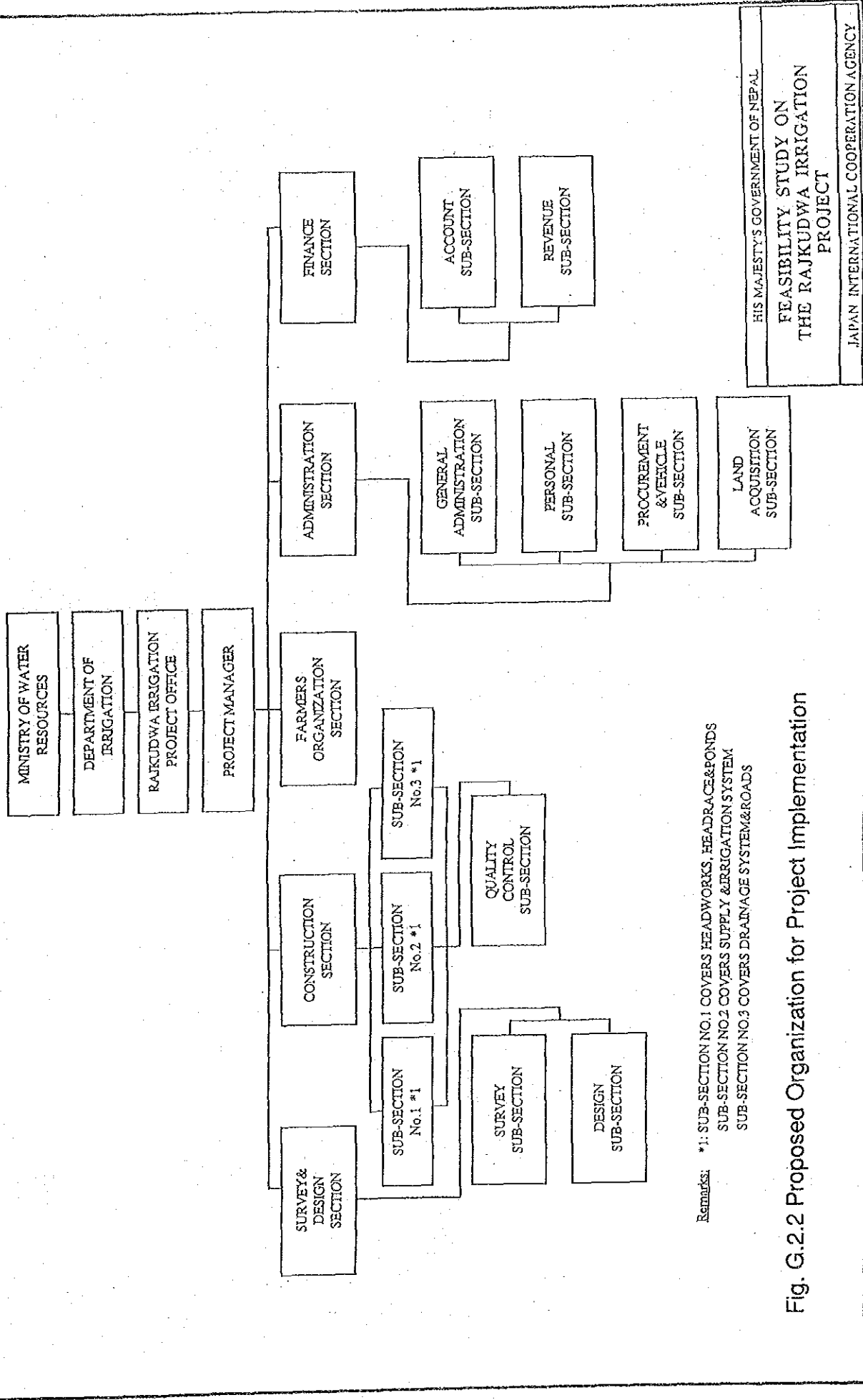
Description	unit	Qty	1st Year 1993/94												2nd Year 1994/95												3rd Year 1995/96												4th Year 1996											
			6			7			8			9			10			11			12			1			2			3			4			5			6			7								
			Rainy						Dry						Rainy						Dry						Rainy						Dry						Rainy						Dry					
1. Budget Arrangement																																																		
2. Detailed Design																																																		
3. Construction Works																																																		
1) Pre-construction Arrangement																																																		
(1) Tendering																																																		
(2) Land acquisition																																																		
(3) Project office																																																		
2) Construction of Irr. & Drain. Facilities																																																		
(1) Mobilization																																																		
(2) Headworks																																																		
(3) Headrace canal																																																		
(4) Irrigation ponds																																																		
(5) Supply system																																																		
(6) Irrigation system																																																		
(7) Drainage System																																																		
(8) Farm roads																																																		
3) Construction of Agri. Support Facilities																																																		
(1) Agricultural cooperative center	m ²	3,000																																																
(2) VDC farmers' cooperative Office	m ²	500x5																																																
4. Project Administration and O&M Works																																																		
1) Project Administration for D/D and Construction																																																		
2) O&M Works																																																		
5. Engineering Services																																																		

Fig. G.2.1 Proposed Implementation Schedule

HIS MAJESTY'S GOVERNMENT OF NEPAL

FEASIBILITY STUDY ON
THE RAJKUDWA IRRIGATION
PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY



Remarks: *1: SUB-SECTION NO.1 COVERS HEADWORKS, HEADRACE&PONDS
 SUB-SECTION NO.2 COVERS SUPPLY &IRRIGATION SYSTEM
 SUB-SECTION NO.3 COVERS DRAINAGE SYSTEM&ROADS

Fig. G.2.2 Proposed Organization for Project Implementation

ANNEX - H
PROJECT EVALUATION

ANNEX - H

PROJECT EVALUATION

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ANNEX H PROJECT EVALUATION

H.1 GENERAL

The evaluation of the Rajkudwa Irrigation Project was made through assessment of the project feasibility from economic, financial, socio-economic, and environmental aspects. The economic feasibility was assessed by the Economic Internal Rate of Return (EIRR), and its sensitivity analysis which was made in order to elucidate the economic viability of the project against adverse changes in the benefit and project cost.

The financial evaluation was carried out by analyzing the effect of the project on the farm economy for respective four types of farmers: large, medium, small, and marginal farmers. The indirect benefit, socio-economic and environmental impacts by the implementation of the project were also studied.

H.2 ECONOMIC EVALUATION

H.2.1 General

The economic evaluation was made following the basic assumptions mentioned below:

- i) The economic effective life of the project is 50 years
- ii) All prices were expressed in constant 1993 price
- iii) The exchange rate of US\$ 1.00 = NRs. 50.0 = Yen 115 was applied (in March 1993)

H.2.2 Evaluation of Economic Factor

H.2.2.1 Standard Conversion Factor

Tariff and trade restrictions introduce a distortion in the price relationship between traded commodities and non-traded commodities. In order to evaluate the project costs and benefits with respected to world market prices, a Standard Conversion Factor (SCF) was applied to the prices of non-traded goods and services. The SCF was calculated on the basis of the following formula:

$$SFC = (X + M) / \{(X + S_x - T_x)\} + (M - S_m + T_m)$$

Where, X: Export value
M: Import value
S_x: Export subsidies
S_m: Import subsidies
T_x: Export taxes
T_m: Import taxes

The CIFs from 1987/88 to 1991/92 were calculated to be from 0.85 to 0.94 and 0.89 on the average as shown in the table below. Accordingly, the SCF of 0.89 was applied in this project evaluation.

(unit: million NRs.)

Year	FOB	CIF Import	Export Subsidy (Es)	Export Tax (Et)	Import Subsidy (Is)	Import Tax (It)	SCF
	Export Value (E)	Value (I)					
1987/88	4,115	13,870	0	181	0	3,333	0.85
1988/89	4,195	16,264	0	118	0	2,307	0.90
1989/90	5,236	18,402	544	33	0	2,654	0.88
1990/91	7,388	23,227	9	77	0	5,415	0.85
1991/92	13,939	32,951	0	116	0	3,246	0.94
Average	34,872	104,713	553	525	0	16,955	0.89

Source: Department Customs and Ministry of Finance

H.2.2.2 Transfer Payment

From the viewpoint of the international economy, the transfer payments such as contract tax, duty, subsidy and interest were considered as a domestic monetary movement without direct productivity. These transfer payments are, therefore, excluded from the project costs as far as economic analysis is concerned.

H.2.2.3 Economic Prices of Inputs and Outputs

The economic prices of tradable agricultural outputs (paddy, wheat, and maize) and farm inputs (urea, triple super phosphate, and potassium chloride) were estimated on the basis of the World Bank projections of world market prices for 2000 in constant 1992 price. The forecasted prices were adjusted to the 1993 constant price level, using the factor of 1.032 based on Manufacturing Unit Value (MUV) index computed by the World Bank. The domestic cost elements such as transport, handling, and processing down to the farm-gate level were multiplied by the SCF of 0.89 in order to compute the farm-gate prices. The economic prices of oilseeds and pulses were applied to present farm-gate prices, considering the economic costs of transportation and handling. The economic farm-gate prices of tradable agricultural outputs and inputs are shown in Table H.2.1.

Shadow wage rate for the unskilled and farm labors was estimated at 0.70, considering the actual present employment opportunities in Nepal. Farm labor was estimated at NRs. 28 per man-day for male labor, NRs. 24.5 per man-day for female labor.

H.2.2.4 Economic Construction Cost

The individual financial cost for major project components were categorized into four (4) items of transfer payment, unskilled labor, non-traded cost, and traded foreign costs, for each of which an economic/financial conversion factor was applied. The Construction

Conversion Factor (CCF) that is the weighted average of the above component, was calculated as shown in Table H.2.3.

H.2.3 Economic Irrigation Benefit

The economic irrigation benefit to be expected is defined as the difference of net profits from crops between future with-project and without-project conditions. On the basis of the estimated production cost, gross income, and net profit for each crop per ha were calculated both on future with and without-project conditions. The details are shown in Tables E.3.3 to E.3.4 of Annex E.

Applying the net crop profit per ha and cropped area, total net profit from agricultural production for the project was estimated both on without and with-project conditions. The irrigation benefit was estimated at NRs. 67.56 million. Table H.2.2 elaborates the irrigation benefit which is summarized as follows:

(unit: 1000NRs)			
Crop	Without Project	With Project	Incremental Benefit
Paddy	18,840	59,040	40,200
Wheat	6,220	21,010	14,800
Maize	330	0	-330
Pulses	930	0	-930
Oilseed	620	2,270	1,660
Vegetables	360	12,530	12,160
Total	27,300	94,850	67,560

The irrigation benefit is expected to increase year to year and will reach the full benefit in five (5) years after the completion of construction. The expected irrigation benefit during construction period was assumed as follows:

Year	Benefit	
Last year of disbursement	1996	40% of the full benefit for winter and spring crops
1st year	1997	40% of the full benefit
2nd year	1998	60%
3rd year	1999	80%
4th year	2000	90%
5th year	2001	100%

H.2.4 Economic Cost

H.2.4.1 Capital Cost

The economic construction cost was estimated by applying Construction Conversion Factor (CCF) to the financial construction cost. The economic cost was estimated to be NRs. 462.84 x 10⁶. The economic capital cost and annual disbursement are shown in Table H.2.3.

H.2.4.2 O&M Cost and Replacement Cost

Economic annual operation and maintenance (O & M) cost was estimated by applying the CCF to the financial O&M cost. Gates for irrigation facilities were assumed to be replaced every 20 years. The economic O & M cost and replacement cost were estimated by applying the financial cost to the CCFs as follows:

	Financial Cost	CCF	Economic Cost
	1000NRs	%	1000NRs
Annual O & M Cost	2,433	77	1,866
Replacement Cost	1,767	82	1,449

H.2.4.3 Annual Cost Flow

The economic cost flow was prepared on the basis of construction schedule as shown in Table H.2.4.

H.2.5 Internal Rate of Return (EIRR)

The EIRR was calculated on the basis of cost-and-benefit flow as presented in Table H.2.4. The calculated result is :

$$\text{EIRR} = 11.4 \%$$

H.2.6 Sensitivity Analysis

A sensibility analysis was carried out to evaluate the soundness of the project against unexpected adverse changes in the future shown below:

- Case 1: Reduction of irrigation benefit by 10 %
- Case 2: Cost overrun by 10 %
- Case 3: Combination of Case (1) and (2)
- Case 4: Reduction of irrigation benefit by 20 %
- Case 5: Cost overrun by 20 %
- Case 6: Combination of Case (3) and (4)

The results are presented below. The details are given in Table H.2.5.

Case	EIRR (%)	Case	EIRR (%)
Base case	11.4		
Case 1	10.4	Case 4	9.3
Case 2	10.5	Case 5	9.8
Case 3	9.6	Case 6	7.9

H.3 FINANCIAL ANALYSIS

H.3.1 General

The financial evaluation of the project was made by the analysis of the typical farm budgets. The farm budget analysis was conducted to assess whether the project would have sufficient incentive to the farmers in the project area and would bring enough income increase in the farmers' economy. Assessment of the water charge to be applied in the irrigated area was also made briefly.

H.3.2 Farm Budget Analysis

In order to evaluate the project from the financial aspect of the farmers, the farm budget analysis of different sizes of farmers were made under future with and without-project conditions. The payment capacity was thought of the ability of farmers benefited by the project, whether they can bear the expenses required for operation and maintenance of the project facilities.

After implementation of the project, the project will fulfill the basic requirements for introducing improved irrigation farming under a stable irrigation water supply. As a result, unit yield and cropping intensity are expected to be increased greatly in the future under with-project condition. Under such situations, a drastic increase on farm income is also expected for the farmers in the project area. On the other hand, substantial increase on farm income is not expected in the future under without-project condition. The farm budgets of typical farmers in both with and without-project conditions are presented in Table H.3.1, which is summarized as follows:

	Farm size	Net Profit		Increment
		Without Project	With Project	
	ha	NRs	NRs	NRs
Large farmer	6.81	24,000	151,070	127,070
Medium farmer	3.05	14,040	80,210	66,170
Small farmer	1.32	9,670	41,540	31,870
Marginal Farmer	0.34	3,010	12,680	9,670
Average	0.84	5,460	25,720	20,260

Net profit of farm income in the future under with-project condition is expected to increase about 4 to 6 times of that under without-project condition. The annual net farm income of the average farmer (farm size of 0.84 ha) is expected to increase by 4.7 times, from NRs. 5,460 under without-project condition up to NRs. 25,260 under with-project condition. Even the marginal farmer (farm size of 0.34 ha), the net farm income will increase from NRs. 3,020 up to NRs. 12,690.

H.3.3 Capacity to Pay

After implementation of the project, the O & M cost will be paid by the beneficiary farmers as water charge. The annual O & M cost was estimated to be NRs. 2,430,000, which is equal to NRs. 1,350 per ha. On the other hand, the annual average incremental net profit per ha is expected to be about NRs. 24,000. The water charge to be paid by the farmers is equivalent to about 6 % of the net profit. Therefore, the increased net profit of the farmers will have enough capability to pay the water charge.

H.4 ENVIRONMENTAL CONSIDERATIONS

H.4.1 Present Environmental Conditions

H.4.1.1 Physical Resources

The present physical environmental conditions of the project area are described in the Annexes as shown below:

Topography and geology:	Annex B
Climate:	Annex A
Hydrology	Annex A
Soils	Annex C
Sedimentation	Annex A

H.4.1.2 Biological Resources

(1) Vegetation

The project area is surrounded by governmental forests as illustrated in the land use map in Annex C. In the project area, forests have been reclaimed for agriculture by immigrants from the hill area and indigenous people. In recent years, the remaining forest land has also been encroached by increasing population and food demands. Furthermore, over-grazing by livestock animals and over-cutting of trees for domestic use have also deteriorated the forest. Under these circumstances, the district forest office in Kapilvastu of Ministry of Forests and Environment (MOFE) are reforesting and protecting some parts of these forests with fences, etc..

Types of forest found in the project area are described in "Forest Resources of Kapilvastu District.(MOFE, 1992)". According to this report, forests are broadly categorized into the following three (3) types:

i) Sal Type (S):

As the name suggests, Sal (*Shorea robusta*) is the predominant species found in this forest type. Other associates are Asna (*Terminalia tomentosa*), Bahera (*Terminalia belerica*), Karma (*Adina cordifolia*), Jamun (*Eugenia jambolena*), and Banjhi

(*Anogeissus latifolia*) among others. This forest type is generally found on the well drained low terrace as well as on the gentle slopes of the lower hills.

ii) Terai Hard-woods Type (TH):

This forest type is comprised of mixed hard-woods other than Sal, and occurs mostly on the depressed plain and flat plain along the streams and rivers. The most common species are Asena, Karma, Jamun, Banjhi, Khair (*Acacia catechu*), Semal (*Bombax malabaricum*), Bel (*Aegle marmelosa*), and Kusum (*Slichera trijuga*) among them.

iii) Khair-Sisso Type (KS):

It consists of the stands of Khair and Sissoo (*Dalbergia sissoo*) with Khair predominating. This type of forest is generally found on new alluvial soils conveyed by streams and rivers.

The type i) and ii) occupy almost all the area, approximately 50% and 50%, respectively, and type iii) is found little. The resources of forest in and around the project area are summarized from the report as below:

<u>Stand size class</u>		Area (% of forest area)
Seedling & Sapling	(< 12.5 cm)	5
Poles	(12.5-25 cm)	20
Small saw timber	(25 -50 cm)	55
Large saw timber	(>50 cm)	20
<u>Stocking class</u>		Area (% of forest area)
Poor	(10 - 39% crown closure)	5
Medium	(40 - 69% crown closure)	45
Well	(70% or more crown closure)	50
<u>Number of stems per ha in average</u>		
	Bigger than one cm in diameter	668
	Bigger than 12.5 cm in diameter	110
<u>Stem volume m³ per ha in average</u>		
	Total	118
	up to 10 cm top diameter	86
	up to 20 cm top diameter	63
<u>Quality to timber for tree in % of total volume</u>		
	High	43
	Other	33
	Cull	24
<u>Growth volume per year</u>		3.8 m ³ /ha/year
<u>Total biomass in ton of air dry per ha</u>		
	Total	134
	Stem	93
	Branch	36
	Leaf	5

(2) Wildlife

There is no site-specific data on the local wildlife such as mammalian, avifauna, reptile, and amphibian. Common species of wildlife in the Terai area are found in and around the project area: several species of monkeys, wild cats, foxes, deer, pheasant, larks, parakeets, etc.

(3) Aquatic Biology

There are small rivers, streams and ponds in and around the project area. About 120 species of fishes were reported in Nepal. However, there is no specific records in the project area on the aquatic biology. Fishing by villagers in the rivers, small streams, and irrigation/drainage canals is a common practice in the project area, using traditional method. Aqua-culture is being conducted in some ponds on a contract basis.

H.4.1.3 Socio-economic Conditions

The socio-economic conditions of the area are described in the Annexes as shown in the following:

Population and labor force	Annex E
Land use	Annex C
Agriculture and its production	Annex D
Farmers' economy	Annex E
Social infrastructure	Annex E
Drinking water supply	Annex E

(1) Public Health

In the project area, instruction and guidance on public health are well done by related agencies together with rural water supply projects, and malaria is not confirmed in recent years.

(2) Historical and Cultural Values

There are historical remains in the vicinity of Taulihawa, south of the Banganga river, so called Tilaurakot ruins of about 2,500 years ago. However, any historical remains or cultural assets have not been found in and around the project area.

H.4.2 Environmental Impacts of the Project

H.4.2.1 Social Environment

(1) Socio-Economic Issues

Irrigation water will be supplied to existing non-irrigated/partially irrigated paddy field in the project area, therefore, there is no substantial change in human life of the villagers. The

Ranikudwa irrigation system is fairly well managed by villagers themselves. The Gudrung river has not been established water right to another farmers or agents located downstream.

Land acquisition for new canals, main, secondary and tertiary canals was basically agreed with at the farmers' meeting held during the period. Irrigation water to existing irrigated area in the construction period will be supplied by temporary by-pass canals.

(2) Health and Sanitary Issues

Amount of applied fertilizers and agro-chemicals increases for introduction of intensive agriculture. It is necessary to give adequate instruction to farmers for avoiding adverse effect of these farm inputs.

It is generally reported that water related diseases increase along with the application of irrigated agriculture. However, since malaria control and sanitary instruction for villagers have been carried out by related agencies, the project is not considered to bring about adverse effect on public health.

Drinking water for domestic use almost depends on shallow groundwater from tubewells or dug wells. After construction of the Gudrung headworks at Patharkot, the recharge of groundwater by the river may decrease, however, the recharge from, i.e., irrigation water, may increase. There is only one dug well that might be affected by the project in Pattharkot. Monitoring of the water table of the dug well is recommended after completion of the project.

H.4.2.2 Natural Environment

(1) Biological and Ecological Issues

The five (5) irrigation ponds will be newly constructed or rehabilitated in the project area. The inundation area is to be extended into the forest at about 100 ha for those ponds. The timber resources of the forest to be lost by inundation are estimated as follows:

<u>Forest type:</u>	Sal	80 %
	Terai hardwood	20%
<u>Stand size:</u>	12.5 - 25 cm	10%
	25 - 50 cm	90%

<u>Stoking:</u>	10 - 39% crown closure	10%
	40 - 69% crown closure	80%
	over 70% crown closure	10%
<u>Number of stems per ha:</u>	total	726
	> 50 cm	18
	25 - 50 cm	35
	12.5 - 25 cm	58
	< 12.5 cm	615
<u>Stem volume in m³ per ha:</u>	total	115
	up to 10 cm	83
	up to 20 cm	61
<u>Growth rate per ha:</u>		3.8 m ³ /ha/year

The forest is generally in matured stage and ranked in a medium class in forestry resources. The abolished forest area occupies only 1.7 % of the total forest land, and no paddy field will be abolished by the ponds. Hence, the change in land use will not significantly affect the vegetation and ecological system.

(2) Soil and Land Resources

The project will bring about no land devastation, soil erosion, soil salinization or soil contamination.

(3) Hydrological, Atmospheric and Water Quality Issues

There is no significant adverse effect on hydrological condition, atmospheric condition and water quality.

