Government of the People's Republic of Bangladesh
Bangladesh Water Development Board
Water Resources Planning Organisation

FLOOD ACTION PLAN

NORTHEAST REGIONAL WATER MANAGEMENT PROJECT (FAP 6)

FINAL
FISHPASS PILOT PROJECT
COMPLETION REPORT
Volume 2: Appendices

October 1998

SNC ♦ LAVALIN International
Northwest Hydraulic Consultants

in association with

Engineering and Planning Consultants Ltd.
Bangladesh Engineering and Technological Services

Canadian International Development Agency

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COVER PHOTO: A typical village in the deeply flooded area of the Northeast Region. The earthen village platform is created to keep the houses above water during the flood season which lasts for five to seven months of the year. The platform is threatened by erosion from wave action; bamboo fencing is used as bank protection but often proves ineffective. The single *hijal* tree in front of the village is all that remains of the past lowland forest. The houses on the platform are squeezed together leaving no space for courtyards, gardens or livestock. Water surrounding the platform is used as a source of drinking water and for waste disposal by the hanging latrines. Life in these crowded villages can become very stressful especially for the women, because of the isolation during the flood season. The only form of transport from the village is by small country boats seen in the picture. The Northeast Regional Water Management Plan aims to improve the quality of life for these people.

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Appendix A

DESCRIPTION OF MANU RIVER IRRIGATION PROJECT

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A.1 PROJECT DESCRIPTION

A.1.1 Location and Boundaries

The MRIP lies between longitudes 91°40' and 92°00', and latitudes 24°55' and 24°40'N. It is situated immediately north of Moulvibazar, about 175 km northeast of Dhaka and 80 km southwest of Sylhet. Administratively, it falls within the Moulvibazar District and includes:

- Chandnighat, Akhikura, and Ekatuna union *parishads* of Moulvibazar *thana*.
- Rajnagar, Mansurnagar, Uttar Bhagh, Panchgaon, Munshibazar, Fatehpur.
- Tengra union *parishads* of Rajnagar *thana*.

The municipal area of Moulvibazar is located mainly on the left bank of the Manu River, and is outside the project area.

A.1.2 Project Rational and Components

The MRIP is a large and complex project. It was conceived to protect about 24,300 ha and irrigate 12,000 ha of agricultural land between the Kushiyara and Manu Rivers. The scheme was originally proposed in 1960 in an engineering report prepared by Consulting Engineers (Pakistan) Ltd. A study on irrigation and flood control for the project by International Engineering Company Inc. was presented in June 1961. Associated Consulting Engineers Ltd., a Bangladeshi consulting firm, undertook the feasibility, planning and design of the project between 1970 and 1975. The project was constructed between 1976 and 1983 using funds provided by the Government of Kuwait. The engineering contractor was Messrs Wahidun Nabi. The pumping station was built by the Korean contractor KDC, and the electrical and mechanical contractor was KSB of Germany. The works were supervised by Associated Consulting Engineers Ltd.

Prior to project implementation, the area was subject to damage from floods in the two rivers every year. Three causes of flooding were:

- Backwater flooding from the Kushiyara River during the pre-monsoon period (March-mid-April) which flooded *boro* crops in the lower areas.
- Overbank spilling from the Manu and Kushiyara Rivers during the monsoon period which flooded *aus* and *aman* crops.
- Runoff from the Bhatera Hills and the project area during times of heavy rain-fall which contributed to the flooding and waterlogging of the low-lying areas.

The design report noted that the project area had a deficit of rice production of about 20%, and that the flood damage was about 40% of rice production. The rice shortage was projected to further increase with the increasing population. The stated objectives of the project were:

- To protect the area from floods.
- To provide irrigation facilities to offset the adverse effects of the dry season.
- To provide adequate drainage facilities to deal with monsoon runoff.
- To increase rice production by protecting the project area from flooding, providing irrigation for winter crops, and introducing improved agricultural practices and cropping patterns.

The project consists of a flood embankment along the right bank of the Manu River from the southern end of the Bhatera Hills to Manumukh (Manu section), and along the left bank of the Kushiyara River from the northern end of the Bhatera Hills to Manumukh (Kushiyara section).

The Kashimpur pumping station, located on the left bank of the Kushiyara River about 3.5 km upstream of Manumukh, is used to drain the project area when the water levels in the Kushiyara River are higher than in the *haor*. There are also two drainage sluices at Kashimpur. These drain the *haor* by gravity whenever the water levels in the river are lower than those in the *haor*.

The drainage system was intended to maintain water levels between elevations 4.1 m PWD and 7.16 m PWD. The pumps were supposed to operate whenever the project water level rose above 4.1 m PWD.

A barrage has been constructed across the Manu River 3.8 km upstream of Moulvibazar. It diverts water into an irrigation system which supports 12,000 ha of gravity irrigation and 877 ha of LLP irrigation. The system was designed to irrigate the relatively higher lands in the project area - those located between elevation 6.6 m and 11.1 m.

During planning of the Manu Irrigation Project many people living along the right bank of the Manu refused to accept the project embankment alignment proposed on the basis of a standard setback distance of 120 m (400 ft) from the river. If the proposed alignment had been adopted in this densely populated area many residents would have had to be re-located and, as they were not threatened by flooding at the time, they refused to re-locate. Consequently, the alignment was altered, leaving many residences outside the project embankment. Construction of the project embankment, and continuing confinement of the Manu upstream of the project, have resulted in higher river stages, which seriously affect the more vulnerable areas on the Manu right bank. About 23.7 km of secondary embankment have been built along the Manu right bank to further protect these areas, and this is constantly being strengthened and raised to protect vulnerable residences. Nevertheless, flooding has persistently recurred in these areas and the residents have been cutting the project embankment whenever their property has been flooded to enable fast drainage of the flood water from their property. Flow through these cuts causes considerable damage to crops within the project area. In addition, six drainage syphons have been constructed under the project embankment downstream of the barrage and these also discharge into the project area. In order to relieve flooding within the project area farmers have started to cut the Kushiyara section of the project embankment. The cutting of the project embankment has resulted in much crop damage and frequent social conflicts. Finding a solution to this problem is one of the major issues of rehabilitation.

The large flood and unauthorised public cutting of the embankment in 1984 caused severe damage to the flood embankment, and to the irrigation and drainage systems. The resulting damage was repaired between 1984 and 1986 under a IDA loan for flood damage repair. Further flood damage has occurred since 1990 as the result of other large floods in the Manu and public cuts in the Manu section of the embankment. People residing outside this section of the embankment, along a 12.5 km length between Baliarbagh and Palpur, are committed to cutting the embankment until their demand to strengthen and raise the pre-existing old dyke along the edge of the Manu right bank is met. It is apparent that public cutting of the embankment has adversely affected past performance of the project and will continue to jeopardise its future performance. Higher rainfall in recent years, the confinement effects of embankments, and possibly deforestation of the Manu and Dhalai catchments, are resulting in higher peak flows in the Manu and this can only lead to more, and more frequent, cutting of the project embankment.

A.1.3 Topography and Drainage

The project encompasses an area of about 24,300 ha. It is roughly trapezoidal in shape, measuring 22.8 km along the southwest-northeast axis and 14.8 km wide. It is bounded by the Kushiyara River to the north, the foot of the Bhatera Hills to the east, and the Manu River to the south and west.

Elevations within the project area range from 1 m PWD at the centre of Kawadighi Haor, to 12.5 m PWD at the foot of the Bhatera Hills. The land forms a concave alluvial plain which slopes upward towards the Bhatera Hills and the surrounding river levees. River banks surrounding the project area are raised or "perched". They were formed by periodic overtopping during floods and deposition of the suspended bed material near the river. Flood water accumulates within the deeper topography of the project (ie *haor* and *beels*). The water bodies of the project area are shown in Figure A.1.

The project area is part of the Surma-Kushiyara floodplain. It is occupied by grey, heavy silty clay loams on the ridges, and by clays in the basins. Non-calcareous Grey Floodplain soils are the only general type. The organic matter content of the soil is moderate. Soil reaction ranges from strongly acidic to neutral. Levels of CEC and Zn are high while those of other essential nutrients are medium.

The project area is dissected by numerous former distributaries of the Manu River, tributaries of the Kushiyara River, and many small drainage *khal*s. The project contains a main *haor* (Boro Kawadighi) and about 50 *beel*s. Drainage water from most of the area is conveyed by natural drainage channels to Kawadighi Haor. From there it is discharged to the Kushiyara River through two drainage sluices at Kashimpur. When the water levels are higher in the river than in the *haor* (during flood stages and pre-monsoon floods), the sluices cannot drain. The Kashimpur pumps are operated to drain the project area.

The project areas receives direct local runoff from the adjacent Batterha Hills catchment area, located to the east. The catchment has an area of 6,000 ha, and rises to a maximum elevation of 433 m PWD. There are 15 *chhora*s (drainage channels) coming from the Bhatera Hills. Depending on rainfall and inflow, thirteen carry water throughout the year. This water is used for irrigating the land in Kawadighi Haor, and many areas in Chhoto Kawadighi Haor are irrigated by *chhora* water. The incoming chhoras are :

- Akali Chhora.
- Binnajori Chhora.
- Udna Chhora.
- Kuchimura Chhora.
- Kaliajuri Chhora.
- Puranuli Chhora.
- Pagla Chhora.
- Haar Chhora.
- Goali Chhora.
- Dhamai Chhora.
- Jamir Chhora.

- Kalamua Chhora.
- Marua Chhora.
- Madra Chhora.
- Kamal Chhora.

A.1.4 Flood Embankments

A 59.9 km long flood embankment exists along the north, west, and south sides of the project area. The embankment protects the area from high floods in the Manu and Kushiyara Rivers. The 28.3 km long Kushiyara section of the embankment extends along the left bank of the Kushiyara River upstream of Manumukh until Muktupur, which is located at the northern end of the Bhatera Hills. This forms the northern project boundary. The 31.6 km long Manu section of the embankment extends along the right bank of the Manu River upstream of Manumukh until Haripasha, which is located at the southern end of the Bhatera Hills. This forms the project's western and southern boundaries. The foot of the Bhatera hills forms the eastern boundary of the project. The crest of the Manu section of the embankment slopes downwards from 16.66 m PWD at Harispur. It drops to 14.59 m PWD at Moulvibazar, and to 11.75 m PWD at Manumukh. The crest of Kushiyara section slopes from 12.06 m PWD at Muktupur to 10.96 m PWD at Manumukh. Both sections of the embankment have 1:2.5 riverside slopes, 1:2 or 1:2.5 countryside slopes, and a crest width of 4.3 m.

During planning of the MRIP, many people living along the right bank of the Manu River refused to accept the proposed 120 m standard setback distance from the river. The alignment was altered, leaving many residences outside the project embankment. Construction of the project embankment and continuous confinement of the Manu River upstream of the project area have resulted in higher river stages. This seriously affect the more vulnerable areas on the right bank of the Manu River. About 23.7 km of secondary embankment have been built along the right bank of the Manu River to protect these areas. This is constantly being strengthened and raised to protect vulnerable residences. Nevertheless, flooding has persistently recurred in these areas, and the residents have been cutting project embankments whenever their property has been flooded. This enables fast drainage of the flood water, but flow through these cuts causes considerable damage to crops within the project area. In addition, 6 drainage syphons have been constructed under the project embankment downstream of the barrage. These also discharge into the project area.

A.1.5 Irrigation Canals

Irrigation water diverted by the Manu barrage is conveyed to the fields via a 105.3 km canal system. The system consists of 2 main canals, 14 secondary canals, and 14 tertiary canals. The 18.6 km Manumukh main canal conveys water to the west. The 18.1 km Rajnagar main canal conveys it to the east. There are 48.9 km of secondary canals, and 19.7 km of tertiary canals.

There has been a general deterioration of the canal system, primarily due to inadequate maintenance and overtopping. The canals cannot support the flood water coming from cuts in the project embankment. Many are choked by aquatic vegetation, and many canal banks have been cut to facilitate drainage. Some canal beds are badly silted as a result of flood water inundation, and bunds have been constructed in some canals for fishing.

A.1.6 Drainage Channels

Natural drainage channels form the main drainage network within the project. No new drainage channels were excavated during the project construction period. The main channels include:

- Akali Chhora.
- Udna Chhorra.
- Kulianara Channel.
- Munia Channel.
- Machua Channel.
- Langun Channel.
- Digola Channel.
- Lash Channel.
- Machuakhali Channel.
- Mogra Channel.
- Koradair Channel.

Drainage water from most of the area is conveyed by these channels to Kawadighi Haor. From there it is discharged to the Kushiyara River via the Koradair Khal. This is done through two drainage sluices or, during high river stages, by pumping at Kashimpur pumping station. Kawadighi Haor, located in the northeast of the project area, is the largest perennial water body inside the MRIP. Most of the smaller *beel*s in the project area dry up during the dry season.

A.1.7 Bridges and Culverts

There are 39 bridges and culverts on the project canals. These are the responsibility of BWDB, and are in good condition. Other bridges and culverts within the project area are generally in reasonable condition, but a number of *thana* structures require urgent repair, and in some cases, replacement. Roads in the project area are vested either in the Thana or the Roads and Highways Department. The roads are reasonably well maintained after each monsoon season.

A.1.8 Manu Barrage

The Manu barrage is located about 3.8 km upstream of Chandighat Bridge in Moulvibazar. It was constructed at a loop in the Manu River. This loop has become the de-silting basin for the whole irrigation system. The depth of silt which has accumulated in the de-silting basin since the beginning of the project is 0.6 m. The eight 7.31 m x 3.81 m flood gates of the barrage have a total safe discharge capacity of 1274 m^3/s. The normal pool level of the barrage is at 12.03 m PWD. The highest water level recorded is 12.95 m PWD. Irrigation water is diverted at the barrage through a 5-vent intake sluice discharging into the de-silting basin. Each vent is 1.52 m x 1.83 m.

A.1.9 Kashimpur Pumping Station

Kashimpur pumping station is located on the left bank of the Kushiyara about 3.5 km east of Manumukh, on the Koradair Khal coming from Kawadighi Haor. It has eight 4.25 m^3/s electrically driven pumps. Electricity is supplied from Shahjibazar (gas fuel) power station near Habiganj via a 132 KV line to Srimangal sub-station, and from there to the pumping station sub-station via a 27.4 km long 33 KV transmission line passing through Moulvibazar. The pumping

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station sub-station reduces the supply voltage from 33 KV to 2.4 KV, the operating voltage of the pump motors. The pumps are operated when high river stages prevent gravity drainage through the two main drainage sluices at Kashimpur. Pumping records show that the pumps are operated during:

- March and April to maintain the water level in Kawadighi Haor below 4.1 m PWD, and so protect the Boro crop from flooding. Normally pumping starts when the haor water level reaches 4.0 m PWD. Additional pumps are started as inundation increases, with all pumps in operation after 4.5 m PWD is reached. Pumping is usually undertaken over about 15 days.

- July through September to protect the b.Aman crop from submergence by maintaining the Kawadighi Haor water level below 7.15 m PWD. Normally pumping starts when the haor water level reaches 7.0 m PWD. Additional pumps are started as inundation increases with all pumps in operation after 8.0 m PWD is reached. Pumping is usually undertaken over about 45 days.

Nevertheless, flooding through embankment cuts, runoff from the Bhatera Hills, and leakage through the regulator gates, mean that there is insufficient pumping capacity to achieve this situation. Consequently, the area of crop production is reduced and pumping is inefficient. The pumping efficiency has been further reduced by leakage through the sluice gates at Kashimpur, and by inadequate maintenance (hampered by a lack of spare parts). In 1988, flood water entered the pumping station, damaging electrical components and silting up the intake channel. Precautions have been taken to prevent further flooding by constructing a sandbag cofferdam around the pumping station and electrical sub-station.

A.1.10 Drainage Structures

There are two main drainage sluices in the Kushiyara River section of the project embankment. These are located on Koradair Khal immediately east of the pumping station. The 6-vent sluice has an invert level of 4.1 m PWD, and the 3-vent sluice has an invert level of 1.4 m PWD. These drainage sluices allow gravity drainage of water from the project area when water levels in the Kushiyara River permit. The 6-vent regulator is opened any time the haor water level is higher than the river level, and closed whenever the river level is higher than the haor level. The regulator may be opened and closed several times during the monsoon season. Considerable leakage through the 3-vent sluice into the project area has been observed during high river stages, when pumping is in progress, and also in the dry season.

There are six surface drainage sluices in the Manu section of the project embankment between Haripasha and the Manu barrage. These are single or two-vent RCC box structures with riverside metal flap gates, and they are used to drain water, which has accumulated between the project and secondary embankments, into the project area. Rehabilitation works are required at all these structures. These works include repair of the RCC basin slabs and slope protection, repair and painting of flap gates, and repair of earthwork.

A.1.11 Irrigation Structures

Bifurcation Structure: Bifurcation structures regulate water flow from the de-silting basin into the Manumukh and Rajnagar main canals. These RCC structures incorporate two head regulators

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from the main canals and a vehicular access bridge. Flows through the three vents of each regulator are controlled by vertical lift gates.

Group Regulators: Group regulators are provided at the junction of the main and secondary canals. There are 8 group regulators in the Manumukh canal system, and 6 in the Rajnagar canal system. Each group regulator consists of a cross regulator in the main canal and a head regulator discharging to the secondary canal. The cross and head regulators consist of RCC boxes with varying ventage (1 to 3) fitted with vertical lift gates.

Cross regulators: In addition to the cross regulators incorporated in the group regulators, there are 2 cross regulators in the Manumukh main canal and 2 others in the Rajnagar main canal.

Group Checks: Group checks are provided at the junction of secondary and tertiary canals. There are six group checks in the Manumukh canal system and seven in the Rajnagar canal system. Each group check consists of a cross check on the secondary canal, and a head check on the tertiary canal. These structures are similar to the group regulators, only smaller.

Cross Checks: In addition to the cross checks incorporated in the group checks, there are 5 cross checks in the Manumukh canal system and 13 in the Rajnagar canal system.

Fall-Cum-Checks: There are several fall-cum-checks in the Manu canal system, and 4 in the Rajnagar canal system. The fall-cum-checks consist of RCC floors and walls fitted with a metal shutter upstream of the glacies. Falls are either 0.30 m or 0.45 m.

Turnouts: There are 262 turnouts delivering irrigation water to the fields from the tertiary and secondary canals, and in some cases from main canals. These structures consist of a single 250 mm diameter RCC pipe 20-25 m long. The pipe is laid at field level between the canal and the fields.

Tail Structures: There are 15 tail structures in the Manumukh canal system, and 14 in the Rajnagar canal system. The tail structures each consist of an RCC box with varying ventage (1 to 3) fitted with vertical lift gates.

LLP inlets: There are 19 LLP inlets through the Kushiyara River section of the project embankment. Each inlet consists of a single 250 mm diameter RCC pipe, an RCC intake fitted with a flap gate on the riverside, and an RCC outlet fitted with a vertical lift gate on the countryside. In most cases gates are damaged or missing.

A.1.12 Syphons

Syphons are provided to drain rain water that accumulates in pockets. They are placed either through the project embankment, or under an adjacent canal. There are 7 syphons through the embankment, and 38 syphons through irrigation canals; 9 of the latter are in the Manu canal system and 29 are in the Rajnagar canal system. Heavy silting of the syphons occurs. They require regular maintenance, but this is not always available. As a result, the syphons are often blocked or their capacity significantly reduced. BWDB has proposed seven additional syphons to relieve local drainage congestion.

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A.1.13 *Haor* and *Beel* Areas

The project area contains the outstandingly important wetland Kawadighi Haor, which has an area of 11,295 ha. *Beels* in the project area are listed in Table A.1.1.

area

Table A.1.1: Areas of beels in MRIP

Beel Names	Area (ha)	*Beel* Names	Area (ha)
Singua Beel	14.37	Kaliara Doba	
Hawa Beel	61.54	Kalibari Khal	4.09
Majerband Beel	76.72	Kanaki Gang	5.26
Patasingra Beel	233.79	Kati taka Beel	1.62
Goali Beel	13.87	Ghaagatia Beel	0.41
Shalkatua Beel	48.87	Charupama Beel	2.74
Peala Beel	11.19	C.M. Karsha Beel	6.00
Kaliakuli Beel	9.68	Chapra Beel	3.65
Noamati Beel	25.91	Chowdighi Beel	0.45
Hawa Beel	24.62	Chota Beel	0.51
Melaghar Beel	12.19	Jibonia Beel	5.06
Munia River	16.84	Jira Beel	4.37
Akali Nadi	24.85	Daldalia Beel	6.11
Erali Pukhuria	14.06	Dewan Dighi	4.29
Chatla Bhurijuri	12.12	Nalua Gang	7.81
Bodirbhara Beel	11.63	Nagori Gang	6.60
Koradair River	13.65	P. Matikura Beel	2.15
Niamoter Doba	12.94	Baladmara Beel	0.32
Bhobanaga Beel	12.72	Balita Beel	3.83
Nalua Nadi	10.29	Bacha Dubi Beel	1.40
Karadair Nadi 2	8.40	Boicha Beel	2.65
Machuakhali fishery	36.44	Bagan Beel	0.49
Agadubi Beel	0.4	Kukua Beel	5.79
Akali Nadi up		Satbhuterdebi Beel	1.61
Upper Goali Beel	2.92	Harium Beel	4.13
Koradair Nadi 1	4.21	Ulauli Beel	2.66
Koia Beel	2.12	Dhansara Beel	3.15
Karira Nadi	5.10	Sagar Dighi	1.65
Total *Jalmohal* Area = 833.46 ha			

A.2 STATUS OF DRAINAGE SYSTEM

A.2.1 Dry Season and Premonsoon Drainage

The drainage system of MRIP is shown in Figure A.1 and in schematic form in Figure A.2.