H.5 SOCIO-ECONOMIC IMPACTS

In addition to direct benefit accounted for in the economic evaluation, various secondary and intangible benefit and favorable socio-economic impacts are described here:

(1) Increase of Employment Opportunities

It is estimated that the project will generate employment opportunities during the construction period. Most of the manpower will be supplied from the farmers in and around the project area. Furthermore, the employee will be able to get more experiences and skillfulness in various working fields. This accumulation of experiences would be greatly useful for O & M work of the irrigation facilities.

In addition, the project creates a demand for farm labor in increased farming activities for intensive use of land. The farm labor requirement will be increased by 130,000 man-days per year: from 292,000 man-days under without-project condition to 422,000 man-days under with-project condition as shown in Table H.5.1. The ratio of labor for farming

activities to total available labor force is expected to increase from present 13 % up to about 19 % in the future under with-project condition.

(2) Self Sufficiency of Food and Improvement of Nutritious Status of Villagers

The stable supply of irrigation water and introduction of improved farming practices will not only increase the crop production but also improve nutritious status of villagers. The marginal farmers (size of 0.33 ha) will be able to produce sufficient food grains for themselves, and moreover, they will be able to sell about 10 % of the production for cash income. The increase of vegetable production will also bring about better nutritious condition for villagers.

The increase of marketable paddy and wheat from the project area will contribute on mitigating the food deficit of other regions. Marketable surplus of food grains; 5,000 tons of paddy, 1,400 tons of wheat is expected to be generated, which will be distributed to the populated and/or remote hill areas.

(3) Activation of Agro-Processing and Marketing System

The increase of crop production mentioned above will give great profits to rice millers and merchants with respect to the processing and marketing cost. Mustard seed production is a valuable source of cash income for farmers as well as it gives a great deal of profits to oil millers.

(4) Aqua-Culture in Ponds

The ponds constructed for irrigation are possibly used for aqua-culture. Fish is a priceless source of protein for the people in the area. Aqua-cultural extension services are being provided by the Bhairahawa fishery development center and Buddi agricultural service center. According to an estimation based on the field survey and related information, it is expected that a pond of one hectare will give NRs. 4,900 of net profit per year.

(5) Usage of Agricultural Byproducts

Byproducts, such as straw, rice bran, mustard cake, will be utilized for feeding livestock animals and fish, as cooking fuels and manure for farming.

(6) Multipurpose Use of Irrigation Water

Irrigation water introduced by canals will be also used for domestic use for villagers and livestock animals as well

(7) Activation of Village Community and People's Participation

One water users' association/cooperative office and five village community buildings will be built in related VDCs in the project area. These facilities will take a great part in activating in and inter-village communications.

The proposed water users association which will be organized for operation and maintenance of facilities concerned will increase the opportunities of people's participation in the project.

(8) Improvement of Local Transportation

The local transportation will be greatly improved by the improvement of existing farm roads, providing smooth transport of farm inputs and outputs, and convenient village life.

H.6 PROJECT JUSTIFICATION

The project is justified to be economically feasible with an EIRR of 11.4 % in applying for an international bank loan. The financial analysis indicates that farmers' income will be drastically increased by the project with enough capacity to pay the water charge. Therefore, the living standard of villagers will be enhanced in considerable magnitude.

This project will be, without any doubt, one of the model irrigation projects of medium size in the Terai area. In the project area, some existing irrigation systems have been constructed and operated successfully by farmers themselves, which is a great advantage of the area for introducing a new irrigation project.

The project is aimed at not only increasing the crop production but also bringing about socio-economic impacts: increase of employment opportunity, improvement of nutritious condition of villagers, activation of agro-processing, promotion of aqua culture, uplifting of people's participation in the project, etc. On the other hand, the project will not significantly affect social and natural environment in and around the project area

Thus, the project is justified to be feasible both in terms of economy and engineering.

TABLES

Table H.2.1 Economic Prices for Major Tradable Crops and Fertilizer

		(unit : per ton)			
		Unit	Paddy	Wheat	Maize
A	MAJOR TRADABLE CROPS				
1	Projected World Market Price in 2000 *1	US\$	271	176	112
2	Quality Adjustment	%	85	100	100
3	Projected Prices Adjustment for Quality Difference	US\$	230	176	112
4	International Shipping and Handling Cost	US\$	45	70	60
5	FOB/CIF Price at Calcutta Port	US\$	275	246	172
6	Transport and Handling from/to Nepal Border	US\$	45	45	45
7	Equivalent in NRs/ton *2	NRs.	16,018	14,550	10,850
8	Domestic Transport and Handling from/to Wholesale Point or Mill *3	NRs.	364	364	364
9	Processing Ratio	%	63	100	100
10	Processing Cost *3	NRs.	127	0	0
11	Transport/Handling from/to Farm-gates *3	NRs.	73	73	73
12	Farm-gates Price	NRs.	9,662	14,113	10,413
		(unit : per ton)			
		Unit	Urea	TSP	KCl
B	FERTILIZER				
1	Projected World Market Price in 2000 *1	US\$	187	138	118
2	International Shipping and Handling	US\$	50	60	60
3	FOB/CIF Price at Calcutta Port	US\$	237	198	178
4	Transport and Handling from/to Nepal Border	US\$	45	45	45
5	Equivalent in NRs/ton *2	NRs.	14,100	12,150	11,150
6	Domestic Transport and Handling from/to Wholesale Point /3	NRs.	364	364	364
7	Transport/Handling from/to Farmgate*3	NRs.	73	73	73
8	Farm-gates Price	NRs.	14,537	12,587	11,587
9	Price of Nutrient Content	NRs.	31,602	26,223	19,312

Note *1 : Based on the World Bank Primary Commodity Price Forecast, December 1992. World Bank prices are given in 1990 constant US\$, which have been adjusted by a factor of 1.1053 (MUV) to allow for price escalation between 1990 and 1993.
Paddy : Rice (Thailand), White, milled, 5% broken, FOB Thunder Bay
Wheat : (Canadian), No.1 Western Red Spring, FOB Thunder Bay
Maize : (US), No.2, Yellow, FOB Gulf ports
*2 : Exchange rate between US\$ and NRs. : US\$ 1.00 = NRs. 5.00 (March 1993)
*3 : Adjusted with SCF 089

Table H.2.2 Economic Irrigation Benefit

	Without Project			With Project			Increment		
	Area	Return	Total	Area	Return	Total	Area	Benefit	
	ha	NRs/ha	1000NRs	ha	NRs/ha	1000NRs	ha	1000NRs	
Paddy									
Full Irrigated	0			1,800	32,798	59,036	1,800	59,036	
Partially Irrigated	837	14,763	12,357	0			-837	-12,357	
Non-irrigated	854	7,586	6,478	0			-854	-6,478	
Total	1,691		18,835	1,800		59,036	109	40,201	
Wheat									
Full Irrigated	0			680	30,905	21,015	680	21,015	
Partially Irrigated	306	17,450	5,340	0			-306	-5,340	
Non-irrigated	116	7,546	875	0			-116	-875	
Total	422		6,215	680		21,015	258	14,800	
Maize									
Partially irrigated	25	13,295	332	0			-25	-332	
Total	25		332	0			-25	-332	
Pulses									
Partially Irrigated	78	4,054	316	0			-78	-316	
Non-irrigated	195	3,161	616	0			-195	-616	
Total	273		933	0			-273	-933	
Oilseeds									
Full Irrigated	0			225	10,112	2,275	225	2,275	
Partially Irrigated	77	6,769	521	0			-77	-521	
Non-irrigated	29	3,312	96	0			-29	-96	
Total	106		617	225		2,275	119	1,658	
Vegetables									
Full Irrigated	0			325	38,543	12,526	325	12,526	
Partially Irrigated	50	7,286	364	0			-50	-364	
Total	50		364	325		12,526	275	12,162	
Total	2,567		27,297	3,030		94,853	463	67,557	

Table H.2.3 Economic Construction Cost and Disbursement Schedule

Item	Financial Cost (x 1000 NRs)	Constructor Conversion Factor	Economic Cost (x 1000 NRs)	Disbursement Schedule			
				1993 (x 1000 NRs.)	1994 (x 1000 NRs.)	1995 (x 1000 NRs.)	1996 (x 1000 NRs.)
I Construction Works							
1. Headworks							
(1) Earthworks	8,818	74%	6,526	0	3,898	23,947	0
(2) Structure	25,999	82%	21,319				
2. Headrace							
Earthworks	1,145	74%	847	0	0	15,368	0
Structure	17,708	82%	14,521				
3. Supply System							
(1) Primary Feeder Canal							
Earthworks	11,204	74%	8,291	0	0	67,853	0
Concrete flume works	42,058	82%	34,488				
Structures	30,579	82%	25,074				
(2) Secondary Feeder Canal							
Earthworks	3,895	74%	2,883	0	0	15,724	0
Concrete flume works	12,121	82%	9,940				
Structures	3,539	82%	2,902				
4. Distribution System							
(1) Main Irrigation Canal							
Earthworks	3,179	74%	2,353	0	0	3,119	3,119
Structures	4,737	82%	3,885				
(2) Secondary Irrigation Canal							
Earthworks	9,079	74%	6,718	0	0	7,500	7,500
Structures	10,099	82%	8,282				
(3) Tertiary Irrigation Canal							
Earthworks	11,907	74%	8,811	0	0	10,307	10,307
Structures	14,395	82%	11,804				
5. Drainage System							
(1) Primary Drainage Canal							
Earthworks	33,960	74%	25,131	0	0	9,253	18,786
Structures	3,547	82%	2,908				
(2) Secondary Drainage Canal							
Earthworks	15,568	74%	11,520	0	0	5,187	10,532
Structures	5,120	82%	4,199				
(3) Tertiary Drainage Canal							
Earthworks	2,181	74%	1,614	0	0	3,380	6,863
Structures	10,524	82%	8,629				
6. Irrigation Pond							
(1) Earthworks	61,928	74%	45,827	0	0	36,305	17,882
(2) Structures	10,196	82%	8,361				
7. Village cum Service Road							
(1) Earthworks	33,935	74%	25,112	0	0	10,483	15,725
(2) Structures	1,338	82%	1,097				
8. Project Office	1,570	72%	1,130	57	1,074	0	0
9. Farmers' Cooperative Offices\							
(1) Agricultural cooperative cent	3,584	72%	2,580	0	0	2,580	0
(2) VDC farmers' cooperative of	10,657	72%	7,673	0	0	2,532	5,141
10. Physical Contingency (20%)	80,914		62,884	11	994	42,708	19,171
II. Administration and Engineering Services							
11. Administration	10,093	87%	8,781	527	3,161	3,161	1,932
12. Engineering Services	79,950	96%	76,752	15,099	29,267	19,930	12,456
Total (Item 1.- 12.)	575,527	80%	462,840	15,694	38,395	279,338	129,413

Table H.2.4 Economic Cost and Benefit Stream

(Unit: 1000 NRs.)

No.	Year	Cost			Total	Incremental Benefit	Balance
		Construction	O & M	Replacement			
1	1993	15,694			15,694.1		-15,694.1
2	1994	38,395			38,394.7		-38,394.7
3	1995	279,338			279,337.8		-279,337.8
4	1996	129,413			129,413.4	10,942.0	-118,471.4
5	1997		1,886		1,886.0	27,022.8	25,136.8
6	1998		1,886		1,886.0	40,534.2	38,648.2
7	1999		1,886		1,886.0	54,045.6	52,159.6
8	2000		1,886		1,886.0	60,801	58,915.3
9	2001		1,886		1,886.0	67,557	65,671.0
10	2002		1,886		1,886.0	67,557	65,671.0
11	2003		1,886		1,886.0	67,557	65,671.0
12	2004		1,886		1,886.0	67,557	65,671.0
13	2005		1,886		1,886.0	67,557	65,671.0
14	2006		1,886		1,886.0	67,557	65,671.0
15	2007		1,886		1,886.0	67,557	65,671.0
16	2008		1,886		1,886.0	67,557	65,671.0
17	2009		1,886		1,886.0	67,557	65,671.0
18	2010		1,886		1,886.0	67,557	65,671.0
19	2011		1,886		1,886.0	67,557	65,671.0
20	2012		1,886		1,886.0	67,557	65,671.0
21	2013		1,886		1,886.0	67,557	65,671.0
22	2014		1,886		1,886.0	67,557	65,671.0
23	2015		1,886		1,886.0	67,557	65,671.0
24	2016		1,886	1,448.9	3,335.0	67,557	64,222.0
25	2017		1,886		1,886.0	67,557	65,671.0
26	2018		1,886		1,886.0	67,557	65,671.0
27	2019		1,886		1,886.0	67,557	65,671.0
28	2020		1,886		1,886.0	67,557	65,671.0
29	2021		1,886		1,886.0	67,557	65,671.0
30	2022		1,886		1,886.0	67,557	65,671.0
31	2023		1,886		1,886.0	67,557	65,671.0
32	2024		1,886		1,886.0	67,557	65,671.0
33	2025		1,886		1,886.0	67,557	65,671.0
34	2026		1,886		1,886.0	67,557	65,671.0
35	2027		1,886		1,886.0	67,557	65,671.0
36	2028		1,886		1,886.0	67,557	65,671.0
37	2029		1,886		1,886.0	67,557	65,671.0
38	2030		1,886		1,886.0	67,557	65,671.0
39	2031		1,886		1,886.0	67,557	65,671.0
40	2032		1,886		1,886.0	67,557	65,671.0
41	2033		1,886		1,886.0	67,557	65,671.0
42	2034		1,886		1,886.0	67,557	65,671.0
43	2035		1,886		1,886.0	67,557	65,671.0
44	2036		1,886	1,448.9	3,335.0	67,557	64,222.0
45	2037		1,886		1,886.0	67,557	65,671.0
46	2038		1,886		1,886.0	67,557	65,671.0
47	2039		1,886		1,886.0	67,557	65,671.0
48	2040		1,886		1,886.0	67,557	65,671.0
49	2041		1,886		1,886.0	67,557	65,671.0
50	2042		1,886		1,886.0	67,557	65,671.0
51	2043		1,886		1,886.0	67,557	65,671.0
52	2044		1,886		1,886.0	67,557	65,671.0
53	2045		1,886		1,886.0	67,557	65,671.0
54	2046		1,886		1,886.0	67,557	65,671.0
Total(1000NRs)		462,839.9	94,301.0	2,897.9	560,038.8	3,300,967.9	2,740,929.1
EIRR =		11.44%					

Table H.2.5 Sensitivity Analysis (1/6)
(Case 1: Reduction of Irrigation Benefit by 10%)

(Unit: 1000 NRs.)

No.	Year	Cost			Total	Incremental Benefit	Balance
		Construction	O & M	Replacement			
1	1993	15,694			15,694.1		-15,694.1
2	1994	38,395			38,394.7		-38,394.7
3	1995	279,338			279,337.8		-279,337.8
4	1996	129,413			129,413.4	9,847.8	-119,565.6
5	1997		1,886		1,886.0	24,320.5	22,434.5
6	1998		1,886		1,886.0	36,480.8	34,594.8
7	1999		1,886		1,886.0	48,641.0	46,755.0
8	2000		1,886		1,886.0	54,721.2	52,835.2
9	2001		1,886		1,886.0	60,801.3	58,915.3
10	2002		1,886		1,886.0	60,801.3	58,915.3
11	2003		1,886		1,886.0	60,801.3	58,915.3
12	2004		1,886		1,886.0	60,801.3	58,915.3
13	2005		1,886		1,886.0	60,801.3	58,915.3
14	2006		1,886		1,886.0	60,801.3	58,915.3
15	2007		1,886		1,886.0	60,801.3	58,915.3
16	2008		1,886		1,886.0	60,801.3	58,915.3
17	2009		1,886		1,886.0	60,801.3	58,915.3
18	2010		1,886		1,886.0	60,801.3	58,915.3
19	2011		1,886		1,886.0	60,801.3	58,915.3
20	2012		1,886		1,886.0	60,801.3	58,915.3
21	2013		1,886		1,886.0	60,801.3	58,915.3
22	2014		1,886		1,886.0	60,801.3	58,915.3
23	2015		1,886		1,886.0	60,801.3	58,915.3
24	2016		1,886	1,448.9	3,335.0	60,801.3	57,466.3
25	2017		1,886		1,886.0	60,801.3	58,915.3
26	2018		1,886		1,886.0	60,801.3	58,915.3
27	2019		1,886		1,886.0	60,801.3	58,915.3
28	2020		1,886		1,886.0	60,801.3	58,915.3
29	2021		1,886		1,886.0	60,801.3	58,915.3
30	2022		1,886		1,886.0	60,801.3	58,915.3
31	2023		1,886		1,886.0	60,801.3	58,915.3
32	2024		1,886		1,886.0	60,801.3	58,915.3
33	2025		1,886		1,886.0	60,801.3	58,915.3
34	2026		1,886		1,886.0	60,801.3	58,915.3
35	2027		1,886		1,886.0	60,801.3	58,915.3
36	2028		1,886		1,886.0	60,801.3	58,915.3
37	2029		1,886		1,886.0	60,801.3	58,915.3
38	2030		1,886		1,886.0	60,801.3	58,915.3
39	2031		1,886		1,886.0	60,801.3	58,915.3
40	2032		1,886		1,886.0	60,801.3	58,915.3
41	2033		1,886		1,886.0	60,801.3	58,915.3
42	2034		1,886		1,886.0	60,801.3	58,915.3
43	2035		1,886		1,886.0	60,801.3	58,915.3
44	2036		1,886	1,448.9	3,335.0	60,801.3	57,466.3
45	2037		1,886		1,886.0	60,801.3	58,915.3
46	2038		1,886		1,886.0	60,801.3	58,915.3
47	2039		1,886		1,886.0	60,801.3	58,915.3
48	2040		1,886		1,886.0	60,801.3	58,915.3
49	2041		1,886		1,886.0	60,801.3	58,915.3
50	2042		1,886		1,886.0	60,801.3	58,915.3
51	2043		1,886		1,886.0	60,801.3	58,915.3
52	2044		1,886		1,886.0	60,801.3	58,915.3
53	2045		1,886		1,886.0	60,801.3	58,915.3
54	2046		1,886		1,886.0	60,801.3	58,915.3
Total(1000NRs)		462,839.9	94,301.0	2,897.9	560,038.8	2,970,871.1	2,410,832.3
EIRR =		10.40%					

Table H.2.5 Sensitivity Analysis (2/6)
(Case 2: Cost Overrun by 10%)

(Unit: 1000 NRs.)

No.	Year	Cost			Total	Incremental Benefit	Balance
		Construction	O & M	Replacement			
1	1993	17,264			17,263.5		-17,263.5
2	1994	42,234			42,234.2		-42,234.2
3	1995	307,272			307,271.5		-307,271.5
4	1996	142,355			142,354.7	10,942.0	-131,412.7
5	1997		1,886		1,886.0	27,022.8	25,136.8
6	1998		1,886		1,886.0	40,534.2	38,648.2
7	1999		1,886		1,886.0	54,045.6	52,159.6
8	2000		1,886		1,886.0	60,801	58,915.3
9	2001		1,886		1,886.0	67,557	65,671.0
10	2002		1,886		1,886.0	67,557	65,671.0
11	2003		1,886		1,886.0	67,557	65,671.0
12	2004		1,886		1,886.0	67,557	65,671.0
13	2005		1,886		1,886.0	67,557	65,671.0
14	2006		1,886		1,886.0	67,557	65,671.0
15	2007		1,886		1,886.0	67,557	65,671.0
16	2008		1,886		1,886.0	67,557	65,671.0
17	2009		1,886		1,886.0	67,557	65,671.0
18	2010		1,886		1,886.0	67,557	65,671.0
19	2011		1,886		1,886.0	67,557	65,671.0
20	2012		1,886		1,886.0	67,557	65,671.0
21	2013		1,886		1,886.0	67,557	65,671.0
22	2014		1,886		1,886.0	67,557	65,671.0
23	2015		1,886		1,886.0	67,557	65,671.0
24	2016		1,886	1,448.9	3,335.0	67,557	64,222.0
25	2017		1,886		1,886.0	67,557	65,671.0
26	2018		1,886		1,886.0	67,557	65,671.0
27	2019		1,886		1,886.0	67,557	65,671.0
28	2020		1,886		1,886.0	67,557	65,671.0
29	2021		1,886		1,886.0	67,557	65,671.0
30	2022		1,886		1,886.0	67,557	65,671.0
31	2023		1,886		1,886.0	67,557	65,671.0
32	2024		1,886		1,886.0	67,557	65,671.0
33	2025		1,886		1,886.0	67,557	65,671.0
34	2026		1,886		1,886.0	67,557	65,671.0
35	2027		1,886		1,886.0	67,557	65,671.0
36	2028		1,886		1,886.0	67,557	65,671.0
37	2029		1,886		1,886.0	67,557	65,671.0
38	2030		1,886		1,886.0	67,557	65,671.0
39	2031		1,886		1,886.0	67,557	65,671.0
40	2032		1,886		1,886.0	67,557	65,671.0
41	2033		1,886		1,886.0	67,557	65,671.0
42	2034		1,886		1,886.0	67,557	65,671.0
43	2035		1,886		1,886.0	67,557	65,671.0
44	2036		1,886	1,448.9	3,335.0	67,557	64,222.0
45	2037		1,886		1,886.0	67,557	65,671.0
46	2038		1,886		1,886.0	67,557	65,671.0
47	2039		1,886		1,886.0	67,557	65,671.0
48	2040		1,886		1,886.0	67,557	65,671.0
49	2041		1,886		1,886.0	67,557	65,671.0
50	2042		1,886		1,886.0	67,557	65,671.0
51	2043		1,886		1,886.0	67,557	65,671.0
52	2044		1,886		1,886.0	67,557	65,671.0
53	2045		1,886		1,886.0	67,557	65,671.0
54	2046		1,886		1,886.0	67,557	65,671.0
Total(1000NRs)		509,123.9	94,301.0	2,897.9	606,322.8	3,300,967.9	2,694,645.1
EIRR =		10.53%					

Table H.2.5 Sensitivity Analysis (3/6)

(Case 3: Combination of Reduction of Benefit by 10% and Cost Overrun by 10%)

(Unit: 1000 NRs.)

No.	Year	Cost			Total	Incremental Benefit	Balance
		Construction	O & M	Replacement			
1	1993	17,264			17,263.5		-17,263.5
2	1994	42,234			42,234.2		-42,234.2
3	1995	307,272			307,271.5		-307,271.5
4	1996	142,355			142,354.7	9,847.8	-132,506.9
5	1997		1,886		1,886.0	24,320.5	22,434.5
6	1998		1,886		1,886.0	36,480.8	34,594.8
7	1999		1,886		1,886.0	48,641.0	46,755.0
8	2000		1,886		1,886.0	54,721.2	52,835.2
9	2001		1,886		1,886.0	60,801.3	58,915.3
10	2002		1,886		1,886.0	60,801.3	58,915.3
11	2003		1,886		1,886.0	60,801.3	58,915.3
12	2004		1,886		1,886.0	60,801.3	58,915.3
13	2005		1,886		1,886.0	60,801.3	58,915.3
14	2006		1,886		1,886.0	60,801.3	58,915.3
15	2007		1,886		1,886.0	60,801.3	58,915.3
16	2008		1,886		1,886.0	60,801.3	58,915.3
17	2009		1,886		1,886.0	60,801.3	58,915.3
18	2010		1,886		1,886.0	60,801.3	58,915.3
19	2011		1,886		1,886.0	60,801.3	58,915.3
20	2012		1,886		1,886.0	60,801.3	58,915.3
21	2013		1,886		1,886.0	60,801.3	58,915.3
22	2014		1,886		1,886.0	60,801.3	58,915.3
23	2015		1,886		1,886.0	60,801.3	58,915.3
24	2016		1,886	1,448.9	3,335.0	60,801.3	57,466.3
25	2017		1,886		1,886.0	60,801.3	58,915.3
26	2018		1,886		1,886.0	60,801.3	58,915.3
27	2019		1,886		1,886.0	60,801.3	58,915.3
28	2020		1,886		1,886.0	60,801.3	58,915.3
29	2021		1,886		1,886.0	60,801.3	58,915.3
30	2022		1,886		1,886.0	60,801.3	58,915.3
31	2023		1,886		1,886.0	60,801.3	58,915.3
32	2024		1,886		1,886.0	60,801.3	58,915.3
33	2025		1,886		1,886.0	60,801.3	58,915.3
34	2026		1,886		1,886.0	60,801.3	58,915.3
35	2027		1,886		1,886.0	60,801.3	58,915.3
36	2028		1,886		1,886.0	60,801.3	58,915.3
37	2029		1,886		1,886.0	60,801.3	58,915.3
38	2030		1,886		1,886.0	60,801.3	58,915.3
39	2031		1,886		1,886.0	60,801.3	58,915.3
40	2032		1,886		1,886.0	60,801.3	58,915.3
41	2033		1,886		1,886.0	60,801.3	58,915.3
42	2034		1,886		1,886.0	60,801.3	58,915.3
43	2035		1,886		1,886.0	60,801.3	58,915.3
44	2036		1,886	1,448.9	3,335.0	60,801.3	57,466.3
45	2037		1,886		1,886.0	60,801.3	58,915.3
46	2038		1,886		1,886.0	60,801.3	58,915.3
47	2039		1,886		1,886.0	60,801.3	58,915.3
48	2040		1,886		1,886.0	60,801.3	58,915.3
49	2041		1,886		1,886.0	60,801.3	58,915.3
50	2042		1,886		1,886.0	60,801.3	58,915.3
51	2043		1,886		1,886.0	60,801.3	58,915.3
52	2044		1,886		1,886.0	60,801.3	58,915.3
53	2045		1,886		1,886.0	60,801.3	58,915.3
54	2046		1,886		1,886.0	60,801.3	58,915.3
Total(1000NRs)		509,123.9	94,301.0	2,897.9	606,322.8	2,970,871.1	2,364,548.3
EIRR =		9.56%					

Table H.2.5 Sensitivity Analysis (4/6)
(Case 4: Reduction of Irrigation Benefit by 20%)

(Unit:1000 NRs.)

No.	Year	Cost			Total	Incremental Benefit	Balance
		Construction	O & M	Replacement			
1	1993	15,694			15,694.1		-15,694.1
2	1994	38,395			38,394.7		-38,394.7
3	1995	279,338			279,337.8		-279,337.8
4	1996	129,413			129,413.4	8,753.6	-120,659.8
5	1997		1,886		1,886.0	21,618.2	19,732.2
6	1998		1,886		1,886.0	32,427.4	30,541.3
7	1999		1,886		1,886.0	43,236.5	41,350.5
8	2000		1,886		1,886.0	48,641.0	46,755.0
9	2001		1,886		1,886.0	54,045.6	52,159.6
10	2002		1,886		1,886.0	54,045.6	52,159.6
11	2003		1,886		1,886.0	54,045.6	52,159.6
12	2004		1,886		1,886.0	54,045.6	52,159.6
13	2005		1,886		1,886.0	54,045.6	52,159.6
14	2006		1,886		1,886.0	54,045.6	52,159.6
15	2007		1,886		1,886.0	54,045.6	52,159.6
16	2008		1,886		1,886.0	54,045.6	52,159.6
17	2009		1,886		1,886.0	54,045.6	52,159.6
18	2010		1,886		1,886.0	54,045.6	52,159.6
19	2011		1,886		1,886.0	54,045.6	52,159.6
20	2012		1,886		1,886.0	54,045.6	52,159.6
21	2013		1,886		1,886.0	54,045.6	52,159.6
22	2014		1,886		1,886.0	54,045.6	52,159.6
23	2015		1,886		1,886.0	54,045.6	52,159.6
24	2016		1,886	1,448.9	3,335.0	54,045.6	50,710.6
25	2017		1,886		1,886.0	54,045.6	52,159.6
26	2018		1,886		1,886.0	54,045.6	52,159.6
27	2019		1,886		1,886.0	54,045.6	52,159.6
28	2020		1,886		1,886.0	54,045.6	52,159.6
29	2021		1,886		1,886.0	54,045.6	52,159.6
30	2022		1,886		1,886.0	54,045.6	52,159.6
31	2023		1,886		1,886.0	54,045.6	52,159.6
32	2024		1,886		1,886.0	54,045.6	52,159.6
33	2025		1,886		1,886.0	54,045.6	52,159.6
34	2026		1,886		1,886.0	54,045.6	52,159.6
35	2027		1,886		1,886.0	54,045.6	52,159.6
36	2028		1,886		1,886.0	54,045.6	52,159.6
37	2029		1,886		1,886.0	54,045.6	52,159.6
38	2030		1,886		1,886.0	54,045.6	52,159.6
39	2031		1,886		1,886.0	54,045.6	52,159.6
40	2032		1,886		1,886.0	54,045.6	52,159.6
41	2033		1,886		1,886.0	54,045.6	52,159.6
42	2034		1,886		1,886.0	54,045.6	52,159.6
43	2035		1,886		1,886.0	54,045.6	52,159.6
44	2036		1,886	1,448.9	3,335.0	54,045.6	50,710.6
45	2037		1,886		1,886.0	54,045.6	52,159.6
46	2038		1,886		1,886.0	54,045.6	52,159.6
47	2039		1,886		1,886.0	54,045.6	52,159.6
48	2040		1,886		1,886.0	54,045.6	52,159.6
49	2041		1,886		1,886.0	54,045.6	52,159.6
50	2042		1,886		1,886.0	54,045.6	52,159.6
51	2043		1,886		1,886.0	54,045.6	52,159.6
52	2044		1,886		1,886.0	54,045.6	52,159.6
53	2045		1,886		1,886.0	54,045.6	52,159.6
54	2046		1,886		1,886.0	54,045.6	52,159.6
Total(1000NRs)		462,839.9	94,301.0	2,897.9	560,038.8	2,640,774.3	2,080,735.5
EIRR =		9.33%					

Table H.2.5 Sensitivity Analysis (5/6)
(Case 5: Cost Overrun by 20%)

(Unit:1000 NRs.)

No.	Year	Cost			Total	Incremental Benefit	Balance
		Construction	O & M	Replacement			
1	1993	18,833			18,832.9		-18,832.9
2	1994	46,074			46,073.6		-46,073.6
3	1995	335,205			335,205.3		-335,205.3
4	1996	155,296			155,296.0	10,942.0	-144,354.0
5	1997		1,886		1,886.0	27,022.8	25,136.8
6	1998		1,886		1,886.0	40,534.2	38,648.2
7	1999		1,886		1,886.0	54,045.6	52,159.6
8	2000		1,886		1,886.0	60,801	58,915.3
9	2001		1,886		1,886.0	67,557	65,671.0
10	2002		1,886		1,886.0	67,557	65,671.0
11	2003		1,886		1,886.0	67,557	65,671.0
12	2004		1,886		1,886.0	67,557	65,671.0
13	2005		1,886		1,886.0	67,557	65,671.0
14	2006		1,886		1,886.0	67,557	65,671.0
15	2007		1,886		1,886.0	67,557	65,671.0
16	2008		1,886		1,886.0	67,557	65,671.0
17	2009		1,886		1,886.0	67,557	65,671.0
18	2010		1,886		1,886.0	67,557	65,671.0
19	2011		1,886		1,886.0	67,557	65,671.0
20	2012		1,886		1,886.0	67,557	65,671.0
21	2013		1,886		1,886.0	67,557	65,671.0
22	2014		1,886		1,886.0	67,557	65,671.0
23	2015		1,886		1,886.0	67,557	65,671.0
24	2016		1,886	1,448.9	3,335.0	67,557	64,222.0
25	2017		1,886		1,886.0	67,557	65,671.0
26	2018		1,886		1,886.0	67,557	65,671.0
27	2019		1,886		1,886.0	67,557	65,671.0
28	2020		1,886		1,886.0	67,557	65,671.0
29	2021		1,886		1,886.0	67,557	65,671.0
30	2022		1,886		1,886.0	67,557	65,671.0
31	2023		1,886		1,886.0	67,557	65,671.0
32	2024		1,886		1,886.0	67,557	65,671.0
33	2025		1,886		1,886.0	67,557	65,671.0
34	2026		1,886		1,886.0	67,557	65,671.0
35	2027		1,886		1,886.0	67,557	65,671.0
36	2028		1,886		1,886.0	67,557	65,671.0
37	2029		1,886		1,886.0	67,557	65,671.0
38	2030		1,886		1,886.0	67,557	65,671.0
39	2031		1,886		1,886.0	67,557	65,671.0
40	2032		1,886		1,886.0	67,557	65,671.0
41	2033		1,886		1,886.0	67,557	65,671.0
42	2034		1,886		1,886.0	67,557	65,671.0
43	2035		1,886		1,886.0	67,557	65,671.0
44	2036		1,886	1,448.9	3,335.0	67,557	64,222.0
45	2037		1,886		1,886.0	67,557	65,671.0
46	2038		1,886		1,886.0	67,557	65,671.0
47	2039		1,886		1,886.0	67,557	65,671.0
48	2040		1,886		1,886.0	67,557	65,671.0
49	2041		1,886		1,886.0	67,557	65,671.0
50	2042		1,886		1,886.0	67,557	65,671.0
51	2043		1,886		1,886.0	67,557	65,671.0
52	2044		1,886		1,886.0	67,557	65,671.0
53	2045		1,886		1,886.0	67,557	65,671.0
54	2046		1,886		1,886.0	67,557	65,671.0
Total(1000NRs)		555,407.9	94,301.0	2,897.9	652,606.8	3,300,967.9	2,648,361.1
EIRR =		9.75%					

Table H.2.5 Sensitivity Analysis (6/6)
(Case 6: Reduction of Irrigation Benefit by 20% and Cost Overrun by 20%)

(Unit:1000 NRs.)

No.	Year	Cost			Total	Incremental Benefit	Balance
		Construction	O & M	Replacement			
1	1993	18,833			18,832.9		-18,832.9
2	1994	46,074			46,073.6		-46,073.6
3	1995	335,205			335,205.3		-335,205.3
4	1996	155,296			155,296.0	8,753.6	-146,542.4
5	1997		1,886		1,886.0	21,618.2	19,732.2
6	1998		1,886		1,886.0	32,427.4	30,541.3
7	1999		1,886		1,886.0	43,236.5	41,350.5
8	2000		1,886		1,886.0	48,641.0	46,755.0
9	2001		1,886		1,886.0	54,045.6	52,159.6
10	2002		1,886		1,886.0	54,045.6	52,159.6
11	2003		1,886		1,886.0	54,045.6	52,159.6
12	2004		1,886		1,886.0	54,045.6	52,159.6
13	2005		1,886		1,886.0	54,045.6	52,159.6
14	2006		1,886		1,886.0	54,045.6	52,159.6
15	2007		1,886		1,886.0	54,045.6	52,159.6
16	2008		1,886		1,886.0	54,045.6	52,159.6
17	2009		1,886		1,886.0	54,045.6	52,159.6
18	2010		1,886		1,886.0	54,045.6	52,159.6
19	2011		1,886		1,886.0	54,045.6	52,159.6
20	2012		1,886		1,886.0	54,045.6	52,159.6
21	2013		1,886		1,886.0	54,045.6	52,159.6
22	2014		1,886		1,886.0	54,045.6	52,159.6
23	2015		1,886		1,886.0	54,045.6	52,159.6
24	2016		1,886	1,448.9	3,335.0	54,045.6	50,710.6
25	2017		1,886		1,886.0	54,045.6	52,159.6
26	2018		1,886		1,886.0	54,045.6	52,159.6
27	2019		1,886		1,886.0	54,045.6	52,159.6
28	2020		1,886		1,886.0	54,045.6	52,159.6
29	2021		1,886		1,886.0	54,045.6	52,159.6
30	2022		1,886		1,886.0	54,045.6	52,159.6
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32	2024		1,886		1,886.0	54,045.6	52,159.6
33	2025		1,886		1,886.0	54,045.6	52,159.6
34	2026		1,886		1,886.0	54,045.6	52,159.6
35	2027		1,886		1,886.0	54,045.6	52,159.6
36	2028		1,886		1,886.0	54,045.6	52,159.6
37	2029		1,886		1,886.0	54,045.6	52,159.6
38	2030		1,886		1,886.0	54,045.6	52,159.6
39	2031		1,886		1,886.0	54,045.6	52,159.6
40	2032		1,886		1,886.0	54,045.6	52,159.6
41	2033		1,886		1,886.0	54,045.6	52,159.6
42	2034		1,886		1,886.0	54,045.6	52,159.6
43	2035		1,886		1,886.0	54,045.6	52,159.6
44	2036		1,886	1,448.9	3,335.0	54,045.6	50,710.6
45	2037		1,886		1,886.0	54,045.6	52,159.6
46	2038		1,886		1,886.0	54,045.6	52,159.6
47	2039		1,886		1,886.0	54,045.6	52,159.6
48	2040		1,886		1,886.0	54,045.6	52,159.6
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51	2043		1,886		1,886.0	54,045.6	52,159.6
52	2044		1,886		1,886.0	54,045.6	52,159.6
53	2045		1,886		1,886.0	54,045.6	52,159.6
54	2046		1,886		1,886.0	54,045.6	52,159.6
Total(1000NRs)		555,407.9	94,301.0	2,897.9	652,606.8	2,640,774.3	1,988,167.6
EIRR =		7.88%					

Table H.3.1 Farm Budgets under Without and with Project Conditions

Farm Type	Large Farmer (size:6.81ha)				Medium Farmer (size:3.05ha)				Small Farmer (size:1.32ha)				Marginal Farmer size:0.34ha)				Average (0.84ha)			
	Crop	Profit NRS/ha	Cropped Area ha	Total Profit NRS	Profit NRS/ha	Cropped Area ha	Total Profit NRS	Profit NRS/ha	Cropped Area ha	Total Profit NRS	Profit NRS/ha	Cropped Area ha	Total Profit NRS	Profit NRS/ha	Cropped Area ha	Total Profit NRS	Profit NRS/ha	Cropped Area ha	Total Profit NRS	
(A) Without Project Conditions																				
Paddy	P.I.	4,225	3.07	12,979	5,197	1.38	7,150	7,504	0.60	4,468	8,802	0.15	1,350	6,817	0.38	2,583			0	
	N.I.	598	3.22	1,926	1,461	1.44	2,107	3,510	0.62	2,191	4,664	0.16	750	2,900	0.40	1,152				
Wheat	P.I.	3,742	0.74	2,770	4,170	0.33	1,382	5,811	0.14	834	6,735	0.04	249	5,323	0.09	486				
	N.I.	127	0.94	120	384	0.42	162	1,607	0.18	294	2,441	0.05	115	1,165	0.12	136				
Maize	P.I.	4,956	0.09	459	5,643	0.04	234	7,275	0.02	130	8,194	0.00	38	6,789	0.01	77				
Pulses	P.I.	4,036	0.13	523	4,670	0.06	271	6,176	0.03	155	7,023	0.01	45	5,728	0.02	92				
	N.I.	2,993	0.57	1,717	3,547	0.26	911	4,863	0.11	541	5,604	0.03	161	4,471	0.07	316				
Oilseeds	P.I.	6,915	0.17	1,152	7,526	0.07	561	8,978	0.03	290	9,795	0.01	81	8,545	0.02	176				
	N.I.	3,166	0.41	1,289	3,697	0.18	674	4,959	0.08	391	5,669	0.02	115	4,583	0.05	230				
Vegetables	P.I.	5,781	0.19	1,070	7,135	0.08	591	10,352	0.04	371	12,163	0.01	112	9,394	0.02	214				
Total			9.53	24,003		4.27	14,045		1.85	9,665		0.48	3,016		1.18	5,462				
(B) With Project Conditions																				
Paddy	F.I.	13,817	6.67	92,159	14,877	2.99	44,482	17,394	1.29	22,438	18,810	0.33	6,207	16,644	0.83	13,815				
	F.I.	8,810	5.29	29,003	9,347	1.24	11,581	11,245	0.49	5,480	12,314	0.09	1,108	10,680	0.31	3,349				
Wheat	F.I.	12,598	0.83	10,504	13,267	0.37	4,939	14,857	0.16	2,396	15,751	0.04	650	14,384	0.10	1,492				
	F.I.	45,126	0.43	19,404	44,625	0.43	19,189	48,188	0.23	11,224	50,192	0.09	4,718	47,127	0.15	7,063				
Vegetable			11.23	151,070		5.03	80,210		2.17	41,538		0.56	12,683		1.40	25,718				
Total																				
(C) Increment																				
Increment			1.70	127,067		0.76	66,166		0.32	31,872		0.08	9,667		0.22	20,256				
Note:	F.I.: Fully Irrigated P.I.: Partially Irrigated N.I.: No-irrigated																			

**Table H.5.1 Labor Requirement for Farming Activities under
Without and with project Conditions**

Crop	Condition	Requirement man-day/ha	Cropped Area ha	Total Requirement man-day
(1) Without Project Conditions				
Paddy	P.I.	133	837	111,321
	N.I.	118	854	100,772
Wheat	P.I.	94	306	28,764
	N.I.	85	116	9,860
Maize	P.I.	93	25	2,325
Pulses	P.I.	86	78	6,708
	N.I.	75	195	14,625
Oilseeds	P.I.	83	77	6,391
	N.I.	72	29	2,088
Vegetables	P.I.	186	50	9,300
Total			2,567	292,154
(2) With Project Conditions				
Paddy	F.I.	145	1,800	261,000
Wheat	F.I.	109	680	74,120
Oilseeds	F.I.	91	225	20,475
Vegetables	F.I.	206	325	66,950
Total			3,030	422,545
(3) Increase				130,391
Note:	F.I. : Fully Irrigated P.I. : Partially Irrigated N.I. : Non-irrigayed			

ANNEX - I
DRAWINGS

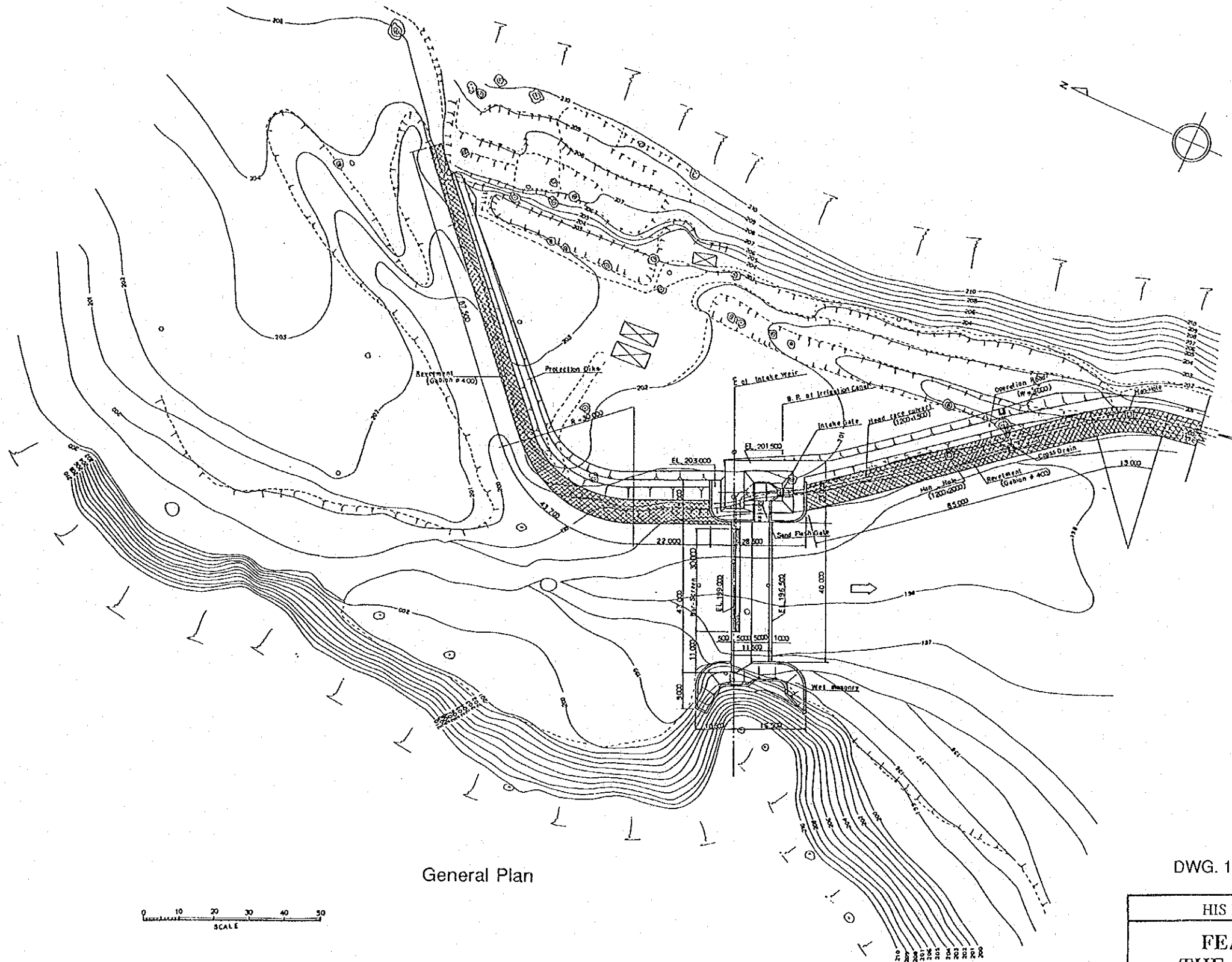
ANNEX - I

DRAWINGS

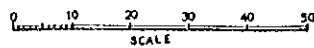
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General Plan