The majority of the runoff from the upper catchment flows into the project area through the following *chhora*s:

- Akali Chhora.
- Binnojuri Chhora.
- Udna Chhora.
- Kuchimura Chhora.
- Pagla Chhora.
- Haar Chhora.
- Dhamai Chhora.
- Madra Chhora.

Most of the *chhora*s are blocked by successive earthen bunds. The retained water is used for irrigation and domestic purposes. In case of excessive rainfall in the upper catchment, however, flow occurs at the incoming *chhora*s. The runoff that enters the project area from the northeast part of the MRIP flows through Akali Chhora, Binnojuri Chhora, and Udna Chhora. This runoff is stored at Boro Kawadighi Haor. The runoff that enters the project area from the east and northeast flows through Udna Chhora, Kuchimura Chhora, Pagla Chhora, Haar Chhora, Dhamai Chhora, and Madra Chhora. This runoff is stored at Chotto Kawadighi Haor.

There are about 50 *beel*s in the project area. The drainage channel system is interlinked with these *beel*s. Drainage flow is not only governed by the channel system, but also by storage at *beel* areas. Initially, runoff is stored in the *beel* areas. Additional runoff flows through the channel system. Chotto Kawadighi Haor is drained by Munia Channel. Though the cross-sectional area of Munia Channel is adequate, the backwater effect of Boro Kawadighi Haor causes slow drainage from Chotto Kawadighi Haor. This congestion results in damage of *boro* crops. The major affected *beel*s are:

- Bara Beel.
- Bhurburi Beel.
- Balita Beel.
- Pukhuria Beel.
- Singua Beel.
- Bhurijuri Channel (large water body).

Boro crops at Chotto Kawadighi Haor are frequently partially or completely ruined. This drainage problem can be reduced by excavating the following main channels (to increase the slope of the channel and increase conveyance):

- Kulaimara Channel.
- Munia Channel.
- Akali Channel.

The drainage problem can also be mitigated by construction of a new drainage channel from Kuchimura Channel to Udna Chhora. This will divert storage from Chotto Kawadighi Haor to Boro Kawadighi Haor.

Langun Channel and Machua Channel receive runoff from areas to the southwest of MRIP. They drain into Akali Chhora. Runoff from the south is received by Digola Channel, and drains into Machua Channel and Patasingra Beel. Southwestern runoff is carried by Lash Channel, and drains into Patasingra Beel. The northwestern runoff is received by Machakhali Channel, and drains into Patasingra beel. The northern catchment runoff is received by Munia channel, and drains into Akali Chhora. Patasingra Beel water is drained by Mogra canal. Ulauli, Shalkatua, Rukkha, Majherbanda, and Chatla Beel water is drained by Akali Chhora. Mogra and Akali Chhoras join together and form Koradair Channel. Koradair Channel is the only drainage outlet of MRIP. The *beel*s of Boro Kawadighi Haor in which *boro* crops are affected are :

- Machuakhali Beel.
- Kapania Beel.
- Patasingra Beel.
- Chalia Beel.
- Shalkatua Beel.
- Rukkha Beel.
- Ulauli Beel.

The drainage through the Koradair River is either by regulators or the pumping station. During the dry season, drainage is carried out by the 3-vent regulator. In the pre-monsoon season, drainage is carried out by the pumping station.

A.2.2 Monsoon and Postmonsoon Drainage

During the monsoon and pre-monsoon seasons, there are only two waterbodies in the project area: Boro Kawadighi Haor and Chhoto Kawadighi Haor. When flood levels are high, 60% - 75% of the project area remains submerged. All the incoming *chhora*s from the upper catchment remain active, so overland runoff continues entering through small openings. The runoff stores in both the *haor*s.

The upper areas of the southeast and southern portions of the project remain flood free. The only active (monsoon) channels identified are Lang channel, Langun Channel, Kodali Channel, and Machua Channel. To keep water level at 7.16 m PWD, monsoon outflow is carried out by eight pumps, which have a total discharge capacity of 35 m^3/s. There is a rise in water level in the project area during the monsoon season since the combined inflow from the upper catchment and rainfall is greater than the discharge by the pumps. During the post-monsoon season when river level is lower than the *haor* water level, gravity drainage starts through the 6-vent regulator. For efficient discharge of the storage during the post-monsoon and pre-monsoon seasons, BWDB (O&M circle, Moulvibazar) has proposed construction of a 3-vent regulator at Machuakhali Channel.

A.3 STATUS OF IRRIGATION SYSTEM

A.3.1 Water Distribution

The irrigation system of MRIP is shown in Figure A.3, and in schematic form in Figure A.4. The irrigation command area in MRIP is 12,000 ha. Water is conveyed to the fields by two main canal systems. One is the Manu main canal which travels along the right bank of the Manu River. The other is the Rajnagar main canal, which travels along the southern and eastern parts of the project area. The total system consists of 105.3 km of canals. This canal system comprises:

- Main canals 36.7 km
- Secondary canals 48.9 km
- Tertiary canals 19.7 km

The Manumukh main canal is 18.6 km long, and its distributaries are 30 km long. Command area of the Manumukh canal system is about 6,000 ha. Area irrigated in the 1995-96 dry season was 2,100 ha. Irrigation discharge through the Manumukh main canal is 2.81 m^3/s.

The Rajnagar main canal is 18.1 km long, and its distributaries are 38.6 km long. Command area of the Rajnagar canal system is 6,000 ha. Area irrigated in the 1995-96 dry season was 5,200 ha. Irrigation discharge through the Rajnagar main canal is 2.90 m^3/s.

Irrigation water supply starts from the end of December and continues until mid-March, when the Manu barrage is closed. The pool level of the barrage is 12.03 m PWD. At this level, the main canals maintain full water supply. Water is supplied simultaneously by both the main canals. Distribution of water from main canals to fields through secondary and tertiary canals starts from the upstream reaches of the main canals. A cyclic order is maintained for water distribution in the secondary canals. This means that first upstream fields are irrigated, then fields in the middle reaches are irrigated, and finally downstream fields are irrigated. This cycle is repeated until the end of March. Twenty to twenty-five metres long turnouts are used between the canals and the fields. The excess irrigation water of the Manumukh main canal falls into Patasingra Beel through overland flows and the following drainage channels: Lash Channel, Machuakhali Channel, and Naria Channel. The excess irrigation water of the Rajnagar canal is received by Langun Channel, Machua Channel, Digola Channel, Akali Chhora, and Udna Chhora. This water falls in Patasingra Beel and Majherbanda Beel, and also passes through Akali Chhora.

A.3.2 Water Use in Postmonsoon and Dry Season Cropping

Surface water available for cropping purposes in the post-monsoon and dry seasons is from:

- Water resources in Bhatera hill.
- Water resources from storage in the project area.
- Irrigation water from the Manu River.
- Kushiyara River water by LLPs.

Surface water and ground water from Bhatera Hills enters the project area through many *chorra*s. This water is used for local *boro* cultivation.

Since the area is embanked, and the river water level remains higher than project water level, during the monsoon season rainfall in the project area and runoff from the upper catchment is stored in the project area. This water is drained through the 6-vent regulator. The area which dries is irrigated with storage water. The low-lying area is irrigated by *beel* water.

There are 19 LLP inlets through the Kushiyara River on the northeast side of the MRIP. Each RCC inlet consists of a single 250 mm diameter pipe fitted with gates on both sides. Most of these inlets are partially damaged. Farmers do not use the inlets for irrigation. Cropping areas from different water resources are shown in Figure A.5.

Area irrigated by different sources of water are as follows :

- Incoming upstream water 1,600 ha
- Post-monsoon storage water 4,300 ha
- Irrigation water 7,300 ha
- Kushiyara River water nil

Cost and yield of HYV *boro* is higher than that of local *boro*, but the cropping period is also longer. Since low areas submerge after little rainfall or inflow from the upper catchment, farmers prefer local *boro* cropping in lower areas. The shorter cropping period reduces the risk of crop damage.

A.3.3 Dry Season Beel Area during 1995-96

*Beel*s within the Machuakhali beel system remained submerged during the 1995-96 dry season. These were Chamka, Dariganga, Topka, Diba Topka, Homia, Chatla, Singua, Petua, and Machuakhali Beels. These *beel*s are interconnected by the Machuakhali Channel. Originally, Machuakhali was a drainage channel which drained *beel* and floodplain waters into the Manu River. The channel therefore slopes towards the Manu River (in the reverse direction of the present drainage system). Since the storage water of the Machuakhali Beel system is drained through Patasingra Beel, and due to the influence of irrigation water distribution through the Manu main canal, water depth in the Machuakhali Channel and *beel* system is higher than other channels and *beel*s in the project area.

Among other *beel*s, Patasingra Beel is a permanent waterbody. It is of one of the lowest pockets in the project area, and influenced by irrigation water coming through Machuakhali Channel, Machua Channel, and Lash Channel. Singua Beel and Bhuribhuri Beel also remained under water because of slow drainage of the system and incoming water from *chhora*s. Pukhuria Beel remained underwater since the bed level of the channel which flows into the *beel* is at a higher elevation than the *beel* bed level. The drainage system is also slow. A portion of Shalkatua Beel remained shallowly submerged. The 1995-96 dry season wet area is shown in Figure A.1. The underwater area of different *beel*s is presented in Table A.3.1.

Table A.3.1: Area and depth of selected beels

Name of *beel*	Approximate Area (ha)	Depth (m)
Machuakhali	90	5.0
Patasingra	160	3.0
Shalkatua	74	1.5
Singua	35	3.0
Bhurburi	20	2.0
Pukhuria	20	3.0

A.3.4 Dry Season Flow System

During the dry season incoming water through *chhoras* is blocked by earthen dams. This is done for irrigation purposes. Post-monsoon water stored in Chotto Kawadighi Haor is slowly drained by Munia Channel, which falls into Akali Chhora. Irrigation water which comes through Manumukh main canal is received by Machuakhali Channel and Lash Channel. This water is stored in Kawadighi Haor, and then drained by Mogra-Koradair Channel. The irrigation water of the Rajnagar main canal is received by Digola, Machua, and Akali Chhoras. It is drained by Akali Chhora into Koradair Channel. Akali Chhora and Mogra Channel join to form Koradair Channel, through which total flow is discharged into the Kushiyara River. This is controlled by the 3-vent regulator. The following discharges were measured during the dry season (11 February, 1996):

- Akali Channel 0.6 m^3/s
- Mogra Channel 0.6 m^3/s
- Koradair Khal 1.6 m^3/s
- Manumukh main canal 2.8 m^3/s
- Rajnagar main canal 2.9 m^3/s

The dry season flow system is shown in schematic form in Figure A.6.

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A.4 BEEL FLUSHING WITH IRRIGATION WATER

A.4.1 Water Distribution System

Significant water quality problems occur in the beels of Kawadighi Haor during the dry season when the water inflow and outflow is much reduced. The upstream *chhora*s carry pesticides which pollute the *beels*. Decomposition of aquatic plants also occurs in the dry season, which contributes to eutrophication, deoxygenation, acidification and increased turbidity. The reduced water quality stresses the fish stocks of the haor. From the field study, it is evident that fish disease (especially EUS) starts when the water begins to drop below *beel* banks. About 40-50% of fish are affected by disease.

In order to control water quality deterioration and provide a better dry season refuge environment for fish stocks, the feasibility of an operating scheme to continuously flush Manu River water through the irrigation canals was investigated. Proposed flushing and drainage systems are shown in Figures A.3 and A.4.

Flushing can be activated through Manumukh main canal and Rajnagar main canal. The status of these canal systems (primary and secondary) are presented in Table A.4.1. For efficient flushing and to minimise water loss, the following irrigation canal and drainage channel system can be considered:

Discharge through Manumukh main canal. The secondary and tertiary canals which can be used are MR_1, MR_1R_2, MR_2L_2, MR_2L_1, MR_4, and MR_6. This irrigation water will fall into the Lash Channel or lands adjacent to Patasingra Beel. Water will be drained into the Kushiyara River through the Lash/Digora Channel-Patasingra Beel-Mogra Channel-Koradair Channel drainage system.

Discharge through Rajnagar main canal. Distributary canals which can be used are RL_2, RL_2L_1, RL_2R_1, RL_4, RL_5 and RL_6L_1. Irrigation canal water will then flow into Digola Channel, Machua channel, and Akali Chhora. This water will be drained into the Kushiyara River through the Digola Channel-Patasingra Beel-Mogra Channel-Koradair Channel drainage system and Machua Channel-Shalkatua Beel-Majherbanda Beel-Akali Chhora-Koradair Channel drainage system.

The inflow of water would be drained through drainage regulators. Total inflow from irrigation canals is 5.70 m^3/sec. One opening of a regulator (1.52 m x 1.83 m) under full flow condition discharges more than 5 m^3/sec during the dry season. This irrigation inflow can be discharged by one vertical gate of a drainage regulator, so the proposed flushing and drainage system will cause no additional storage in the project area.

Table A.4.1: Irrigation Canal Status in MRIP

Name	Discharge (m^3/s)	Length (km)	No. of Turn outs	Crop at Canal End	Harvesting Period	Physical Status	Canal end Distance from *beel* or Channel (m)
Manu	2.81	12				Good	
Rajnagar	2.90	18				Good	
MR_2	0.94	5.73	17	B. *aman*, T. *aman*	Nov. 30	T. *aman* at the canal bed	
MR_2L_1	0.20	1.53	4	B. *aman*, T. *aman*	Nov. 30	Weeds and water hyacinth at canal bed	250
MR_2L_2	0.17	1.14	4	B. *aman*	Nov. 10	Good	400
MR_4	0.29	1.45	6	B. *aman*, T. *aman*	Nov. 30	Good	250
RL_2L_1	0.20	1.45	8	B. *aman*	Nov. 10	Canal banks breached	300
Rl_2	0.67	5.57	21				
RL_4	0.95	6.20	27	B. *aman*	Nov. 10		
RL_5	0.48	3.55	10	B. *aman*, T. Aman	Nov. 30	Breached, and public cut,	500
RL_6L_1	0.21	1.06	5	B. *aman*	Nov. 10	Good	
RL_6	0.53	3.94	15	B. *aman*	Nov. 10	Good	500
MR_6				B. *aman* T. *aman*	Nov. 30	Good	300

A.4.2 Flushing Period

It is evident that fish disease starts when individual waterbodies form during the post-monsoon drainage period. Flushing of irrigation water should be started when banks of the *beels* are submerged by 0.30 m. Some of the irrigation canals are not directly connected with channels or *beels*. Some overland flow will occur during the flushing period. It has been verified in the field that overland flow will occur on 100 to 500 m of land adjacent to these canals. On these lands, either b. *aman* or t. *aman* is cultivated. Since harvesting of t. *aman* will be completed by the end of November, it is recommended to start flushing Manu River water from the first week of December. Flushing of beels with Manu river water may only be possible in the month of December. From January onwards, Manu River water is used for irrigation purposes.

Events during the late monsoon of 1996 and early dry season of 1997 give an indication of the likely benefit that beel flushing might have on fish disease control. Significant rainfall occurred in October 1996 which contributed to reducing turbidity of storage water. Continuous rainfall and drainage through the 6-vent regulator has served the purpose of flushing. In December, no fish disease was observed in beels. Water level at the beginning of December was at 6 m PWD which corresponded to a submerged area of 5,645 ha. The stored volume of water was higher and is likely responsible for the better resistance of fish to disease outbreak. For the above reason flushing activities were not carried out in 1996. Some diseases were observed from the middle of January. At that time, flushing was not possible for irrigation activities, and also the leaseholder refused to allow entry of any additional water into the beels (which interferes with the dewatering of beels to catch fish).

Depending on *haor* water level, fish can begin contracting diseases as early as November. *Aman* is still being cultivated at this time, and it is not possible to begin flushing with Manu River water. This problem can be overcome by connecting the end of the canal to the edge of the *beel* using 0.45 to 0.60 m diameter RCC pipe. Approximately 2,500 m of pipe will be required for the total flushing system. If pipes are used, it will be possible to flush river water at any time during the post-monsoon.

A.4.3 Maintenance Works and Necessary Steps

Some irrigation canal banks are damaged by flood water. There are also public cuts that were done because of waterlogging and to hasten drainage. These banks need to be improved. There are some aquatic weeds in the canal bed and earthen dams which also have to be removed.

To avoid overland flow, turnouts in the main canals and secondary canals will have to be closed by wooden or steel plates. Earthen materials can be used to close turnouts that have small diameters. To raise the water level of the Manu River to pool level (12.03 m PWD), Manu barrage gates need to be closed about ten days before flushing begins.

A.4.4 BWDB Assistance

MRIP is operated and monitored by BWDB, and the Manu barrage is also under the control of BWDB. To flush Manu River water into the Kawadighi Haor, the gates of the Manu barrage have to be closed by the middle of November. Gate operation of the Manu barrage and irrigation structures have to be maintained by BWDB. Assistance from the BWDB field staff who control internal irrigation structures is also essential. Several discussions were held between NERP and

2a

BWDB O&M Division, Moulvibazar. The objective of the discussions were closing of Manu barrage, and assistance in opening and closing canal structures. BWDB had no special objections to carrying out beel flushing as proposed in the above scheme, and agreed to carry out a trial.

A.4.5 Water Quality Test

Before flushing starts, Manu River water quality should be tested to avoid any adverse effects in the *beel* area. During flushing, the water quality of inflow from *chhoras*, *beel* water, and outgoing water through the regulator should be tested to observe the impact of flushing.

A.4.6 Fisheries and Agricultural Considerations

Beel fishing and *boro* cultivation in the project area begin simultaneously during the dry season. Irrigating the *beel* areas before fishing can cause some fish migration, and can decrease the total catch. This is generally desirable from the perspective of protection of the overwintering brood fish which are required to replenish the haor fish stocks during the coming early monsoon breeding season.

Fishing can be marginally more time and labor intensive when the water volume in fishing areas increases. Barrage water supply to *boro* land is delayed in the interest of fishermen and lessees.

Timely, reliable, and regular supply of water are the important factors in HYV *boro* cultivation. Irrigation starting date is fixed in consultation with farmers. Accordingly, farmers prepare seedbeds, raise seedlings, and start transplantation. Delays in irrigation damages seedlings, hampers transplantation, and frustrates farmers.

Timely irrigation is critical to sensitive HYV cultivation practices. HYV *boro* rice is entirely irrigated by water from project canals. According to some farmers, maximising HYV *boro* yields is generally unachievable. Surplus rice growers lose incentive because of low returns. Adoption of improved cultivation and soil management practices, along with timely and adequate irrigation and drainage, are required to improve HYV *boro* yield levels.

In some areas, farmers benefit from the delay in water supply from project canals. According to them, their lands remained waterlogged for a substantial part of the post-monsoon season. Consequently, the soils lose the capacity to bear draft animals, making tillage difficult in winter. The farmers stopped or delayed barrage water supply in their area in order to make the land ready for tillage in *aus* season.

B. Aman and T. Aman are grown at the end sections of the flushing canals. B. Aman is harvested by the 15th of November, while T. Aman is harvested by the end of the November. Therefore farmers require 15 days beyond the harvest dates to prepare their fields for the next *boro* crop. From an agricultural perspective, flushing of the canals should best take place between December 1 and January 15th. Farmers need to be informed of the flushing dates one month ahead of time. Farmers request that all unauthorised cuts in the canals and gates at the head of the canals should be closed before flushing. Farmers request that BWDB staff should be deputed to patrol during the flushing period in order to save prevent damage to seedlings and the seed beds.

A.4.7 Social Activities

Villages located along the proposed flushing canals were identified as follows:

Canal Name	Involved Villages
• MR2	Raipur, Ekatona, Uttar Malain and Mallik Sarail.
• MR2L1	Uluail, Mallik Sarail and Uttar Malain.
• MR2L2	Banasri, Raipur, Ekatona and Uttar Malain.
• MR4	Lalpur, Haripur, Badh Uluail and Sampashi.
• MR6	Kandigaon, Durgapur, Parasimul, Sanandapur, Jagatpur and Paguria.
• RL2L1	Borogaon, Bahadurgonj, Banamali-panchesar, Munsurnagar, Panchesar and Malalpur.
RL2	(As above).
• RL4	Rakta, Modhubazar and Gargaon.
• RL5	Sarampur, Uthaia, Baitakhal, Deuail, Bhoradoba, Khemsahasro, Bhabanipur, Nandiura and Chowdhury Bazar.
• RL6L1	Dhulizuri and Keula.
• RL6	(As above).

Discussions were held with fishermen and leaseholders about the water quality and fish disease in the *haor* in relation to flushing of the canals. The beneficiaries presented the following comments and suggestions for flushing:

- Fish disease is related to stagnant water. Fish disease has increased since the construction of the embankments along the Manu River and the consequent obstruction of the natural drainage system. Fish disease has also increased as a result of the use of pesticides and fertiliser in the thirteen tea gardens upstream of the *haor*. Fish disease is mostly observed in January and February. During this time 40 to 50 percent of fish in the *beels* die from disease.