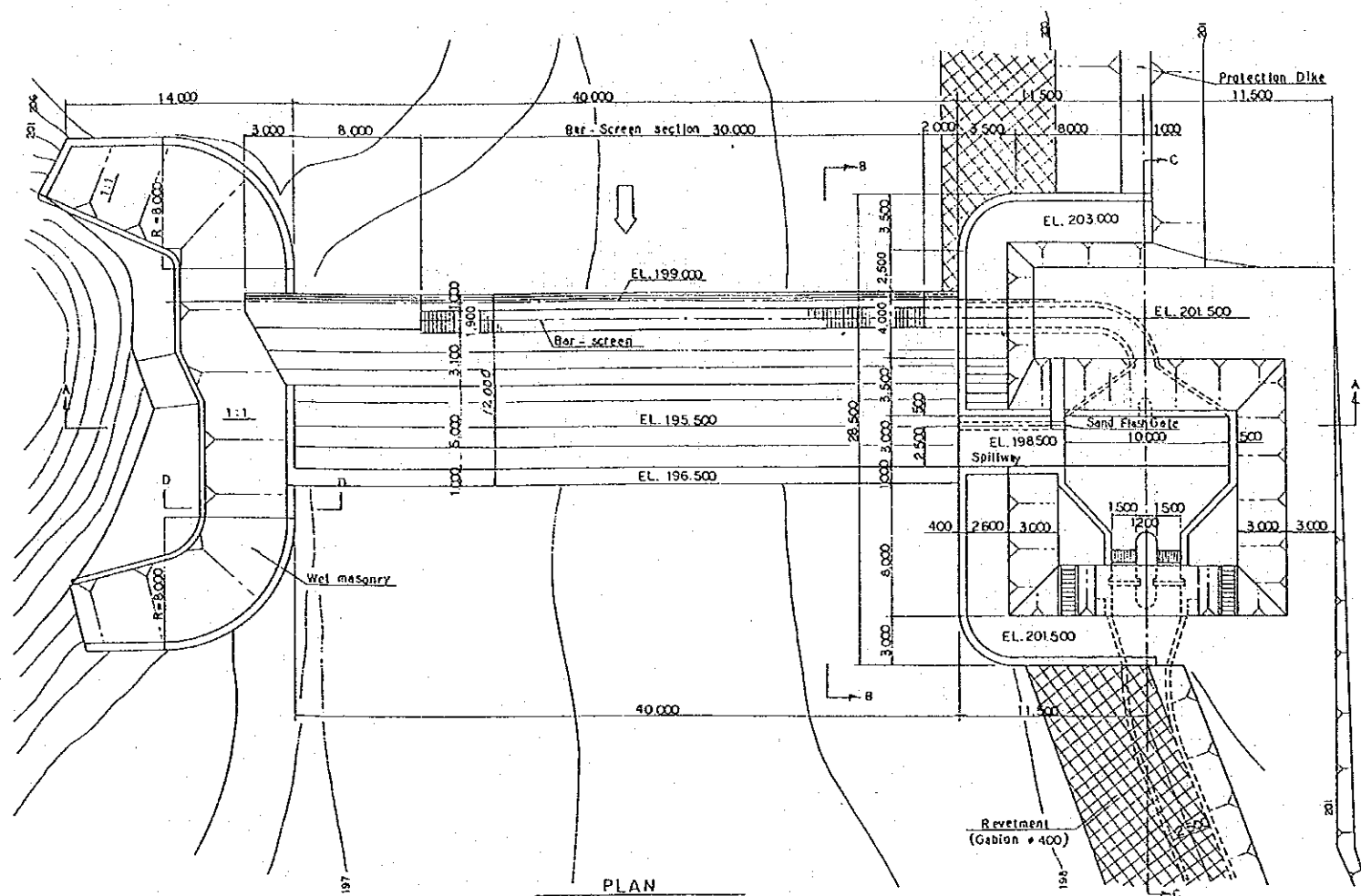


DWG. 1 GUDRUNG HEADWORKS (1/4)

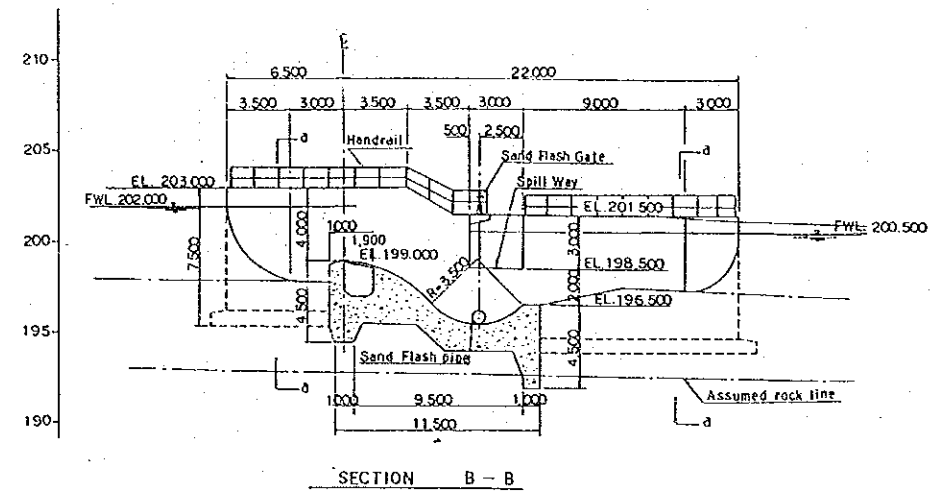
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**FEASIBILITY STUDY ON
THE RAJKUDWA IRRIGATION
PROJECT**

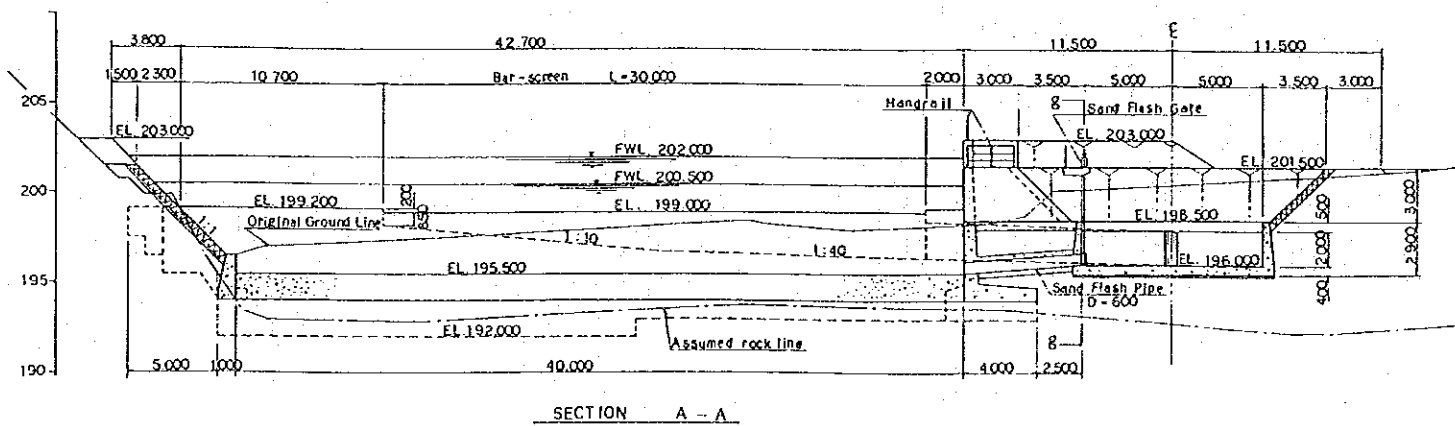
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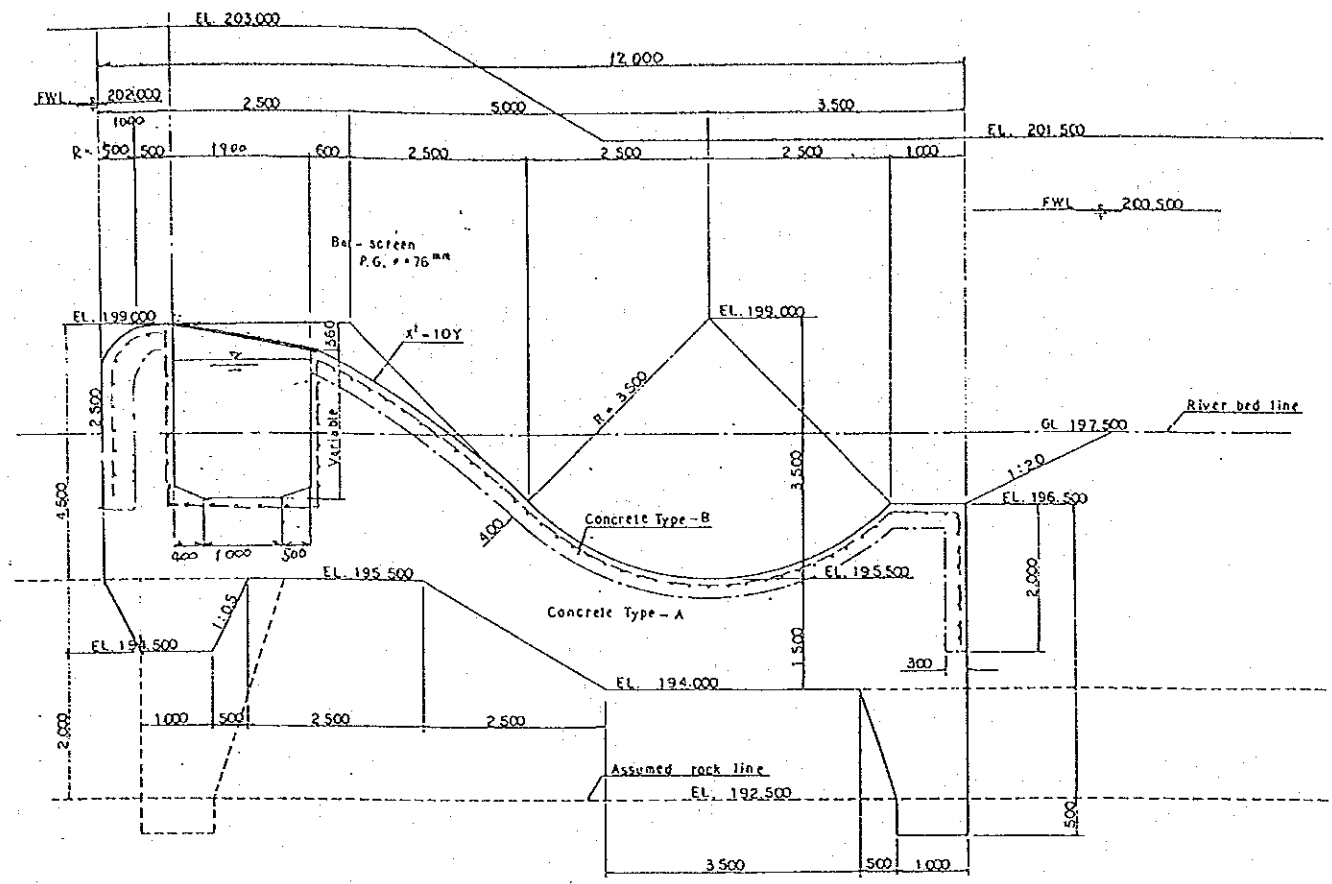
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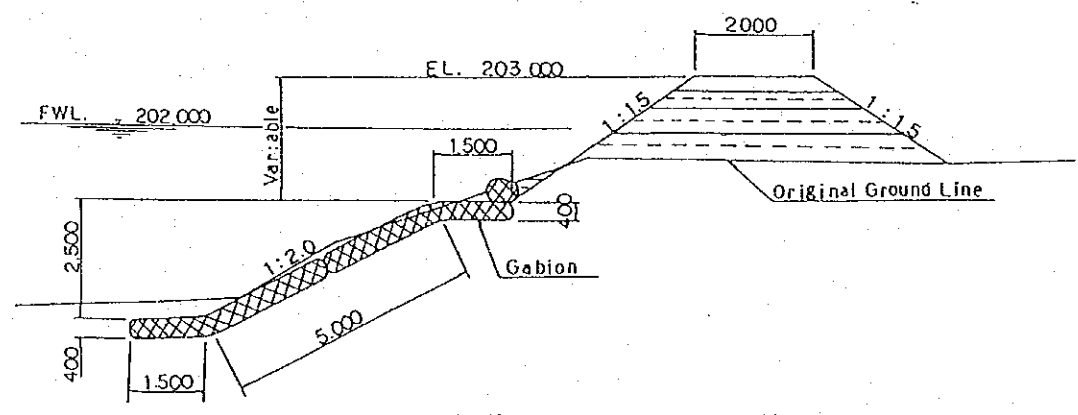
SECTION A - A

DWG. 2 GUDRUNG HEADWORKS (2/4)

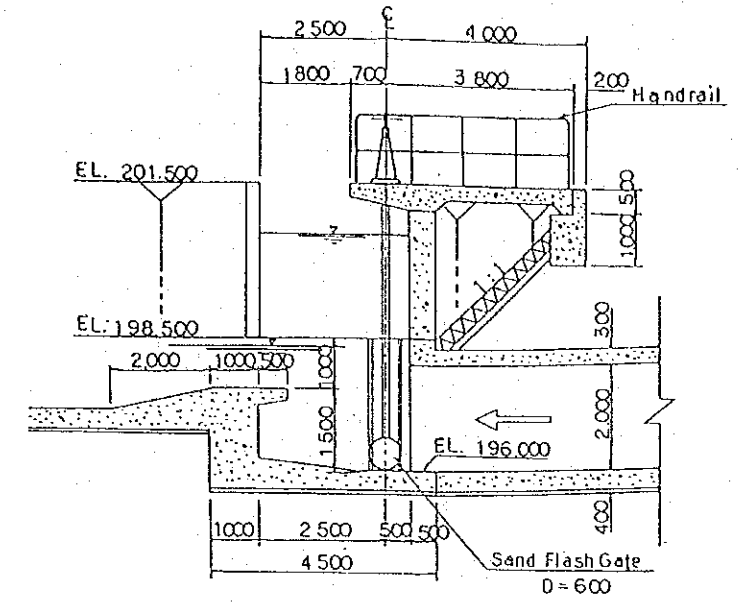
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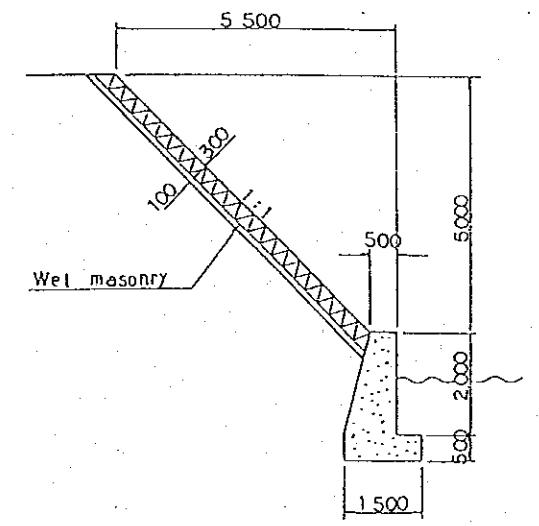
TYPICAL SECTION OF WEIR



Typical Section of Protection Dike



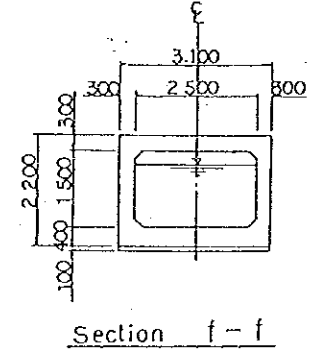
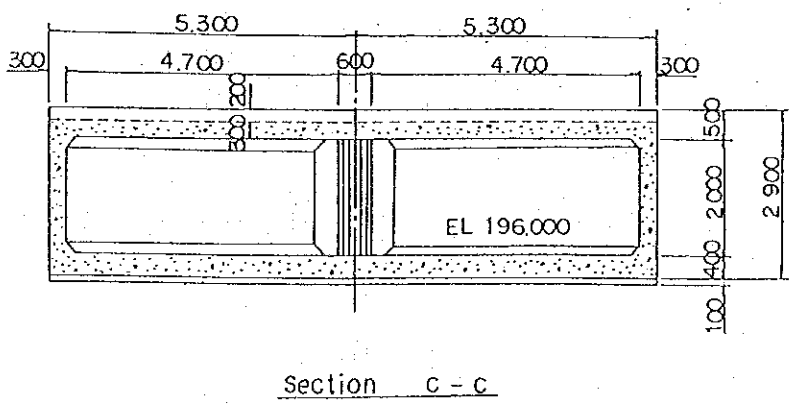
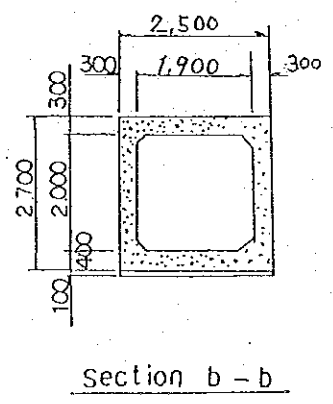
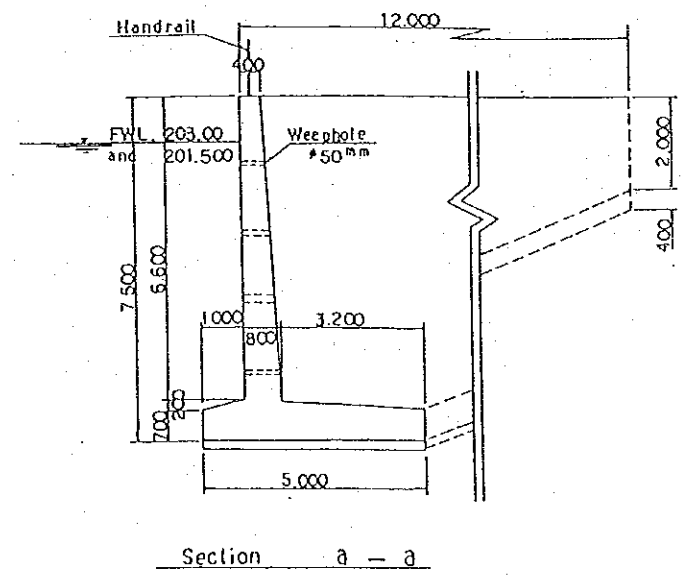
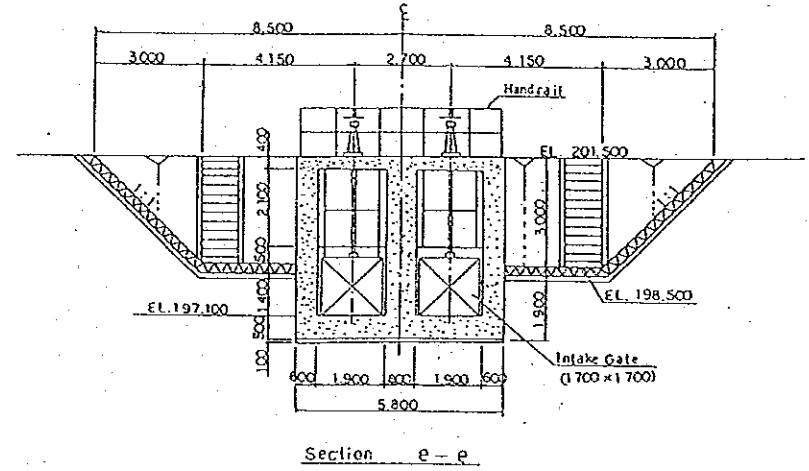
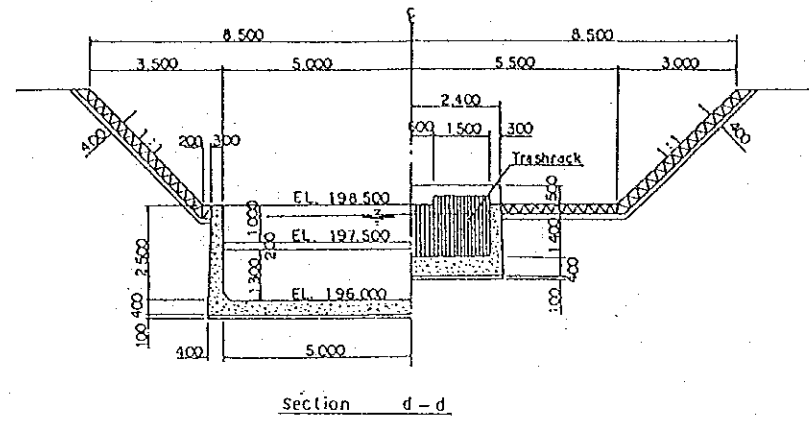
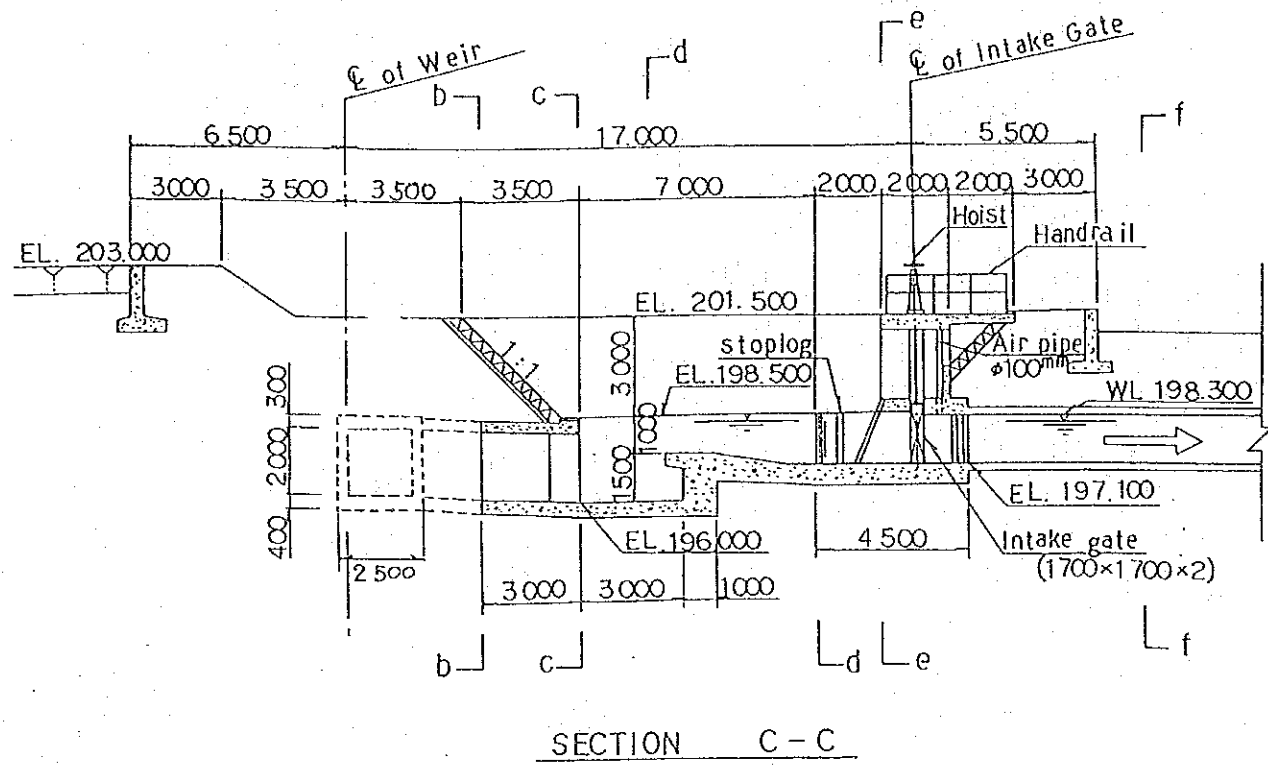
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DWG. 3 GUDRUNG HEADWORKS (3/4)