- Flushing of the haor is essential to improve the water quality. Flushing of the *haor* can be done by flushing water through the secondary and tertiary canals of the MRIP. The suggested time period is between December 1 and January 15. This period will not present problems for either farmers or fishermen. Fishermen and leaseholders request that periodic water quality testing be carried out before and after flushing to assure that the flushing has been adequate.

A.4.8 Conclusions and Recommendations

It is concluded from the study that beel flushing to improve water quality and quantity during the dry season with the objective of reducing the incidence of fish mortality due to stress and disease is feasible.

It is recommended that a beel flushing trial be conducted over a two year period. The impacts of flushing on fish disease, fish catch, fish abundance, fish biodiversity and agricultural production should be monitored, and the results used to decide whether or not to incorporate dry season flushing of Kawadighi haor beels as a routine component of MRIP operations in the future.

Figure A.1

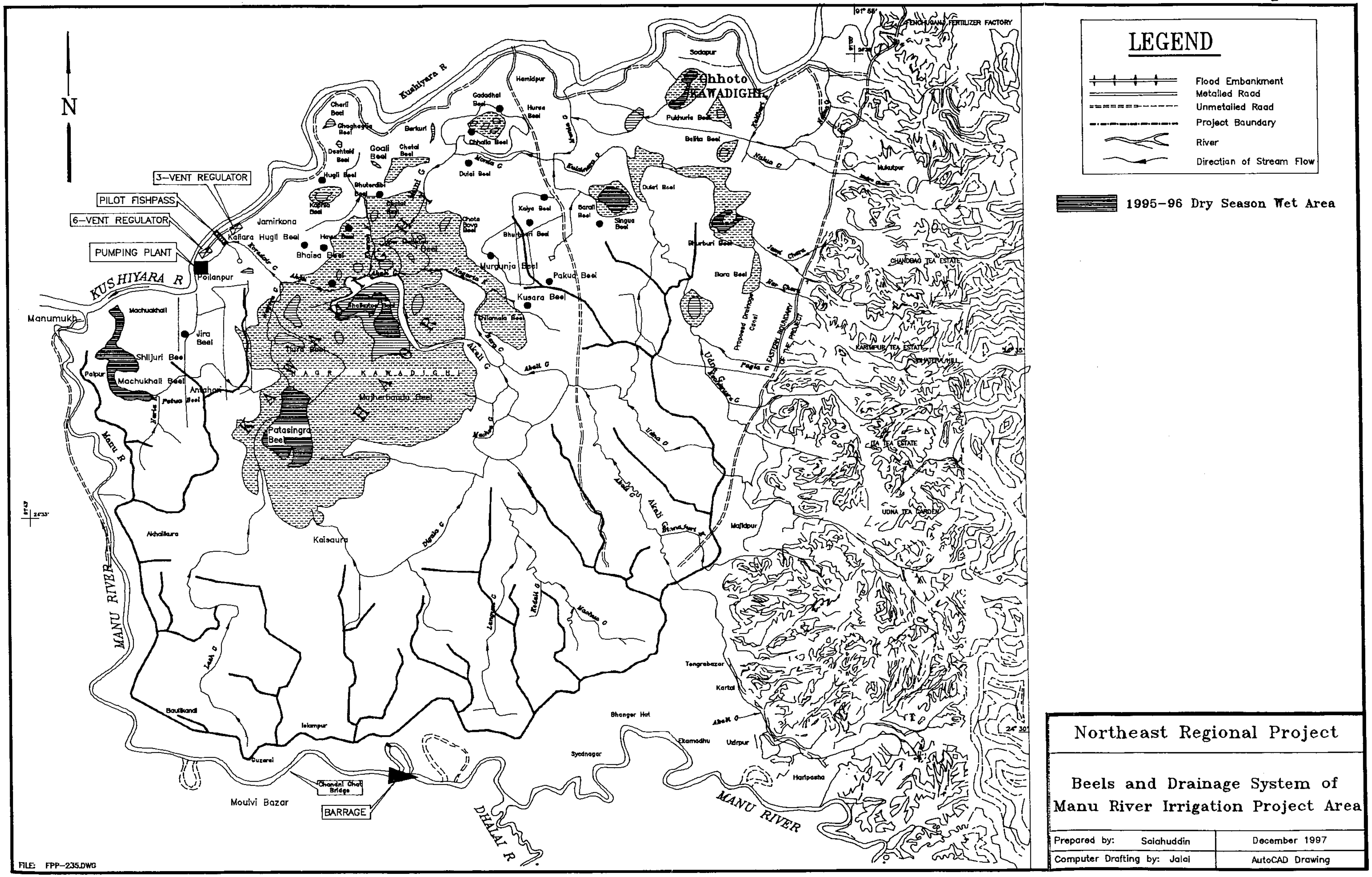
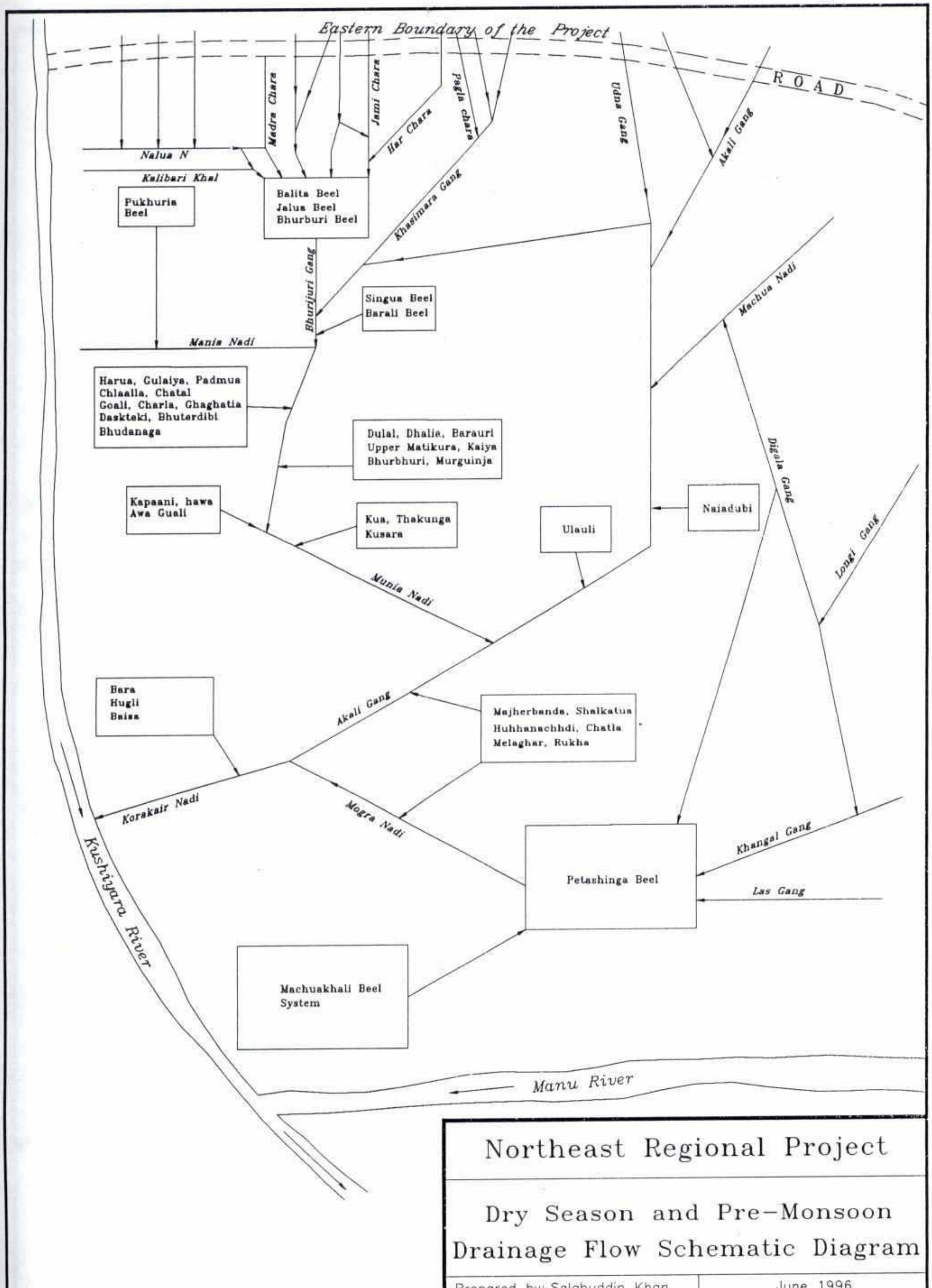

LEGEND
Flood Embankment
Metalled Road
Unmetalled Road
Project Boundary
River
Direction of Stream Flow
1995-96 Dry Season Wet Area
N
KUSHIYARA R
Kushiyara R
3-VENT REGULATOR
PILOT FISHPASS
6-VENT REGULATOR
PUMPING PLANT
Manumukh
Jamirkona
Poilanpur
Chhoto KAWADIGHI
HAOR KAWADIGHI
Patasingra Beel
Machukhali Beel
Shiljuri Beel
Jira Beel
MANU RIVER
Manu R
Moulvi Bazar
BARRAGE
Chandni Ghat Bridge
DHALAI R
Kaisaura
Akhailkura
Baulikandi
Islampur
Cuzarai
Bhanger Hat
Syednagar
Ekamodhu
Udirpur
Haripasha
Tengrabazar
Kartal
Majidpur
Sodapur
Hamidpur
FENCHUGANJ FERTILIZER FACTORY
CHANDBAG TEA ESTATE
KARIMPUR TEA ESTATE
ITA TEA ESTATE
UDNA TEA GARDEN
Proposed Drainage Canal
EASTERN BOUNDARY OF THE PROJECT
Northeast Regional Project
Beels and Drainage System of Manu River Irrigation Project Area
Prepared by: Salahuddin
December 1997
Computer Drafting by: Jalal
AutoCAD Drawing
FILE: FPP-235.DWG

Figure A.2



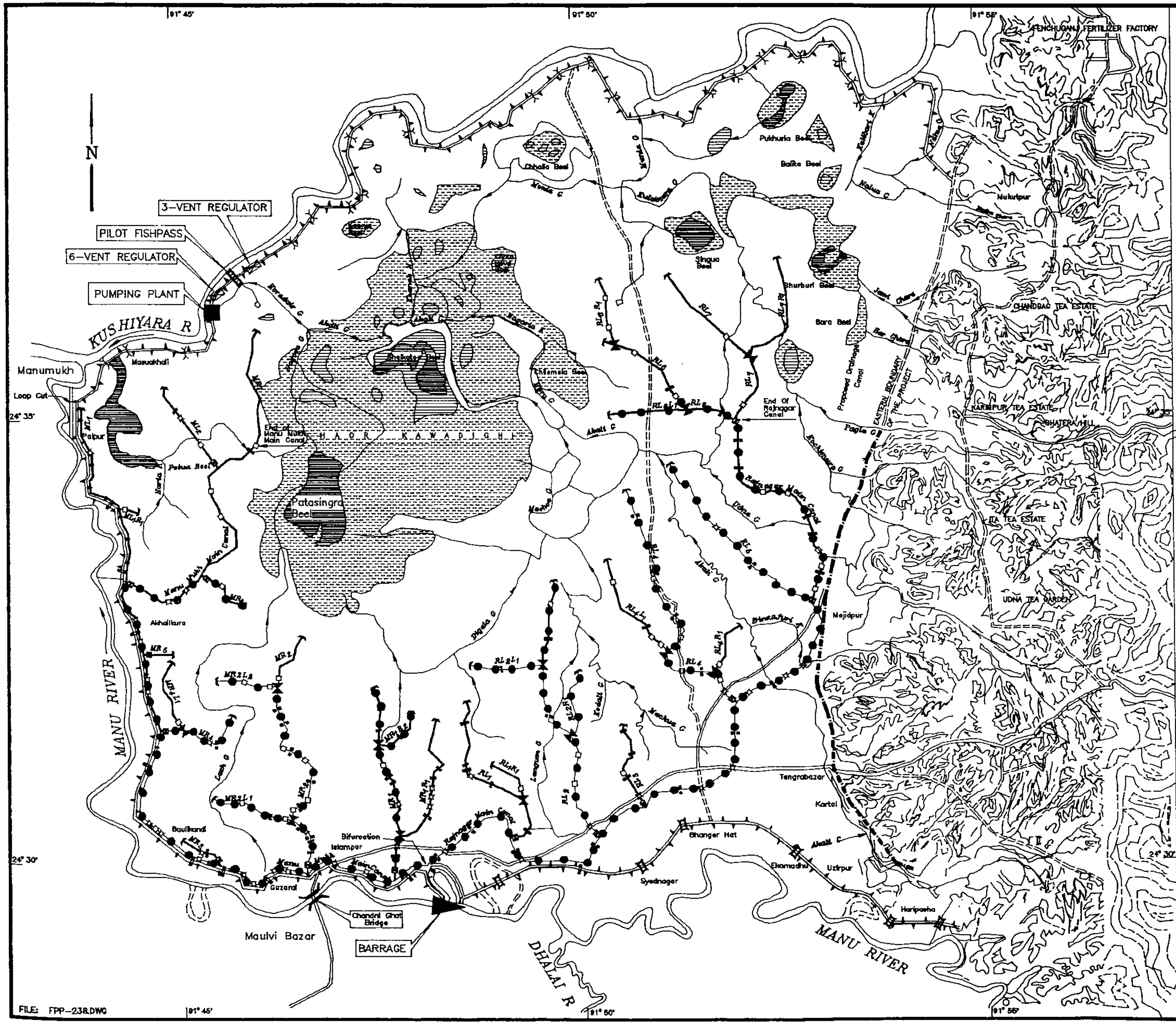
Northeast Regional Project

Dry Season and Pre-Monsoon Drainage Flow Schematic Diagram

Prepared by: Salahuddin Khan	June 1996
Computer Drafting by: Jalal	AutoCAD Drawing

FILE: FPP-237.DWG

Figure A.3



LEGEND

- Flood Embankment
- Metalled Road
- Unmetalled Road
- Project Boundary
- River

- Irrigation Canal
- Embankment Sluice
- Drainage Sluice
- Pumping Plant
- Barrage
- Syphon in Manu Flood Embankment
- Group Regulator
- Syphon
- Foot Bridge
- LLP Inlet Structure
- Box Culvert
- Group check
- Fall-Cum-Check

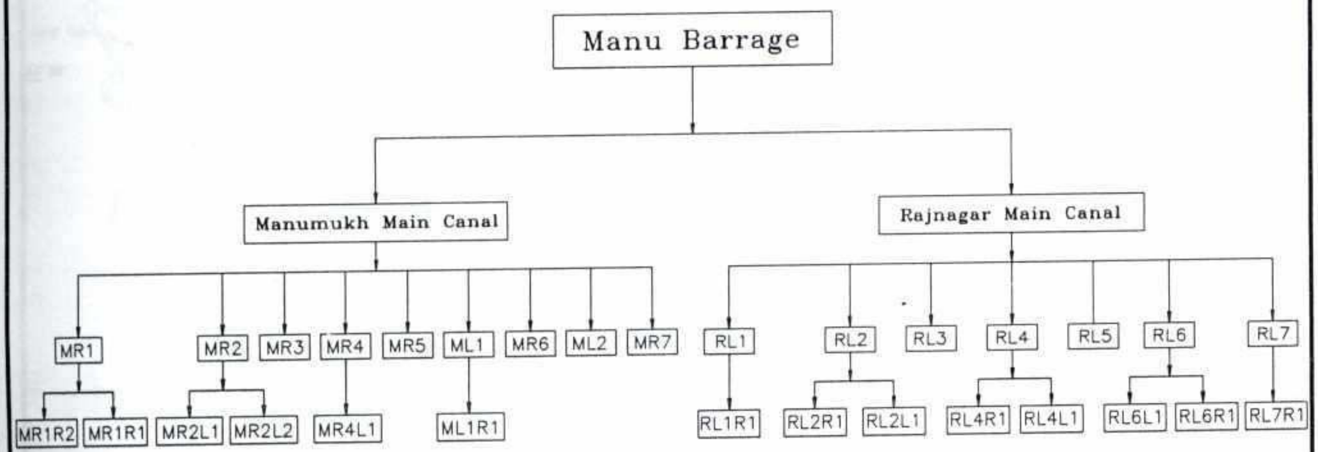
Proposed Flushing System

1995-96 Dry Season Wet Area

Scale 1 0 1 2 km

Northeast Regional Project	
Irrigation System of Manu River Irrigation Project	
Prepared by: Salahuddin	December 1997
Drawn by: Jalal	AutoCAD Drawing

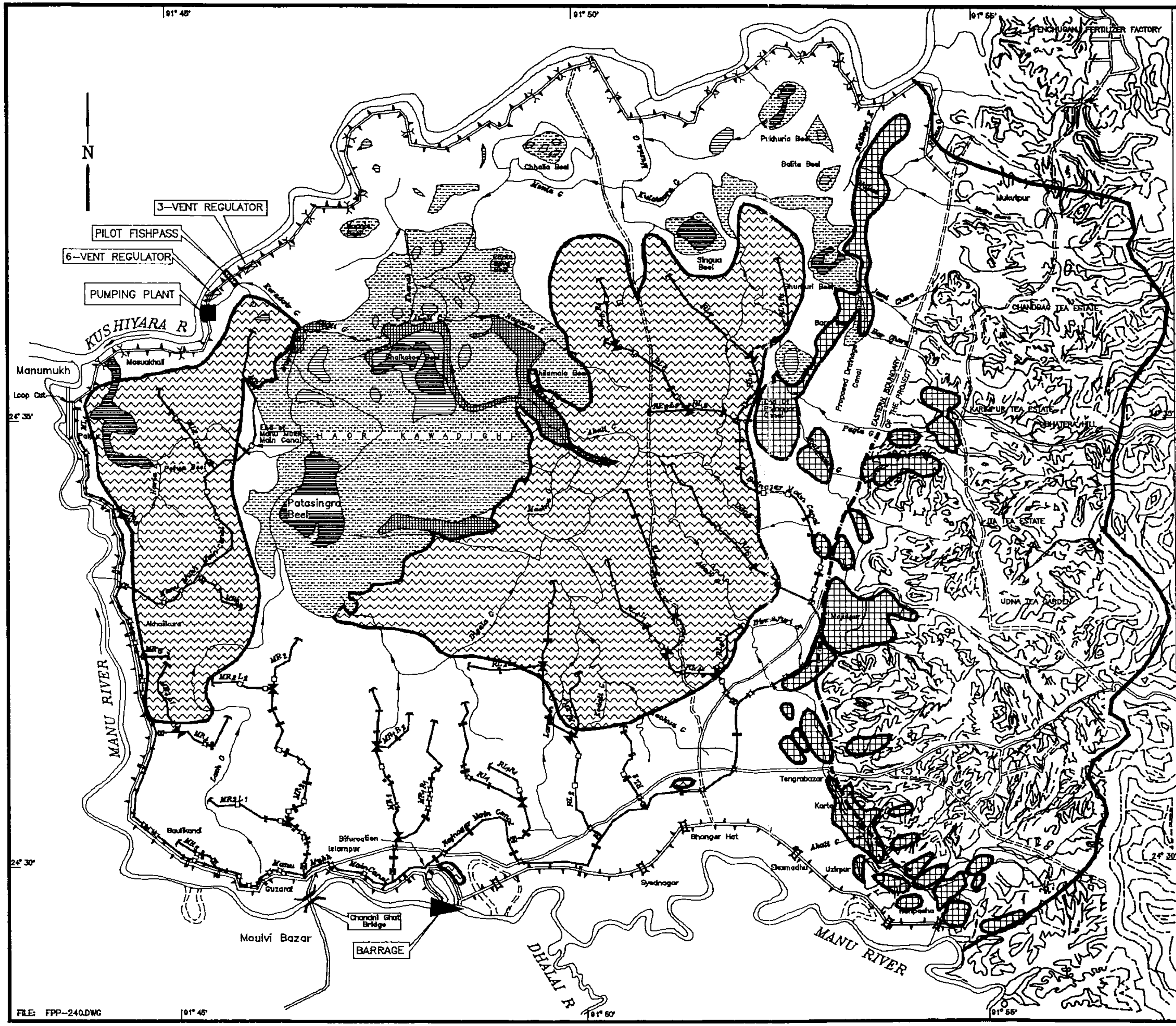
Figure A.4



Northeast Regional Project	
Schematic Flow Diagram of Irrigation System of MRIP	
Prepared by: Salahuddin	December 1997
Computer Drafting by: Jalal	AutoCAD Drawing

FILE: FPP-239.DWG

Figure A.5



LEGEND

	Irrigation Canal
	Flood Embankment
	Metalled Road
	Unmetalled Road
	Project Boundary
	River

	Irrigation Canal
	Embankment Sluice
	Drainage Sluice
	Pumping Plant
	Barrage
	Syphon in Manu Flood Embankment
	Group Regulator
	Syphon
	Foot Bridge
	LLP Inlet Structure
	Box Culvert
	Group check
	Fall-Cum-Check