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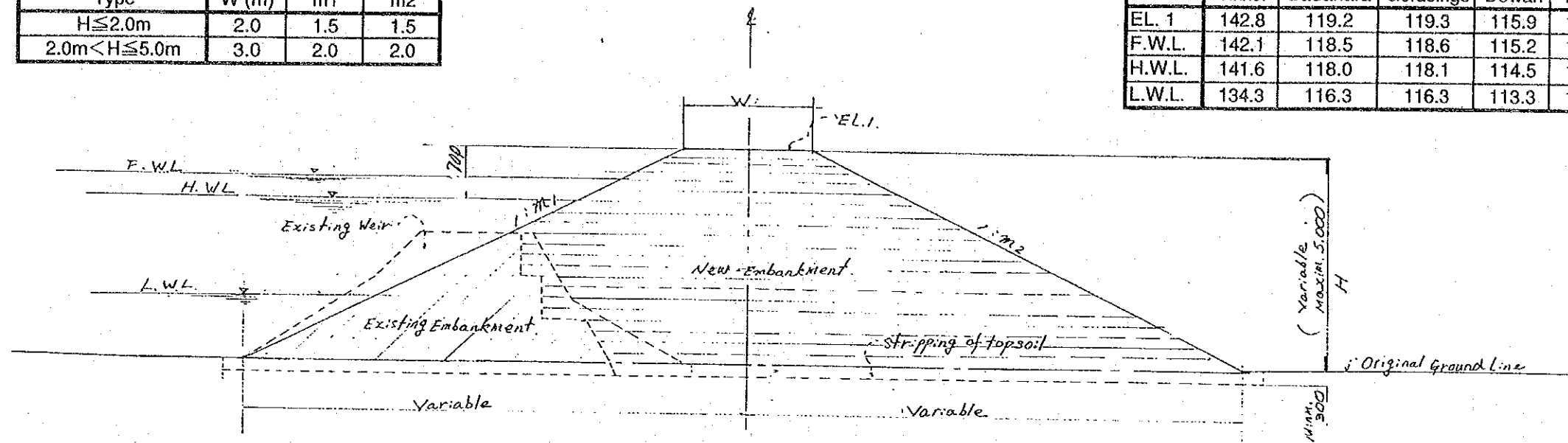


DWG. 4 GUDRUNG HEADWORKS (4/4)

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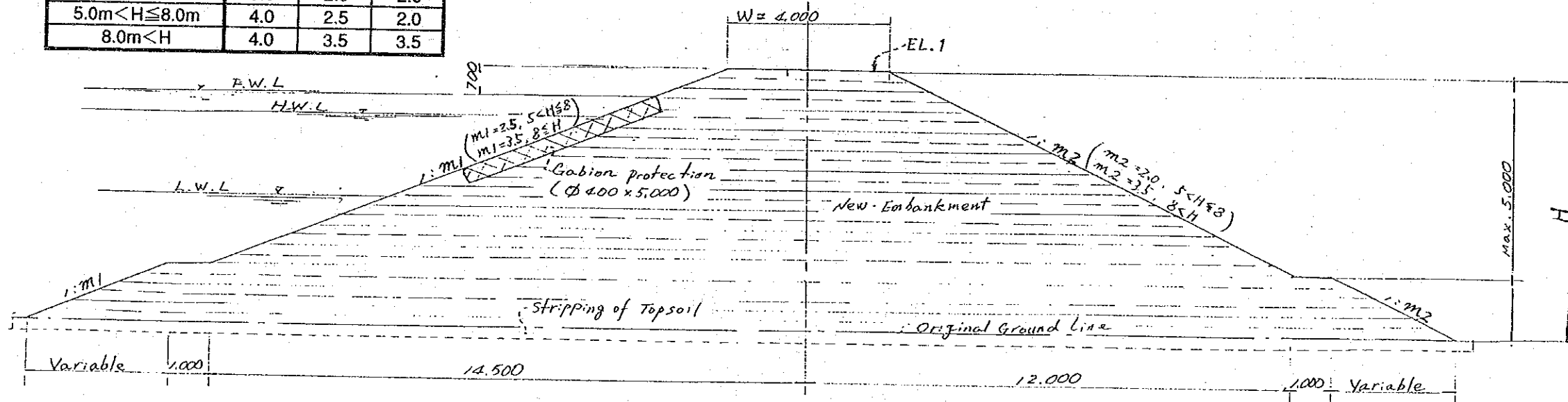
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$H \leq 2.0m$	2.0	1.5	1.5
$2.0m < H \leq 5.0m$	3.0	2.0	2.0

(m)					
E.L.	Tikker	Badahara	Gorusinge	Dewari	Buddi
EL. 1	142.8	119.2	119.3	115.9	115.9
F.W.L.	142.1	118.5	118.6	115.2	115.2
H.W.L.	141.6	118.0	118.1	114.5	114.5
L.W.L.	134.3	116.3	116.3	113.3	113.3



TYPICAL SECTION OF LEVEE ($H \leq 5.000m$)
(Badahara, Gorusinge, Dewari, and Buddi Ponds to be improved)

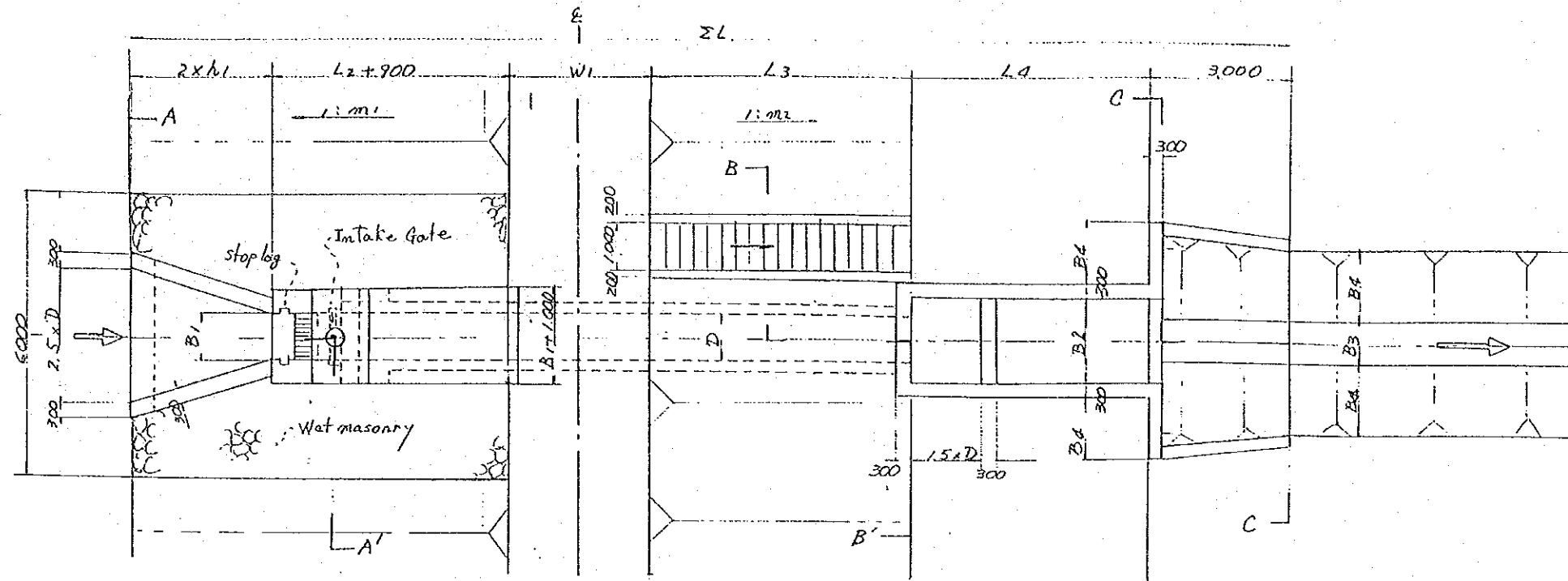
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$H \leq 2.0m$	2.0	1.5	1.5
$2.0m < H \leq 5.0m$	3.0	2.0	2.0
$5.0m < H \leq 8.0m$	4.0	2.5	2.0
$8.0m < H$	4.0	3.5	3.5



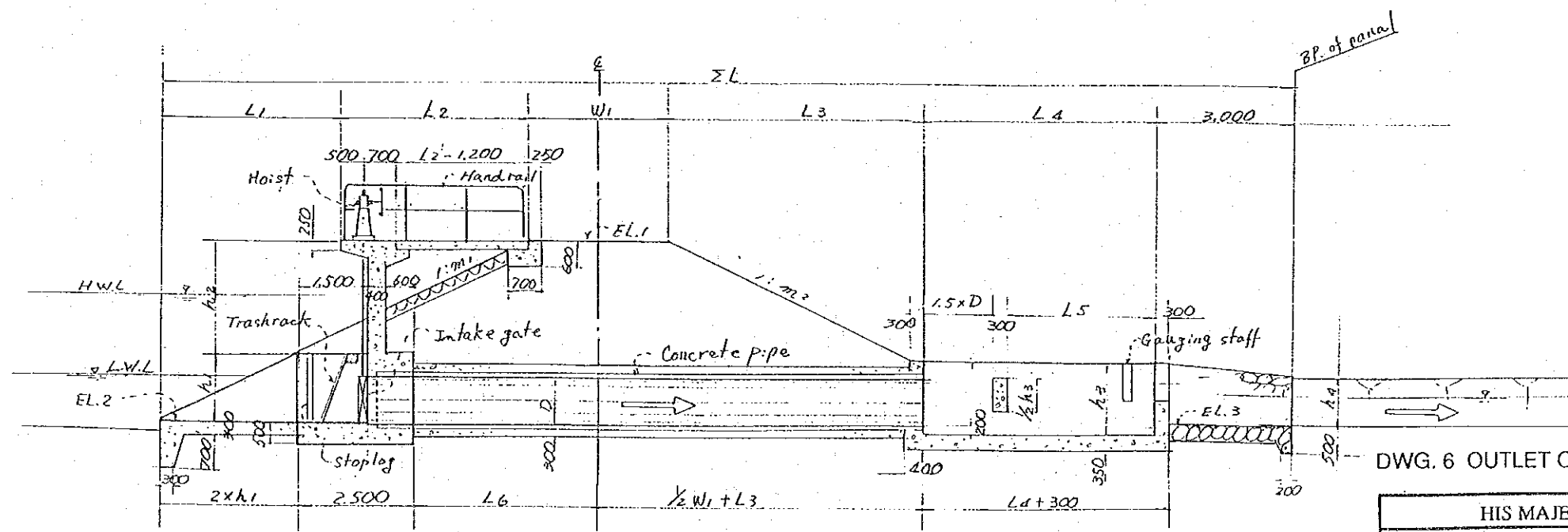
TYPICAL SECTION OF DIKE ($H > 5.000m$)
(Tikker Pond to be constructed)

DWG. 5 TYPICAL SECTION OF IRRIGATION POND

HIS MAJESTY'S GOVERNMENT OF NEPAL
FEASIBILITY STUDY ON
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JAPAN INTERNATIONAL COOPERATION AGENCY



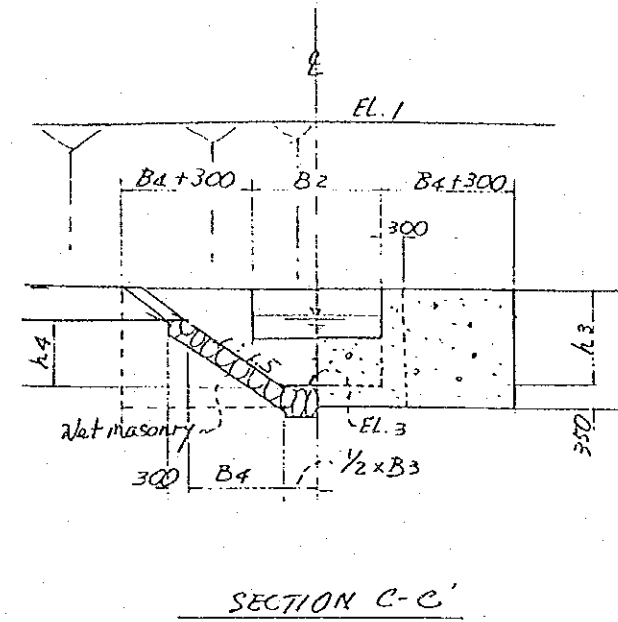
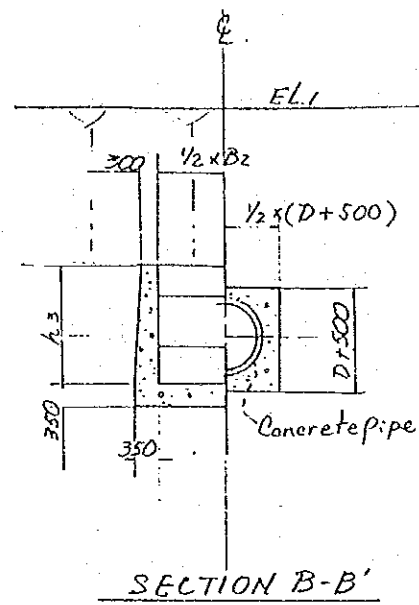
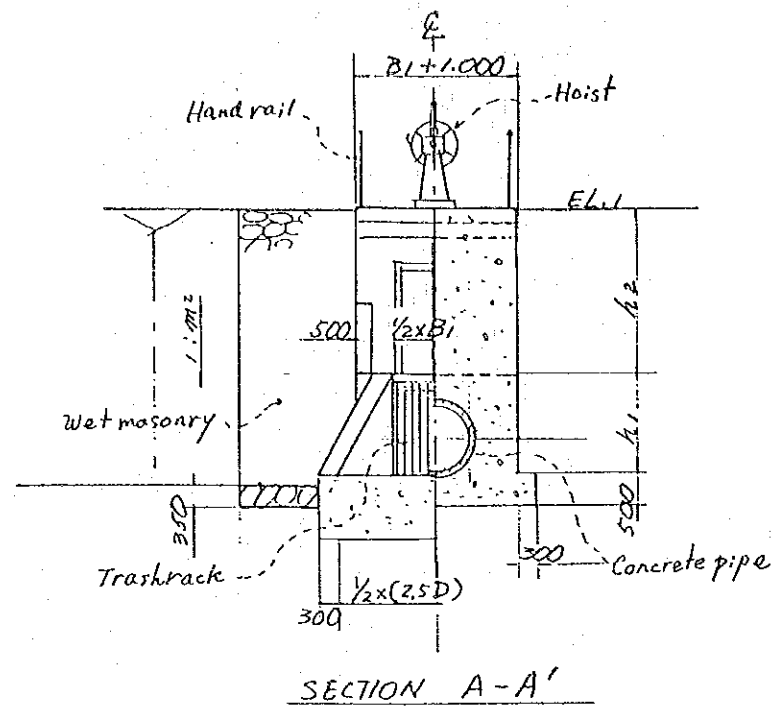
TYPICAL PLAN



TYPICAL SECTION

DWG. 6 OUTLET OF IMPROVED IRRIGATION POND (1/2)

HIS MAJESTY'S GOVERNMENT OF NEPAL
 FEASIBILITY STUDY ON
 THE RAJKUDWA IRRIGATION
 PROJECT
 JAPAN INTERNATIONAL COOPERATION AGENCY

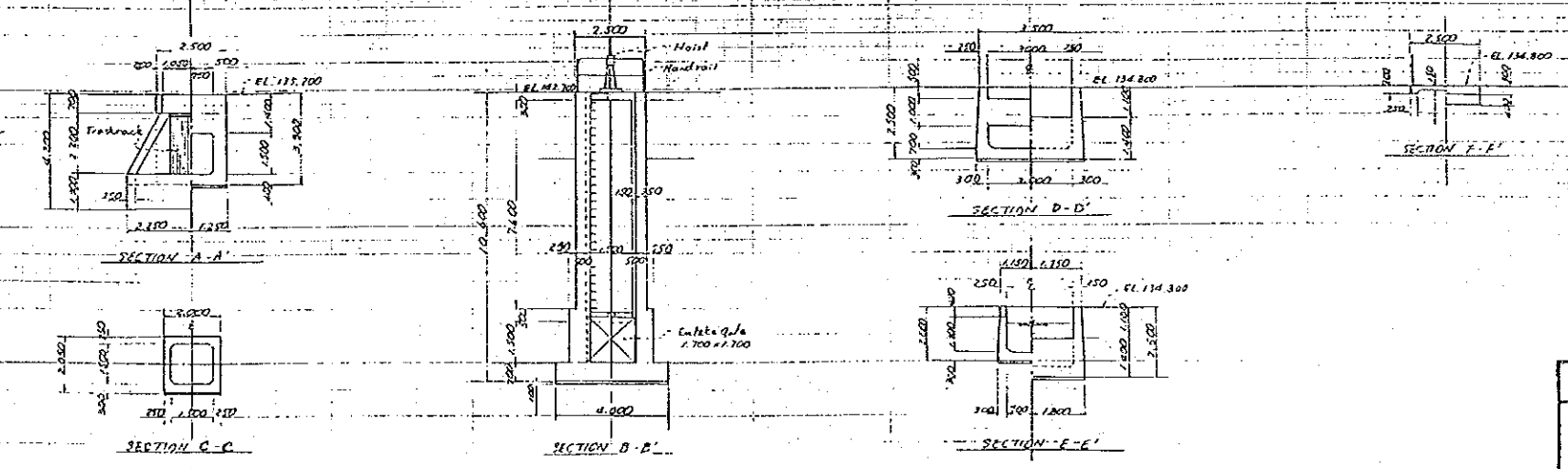
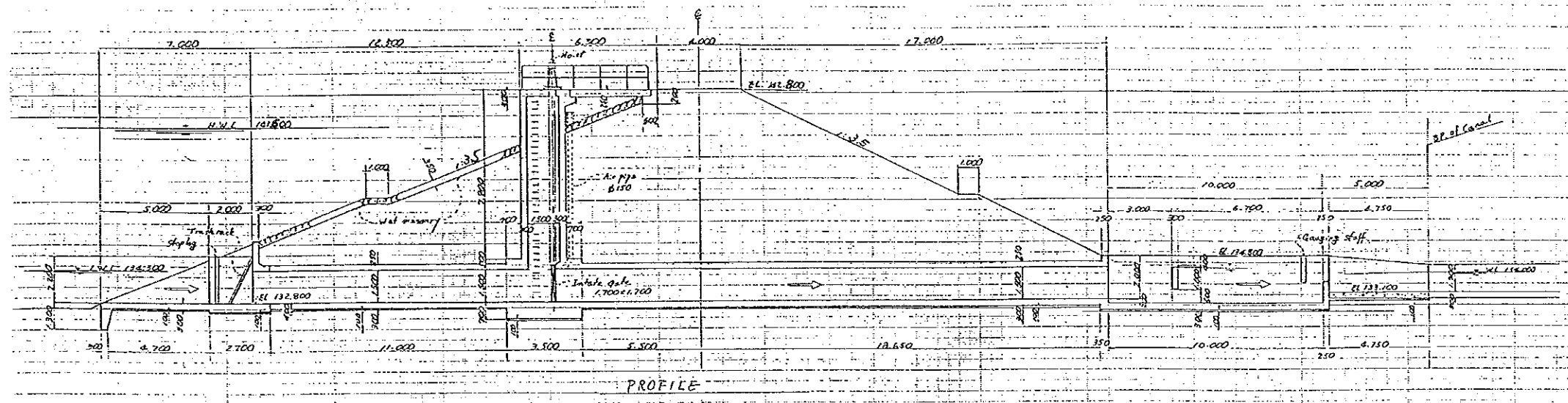
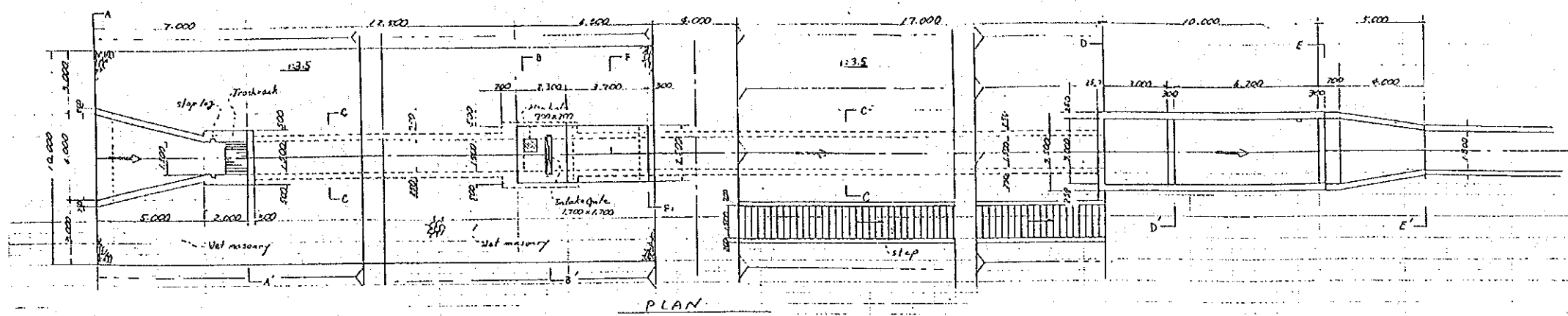