WATER RESOURCE FOR CROPPING

- Project Irrigation Canals
- Water Resource from Bhattara Hills
- Water Resource from Beel Area
- Kanda (fallow land)
- Beel

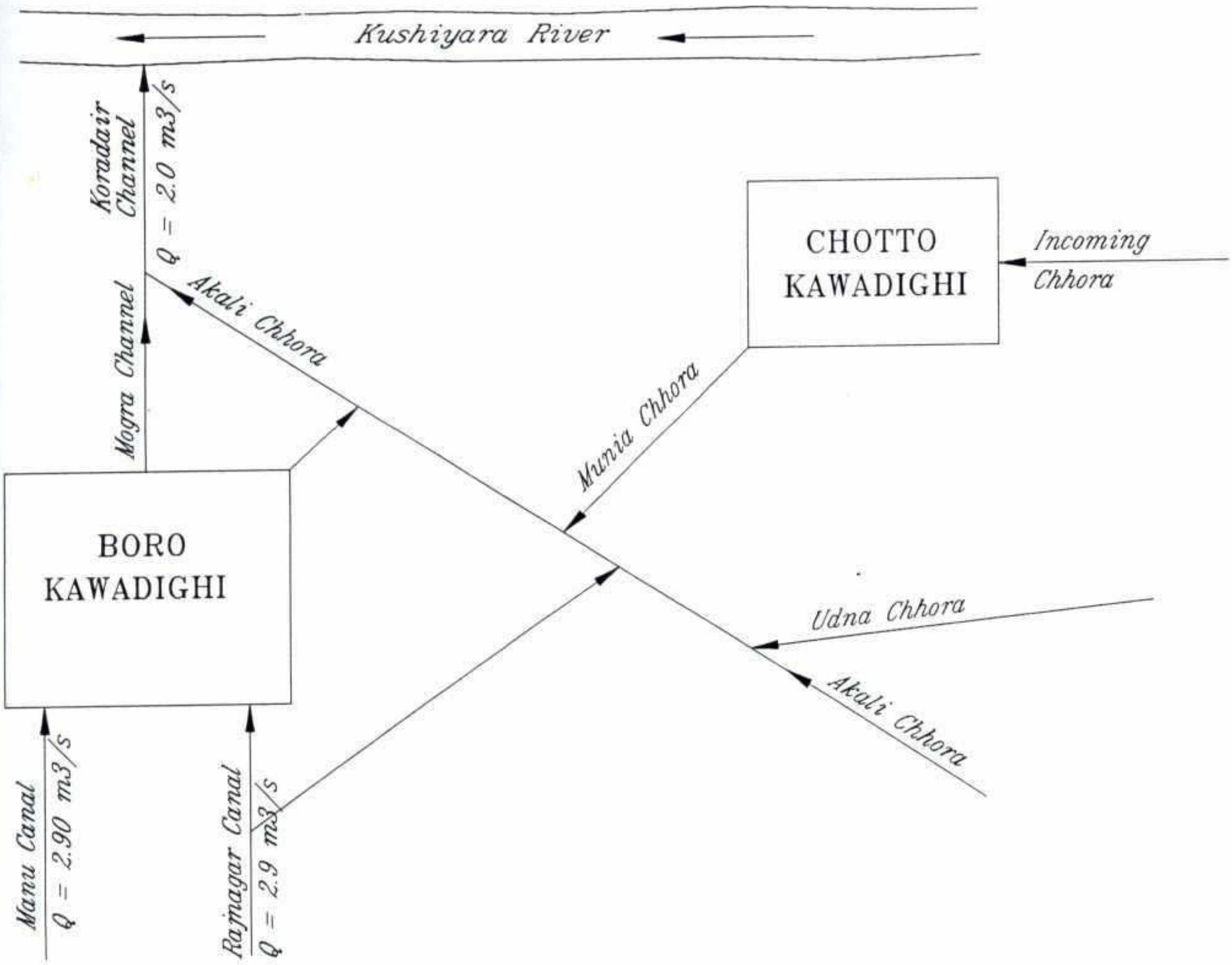
1995-96 Dry Season Wet Area

Scale 1 0 1 2 km

Northeast Regional Project

Manu River Irrigation Project
Cropping Area in
1995-96 Dry Season

Prepared by:	Salahuddin	December 1997
Drawn by:	Jalal	AutoCAD Drawing



Northeast Regional Project	
Schematic Drainage Flow Diagram of MRIP(February'96)	
Prepared by: Salahuddin	December 1997
Computer Drafting by: Jalal	AutoCAD Drawing

FILE: FPP-241.DWG

Appendix B

CONSTRUCTION CONTRACTING DOCUMENTS AND ENGINEERING DRAWINGS

TABLE OF CONTENTS

List of Tendering and Construction Documents

List of Drawings

Canadian International Development Agency
NORTHEAST REGIONAL PROJECT

Gulshan P.O. Box: 6096
House 3A, Road 22, Gulshan, Dhaka
Phone: 882823, 882923, 605539

TENDER NOTICE

CLOSED TENDER No. 1 of 1994-95
FISHPASS TEST PROJECT

CONSTRUCTION OF A SINGLE-JET VERTICAL SLOT RCC FISHPASS STRUCTURE IN MANU RIVER FCDI PROJECT EMBANKMENT AT KASHIMPUR UNDER RAJNAGHAT THANA IN MOULVIBAZAR DISTRICT

1. Sealed tenders are hereby invited from the selected Pre-qualified "A" Class BWDB contractors for construction of one Fishpass Structure at Kashimpur under Rajnaghat Thana of Moulvibazar District in 1994-95

2. Tenders will be received in the Office of

   The Team Leader
   Northeast Regional Water Management Project
   House 3A, Road 22, Gulshan, Dhaka

   in quadruplicate up to 12:00 noon of 15th December 1994. The tenders will be opened on the same day at 13:00 PM in presence of tenderers who wish to be present.

3. Tender documents (including photocopy of preliminary design drawings) may be obtained from the Office of the Northeast Regional Water Management Project, House 3A, Road 22, Gulshan, Dhaka on payment of Tk 1000/- (one thousand) (not refundable) only per set of 5 copies up to 16:30 PM of 14th December 1994.

4. No tender will be sold after 14 December 1994.

5. Tenders must be accompanied by earnest money in the form of Bank Draft from any scheduled bank of Bangladesh valid for 6 (six) months for an amount of Tk 1.74 lac in favor of

   Shawinigan Lavalin (1991) Inc.

6. Tenders must be firm and unconditional. The rate is to be quoted both in figures as well as in words in single percentage above/as per/below the schedule of rates vide the schedule of work enclosed herewith as a whole.

7. Contractors quoting rates of more than 10% above or less than 5% below the Schedule of Rates shall submit detailed analysis of all items of work along with the tender, failing which the tender will be treated as informal.

8. This tender estimate has been prepared on the basis of preliminary design drawings. Hence the bill of quantities may be changed but the quoted rate (% above or below the schedule of rates) will remain binding upon the Contractor.

9. The accepting authority reserves the right to reject any or all the tenders without assigning any reason and he will not be bound to accept either the lowest tender or any of the tenders.

Gulshan P.O. Box : 6096
House 3A, Road 22, Gulshan, Dhaka
Phone : 882823, 882923, 605539

10. The construction of the fishpass structure is a test project. The Northeast Regional Water Management Project is to receive clearance from BWDB for the construction of the fishpass structure. The contract will not be awarded until the Northeast Regional Water Management Project receive BWDB clearance.

Dhaka, 5 December 1994

SLI/NHC JOINT VENTURE

Harry King
Team Leader
Northeast Regional Water Management Project

Copy for information to:

1. The First Secretary (Development), Canadian High Commission, Dhaka.
2. Director, Planning Schemes I, BWDB, Dhaka.
3. The Chief Engineer, Flood Plan Coordination Organization, Dhaka.
4. The Superintending Engineer, Flood Plan Coordination Organization, Dhaka.
5. The Chief Engineer, Northeastern Zone, BWDB, Comilla.
6. The Superintending Engineer, Moulvibazar O&M Circle, BWDB, Moulvibazar.
7. Executive Engineer, Moulvibazar O&M Division I, BWDB, Moulvibazar.
8. Executive Engineer, Habiganj O&M Division, BWDB, Habiganj.
9. The Deputy Commissioner, Moulvibazar.
10. The Chief of Police, Moulvibazar.
11. The Thana Nirbahi Officer, Rajnagar, Moulvibazar.

Canadian International Development Agency
NORTHEAST REGIONAL PROJECT

Gulshan P.O. Box : 6096
House 3A, Road 22, Gulshan, Dhaka
Phone : 882823, 882923, 605539

TENDER OPENING

Date : December 15, 1994

Tender Name : **Closed Tender No. 1 of 1994-95**, Fishpass Test Project

Sealed tenders were received from the Pre-qualified "A" Class BWDB Contractors in the office of the Team Leader, Northeast Regional water Management Project, House 3A, Road 22, Gulshan, Dhaka up to 12:00 noon of the 15th December 1994.

The tenders were opened on the same day at 13:00 PM in presence of the following personnel:

1. H. J. King
   The Team Leader
   Northeast Regional Water Management Project
   15/12/94

2. Mr. Syed Sharafat Hossain
   SE, Design Circle
   NEZ, BWDB, Dhaka
   15/12/94

3. Mr. Muzibul Huq
   The Deputy Team Leader
   Northeast Regional Water Management Project
   15/12/94

4. Mahbub Ali
   Water Resources Planning Engineer
   Northeast Regional Water Management Project

5. Nirmal Kumar Ganguly
   Soil Survey Officer
   DPS-1, BWDB
   Dhaka
   15/12/94

6. Saleh Ahmed
   Assistant Engineer
   DPS-1, BWDB
   Dhaka

7. Md. Salahuddin Khan
   Hydrologist
   Northeast Regional Project
   Salahuddin

8. Md. Monsuruzzaman
   Contractor, BWDB
   Moulvibazar
   15/12/94

Canadian International Development Agency
NORTHEAST REGIONAL PROJECT

Gulshan P.O. Box: 6096
House 3A, Road 22, Gulshan, Dhaka
Phone: 882823, 882923, 605539

TENDER EVALUATION

Name of the Firm	Quoted rate (percent above/below/at par the schedule of rates mentioned in the Tender Document)	Signature
1. Md. Monsuruzzaman College Gate Moulvibazar	At par schedule Earnest Money deposited vide Ch.no. 274031 National Bank, Moulvibazar, dt. 14-12-94	15/12/94
2. M/S Rahman Enterprise Shaistanagar R/A Habiganj	Above 9.79 (above nine point seventy nine) Earnest Money deposited vide Ch.no. 1440180/153/94 Pubali Bank, Habiganj Branch dt. 15-12-94	

H. J. King
The Team Leader
Northeast Regional Water Management Plan — 15/12/94

Witness

1. Mr. Syed Sharafat Hossain
SE, Design Circle
NEZ, BWDB, Dhaka — 15/12/94

2. Mr. Mujibul Huq
Deputy Team Leader
Northeast Regional Water Management Project — 15/12/94

3. Mr. Nirmal Kumar Ganguly
Soil Survey Officer
DPS-1, BWDB
Dhaka — 15/12/94

4. Mr. Saleh Ahmed
Assistant Engineer
DPS-1, BWDB
Dhaka

Canadian International Development Agency
NORTHEAST REGIONAL PROJECT

Gulshan P.O. Box : 6096
House 3A, Road 22, Gulshan, Dhaka
Phone : 882823, 882923, 605539

20 December 1994

File : FPP

Mr. M. Azhar Ali
Director,
Planning Schemes-1
BWDB, Dhaka

Subject : Work **Order for the construction of FISHPASS TEST PROJECT.**

Dear Sir,

Enclosed is a draft Work Order for the construction of a Vertical Slot RCC Fishpass Structure in Manu River FCDI Project embankment at Kashimpur under Rajnagar Thana in Moulvibazar District. The cost of the single vent structure is Tk. 69.69 (Sixty nine point six nine) lakh.

As the construction schedule is extremely tight to complete the structure by 31 March 1995, we kindly request that we receive BWDB clearance to issue the Work Order as soon as possible.

With Regards,

SLI/NHC JOINT VENTURE

Harry King
Team Leader,
Northeast Regional Water Management Project

Enclosure :

1. Work Order

cc. Mr. M. H. Siddiqi, Chief Engineer, FPCO, Dhaka

Document B.5

→ File 208

OFFICE OF THE DIRECTOR
PLANNING SCHEMES-I
WATER DEVELOPMENT BOARD
SWANTEX COURT BHABAN, 4TH FLOOR
9/I, MOTIJHEEL C/A, DHAKA -1000

PHONE: OFF: 230976
253028

Memo No. 30 Dated:- January 05, 1995.

To
The Team Leader,
North-East Regional Study (FAP-6)
House No.3A, Road No. 22,
Gulshan, Dhaka.

Sub:- Construction of Fish Pass Structure at Kashimpur under Manu River Project.

Ref:- Your memo dated November 22, 1994.

Dear Sir,

This is to inform you that Board has kindly agreed to accord permission to your proposed construction of the Test Fish Pass Structure subject to the conditions that consultant will be fully responsible for design and implementation of the structure and that the design of the structure may be vetted by the concerned Design Directorate of BWDB.

Thanking you.

(M. AZHAR ALI)
Director
Planning Schemes-I, BWDB,
Dhaka.

Memo No. 30/1 (5) Dated:- January 05, 1995.

Copy for favour of information to :-

1. Member, Planning, BWDB, Dhaka.
2. Chief Engineer, Planning, BWDB, Dhaka.
3. Chief Engineer, North-Eastern Zone, BWDB, Comilla.
4. Superintending Engineer, Moulvi Bazar O&M Circle, BWDB, Moulvi Bazar.
5. Chief Staff Officer to the Chairman, BWDB, Dhaka.

(M. AZHAR ALI)
Director
Planning Schemes-I, BWDB,
Dhaka.

*BELAYET/=

Canadian International Development Agency
NORTHEAST REGIONAL PROJECT

Gulshan P.O. Box : 6096
House 3A, Road 22, Gulshan, Dhaka
Phone : 882823, 882923, 605539

11 January 1995

File: 902

Mr. Md. Monsuruzzaman
College Gate
Moulvibazar
Reg. No. A-393/WDB/93-94

Subject: Detailed Work Order for construction of a Single-jet Vertical Slot RCC Fishpass Structure in Manu River FCDI Project embankment at Kashimpur under Rajnaghat Thana in Moulvibazar District under CIDA financed Northeast Regional Management Project during 1994-95.

Ref: - This Office Tender No. 1 of 1994-95, Fishpass Test Project, dated 6 December 1994.

- Your Tender dated 15 December 1994.

Dear Sir:

Attached please find the Detailed Work Order with the Schedule of Works for the above work amounting to Tk 70,43,624/- (Taka seventy lac forty three thousand and six hundred twenty four) only.

You are requested to start the work by 15 January 1995.

Yours sincerely,

SLI/NHC Joint Venture

Harry J. King
Team Leader, Northeast Regional Project

Copy for information to:
1. The First Secretary (Development), Canadian High Commission, Dhaka.
2. The Chief Engineer, FPCO, Dhaka.
3. The Director, Planning Schemes-1, BWDB, Dhaka.

June 11, 1995

Team Leader
SLI/NHC Joint Venture
Northeast Regional Water Management Project
Dhaka

Subject: **Completion Report of the Single-Jet Vertical Slot RCC Fishpass Structure in Manu River FCDI Project Embankment at Kashimpur under Rajnaghar thana in Moulvibazar District**

Dear Sir,

Please find herewith the completion Report of the above mentioned structure for favour of your kind disposal. The structure has been completed in all respects. The date of completion is 10-6-95.

Thanking you,

Yours faithfully,

~~Syed Sharafat~~ Hossain
Fishpass Construction Supervisory Engineer
Northeast Regional Water Management Project
Fishpass Test Project
SLI/NHC Joint Venture, Dhaka

Encl: Completion Report

cc:
1. Henryk Werszko
   Monitor, Fishpass Test Project

2. Md. Monsuruzzaman
   Tilabari, Moulvibazar

COMPLETION REPORT

Structure No.	:	A Single-Jet vertical slot R.C.C Fishpass Test Structure
Location of Structure	:	In Manu River FCDI Project Embankment At Kashimpur under Rajnaghar thana in Moulvibazar District
Name of Contractor	:	Md. Monsuruzzaman
Date of Commencement	:	15-1-95
Contract Amount	:	Tk. 76,93,661.27
Scheduled Date of Completion	:	31-3-95
Actual Date of Completion	:	10-6-95

Comments

In accordance with the condition of contract, technical specification and approved drawing, the contractor has completed the project satisfactorily.

The contractor shall maintain the structure for a period of 1 (one) year from the date of completion i.e. till 10-6-96.

Syed Sharafat Hossain
Fishpass Construction Supervisory Engineer
Northeast Regional Water Management Project (FAP-6)

Bangladesh Water Development Board
Canadian International Development Agency
SLI/NHC Joint Venture
Dhaka

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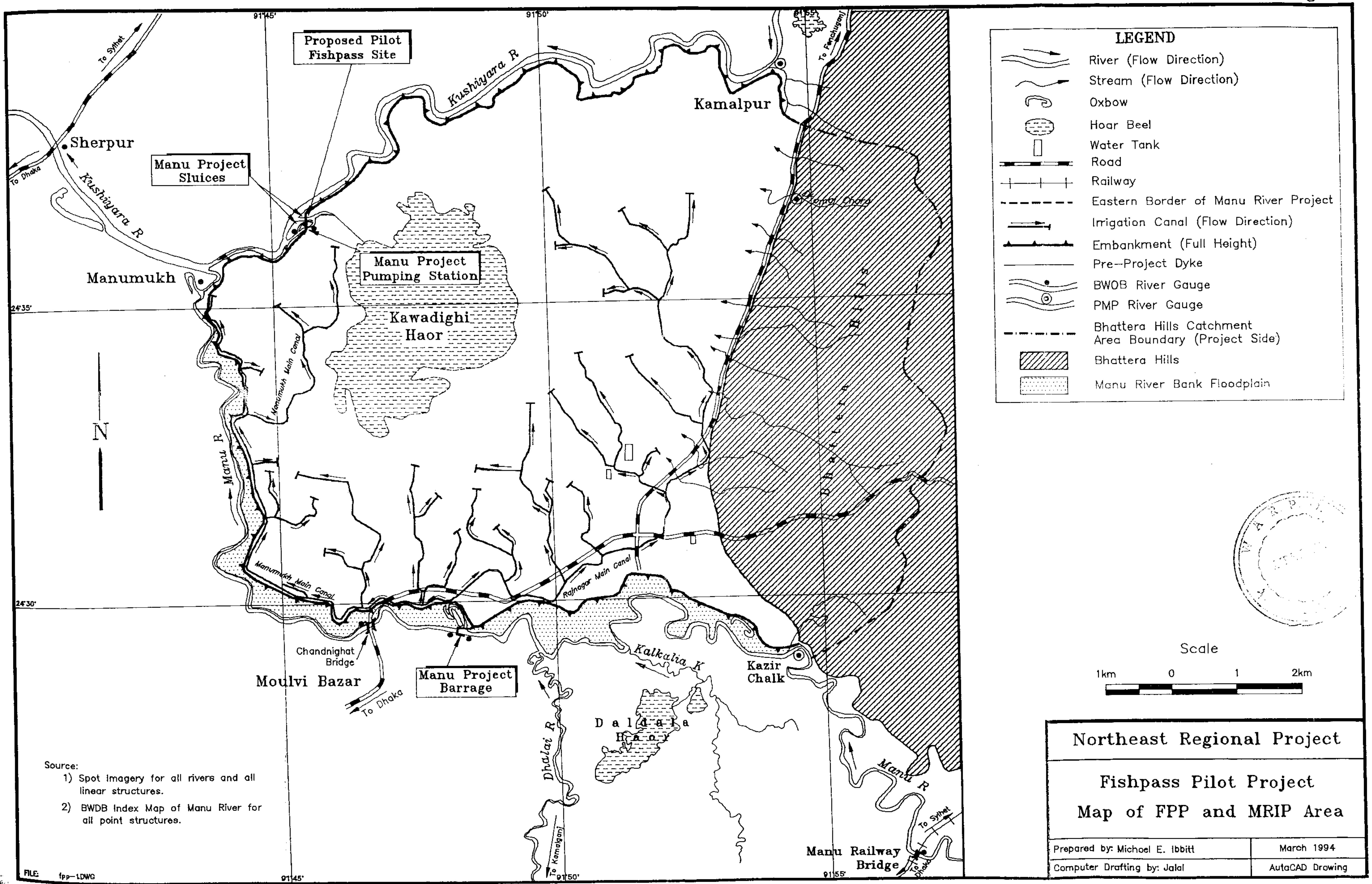
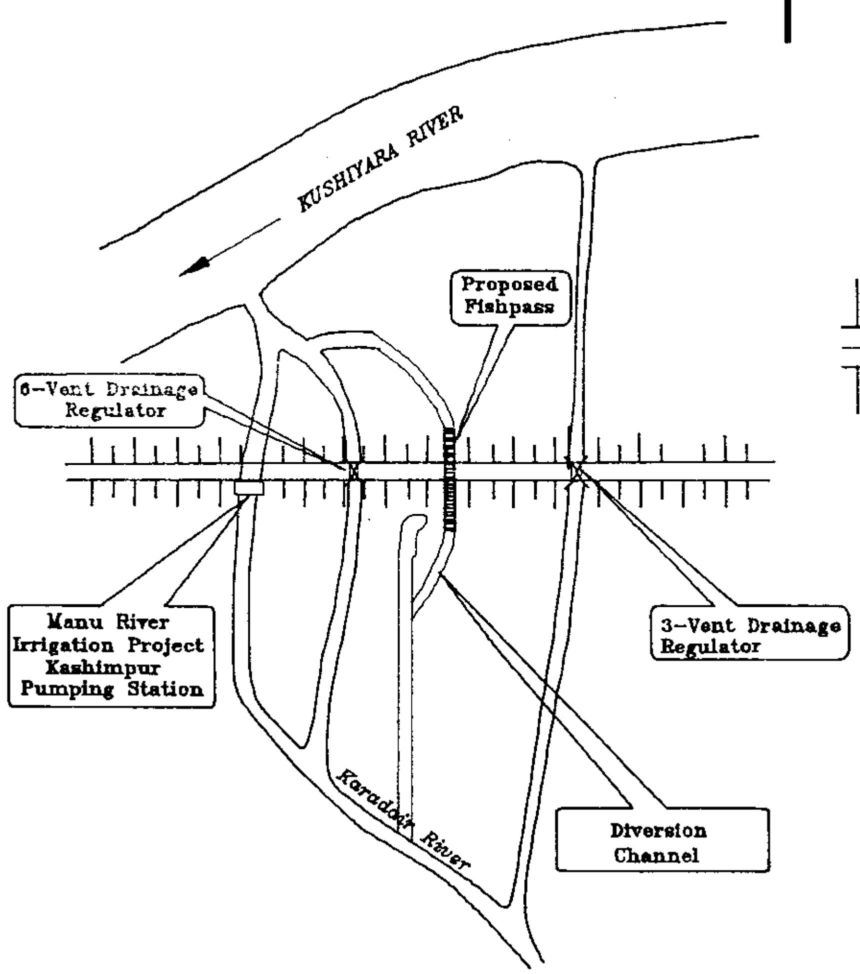
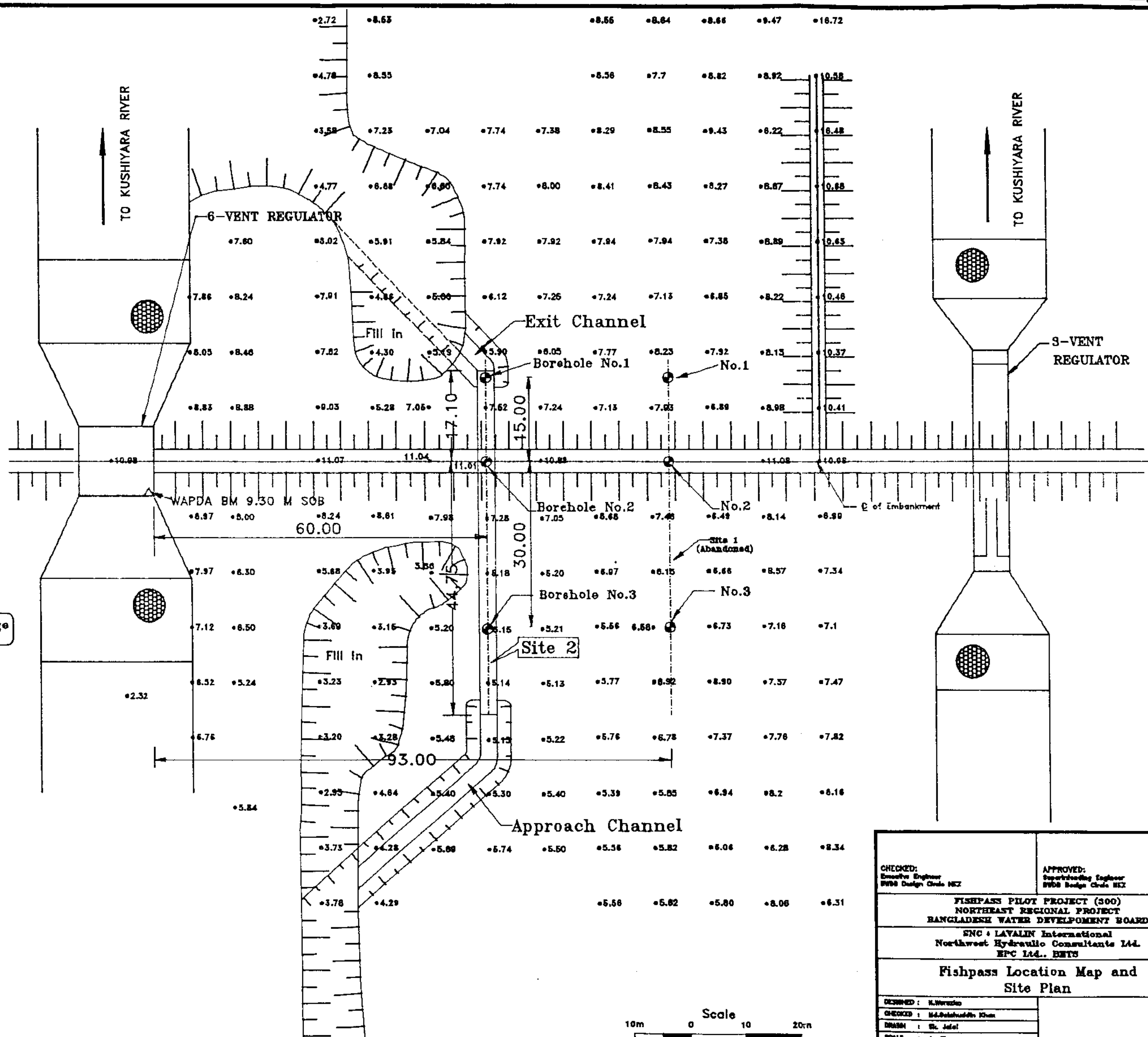
Drawing B.1



Drawing B.2



Location Map
Not to Scale



Site plan

Note :
Elevations are in m(PWD)

CHECKED:
Executive Engineer
BWDB Design Circle NEZ

APPROVED:
Superintending Engineer
BWDB Design Circle NEZ

FISHPASS PILOT PROJECT (300)
NORTHEAST REGIONAL PROJECT
BANGLADESH WATER DEVELPOMENT BOARD

SNC + LAVALIN International
Northwest Hydraulic Consultants Ltd.
EPC Ltd., BETS

Fishpass Location Map and Site Plan

SCALE : As Shown

TEAM LEADER
NERP

Dwg. No.: NERP/FPP-01/1/8

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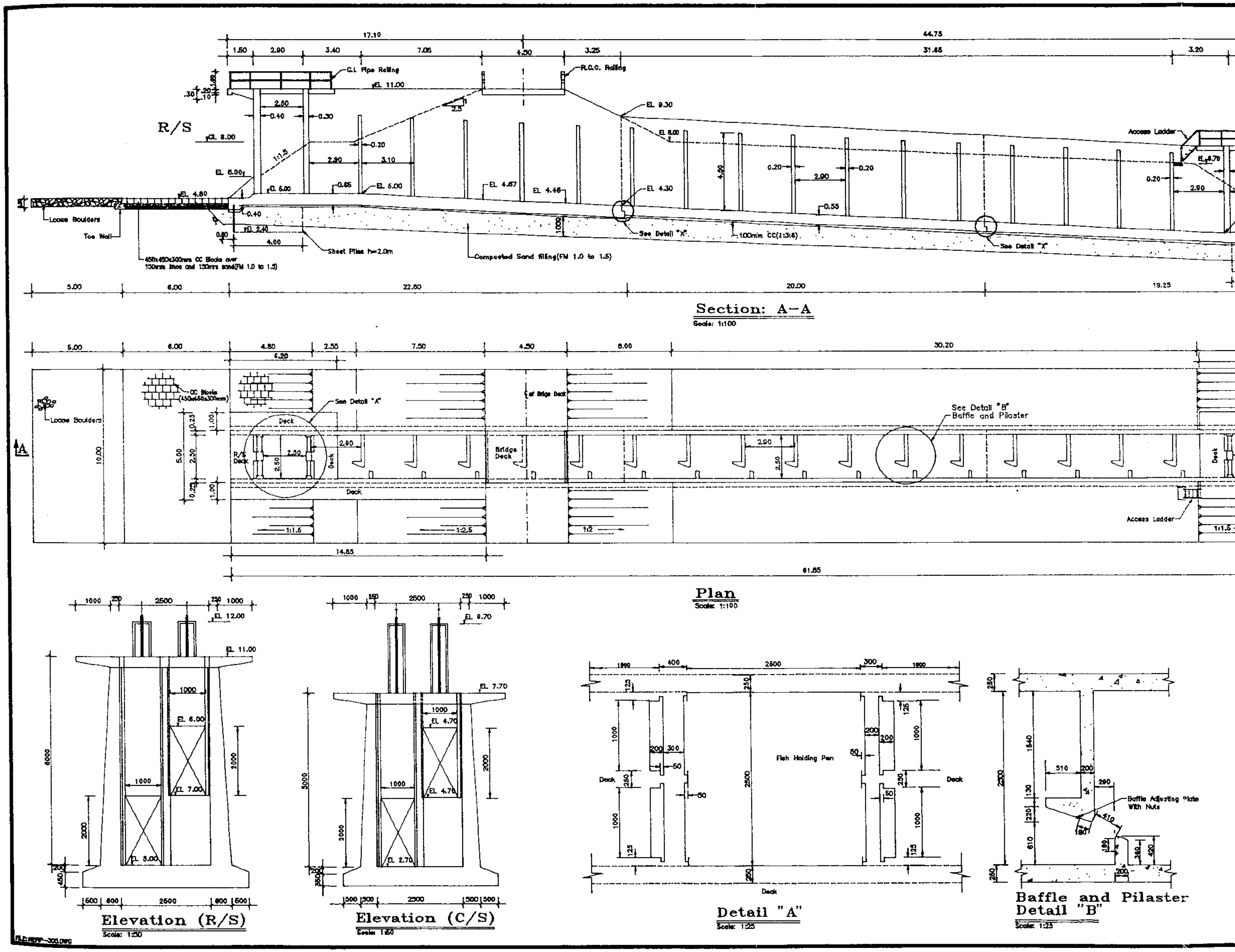
Drawing B.3



CHECKED:
Executive Engineer
BWDB Design Circle NEZ

APPROVED:
Superintending Engineer
BWDB Design Circle NEZ

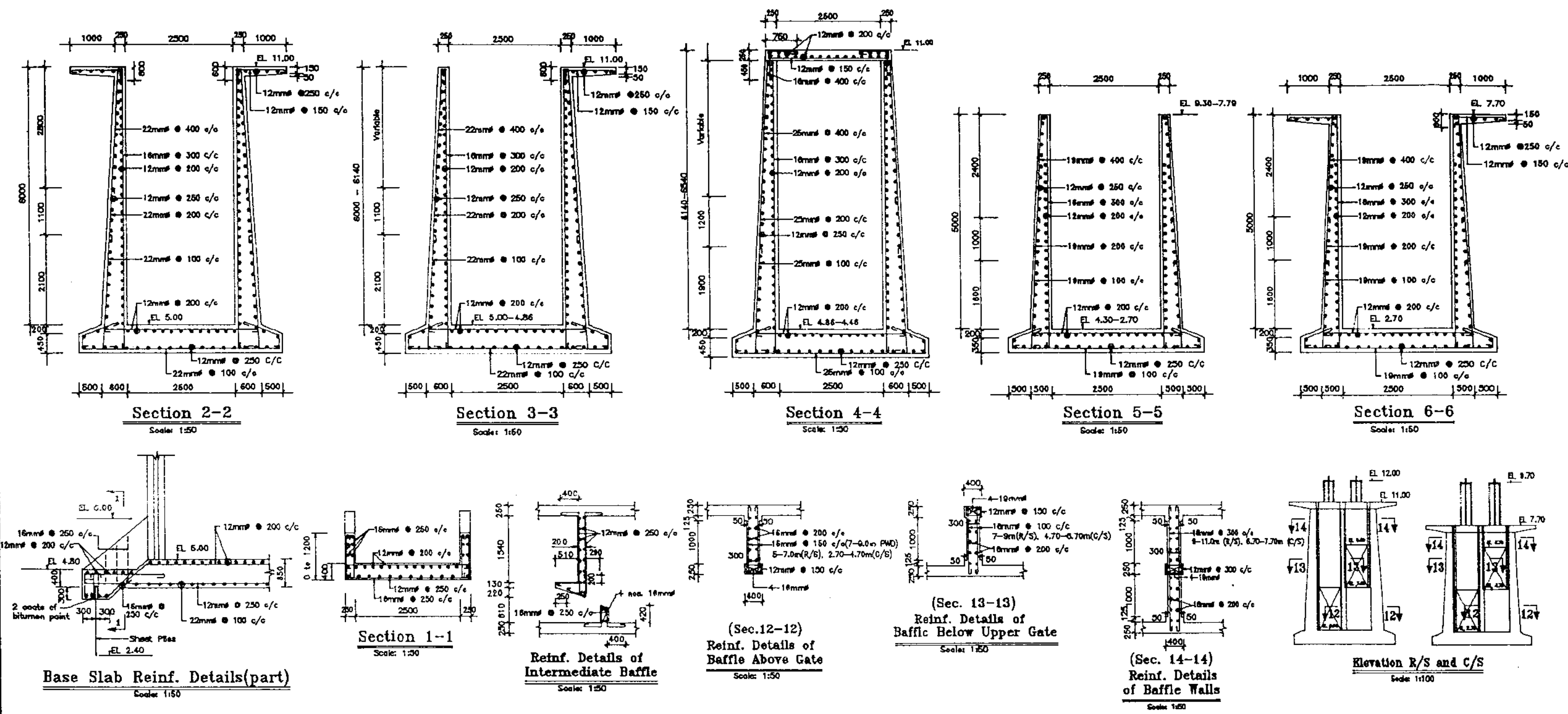
FISHPASS PILOT PROJECT (300)
NORTHEAST REGIONAL PROJECT
BANGLADESH WATER DEVELPOMENT BOARD

SNC • LAVALIN International
Northwest Hydraulic Consultants Ltd.
EPC Ltd., BETS

Plan and Section

DESIGNED	: N.Menzies
CHECKED	: S.M.A. Hossain
DRAWN	: Sk. Jalal
SCALE	: As Shown
DATE	: January 1996
Dwg. No.	: NERP/FPP-01/E/0

TEAM LEADER
NERP

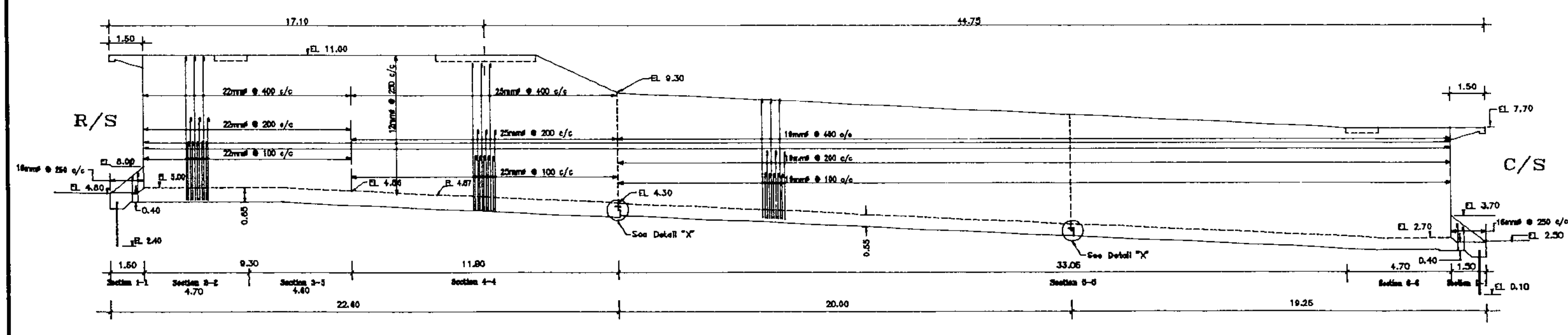


TECHNICAL SPECIFICATIONS:

1. Elevations shown in the drawings are meters (PWD datum): dimensions are in meters and millimeters.
2. Concrete shall develop a crushing strength (cylindrical strength) of 18N/mm² or more at 28 days and shall be checked by collecting samples and testing during construction.
3. Concrete mixture shall be poured as quick as possible but not later than 45 minutes of mixing.
4. Water cement ratio for concrete mix shall be 0.45 by weight and the following slump value shall be obtained.
   Foundation concrete : 50mm
   Superstructure concrete ; 60mm
5. Reinforcing bars shall be mild steel round, hot rolled and free from rust, mill scale, grease and oily materials and shall have a minimum yield strength of 248N/mm .
6. Unless otherwise shown, the minimum length of lap for splicing parallel bars with hooks shall be as given below. When reinforcing bars of different sizes are lapped, lap length shall be governed by smaller diameter bars.

BAR NUMBER(mm)	L (mm)	BAR NUMBER(mm)	L (mm)
3 (10)	356	6 (19)	686
4 (12)	457	7 (22)	800
5 (16)	572	8 (25)	914

   Where "L" is the length of lapped splice in millimetres.
7. All reinforcing bars shall be anchored at the end with the standard hooks.
8. The clear concrete cover to reinforcement shall be as follows :
   Operating deck slab 25mm
   Railing & post 25mm
   Abutment, Wingwalls, Returnwalls etc...., 50mm
   Foundation slab 60mm
9. Splicing of rebars shall be staggered.
10. Unless otherwise specified, back filling shall be done with locally available sandy soil free from vegetable root and organic matter. Backfilling for U shaped walls shall be done simultaneously on both walls.
11. Cement concrete blocks (mortar proportion 1:3:6) shall be made with shingles. Curing of blocks shall be done properly for at least 14 days before placing.
12. The surface of construction joints shall be washed thoroughly with water jetting and shall have a clean, rough and dry surface prior to placement of adjoining concrete.
13. Adequate and proper dewatering measure has to be taken so that ground water level is below the lowest excavated level. The level has to be maintained during construction of foundation. Observation wells should be installed to monitor the lowering of subsoil water table.
14. Embankment slope and berms shall be turfed immediately after construction to eliminate the possibility of erosion.
15. The PVC waterstop shall be of approved quality having 3 bulbs and tensile strength of 13.80N/mm at 225% elongation and shall be placed as shown on the drawing.