(m)

Intake	EL1	EL2	EL3	D	B1	B2	B3	B4	h1	h2	h3	h4	w1	Sum. L	L1	L2	L3	L4	L5	L6	m1 and m2	Q(m ³ /sec)
Badahara	119.20	115.90	115.70	0.40	0.70	0.60	0.30	0.55	0.90	2.40	0.80	0.55	2.00	16.50	2.70	2.25	4.05	2.50	1.60	1.65	1 : 1.5	0.10
Gorusinge	119.30	115.30	115.40	1.00	1.30	1.80	0.90	1.50	1.50	2.50	1.50	1.00	3.00	24.40	3.90	4.10	5.40	5.00	3.20	4.00	1 : 2.0	0.55
Dewari	115.90	112.30	112.40	1.00	1.30	1.80	1.20	1.50	1.50	2.10	1.50	1.00	3.00	22.80	3.90	3.30	4.60	5.00	3.20	3.20	1 : 2.0	0.60

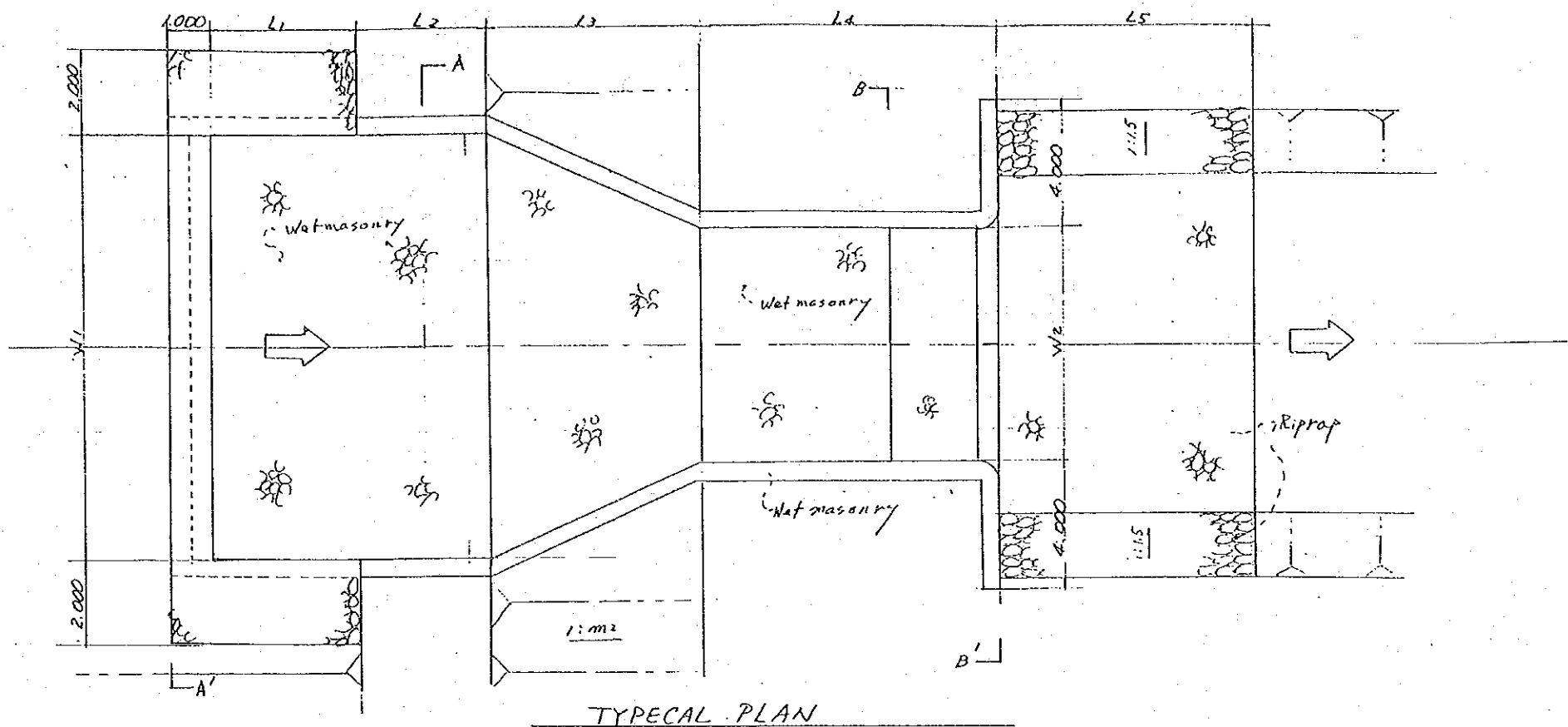
DWG. 7 OUTLET OF IMPROVED IRRIGATION POND (2/2)

HIS MAJESTY'S GOVERNMENT OF NEPAL
**FEASIBILITY STUDY ON
 THE RAJKUDWA IRRIGATION
 PROJECT**
 JAPAN INTERNATIONAL COOPERATION AGENCY

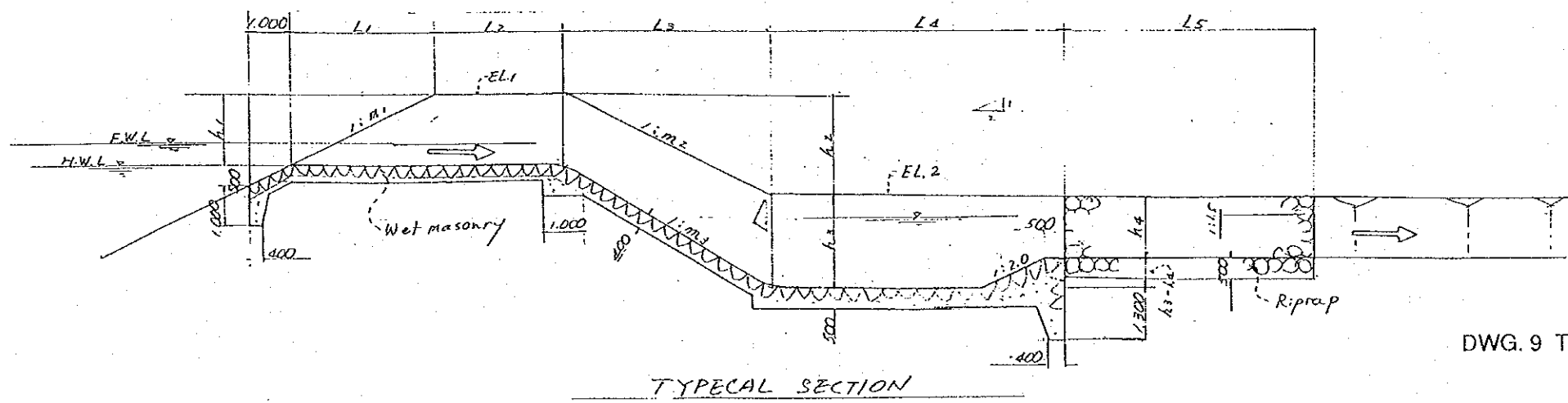


DWG. 8 OUTLET OF TIKKER IRRIGATION POND

HIS MAJESTY'S GOVERNMENT OF NEPAL
**FEASIBILITY STUDY ON
 THE RAJKUDWA IRRIGATION
 PROJECT**
 JAPAN INTERNATIONAL COOPERATION AGENCY



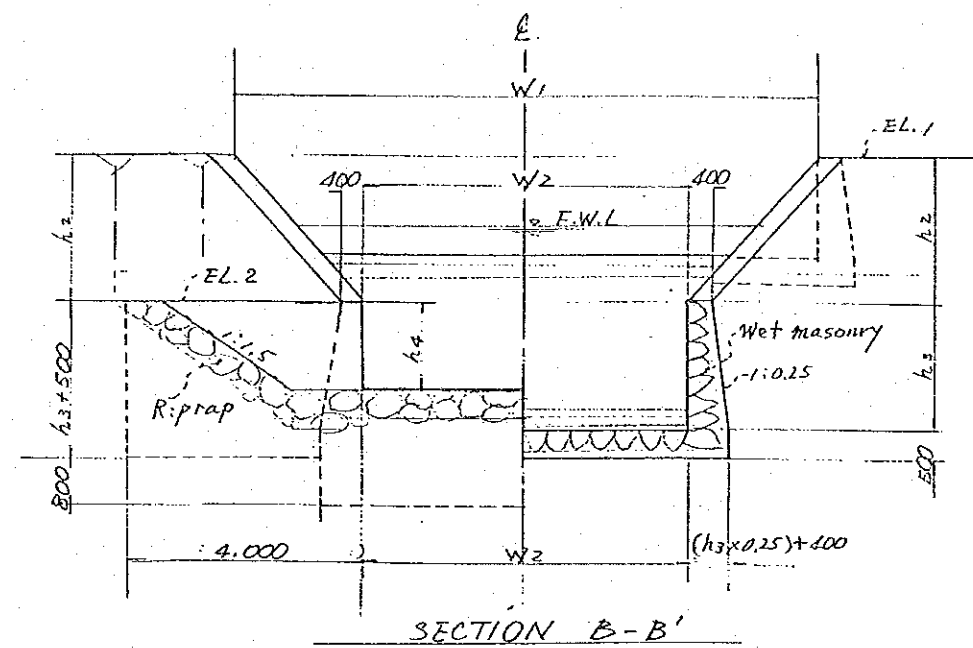
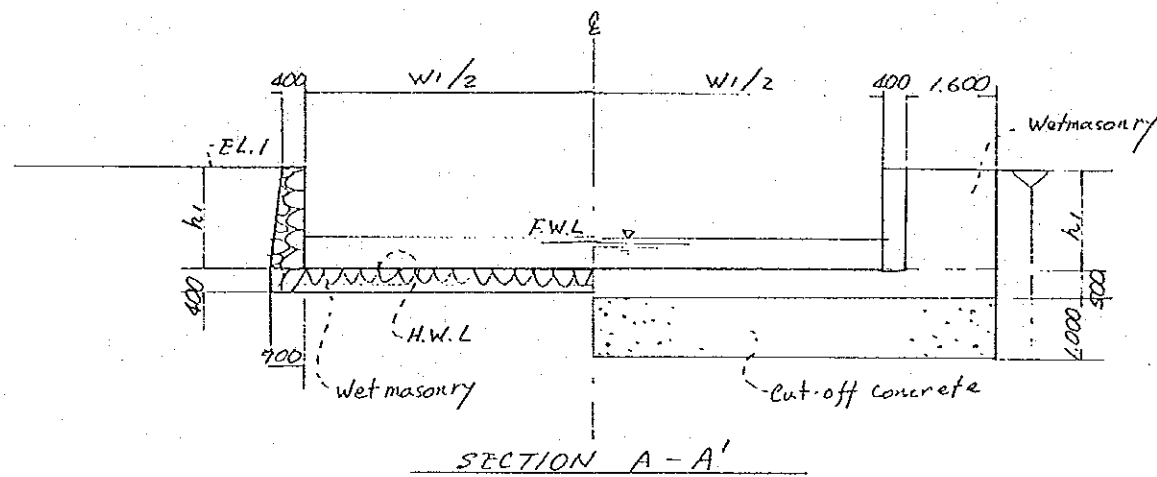
TYPICAL PLAN



TYPICAL SECTION

DWG. 9 TYPICAL SPILLWAY OF IRRIGATION PONDS (1/2)

HIS MAJESTY'S GOVERNMENT OF NEPAL
**FEASIBILITY STUDY ON
 THE RAJKUDWA IRRIGATION
 PROJECT**
 JAPAN INTERNATIONAL COOPERATION AGENCY

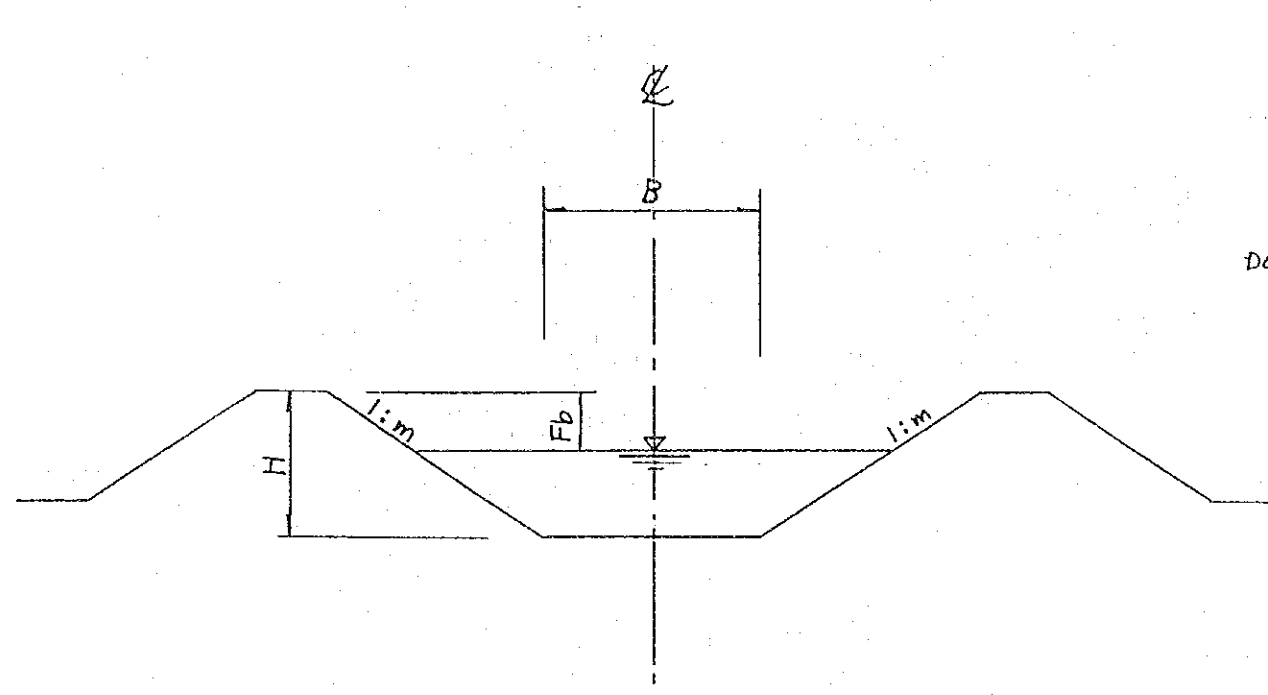


(m)

Location	F.W.L	H.W.L	EL.1	EL.2	m1	m2	w1	w2	h1	h2	h3	h4	L1	L2	L3	L4	L5
Tikker	142.00	141.50	142.70	140.50	2.00	2.00	22.50	8.00	1.20	2.20	2.20	1.70	2.40	3.00	4.40	7.50	6.00
Badahara	118.50	118.00	119.20	118.00	1.50	1.50	12.00	5.50	1.20	1.20	1.80	1.30	1.80	2.00	2.70	4.00	4.00
Gorusinge	118.60	118.10	119.30	118.00	1.50	1.50	9.50	5.00	1.20	1.30	1.50	1.00	1.80	2.00	2.25	4.00	4.00
Dewari	115.20	114.50	115.90	113.00	2.00	2.00	14.00	8.00	1.40	2.90	2.20	1.70	2.80	3.00	5.80	10.50	8.00
Buddi	115.20	114.50	115.90	112.50	2.00	2.00	14.00	8.00	1.40	3.90	2.20	1.70	2.80	3.00	7.80	12.50	12.00

DWG. 10 TYPICAL SPILLWAY OF IRRIGATION PONDS (2/2)

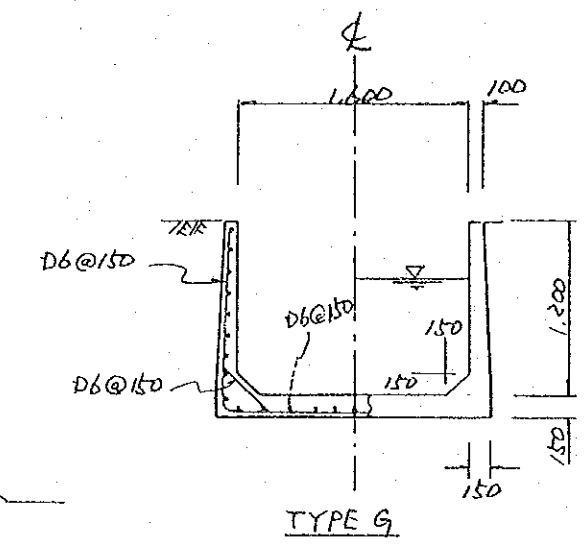
HIS MAJESTY'S GOVERNMENT OF NEPAL
**FEASIBILITY STUDY ON
 THE RAJKUDWA IRRIGATION
 PROJECT**
 JAPAN INTERNATIONAL COOPERATION AGENCY



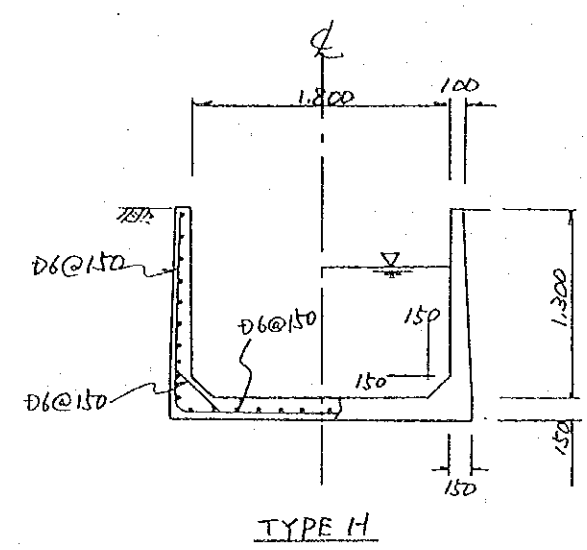
CROSS SECTION OF FEEDER AND IRRIGATION CANALS

DIMENSION TABLE OF IRRIGATION CANAL SECTION

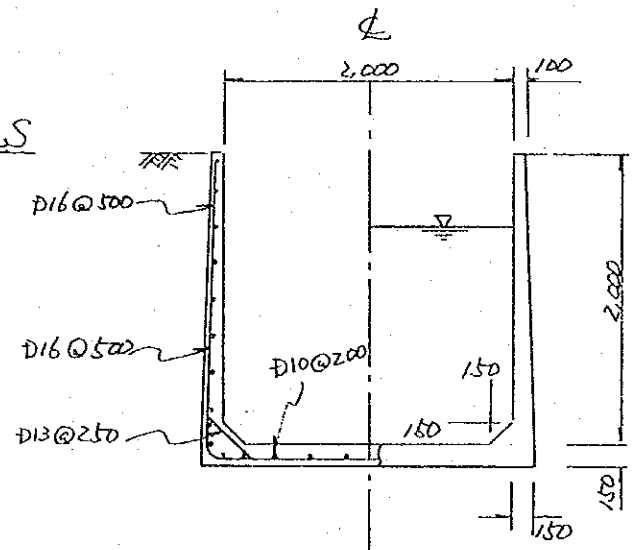
TYPE		B (mm)	H (mm)	Fb (mm)	m	Q (m ³ /sec)
A	Earth canal	300	550	250	1.0	0.01-0.10
B	Earth canal	500	700	250	1.0	0.11-0.24
C	Earth canal	700	900	300	1.0	0.24-0.45
D	Earth canal	900	1,000	400	1.5	0.46-0.57
E	Earth canal	1,200	1,000	400	1.5	0.58-0.75
F	Earth canal	1,500	1,100	400	1.5	0.76-0.84
G	Concrete flume	1,600	1,200	400	-	1.65-1.94
H	Concrete flume	1,800	1,300	400	-	1.95-2.40
I	Concrete flume	2,000	2,000	500	-	4.40
J	Concrete flume	2,500	1,000	400	-	4.40