Elevation Showing Wall Reinforcement (Earth Face)
Scale: 1:100

CHECKED: Executive Engineer BWDB Design Circle NEZ	APPROVED: Superintending Engineer BWDB Design Circle NEZ

FISHPASS PILOT PROJECT (800)
NORTHEAST REGIONAL PROJECT
BANGLADESH WATER DEVELPOMENT BOARD

SNC • LAVALIN International
Northwest Hydraulic Consultants Ltd.
EPC Ltd., BETS

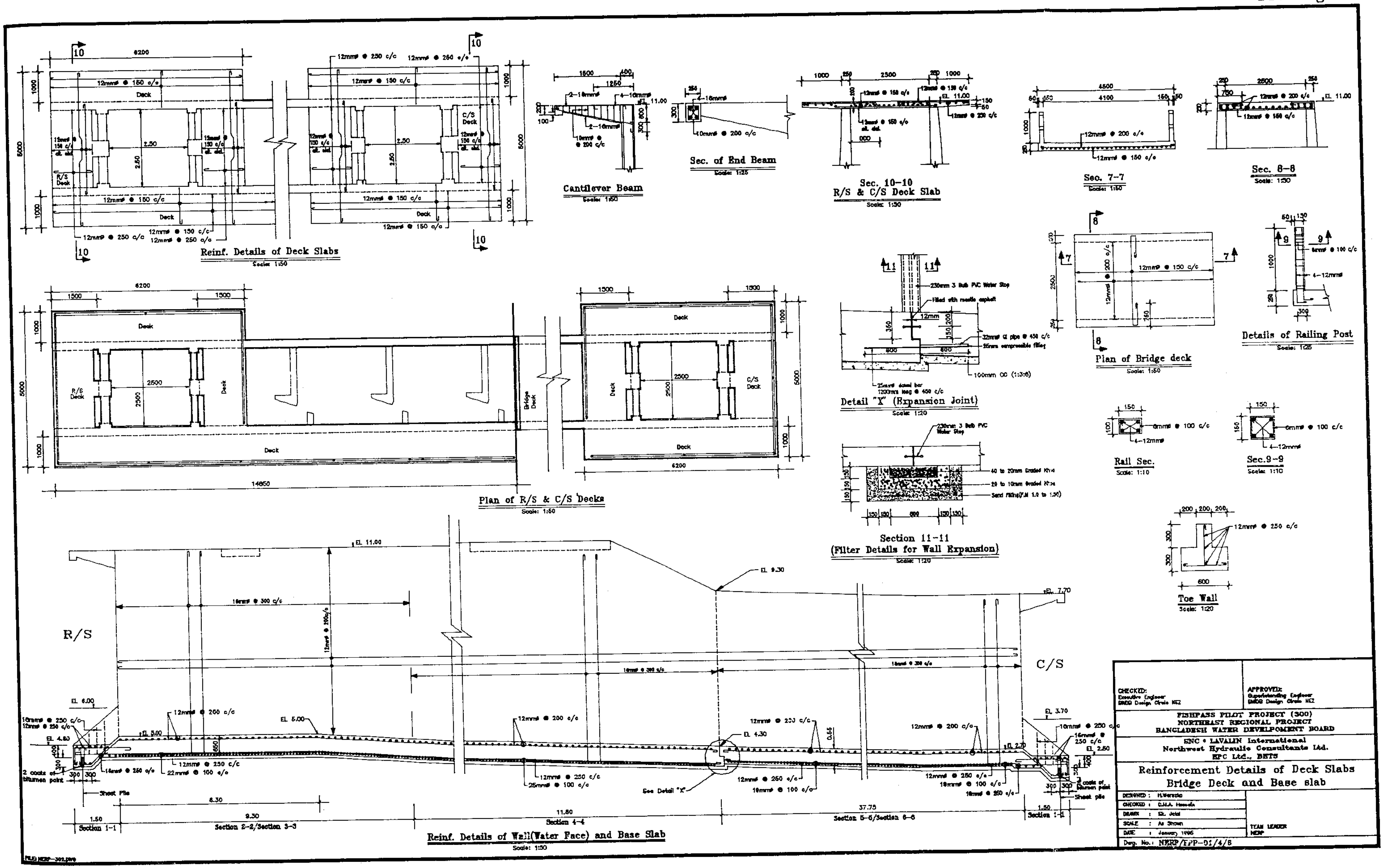
Reinforcement Details of Walls, Baffles and Base Slab

DESIGNED : N.Weresko	TEAM LEADER NERP
CHECKED : C.M.A. Hossain	
DRAWN : Sk. Jalal	
SCALE : As Shown	
DATE : January 1995	

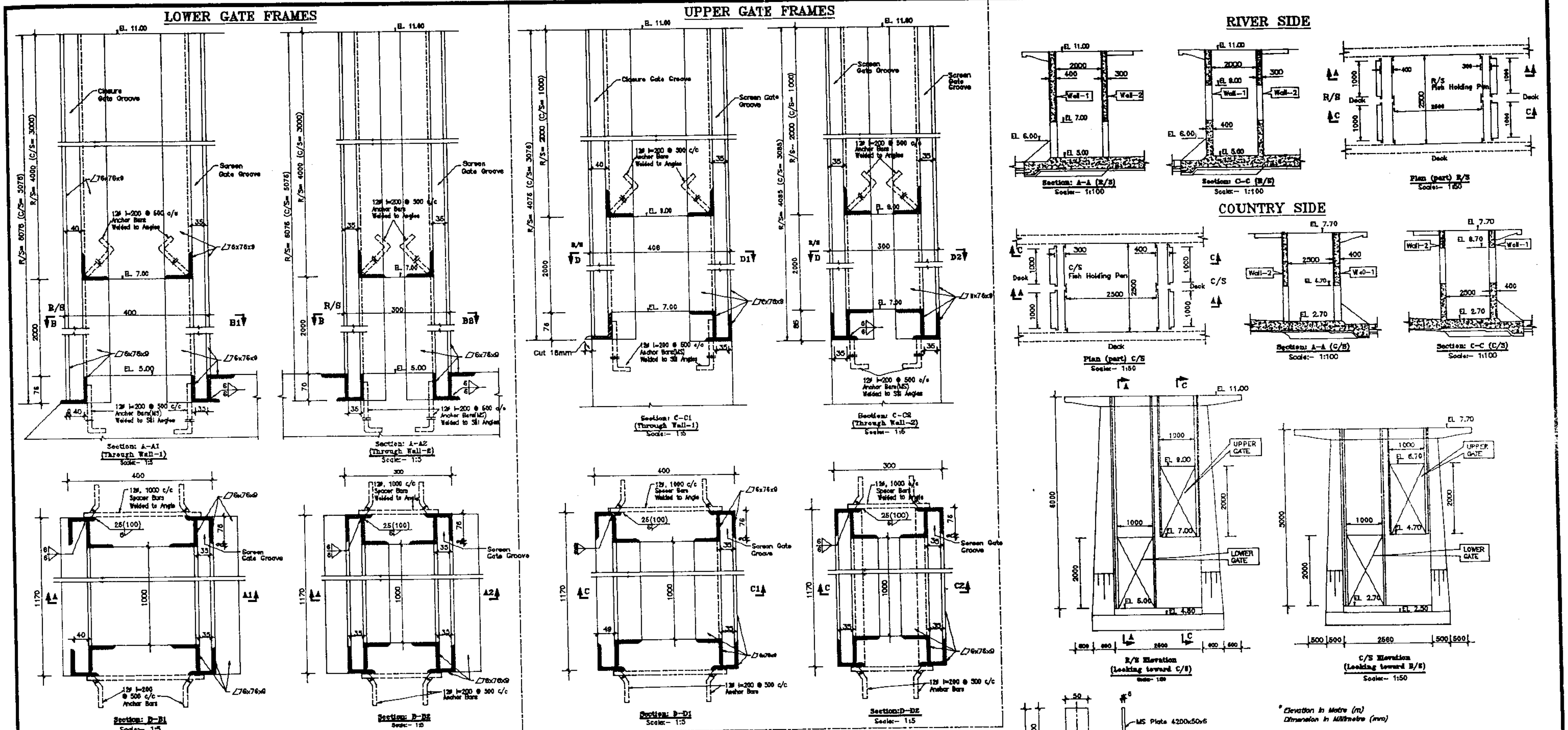
Dwg. No.: NERP/FPP-01/3/8

FILE: NERP-30L.DWG

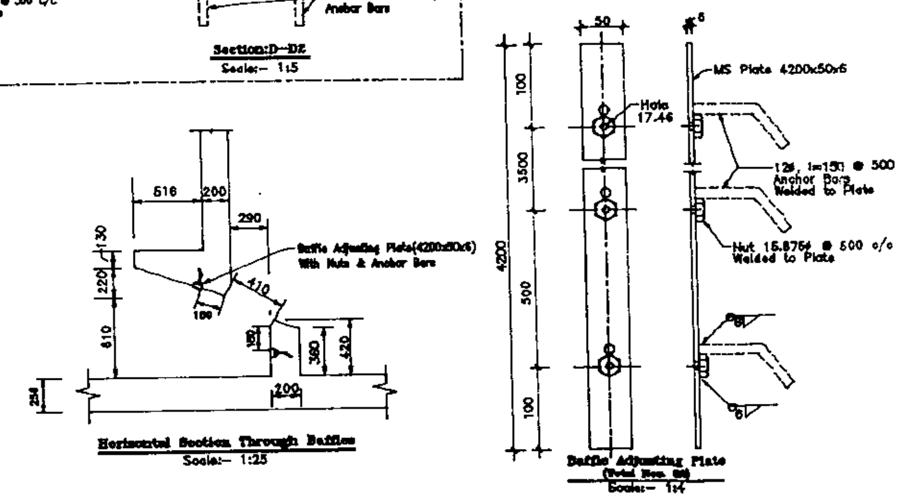
Drawing B.5


Reinf. Details of Deck Slabs
Scale: 1:50
Cantilever Beam
Scale: 1:50
Sec. of End Beam
Scale: 1:25
Sec. 10-10
R/S & C/S Deck Slab
Scale: 1:50
Sec. 7-7
Scale: 1:50
Sec. 8-8
Scale: 1:50
Plan of R/S & C/S Decks
Scale: 1:50
Detail "X" (Expansion Joint)
Scale: 1:20
Plan of Bridge deck
Scale: 1:50
Details of Railing Post
Scale: 1:25
Rail Sec.
Scale: 1:10
Sec. 9-9
Scale: 1:10
Section 11-11
(Filter Details for Wall Expansion)
Scale: 1:20
Toe Wall
Scale: 1:20
R/S
C/S
Reinf. Details of Wall(Water Face) and Base Slab
Scale: 1:50
CHECKED:
Executive Engineer
BWDB Design Circle NEZ
APPROVED:
Superintending Engineer
BWDB Design Circle NEZ
FISHPASS PILOT PROJECT (300)
NORTHEAST REGIONAL PROJECT
BANGLADESH WATER DEVELPOMENT BOARD
SNC • LAVALIN International
Northwest Hydraulic Consultants Ltd.
EPC Ltd., BETS
Reinforcement Details of Deck Slabs
Bridge Deck and Base slab
DESIGNED : H.Werszko
CHECKED : C.M.A. Hossain
DRAWN : Sk. Jelal
SCALE : As Shown
DATE : January 1996
TEAM LEADER
NERP
Dwg. No.: NERP/FPP-01/4/8

Drawing B.6



* Elevation in Metre (m)
Dimension in Millimetre (mm)



NOTES ON WELDING

A. All welding shall be performed by certified welders and in accordence with American Welding Society (AWS) Structural Welding Code.

B. All welding electrodes shall be thoroughly dry when used. Wet or dry coated electrodes shall not be used. Electrodes taken from sealed containers shall be used within four(4) hours.

C. Manual welding shall meet the following requirements for workmanship and visual quality:

i. Members to be welded shall be cut and sized accurately. The surfaces to be welded shall be free from rust grease, paint and other foreign materials.

ii. Each weld shall be smooth, free of slag, cracks pinholes and undercuts and shall be uniform in width & size through out its length.

iii. Fillet weld shall be of specified size with full throat thickness and uniform length.

iv. Repair, chipping or grinding of welds shall be done in such a manner as not to gouge, groove or reduce the base metal thickness.

v. Care must be taken to avoid any strains and internal stresses arising in welding.

D. Flowing Welding Symbols are used: For similar joint,welding symbols are not repeated.

Fillet Weld, one side
Fillet Weld, both side
Fillet Weld, all Around
Fillet Weld, intermittent L (P) L= Length of Weld
P= Pitch Length

NOTES ON PAINT

1. Do not paint embedded parts that will be bonded with concrete.
2. The exposed faces of angles to be painted with 1 coat of epicote paint over 1 coat of epicote primer after cleaning by sand blasting or pickling in muriatic acid solution

CHECKED: Executive Engineer BWDB Design Circle NEZ	APPROVED: Superintending Engineer BWDB Design Circle NEZ

FISHPASS PILOT PROJECT (300)
NORTHEAST REGIONAL PROJECT
BANGLADESH WATER DEVELPOMENT BOARD

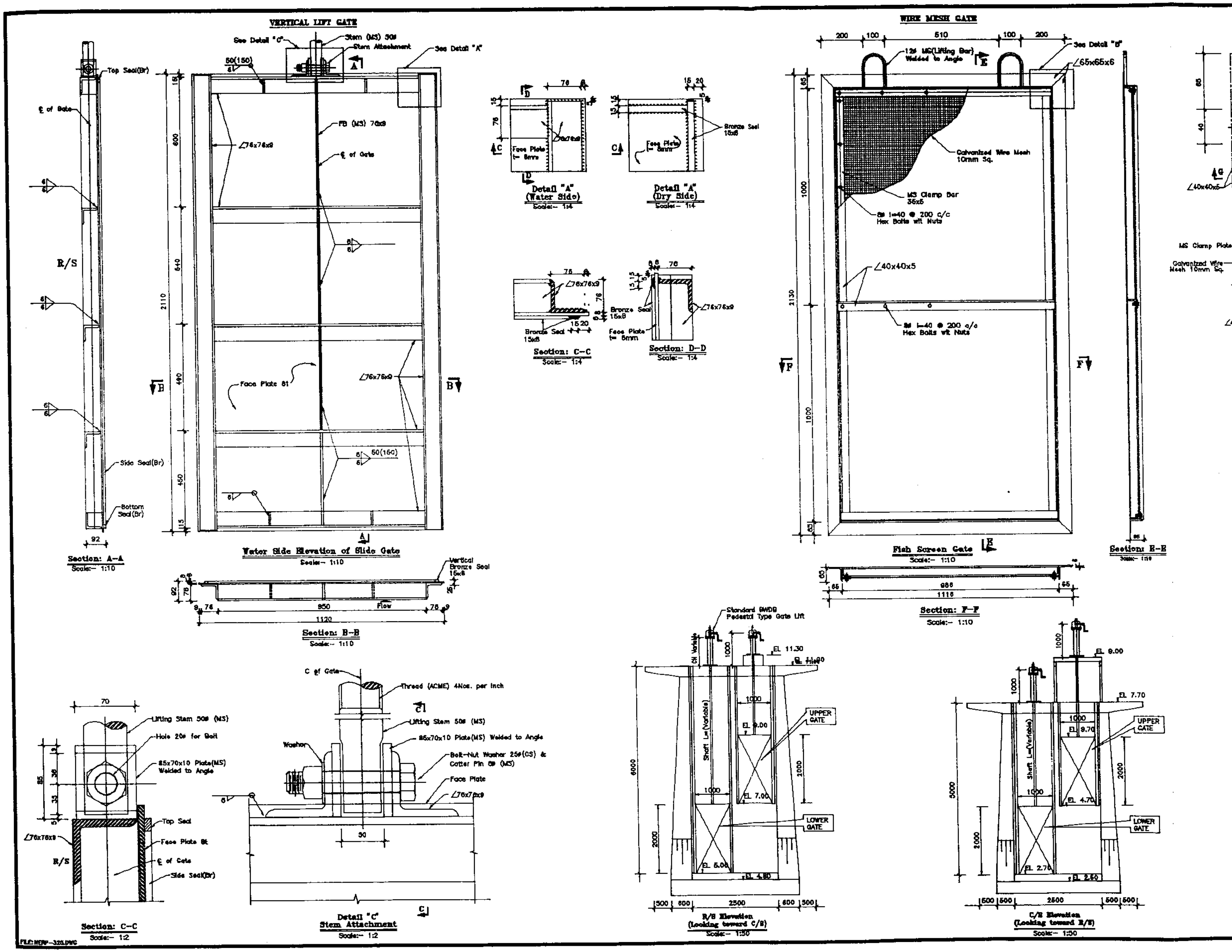
SNC • LAVALIN International
Northwest Hydraulic Consultants Ltd.
EPC Ltd., BETS

Embedded Parts/Frames (Grooves) for R/S and C/S Gates

DESIGNED : H.Werezko	
CHECKED : Jehar Lal Kar	
DRAWN : Ch. Jalal	
SCALE : As Shown	TEAM LEADER
DATE : January 1995	NERP
Dwg. No.: NERP/FPP-01/5/7	

FILE:NERP-324.DWG

Drawing B.7



CHECKED: Executive Engineer BWDB Design Circle NEZ	APPROVED: Superintending Engineer BWDB Design Circle NEZ

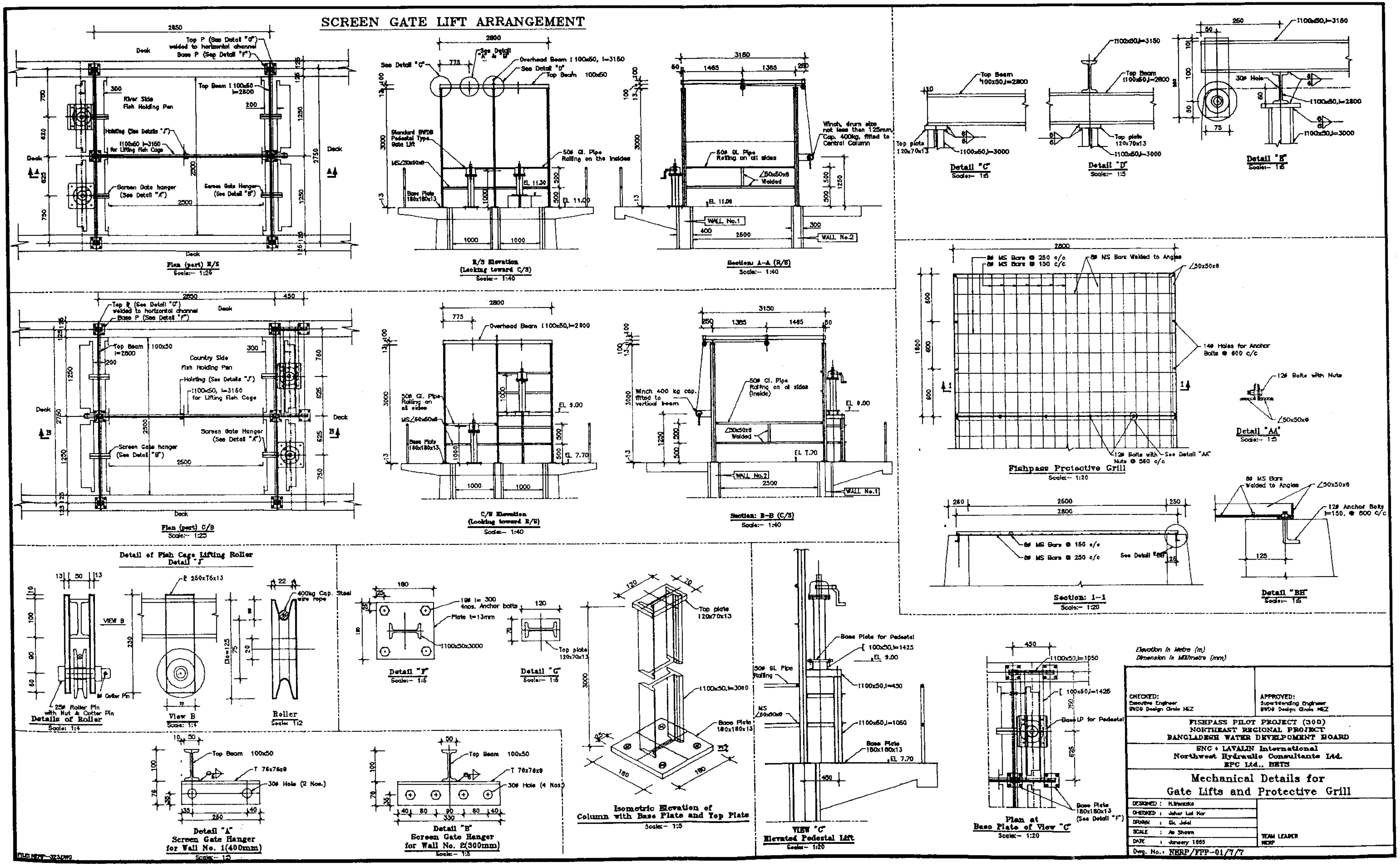
FISHPASS PILOT PROJECT (9(c))
NORTHEAST REGIONAL PROJECT
BANGLADESH WATER DEVELPOMENT BOARD

SNC • LAVALIN International
Northwest Hydraulic Consultants Ltd.
EPC Ltd., BETS

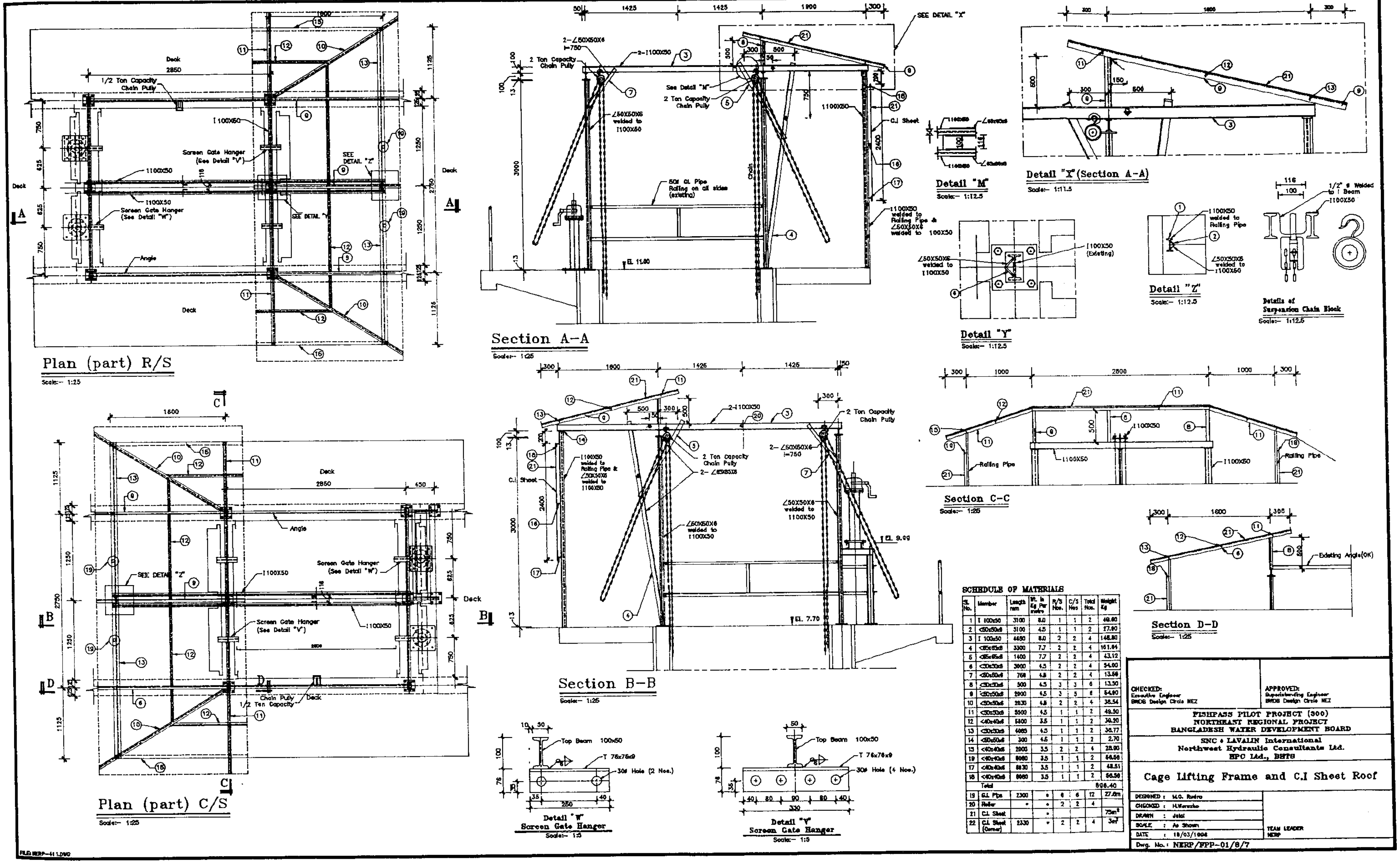
Fishpass Gates

DESIGNED : H. Wenzlo	
CHECKED : Jahar Lal Kar	
DRAWN : Sk. Jalal	
SCALE : As Shown	TEAM LEADER NERP
DATE : January 1995	
Dwg. No.: NERP/FPP-01/6/7	