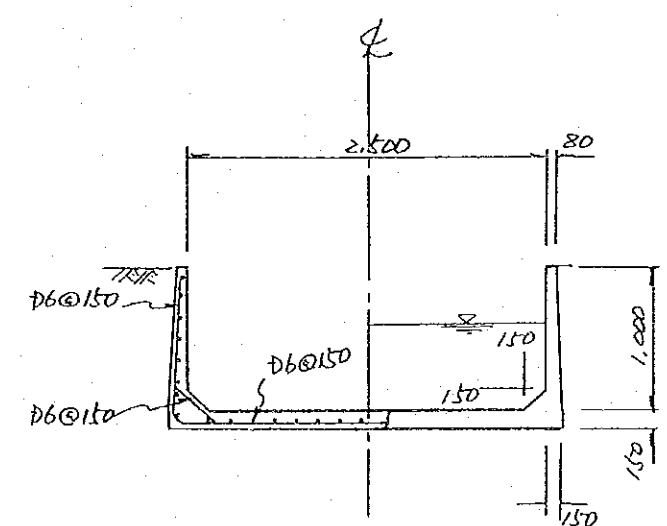
TYPE G



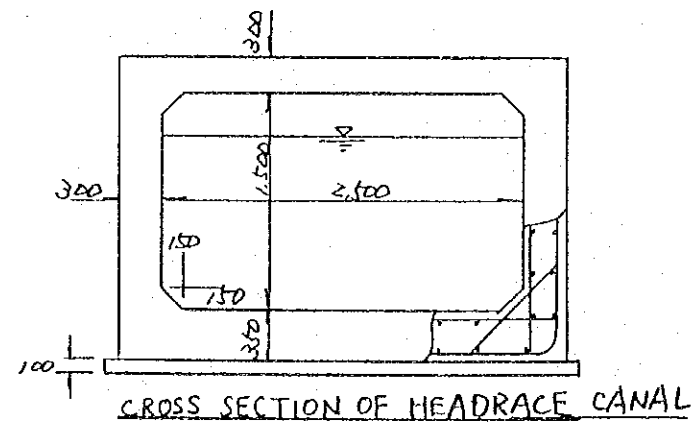
TYPE H



TYPE I



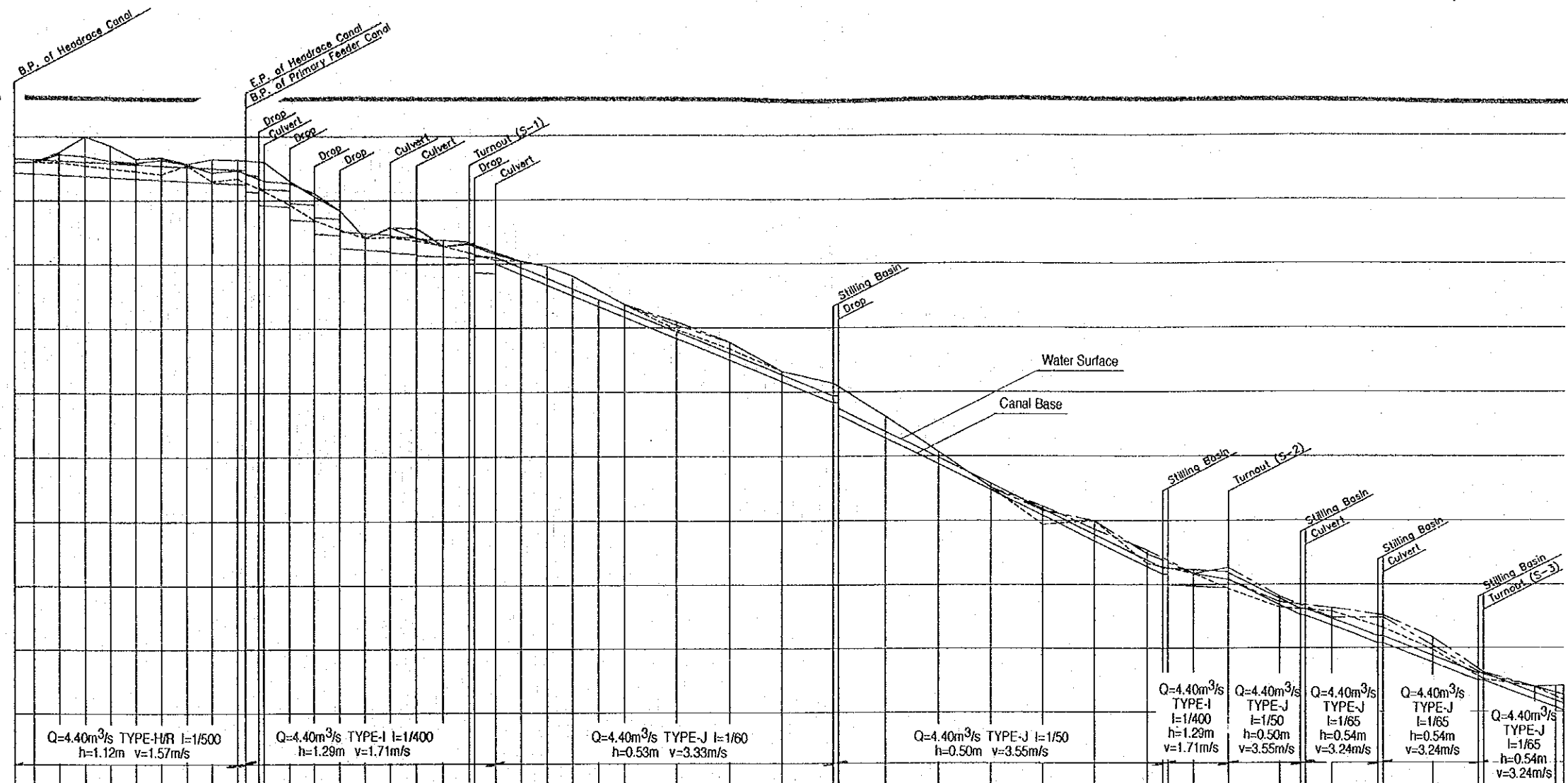
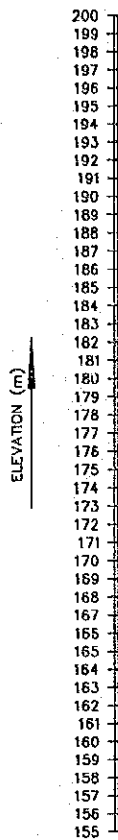
TYPE J



CROSS SECTION OF HEADRACE CANAL

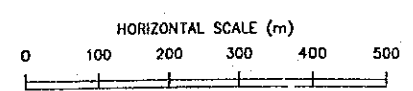
DWG. 11 TYPICAL SECTION OF IRRIGATION CANALS

HIS MAJESTY'S GOVERNMENT OF NEPAL
 FEASIBILITY STUDY ON
 THE RAJKUDWA IRRIGATION
 PROJECT
 JAPAN INTERNATIONAL COOPERATION AGENCY



$Q=4.40m^3/s$ TYPE-HR $I=1/500$ $h=1.12m$ $v=1.57m/s$
 $Q=4.40m^3/s$ TYPE-I $I=1/400$ $h=1.29m$ $v=1.71m/s$
 $Q=4.40m^3/s$ TYPE-J $I=1/60$ $h=0.53m$ $v=3.33m/s$
 $Q=4.40m^3/s$ TYPE-J $I=1/50$ $h=0.50m$ $v=3.55m/s$
 $Q=4.40m^3/s$ TYPE-I $I=1/400$ $h=1.29m$ $v=1.71m/s$
 $Q=4.40m^3/s$ TYPE-J $I=1/50$ $h=0.50m$ $v=3.55m/s$
 $Q=4.40m^3/s$ TYPE-J $I=1/65$ $h=0.54m$ $v=3.24m/s$
 $Q=4.40m^3/s$ TYPE-J $I=1/65$ $h=0.54m$ $v=3.24m/s$
 $Q=4.40m^3/s$ TYPE-J $I=1/65$ $h=0.54m$ $v=3.24m/s$

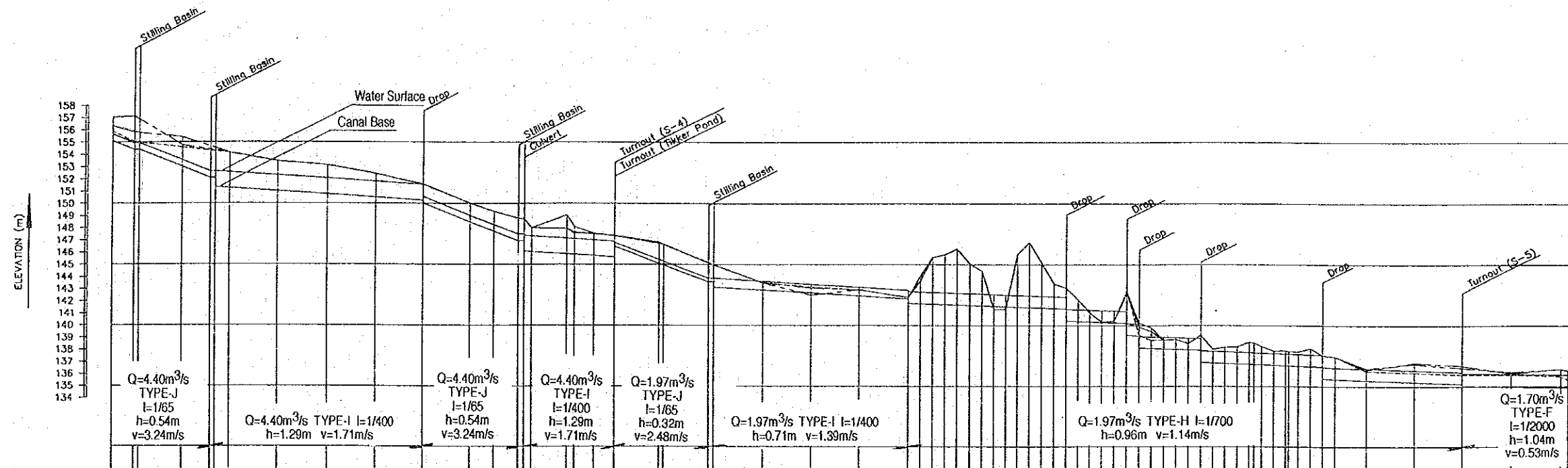
DISTANCE	REDUCED DISTANCE	EXISTING CONDITIONS			PROPOSED	
		GROUND SURFACE ELEVATION	CANAL BANK ELE.(LEFT)	CANAL BANK ELE.(RIGHT)	CANAL BASE ELEVATION	WATER SURFACE ELEVATION
15.00	15.00	198.00	198.00	198.00	197.19	198.30
37.00	52.00	198.00	198.00	198.00	197.11	198.23
48.00	100.00	197.98	198.60	198.77	197.01	198.13
50.00	150.00	197.74	198.45	200.00	196.81	198.03
50.00	200.00	197.50	198.11	199.29	196.81	197.93
50.00	250.00	197.29	197.96	198.25	196.71	197.83
50.00	300.00	197.04	198.16	198.35	196.61	197.73
50.00	350.00	197.74	197.83	197.87	196.51	197.63
50.00	400.00	196.51	197.16	198.24	196.41	197.53
50.00	450.00	198.70	197.37	198.18	196.31	197.43
15.00	465.00	198.70	197.37	198.18	196.21	197.33
25.00	480.00	198.53	198.04	198.04	196.11	197.23
10.00	500.00	198.74	198.36	198.51	196.01	197.13
50.00	550.00	194.68	196.36	196.51	195.91	197.03
50.00	600.00	193.41	195.56	195.33	195.81	196.93
50.00	650.00	192.71	194.22	194.22	195.71	196.83
50.00	700.00	192.05	192.05	192.05	195.61	196.73
50.00	750.00	192.13	192.84	192.80	195.51	196.63
50.00	800.00	191.84	192.82	192.09	195.41	196.53
50.00	850.00	191.40	191.40	191.40	195.31	196.43
50.00	900.00	190.87	191.53	191.64	195.21	196.33
10.00	910.00	190.87	191.53	191.64	195.11	196.23
40.00	950.00	190.28	190.74	190.90	195.01	196.13
50.00	1000.00	190.21	190.21	190.21	194.91	196.03
50.00	1050.00	189.77	189.77	189.77	194.81	195.93
50.00	1100.00	189.03	189.03	189.03	194.71	195.83
50.00	1150.00	188.60	188.60	188.60	194.61	195.73
50.00	1200.00	188.45	188.45	188.45	194.51	195.63
100.00	1300.00	184.85	185.46	185.21	184.16	184.63
100.00	1400.00	183.35	183.87	183.85	182.48	183.02
100.00	1500.00	181.60	181.60	181.60	180.82	181.35
100.00	1600.00	180.67	180.67	180.67	179.15	179.68
10.00	1610.00	180.67	180.67	180.67	179.05	179.58
90.00	1700.00	178.08	178.08	178.08	177.38	177.91
100.00	1800.00	175.32	175.32	175.32	174.39	174.89
100.00	1900.00	172.56	172.56	172.56	172.89	172.89
100.00	2000.00	169.65	170.78	171.12	170.39	170.89
100.00	2100.00	169.97	169.97	169.31	168.39	168.89
100.00	2200.00	166.63	167.40	167.69	166.39	166.89
38.00	2230.00	166.63	167.40	167.69	166.29	166.79
10.00	2240.00	166.63	167.40	167.69	166.19	166.69
91.00	2291.00	165.84	165.84	165.84	164.87	165.37
20.00	2350.00	164.67	165.38	166.30	163.70	164.20
100.00	2450.00	163.19	163.62	164.05	162.39	162.89
40.00	2500.00	162.59	162.59	162.59	161.78	162.28
10.00	2510.00	162.59	162.59	162.59	161.68	162.18
50.00	2560.00	162.87	163.15	162.99	161.78	162.28
90.90	2650.00	161.59	162.56	162.40	160.40	160.94
100.00	2750.00	159.88	160.85	160.78	158.86	159.40
50.00	2850.00	157.56	158.10	157.92	157.48	158.02
10.00	2860.00	157.56	158.10	157.92	157.38	157.92
100.00	2960.00	156.95	156.95	156.95	155.94	156.48
49.00	3000.00	156.89	156.89	156.89	155.78	156.32



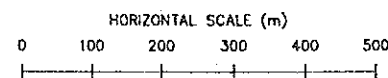
LEGEND
 - - - - - GROUND SURFACE
 - - - - - EXISTING RIGHT BANK
 - - - - - EXISTING LEFT BANK

DWG. 12 LONGITUDINAL SECTION OF HEADRACE AND PRIMARY FEEDER CANAL (1/6)

HIS MAJESTY'S GOVERNMENT OF NEPAL
**FEASIBILITY STUDY ON
 THE RAJKUDWA IRRIGATION
 PROJECT**
 JAPAN INTERNATIONAL COOPERATION AGENCY



DISTANCE	EXISTING CONDITIONS				PROPOSED	
	REDUCED DISTANCE	GROUND SURFACE ELEVATION	CANAL BANK ELE.(RIGHT)	CANAL BANK ELE.(LEFT)	CANAL BASE ELEVATION	WATER SURFACE ELEVATION
15.00	3015.00	155.89	156.32	157.05	155.10	155.64
48.00	3058.00	155.03	155.81	157.12	154.40	154.84
90.00	3160.00	154.58	155.41	154.72	153.02	153.56
60.00	3220.00				152.09	152.63
10.00	3230.00				151.27	151.81
30.00	3260.00	154.15	154.15	154.15	151.02	151.02
100.00	3360.00	153.15	153.45	153.45	150.77	150.77
100.00	3460.00	153.13	153.13	153.13	150.52	150.52
100.00	3560.00	152.44	152.44	152.44	150.27	150.27
100.00	3660.00	151.57	151.57	151.57	149.46	149.02
50.00	3760.00	149.35	149.35	149.35	148.25	147.81
50.00	3860.00	148.78	148.78	148.78	147.48	147.04
12.00	3872.00	148.71	148.71	148.71	146.71	146.27
15.00	3887.00	148.00	148.00	148.00	145.94	145.50
73.00	3960.00	147.84	147.84	147.84	145.17	144.73
18.00	3978.00	147.85	147.85	147.85	144.40	143.96
41.00	4017.00	147.54	147.54	147.54	143.63	143.19
43.00	4060.00	147.35	147.35	147.35	142.86	142.42
91.00	4151.00	146.73	146.73	146.73	142.09	141.65
8.00	4160.00	146.65	146.65	146.65	141.32	140.88
90.00	4290.00	144.97	144.97	144.97	140.55	140.11
10.00	4260.00	143.51	143.51	143.51	139.78	139.34
100.00	4360.00	143.14	143.06	142.49	139.01	138.57
100.00	4460.00	142.95	142.95	142.95	138.24	137.80
100.00	4560.00	142.30	142.30	142.30	137.47	137.03
25.00	4585.00	143.80	144.04	143.80	136.70	136.26
25.00	4710.00	145.82	145.82	145.82	135.93	135.49
25.00	4735.00	146.28	146.28	146.28	135.16	134.72
25.00	4785.00	145.05	145.05	145.05	134.39	133.95
25.00	4810.00	144.46	144.46	144.46	133.62	133.18
25.00	4835.00	141.31	141.31	141.31	132.85	132.41
25.00	4860.00	141.34	141.34	141.34	132.08	131.64
25.00	4885.00	145.83	145.83	145.83	131.31	130.87
25.00	4910.00	146.81	146.81	146.81	130.54	130.10
25.00	4935.00	145.14	145.14	145.14	129.77	129.33
25.00	4960.00	143.44	143.44	143.44	129.00	128.56
25.00	4985.00	143.08	143.08	143.08	128.23	127.79
25.00	5010.00	142.11	142.11	142.11	127.46	127.02
25.00	5035.00	141.04	141.04	141.04	126.69	126.25
25.00	5060.00	140.27	140.27	140.27	125.92	125.48
25.00	5085.00	140.35	140.35	140.35	125.15	124.71
25.00	5110.00	142.75	142.75	142.75	124.38	123.94
25.00	5135.00	139.21	139.07	140.21	123.61	123.17
25.00	5160.00	138.78	139.51	139.82	122.84	122.40
25.00	5185.00	138.81	138.81	138.81	122.07	121.63
25.00	5210.00	138.85	138.85	138.85	121.30	120.86
25.00	5235.00	138.52	138.52	138.52	120.53	120.09
25.00	5260.00	139.22	139.22	139.22	119.76	119.32
25.00	5285.00	138.04	138.04	138.04	118.99	118.55
25.00	5310.00	138.21	138.21	138.21	118.22	117.78
25.00	5335.00	138.26	138.26	138.26	117.45	117.01
25.00	5360.00	138.64	138.64	138.64	116.68	116.24
25.00	5385.00	138.57	138.57	138.57	115.91	115.47
25.00	5410.00	137.91	137.91	137.91	115.14	114.70
25.00	5435.00	137.95	137.95	137.95	114.37	113.93
18.00	5460.00	137.82	137.82	137.82	113.60	113.16
25.00	5485.00	138.13	138.13	138.13	112.83	112.39
25.00	5510.00	137.54	137.54	137.54	112.06	111.62
25.00	5535.00	137.44	137.44	137.44	111.29	110.85
65.00	5590.00	136.24	136.33	136.44	110.52	110.08
100.00	5700.00	136.12	136.93	136.84	109.75	109.31
100.00	5800.00	135.96	136.69	136.51	108.98	108.54
100.00	5900.00	135.96	136.06	136.17	108.21	107.77
100.00	6000.00	135.86	135.44	135.30	107.44	107.00



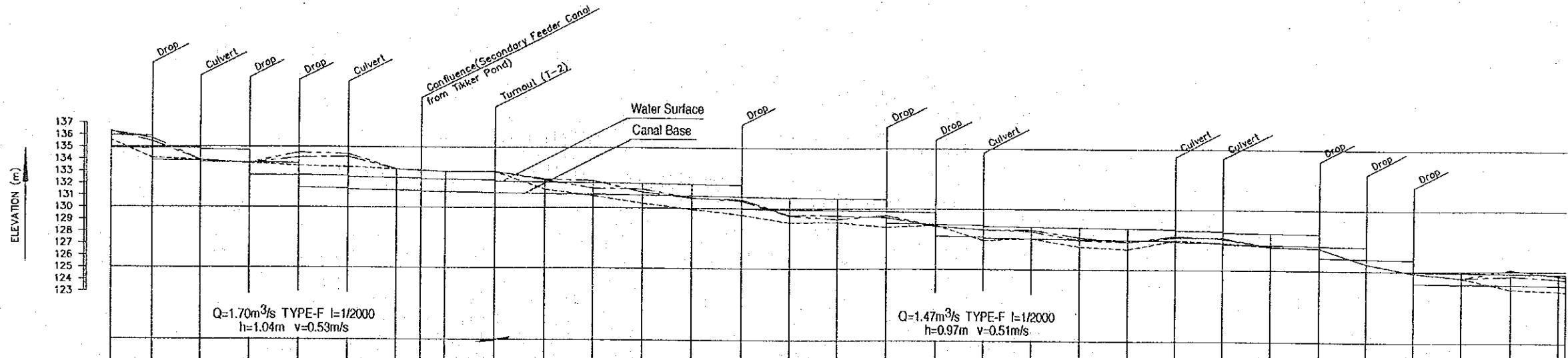
LEGEND	
---	GROUND SURFACE
---	EXISTING RIGHT BANK
---	EXISTING LEFT BANK

DWG. 13 LONGITUDINAL SECTION OF HEADRACE AND PRIMARY FEEDER CANAL (2/6)