Drawing B.8


SCREEN GATE LIFT ARRANGEMENT
Plan (part) R/S
Scale:- 1:25
R/S Elevation
(Looking toward C/S)
Scale:- 1:40
Section: A-A (R/S)
Scale:- 1:40
Plan (part) C/S
Scale:- 1:25
C/S Elevation
(Looking toward R/S)
Scale:- 1:40
Section: B-B (C/S)
Scale:- 1:40
Detail "C"
Scale:- 1:5
Detail "D"
Scale:- 1:5
Detail "E"
Scale:- 1:5
Fishpass Protective Grill
Scale:- 1:20
Detail "AA"
Scale:- 1:5
Section: 1-1
Scale:- 1:20
Detail "BB"
Scale:- 1:5
Detail of Fish Cage Lifting Roller
Detail "J"
Details of Roller
Scale: 1:4
View B
Scale: 1:4
Roller
Scale: 1:2
Detail "F"
Scale:- 1:5
Detail "G"
Scale:- 1:5
Isometric Elevation of
Column with Base Plate and Top Plate
Scale:- 1:5
VIEW "C"
Elevated Pedestal Lift
Scale:- 1:20
Plan at
Base Plate of View "C"
Scale:- 1:20
Detail "A"
Screen Gate Hanger
for Wall No. 1(400mm)
Scale:- 1:5
Detail "B"
Screen Gate Hanger
for Wall No. 2(300mm)
Scale:- 1:5
Elevation in Metre (m)
Dimension in Millimetre (mm)
CHECKED:
Executive Engineer
BWDB Design Circle NEZ
APPROVED:
Superintending Engineer
BWDB Design Circle NEZ
FISHPASS PILOT PROJECT (300)
NORTHEAST REGIONAL PROJECT
BANGLADESH WATER DEVELOPMENT BOARD
SNC + LAVALIN International
Northwest Hydraulic Consultants Ltd.
EPC Ltd., BETS
Mechanical Details for
Gate Lifts and Protective Grill
DESIGNED : H.Wenzke
CHECKED : Joher Lal Kar
DRAWN : Sk. Jalal
SCALE : As Shown
DATE : January 1995
TEAM LEADER
NERP
Dwg. No.: NERP/FPP-01/7/7
FILE: NERP-323.DWG

Drawing B.9



SCHEDULE OF MATERIALS

SL No.	Member	Length mm	Wt. in Kg Per metre	R/S Nos.	C/S Nos	Total Nos.	Weight Kg
1	I 100x50	3100	8.0	1	1	2	49.60
2	<50x50x6	3100	4.5	1	1	2	27.90
3	I 100x50	4650	8.0	2	2	4	148.80
4	<65x65x8	3300	7.7	2	2	4	161.64
5	<65x65x8	1400	7.7	2	2	4	43.12
6	<50x50x6	3000	4.5	2	2	4	54.00
7	<50x50x6	760	4.5	2	2	4	13.68
8	<50x50x6	500	4.5	3	3	6	13.50
9	<50x50x6	2000	4.5	3	3	6	54.00
10	<50x50x6	2030	4.5	2	2	4	36.54
11	<50x50x6	5500	4.5	1	1	2	49.50
12	<40x40x6	5400	3.5	1	1	2	39.20
13	<50x50x6	4085	4.5	1	1	2	36.77
14	<50x50x6	300	4.5	1	1	2	2.70
15	<40x40x6	2000	3.5	2	2	4	28.00
16	<40x40x6	8080	3.5	1	1	2	56.56
17	<40x40x6	6930	3.5	1	1	2	48.51
18	<40x40x6	8080	3.5	1	1	2	56.56
	Total						898.40
19	G.I. Pipe	2300	•	6	6	12	27.6m
20	Roller	•	•	2	2	4	
21	C.I. Sheet		•				75m²
22	C.I. Sheet (Corner)	2330	•	2	2	4	3m²

CHECKED:
Executive Engineer
BWDB Design Circle NEZ

APPROVED:
Superintending Engineer
BWDB Design Circle NEZ

FISHPASS PILOT PROJECT (300)
NORTHEAST REGIONAL PROJECT
BANGLADESH WATER DEVELOPMENT BOARD

SNC • LAVALIN International
Northwest Hydraulic Consultants Ltd.
EPC Ltd., BETS

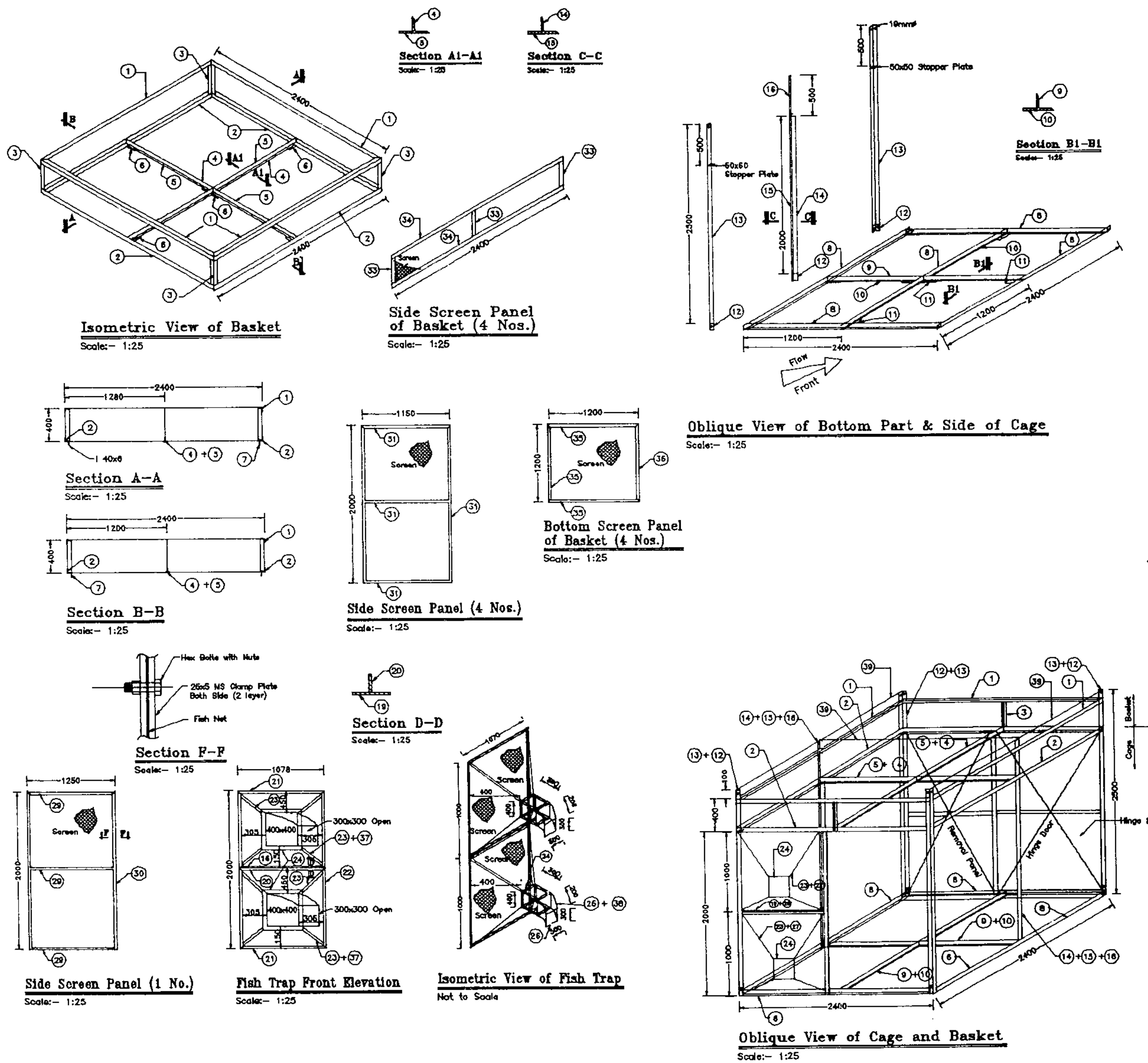
Cage Lifting Frame and C.I Sheet Roof

DESIGNED : M.O. Rudro
CHECKED : H.Werecho
DRAWN : Jalal
SCALE : As Shown
DATE : 18/03/1994
TEAM LEADER NERP

Dwg. No.: NERP/FPP-01/8/7

FILE: NERP-41 1.DWG

Drawing B.11



Isometric View of Basket
Scale:- 1:25

Section A1-A1
Scale:- 1:25

Section C-C
Scale:- 1:25

Side Screen Panel of Basket (4 Nos.)
Scale:- 1:25

Oblique View of Bottom Part & Side of Cage
Scale:- 1:25

Section B1-B1
Scale:- 1:25

Section A-A
Scale:- 1:25

Section B-B
Scale:- 1:25

Side Screen Panel (4 Nos.)
Scale:- 1:25

Bottom Screen Panel of Basket (4 Nos.)
Scale:- 1:25

Section F-F
Scale:- 1:25

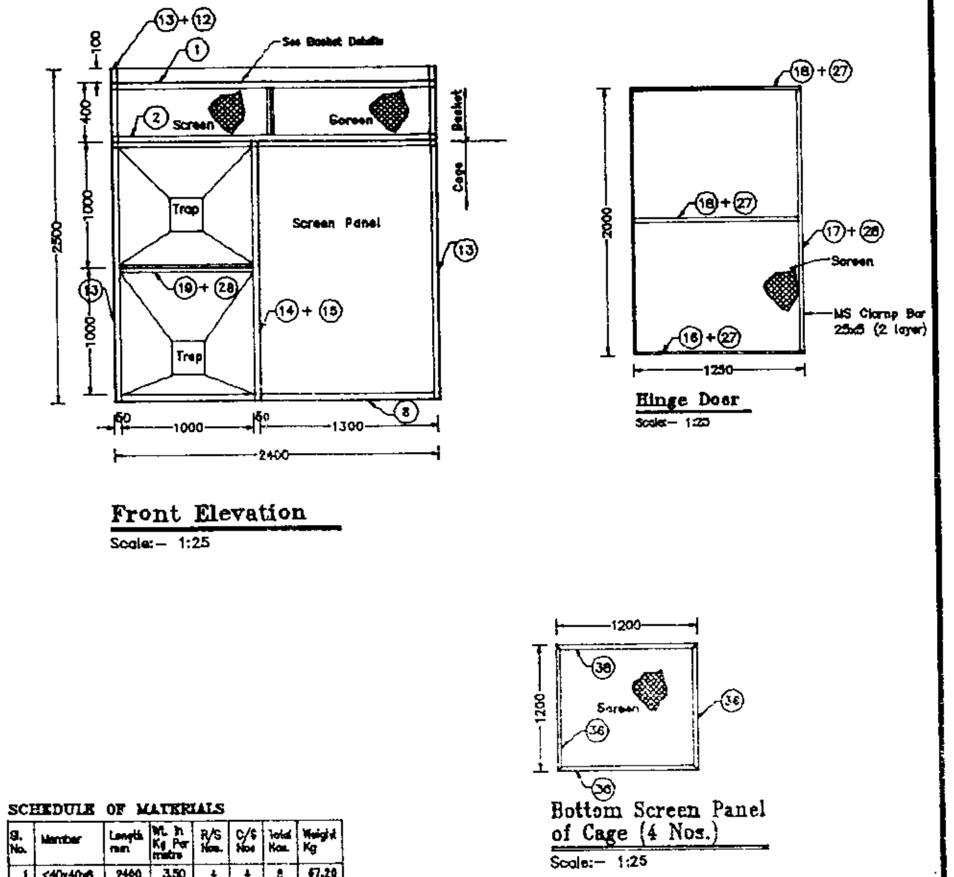
Section D-D
Scale:- 1:25

Side Screen Panel (1 No.)
Scale:- 1:25

Fish Trap Front Elevation
Scale:- 1:25

Isometric View of Fish Trap
Not to Scale

Oblique View of Cage and Basket
Scale:- 1:25



Front Elevation
Scale:- 1:25

Hinge Door
Scale:- 1:25

Bottom Screen Panel of Cage (4 Nos.)
Scale:- 1:25

SCHEDULE OF MATERIALS

Sl. No.	Member	Length mm	Wt. in Kg Per metre	R/S Nos.	C/S Nos	Total Nos.	Weight Kg
1	<40x40x6	2400	3.50	4	4	8	67.20
2	<50x50x6	2400	4.50	4	4	6	86.40
3	<40x40x6	400	3.50	4	4	8	11.20
4	<40x40x6	2400	3.50	2	2	4	33.60
5	Bar 40x6	2400	1.89	2	2	4	18.14
6	Bar 50x6	100	2.36	6	6	12	2.83
7	Bar 40x6	2400	1.89	4	4	8	36.29
8	<50x50x6	2400	4.50	4	4	8	86.40
9	<50x50x6	2400	4.50	2	2	4	43.20
10	Bar 50x6	2400	2.36	2	2	4	22.66
11	Bar 50x6	100	2.36	6	6	12	2.83
12	Bar 50x6	75	2.36	16	16	32	5.66
13	<50x50x6	2500	4.50	4	4	8	90.00
14	<50x50x6	2000	4.50	4	4	8	72.00
15	Bar 50x6	2000	2.36	4	4	8	37.76
16	Bar 50x6	500	2.36	4	4	8	9.44
17	<25x25x5	2000	1.89	2	2	4	14.64
18	<25x25x6	1250	1.89	3	3	6	13.59
19	Bar 50x6	1870	2.36	2	2	4	10.18
20	Bar 40x6	1870	1.89	2	2	4	8.00
21	<40x40x6	1070	3.50	4	4	6	29.96
22	<40x40x6	2000	3.50	4	4	8	56.00
23	<40x40x6	650	3.50	16	16	32	72.80
24	<40x40x6	1800	3.50	4	4	8	50.40
25	<25x25x5	750	1.80	8	8	16	21.60
26	<25x25x5	300	1.80	8	8	16	8.64
27	Bar 25x5	1250	0.98	4	4	8	9.80
28	Bar 25x5	2000	0.98	2	2	4	7.84
29	Bar 25x5	1250	0.98	6	6	12	14.70
30	Bar 25x5	2000	0.98	4	4	8	15.68
31	Bar 25x5	1150	0.98	24	24	48	54.14
32	Bar 25x5	2000	0.98	16	16	32	62.72
33	Bar 25x5	400	0.98	24	24	48	18.82
34	Bar 25x5	2400	0.98	16	16	32	75.26
35	Bar 25x5	1200	0.98	32	32	64	75.26
36	Bar 25x5	1200	0.98	32	32	64	75.26
37	Bar 25x5	2400	0.98	16	16	32	75.26
38	Bar 25x5	600	0.98	16	16	32	18.82
39	I 100x50	2400	8.00	3	3	6	115.20
	Total						1525.86
38	Nut with Bolt (Total)						37

CHECKED: Executive Engineer BWDB Design Circle NEZ	APPROVED: Superintending Engineer BWDB Design Circle NEZ

FISHPASS PILOT PROJECT (300)
NORTHEAST REGIONAL PROJECT
BANGLADESH WATER DEVELPOMENT BOARD

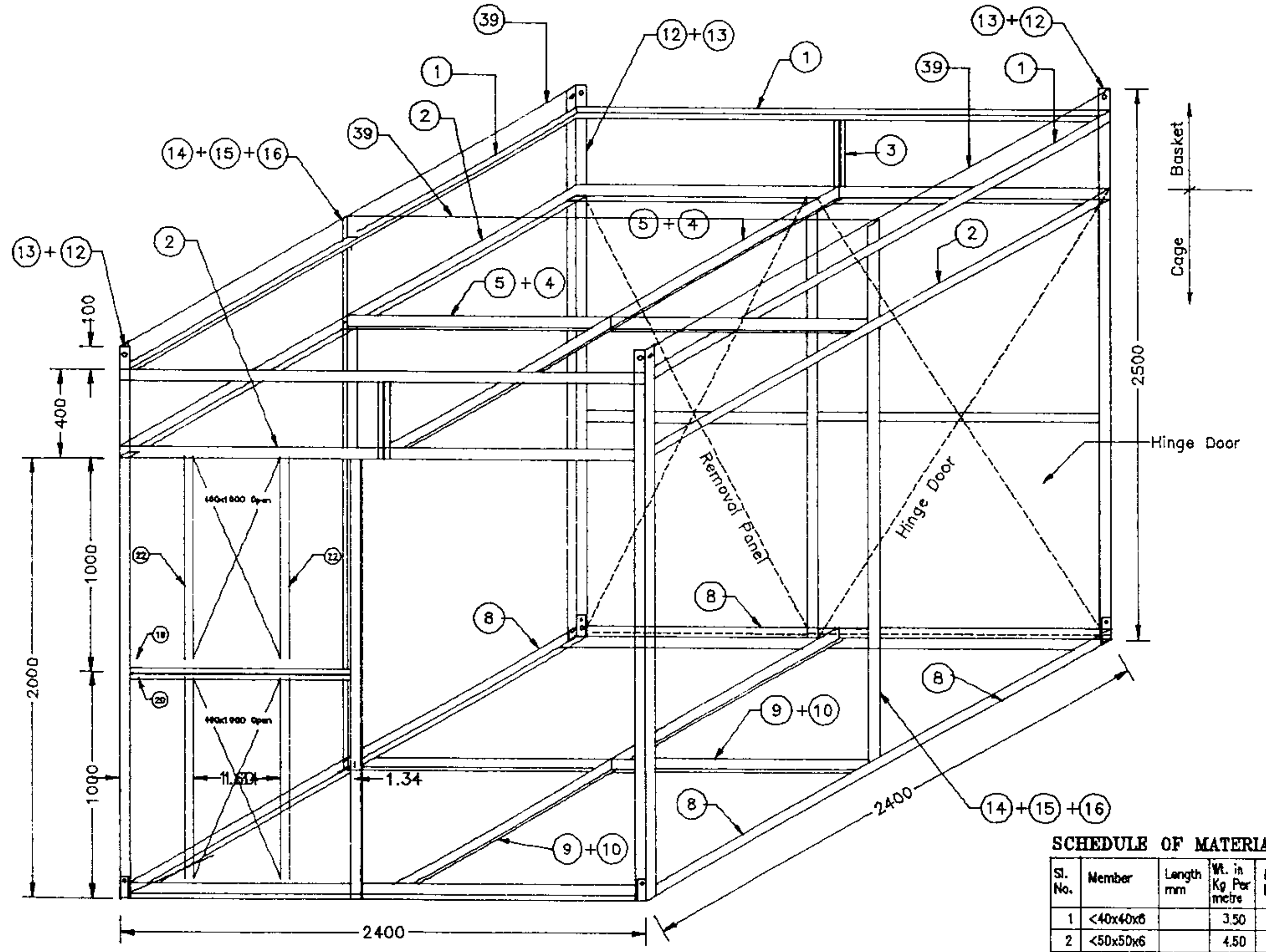
SNC • LAVALIN International
Northwest Hydraulic Consultants Ltd.
EPC Ltd., BETS

Sampling Cage

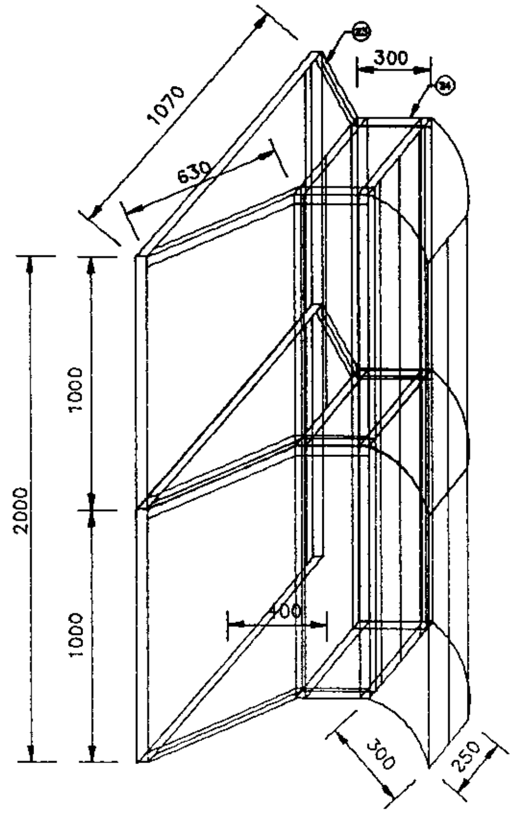
DESIGNED : M.C. Rudra	
CHECKED : H. Wessels	
DRAWN : Jalal	
SCALE : As Shown	TEAM LEADER NERP
DATE : 18/03/1996	
Dwg. No. : NERP/FPP-01/9/7	