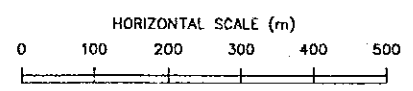
HIS MAJESTY'S GOVERNMENT OF NEPAL

**FEASIBILITY STUDY ON
THE RAJKUDWA IRRIGATION
PROJECT**

JAPAN INTERNATIONAL COOPERATION AGENCY



DISTANCE	EXISTING CONDITIONS			PROPOSED	
	GROUND SURFACE ELEVATION	CANAL BANK ELE.(RIGHT)	CANAL BANK ELE.(LEFT)	CANAL BASE ELEVATION	WATER SURFACE ELEVATION
15.00	135.36	136.29	136.30	134.91	135.95
85.00	134.07	135.45	135.71	133.67	134.91
100.00	133.88	133.88	133.88	133.92	134.85
200.00	133.63	133.63	133.63	133.57	134.71
300.00	133.42	134.12	134.52	133.82	133.66
400.00	133.33	134.17	134.40	131.77	132.61
500.00	133.17	133.17	133.17	131.42	132.46
600.00	133.07	133.07	133.07	131.40	132.44
700.00	132.97	132.97	132.97	131.28	132.32
800.00	132.96	132.96	132.96	131.23	132.27
900.00	131.52	132.37	132.31	131.15	132.12
1000.00	130.99	132.25	131.61	131.10	132.07
1100.00	130.35	131.31	131.56	131.05	132.02
1200.00	129.89	130.83	130.84	131.00	131.97
1300.00	129.44	130.71	130.50	130.98	131.92
1400.00	128.81	129.43	129.37	129.90	130.87
1500.00	128.85	129.40	129.11	129.85	130.82
1600.00	128.47	129.27	129.44	129.80	130.77
1700.00	128.65	128.56	128.55	129.75	130.72
1800.00	127.40	128.29	128.30	127.60	128.67
1900.00	127.55	128.29	128.15	127.55	128.52
2000.00	126.89	127.65	127.43	127.50	128.47
2100.00	126.70	127.31	127.31	127.45	128.42
2200.00	127.43	127.78	127.68	127.50	128.37
2300.00	127.26	127.61	127.68	127.45	128.32
2400.00	126.94	126.94	126.94	127.10	128.07
2500.00	126.84	126.84	126.84	127.05	128.02
2600.00	125.55	125.55	125.55	125.00	125.97
2700.00	124.83	124.83	124.83	124.95	124.92
2800.00	124.43	124.43	124.43	123.90	124.87
2900.00	123.49	124.59	125.11	123.85	124.82
3000.00	123.35	124.37	124.53	123.80	124.77



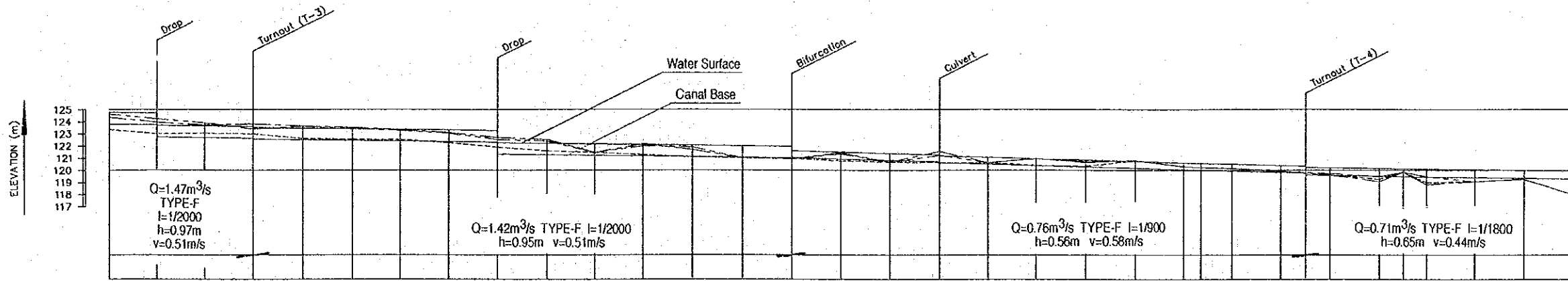
LEGEND	
---	GROUND SURFACE
---	EXISTING RIGHT BANK
---	EXISTING LEFT BANK

DWG. 14 LONGITUDINAL SECTION OF HEADRACE AND PRIMARY FEEDER CANAL (3/6)

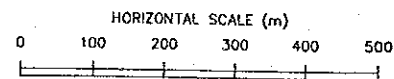
HIS MAJESTY'S GOVERNMENT OF NEPAL

**FEASIBILITY STUDY ON
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PROJECT**

JAPAN INTERNATIONAL COOPERATION AGENCY



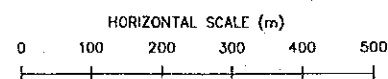
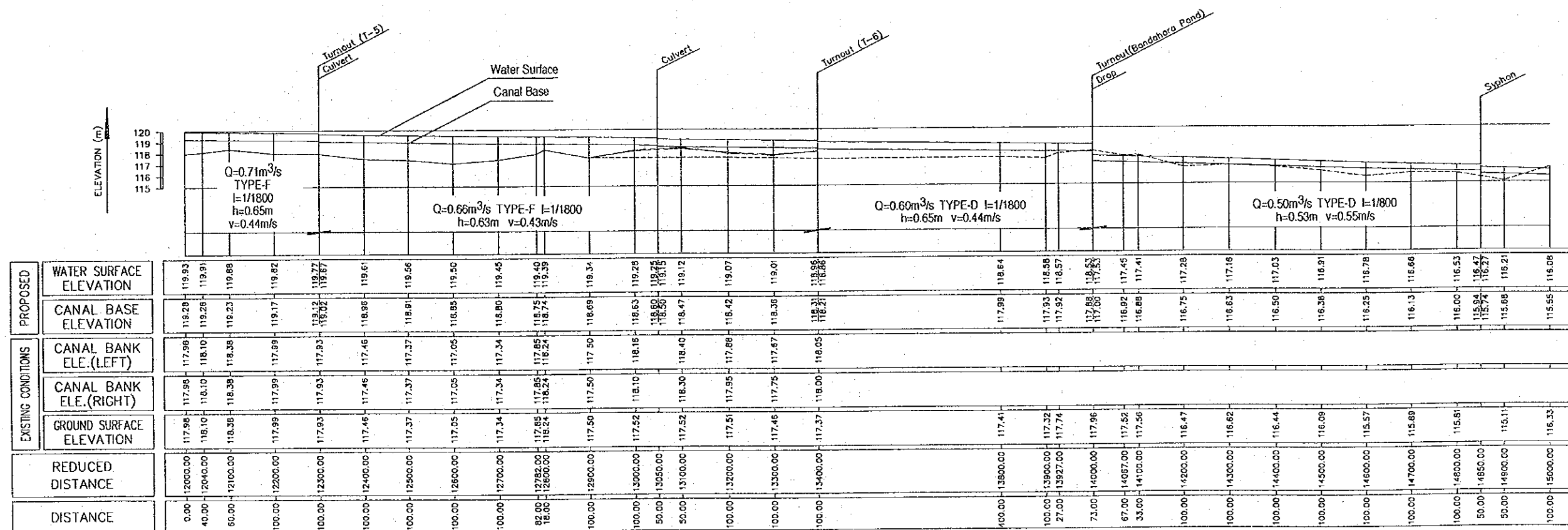
DISTANCE	EXISTING CONDITIONS			PROPOSED	
	GROUND SURFACE ELEVATION	CANAL BANK ELE.(LEFT)	CANAL BANK ELE.(RIGHT)	CANAL BASE ELEVATION	WATER SURFACE ELEVATION
0.00	123.35	124.37	124.63	123.60	124.77
100.00	123.00	123.86	124.25	123.75	124.72
200.00	123.04	123.74	123.91	122.70	123.67
300.00	123.00	123.82	123.41	122.65	123.52
400.00	122.62	123.64	123.53	122.52	123.47
500.00	122.56	123.54	123.41	122.47	123.42
600.00	122.53	123.54	123.28	122.42	123.37
700.00	122.27	123.11	123.08	122.37	123.32
800.00	121.90	122.70	122.53	122.32	123.27
900.00	121.60	122.54	122.39	121.27	122.22
1000.00	121.46	121.46	121.46	121.22	122.17
10100.00	121.28	122.16	121.69	121.17	122.12
10200.00	121.08	121.71	121.90	121.12	122.07
10300.00	121.00	121.00	121.00	121.07	122.02
10400.00	120.95	120.95	120.95	121.02	121.97
10500.00	120.77	121.43	121.34	120.93	121.49
10600.00	120.67	120.67	120.67	120.82	121.39
10700.00	120.62	121.56	121.21	120.71	121.37
10800.00	120.62	120.62	120.62	120.50	121.06
10900.00	120.40	120.96	120.95	120.39	120.85
11000.00	120.33	120.68	120.65	120.28	120.84
11100.00	120.79	120.79	120.79	120.17	120.73
11200.00	120.32	120.32	120.32	120.05	120.61
11236.00	120.22	120.22	120.22	120.01	120.57
11300.00	120.16	120.16	120.16	119.94	120.50
11400.00	119.89	119.89	119.89	119.83	120.39
11450.00				119.78	120.34
11500.00	119.62	119.60	119.74	119.58	120.24
11600.00	119.26	119.07	119.48	119.51	120.21
11650.00	119.86	119.86	119.86	119.48	120.16
11700.00	118.98	118.50	119.46	119.45	120.13
11800.00	119.07	119.07	119.07	119.40	120.10
11900.00	119.25	119.25	119.25	119.34	120.05
12000.00	117.98	117.98	117.98	119.34	119.99
				119.28	119.93



LEGEND	
---	GROUND SURFACE
---	EXISTING RIGHT BANK
---	EXISTING LEFT BANK

DWG. 15 LONGITUDINAL SECTION OF HEADRACE AND PRIMARY FEEDER CANAL (4/6)

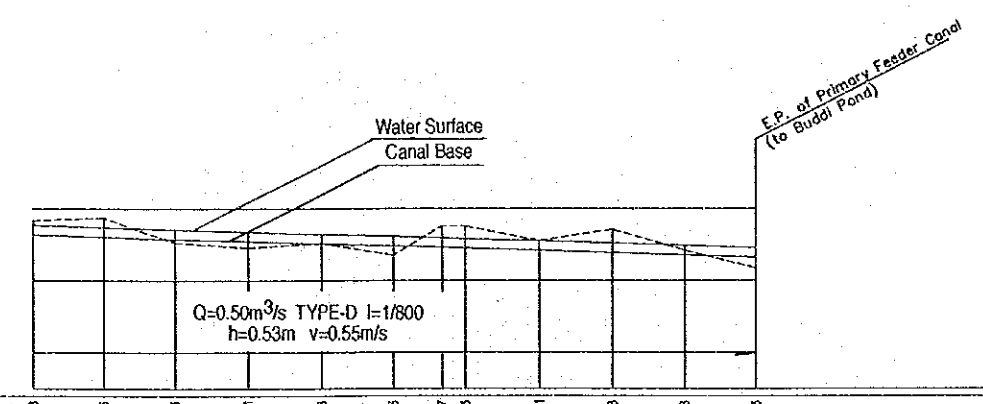
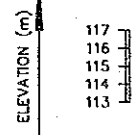
HIS MAJESTY'S GOVERNMENT OF NEPAL
**FEASIBILITY STUDY ON
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 JAPAN INTERNATIONAL COOPERATION AGENCY



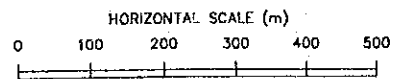
LEGEND	
---	GROUND SURFACE
---	EXISTING RIGHT BANK
---	EXISTING LEFT BANK

DWG. 16 LONGITUDINAL SECTION OF HEADRACE AND PRIMARY FEEDER CANAL (5/6)

HIS MAJESTY'S GOVERNMENT OF NEPAL
**FEASIBILITY STUDY ON
 THE RAJKUDWA IRRIGATION
 PROJECT**
 JAPAN INTERNATIONAL COOPERATION AGENCY



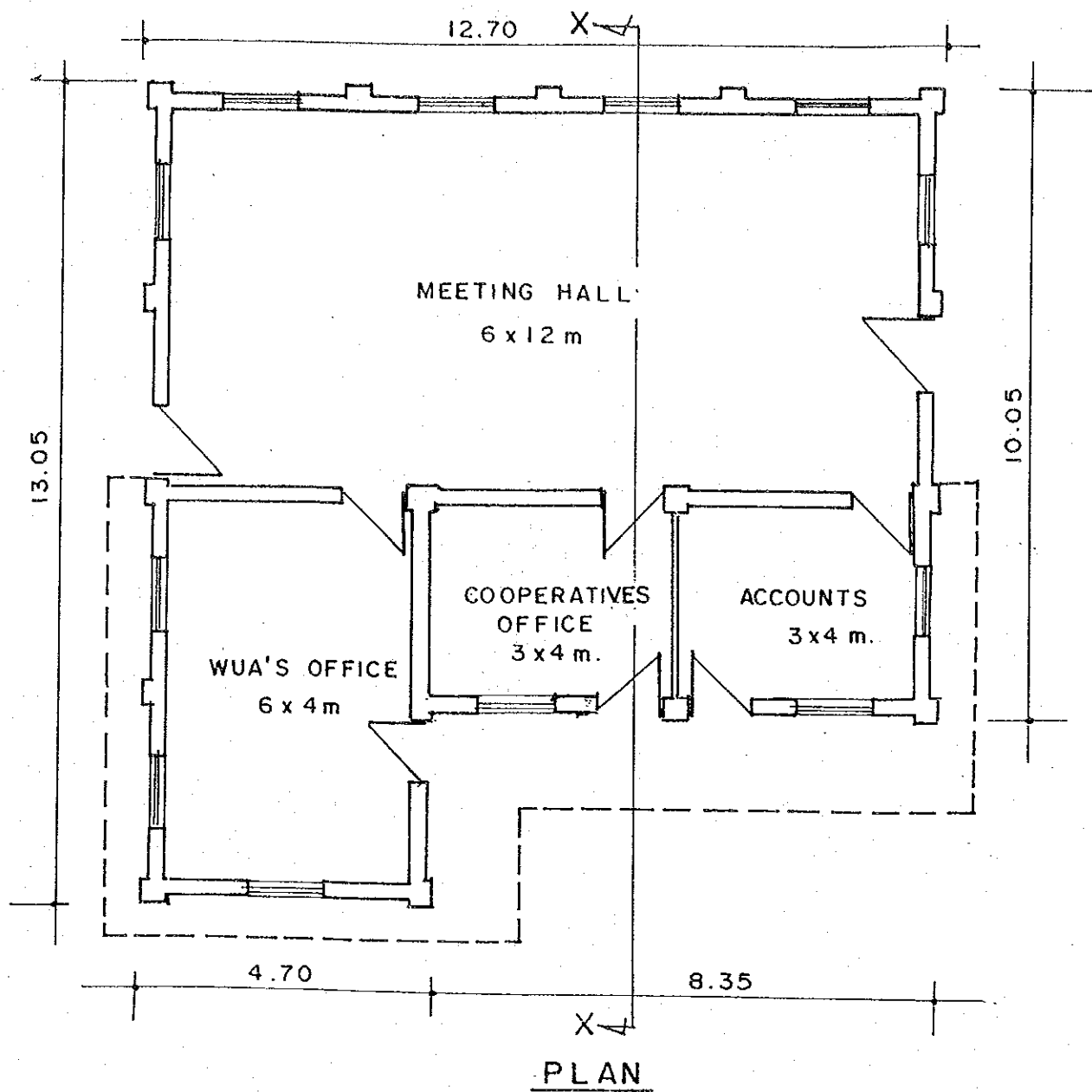
PROPOSED	WATER SURFACE ELEVATION	116.08	115.96	115.83	115.71	115.58	115.46	115.37	115.33	115.21	115.08	114.96	114.83
	CANAL BASE ELEVATION	115.55	115.43	115.30	115.18	115.05	114.93	114.84	114.80	114.68	114.55	114.43	114.30
EXISTING CONDITIONS	CANAL BANK ELE.(LEFT)												
	CANAL BANK ELE.(RIGHT)												
	GROUND SURFACE ELEVATION	116.33	116.48	115.10	114.82	115.07	114.41	116.03	116.02	115.22	115.84	114.69	113.70
	REDUCED DISTANCE	0.00	15100.00	15200.00	15300.00	15400.00	15500.00	15586.00	15600.00	15700.00	15800.00	15900.00	16000.00
	DISTANCE	0.00	100.00	200.00	300.00	400.00	500.00	582.00	600.00	700.00	800.00	900.00	1000.00



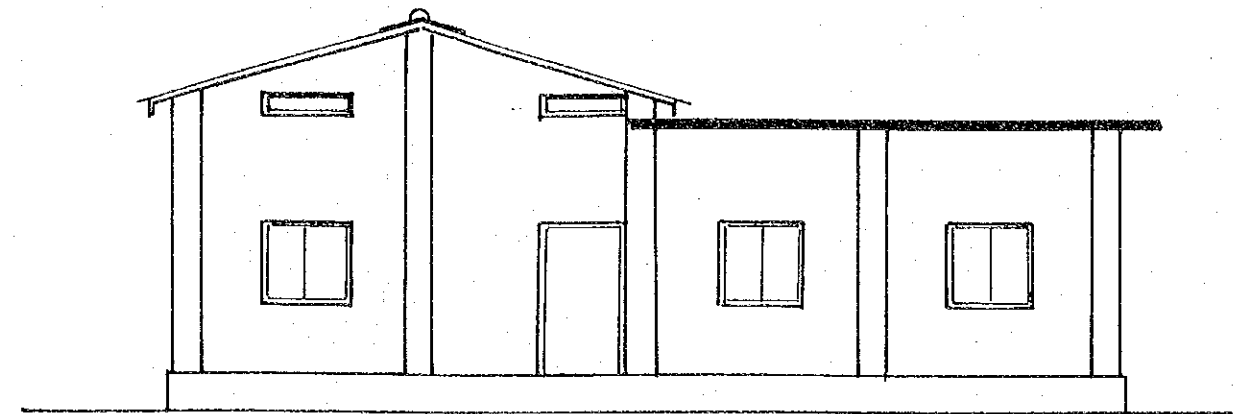
LEGEND	
---	GROUND SURFACE
---	EXISTING RIGHT BANK
---	EXISTING LEFT BANK

DWG. 17 LONGITUDINAL SECTION OF HEADRACE AND PRIMARY FEEDER CANAL (6/6)

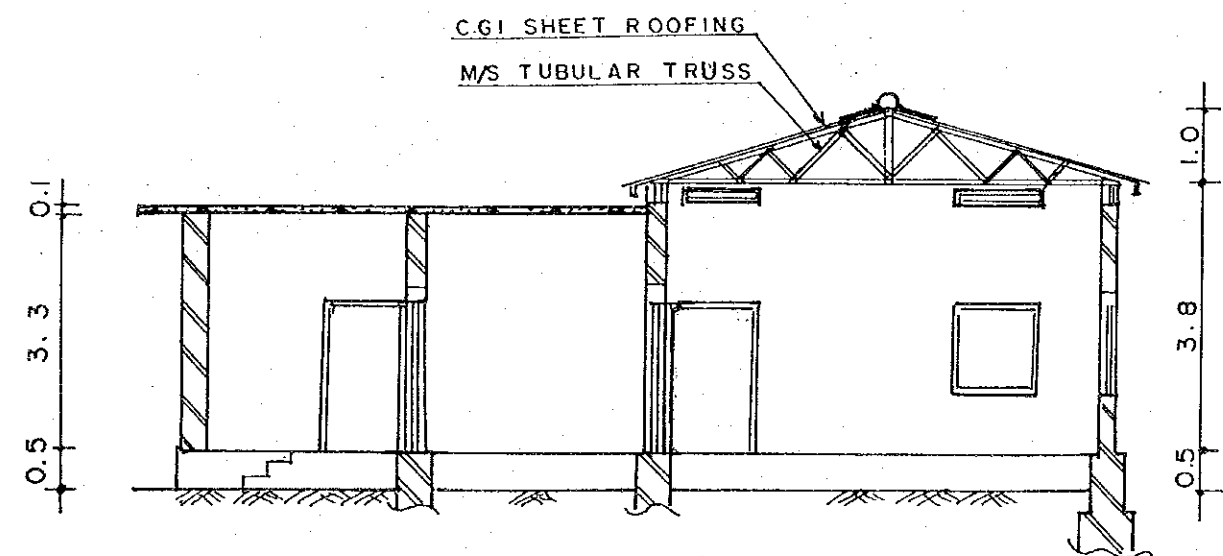
HIS MAJESTY'S GOVERNMENT OF NEPAL
FEASIBILITY STUDY ON THE RAJKUDWA IRRIGATION PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY



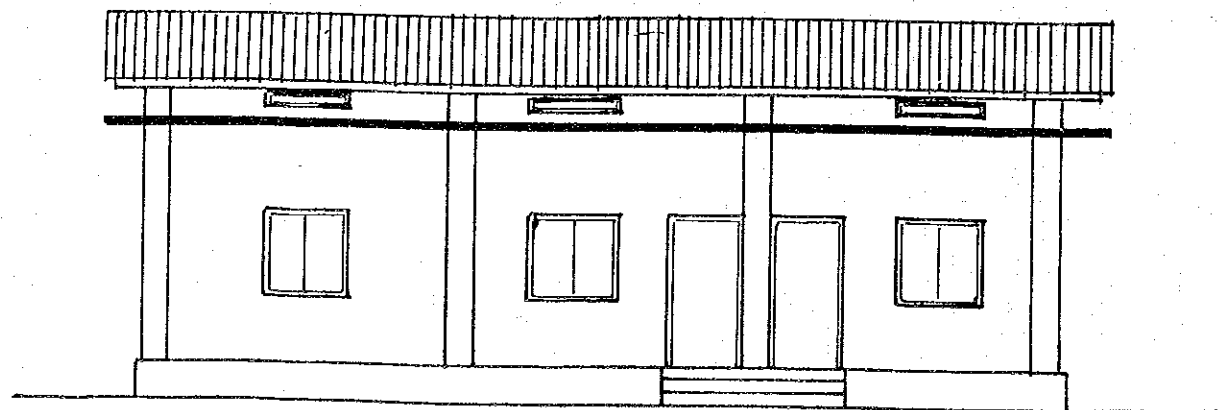
PLAN



SIDE ELEVATION



SECTION AT X-X



FRONT ELEVATION

DWG. 18 FARMERS' COOPERATIVE CENTER (1/2)

RAJKUDWA IRRIGATION PROJECT KAPILVASTU, NEPAL	
WUA'S OFFICE / COOPERATIVES BUILDING	
JAPAN INTERNATIONAL COOPERATION AGENCY	
SCALE: 1: 100	DATE: March 15, 1993