FILE: NERP-11.2.DWG

Drawing B.12

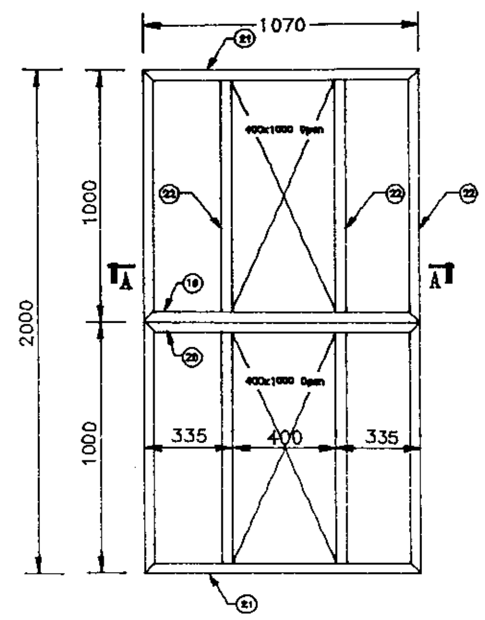


Oblique View of Cage and Basket

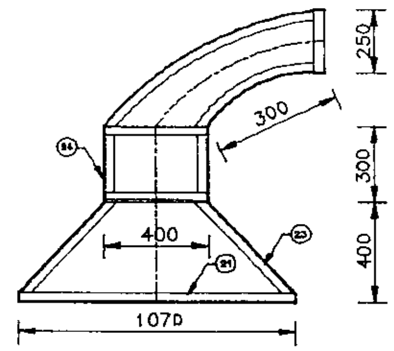


Isometric View of Fish Trap

Not to Scale



Fish Trap Front Elevation



Section A–A

SCHEDULE OF MATERIALS

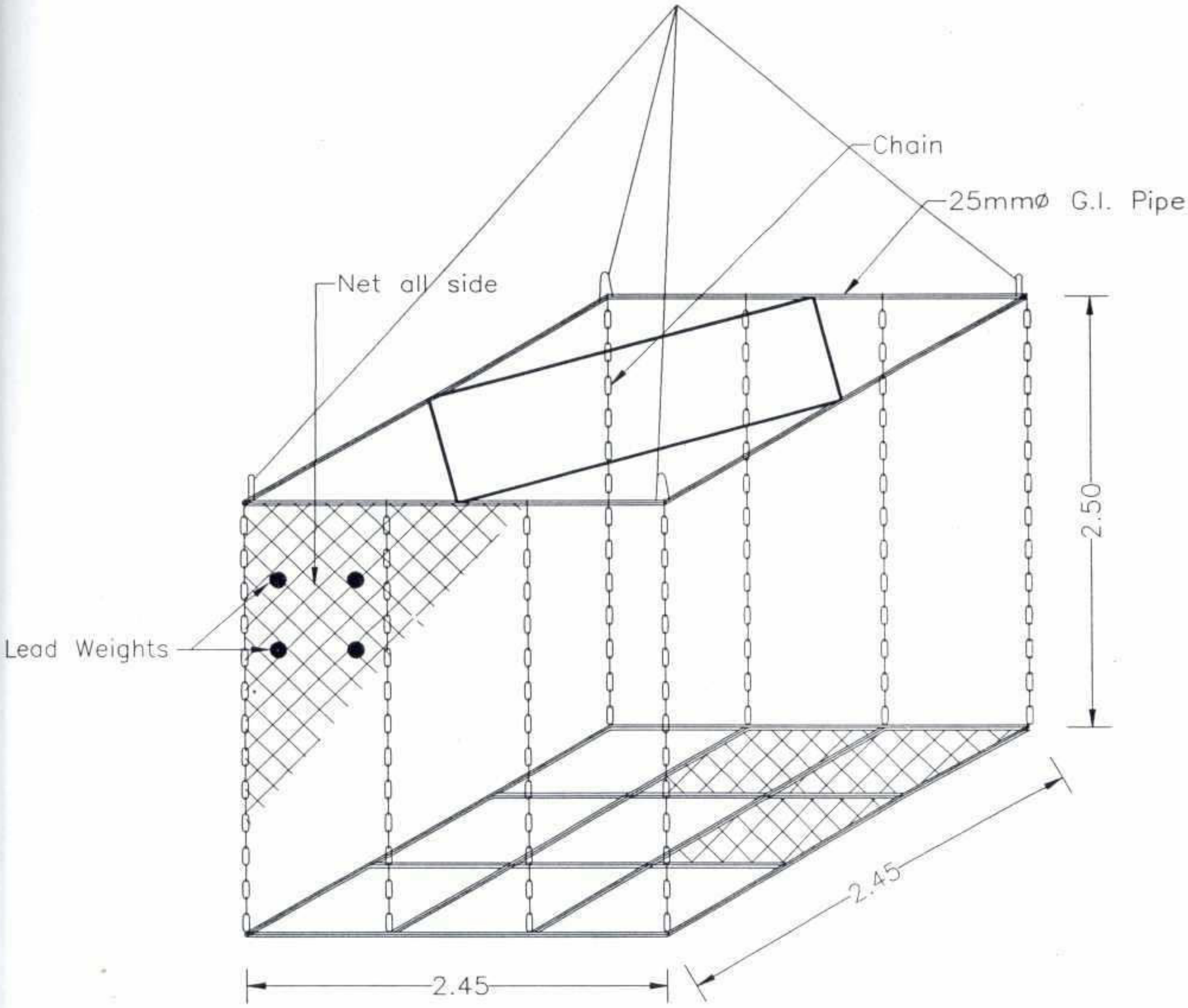
Sl. No.	Member	Length mm	Wt. in Kg Per metre	R/S Nos.	C/S Nos	Total Nos.	Weight Kg
1	<40x40x6		3.50				
2	<50x50x6		4.50				
3	<40x40x6		3.50				
4	<40x40x6		3.50				
5	Bar 40x6		1.89				
6	Bar 50x6		2.36				
7	Bar 40x6		1.89				
8	<50x50x6		4.50				
9	<50x50x6		4.50				
10	Bar 50x6		2.36				
11	Bar 50x6		2.36				
12	Bar 50x6		2.36				
13	<50x50x6		4.50				
14	<50x50x6		4.50				
15	Bar 50x6		2.36				
16	Bar 50x6		2.36				
17	<25x25x5		1.80				
18	<25x25x6		1.80				
19	Bar 50x6		2.36				
20	Bar 40x6		1.89				

SCHEDULE OF MATERIALS

Sl. No.	Member	Length mm	Wt. in Kg Per metre	R/S Nos.	C/S Nos	Total Nos.	Weight Kg
21	<40x40x6		3.50				
22	<40x40x6		5.50				
23	<40x40x6		3.50				
24	<40x40x6		3.50				
25	<25x25x5		1.80				
26	<25x25x5		1.80				
27	Bar 25x5		0.98				
28	Bar 25x5		0.98				
29	Bar 25x5		0.98				
30	Bar 25x5		0.98				
31	Bar 25x5		0.96				
32	Bar 25x5		0.98				
33	Bar 25x5		0.98				
34	Bar 25x5		0.98				
35	Bar 25x5		0.98				
36	Bar 25x5		0.98				
37	Bar 25x5		0.98				
38	Bar 25x5		0.98				
39	I 100x50		8.00				
	Total						
39	Nut with Bolt (Total)						

Northeast Regional Project	
Fishpass Pilot Project Improved Cage Opening	
Prepared by: Salahuddin	November 96
Computer Drafting by: Jalal	AutoCAD Drawing

FILE: FPP-138a.DWG



Northeast Regional Project	
Fishpass Pilot Project Collapsible Metal Basket	
Prepared by: Salahuddin	December 1997
Computer Drafting by: Jalal	AutoCAD Drawing

FILE: FPP-243.DWG

Appendix C

BIOLOGICAL PROFILES OF SOME COMMERCIALLY IMPORTANT FISH SPECIES

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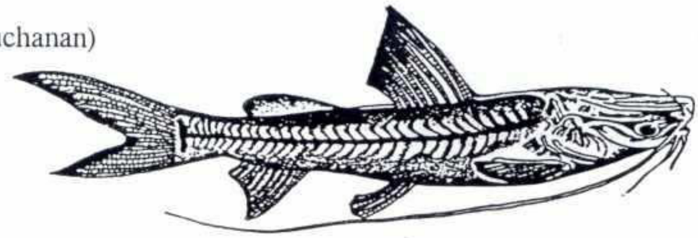
Ω+

C.1 *AIR*



Aorichthys aor

Species: Aorichthys aor (Hamilton-Buchanan)

Family: Bagridae

Standard name: *Air*

Other names: *Air, Guzi air*

Status in Northeast Region: This species of catfish is common in all water bodies of the Sylhet region.

Preferred Habitat: *Air* prefers open water, and mainly riverine habitat. This species is abundant in Sunamgonj *haor* areas, especially in the Surma and Kushiyara Rivers. During the dry season, it takes shelter in *katha*s in the *haor* and *duar*s in the river.

Feeding: *Air* is a bottom column feeding species, preferring zooplankton, benthos, small fish species, and crustaceans. It also eats dead bait and earthworms.

Migration and Reproduction: It prefers short distance migration during the period April-October. *Air* spawns during the period April to July. Spawning takes place in less flashy rivers and channels inside the *haor*. They dig pits in the river bed for spawning and give parental care to their offspring.

Growth: *Air* has a high growth rate in open water. Within the first six months, it grows about 41 cm in length and 550 gm in weight. The size at first maturity is 50 cm at about one year of age. The biggest specimen seen at the Sherpur fish market was 90 cm long and weighed 4,700 g. The individuals migrating through the fishpass ranged in length from 4.3 to 33.0 cm.

Economic importance: *Air* is one of the most commercially important catfish in Bangladesh. The high price is due to its tasty boneless flesh. *Air* has been exported to different foreign countries after processing at Ajmiriganj Fish Industries and Kuliarchar Cold Storage.

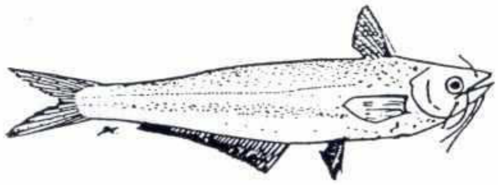
C.2 *BACHA*

Species: <u>Eutropiichthys</u> <u>vacha</u> (Hamilton-Buchanan)

Family: Schilbeidae

Standard name: *Bacha*

Other names: *Bacha*



Eutropiichthys vacha

Status in Northeast Region: Bacha is a riverine fish species found all over Bangladesh. In the Sylhet region, it is abundant in almost all the rivers. Bacha constitutes about seven percent of the total fish production of the Kushiyara River.

Preferred Habitat: It is a fresh and tidal water fish species. It only migrates to the *haors* and *beels* to graze.

Feeding: *Bacha* is a surface feeding species. It is a voracious feeder on smaller fish and insects.

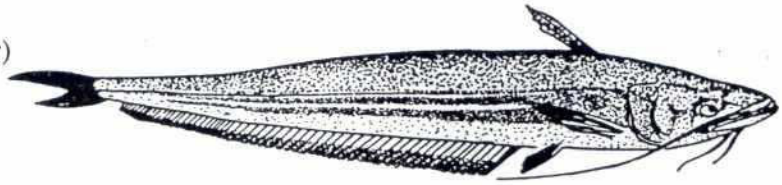
Migration and Reproduction: It is most abundant during the period March-November and spawns in June/July.

Growth: In its first year, bacha grows to 21 cm in length and 70 g in weight. The size at first maturity is 17 cm. The species migrating through the fishpass had lowest and highest lengths of 2.9 and 24.8 cm, respectively. The highest size seen in Sherpur fish market was 30 cm long.

Economic Importance: It is one of the most popular table-fish in the country due to its oily flesh. In the market it fetches a higher price than other similar-sized species. This species is also being exported.

C.3 *BOAL*

Species: Wallago attu (Schneider)



Wallagu attu

Family: Siluridae

Standard name: *Boal*

Other names: *Bol, Boali, Paira, Paran*

Status in Northeast Region: *Boal* is a dominant species in the waters of the region. It constitutes the highest proportion of large-sized fish production.

Preferred Habitat: *Boal* are present in all types of water bodies. In the Sylhet region, they are abundant in *beel*s and rivers. During the dry season, they take shelter in *katha*s set in the *haor* and *duar*s in the river.

Feeding: *Boal* is a voracious and carnivorous fish species. It is well known for its predatory behaviour, and is often termed a freshwater shark. It eats small fish, crustaceans, and insects. It also feeds on live and dead bait.

Migration and Reproduction: *Boal* is a local migrant, moving short distances for feeding and breeding. It spawns during the period May-July. Spawning takes place in shallow areas flooded by rain. During the breeding season, they form pairs and run towards shallow water, which is locally called "birdhara".

Growth: The first year growth rate of *boal* observed at Kawadighi Haor was 78 cm in length and 1,350 g in weight. The size at first maturity is 50 cm in length at about one year of age. The biggest size, seen at the Sherpur Fish Fair in January 1993, was 180 cm. Species migrating through the fishpass ranged in length from 8.7 to 73 cm.

Economic Importance: Boal is one of the most commercially important large catfish in Bangladesh. *Boal* is a high value fish in the market due to its oily boneless flesh. This species has been exported to different foreign countries.

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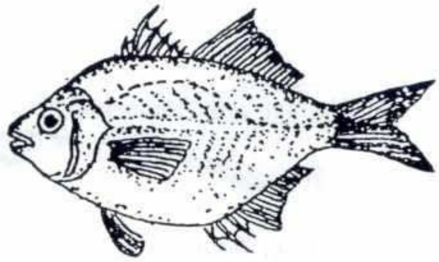
C.4 *CHANDA*



Chanda ranga

Species: Chanda ranga (Hamilton)

Family: Ambassidae

Standard name: *Chanda*

Other names: *Chandu, Lal chanda, Ranga chanda*

Status in Northeast Region: It is a transparent freshwater fish exceedingly common in all parts of the country. In the Sylhet and Mymensingh regions it is more abundant in the rivers, channels, *haor*, *beels*, ponds, and floodplain (especially in clear water) than in any other area of the country.

Preferred Habitat: They prefer clear shallow floodplain water, and as such are most abundant during the rainy season. *Chanda* also grows well in closed water bodies.

Feeding: *Chanda* is a mid-level and surface feeding species, preferring phytoplankton, zooplankton, and mosquito larvae.

Migration and Breeding: They generally migrate in schools towards clear shallow water as soon as the monsoon water begins rising. The period March-September is the main breeding season of *chanda*. They breed more than twice a year, and make nests to guard their fry.

Growth: It attains a maximum length of 10 cm. Their size at first maturity is 4 cm at about 4 months of age. The *chanda* migrating through the fishpass ranged in length from 1.0 to 9.7 cm.

Economic Importance: This small fish is sold along with other small fish in the fish markets. This species is preferred by the poor people due to its low price.

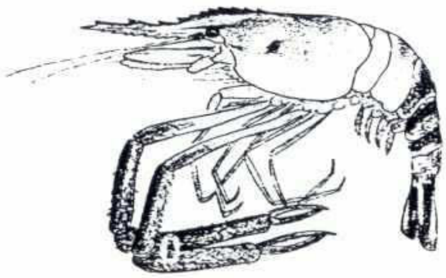
C.5 *GOLDA CHINGRI*

Species: Macrobrachium rosenbergii (De Man)

Family: Palaemonidae

Standard name: *Golda chingri*

Other names: *Boro icha, Golda icha, Mocha icha*



Macrobrachium rosenbergii

Status in Northeast Region: This species is found in abundance in the northeast region from Bhairab to Ajmiriganj. It migrates on to the floodplain areas of the region when rivers overspill their banks during the monsoon. Young *golda chingri* are also abundant in floodplains and *beels* of the region during the monsoon season.

Preferred Habitat: *Golda chingri* occurs in a wide range of environmental conditions. They are found in estuarine, freshwater lentic, and lotic habitats. Culturing *golda chingri* in ponds has recently become popular in the country.

Feeding: It is an omnivorous bottom feeding species. It prefers to feed on diatoms, aquatic vegetation, crustaceans, and small aquatic animals.

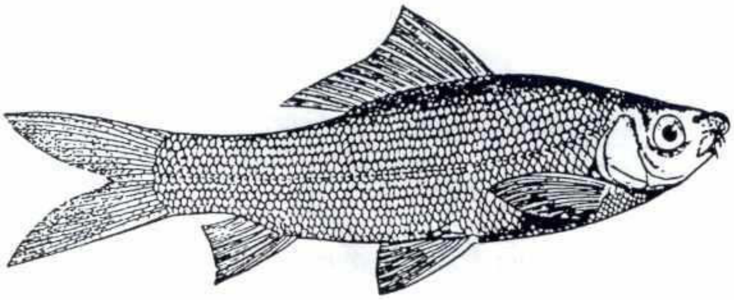
Migration and Breeding: The species breeds during the period May-July, with the peak falling in June/July. It is a long distance migratory species, and travels up to about 400 km upstream to graze. It is found most abundantly in the rivers from September-February. After attainment of maturity, it migrates downstream towards coastal areas to breed. The larve grow to juvenile stage in brackish water, then migrate into freshwater habitats for grazing and growth to maturity.

Growth: The size at first maturity is 15 cm, and it attains a maximum length of 27 cm. The individuals migrating through fishpass ranged in length from 4.4 to 21.2 cm.

Economic Importance: *Golda chingri* is a highly priced and important commercial species in Bangladesh. Significant amounts of foreign currency are earned through export of processed *golda chingri*. Catches from the region that are intended for export are processed mainly in Kuliarchar Cold Storage at the district of Kishoreganj.

C.6 *GONIA*

Species: Labeo gonius (Hamilton)



Labeo gonius

Family: Cyprinidae

Standard name: *Gonia*

Other names: *Goainna, Goni, Kurchi.*

Status in Northeast Region: Although it is widely abundant in the Northeast, it is not commonly seen in other areas of the country. In the Sylhet region it is most abundant in the Baulai River, Nandina River, Hashmara River, and Tanguar Haor.

Preferred Habitat: It is a riverine freshwater fish species which prefers uniform flow with low velocity. It does not normally frequent excessively vegetated habitats. During the dry season, *gonia* takes shelter in *katha*s in the *beel*s and *duar*s in the rivers.

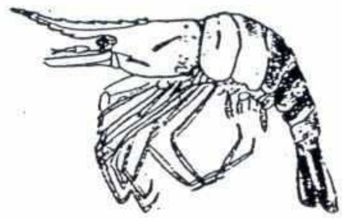
Feeding: It is a bottom column feeding species, preferring algae, plankton, aquatic plants, and crustaceans.

Migration and Reproduction: April to June is the main period for their breeding migration. When the early flash floods begin, *Gonia* starts looking for suitable breeding places. They move in schools and prefer low velocity, shallow, clear water. Halir Haor, Shanir Haor, Matian Haor, Tanguar Haor, and the adjacent rivers in Sunamgong district are the important breeding grounds for *gonia*. They start breeding in the shallow water of the *haor* just after the harvesting of the rice crop.

Growth: In open water, first year growth is 450 g in weight and 32 cm in length. In closed water their growth is comparatively slow. The size at first maturity is 23 cm, and it reaches a maximum length of 40 cm. The individuals found migrating through the fishpass ranged in length from 3.9 to 23.6 cm.

Economic Importance: It has one of the highest market values of any carp species.

C.7 *ICHA*



Macrobrachium species

Species: Macrobrachium species

Family: Palaemonidae

Species: Caradina species

Family: Alpheidae

Standard name: *Icha, Choto chingri*

Other names: *Gura icha, Shul icha, Dema icha, Dhangua icha*

Status in Northeast Region: Small prawns are highly abundant in all types of water bodies in Bangladesh. In the Northeast Region they occur widely in rivers, *haor*s, *beel*s, ponds, and are very common in catches.

Preferred Habitat: Icha is highly abundant in the *haor*s, *beel*s and floodplains of the Northeast Region. In the monsoon season it prefers shallow paddy land. Some species are common in closed water bodies.

Feeding: *Icha* is a nocturnal and bottom feeding species. They are omnivorous and feed on smaller animals and plants, partly decomposed animals, and also ingest clay and sand particles.

Migration and Breeding: Most of the species were observed migrating locally, but some can migrate long distances. They spawn during the period March-October. *Icha* normally breeds two or more times a year. Most of them breed in both running and closed freshwater environments.

Growth: The spawning and growth rate of *icha* are very high. Some species attain maturity within 3 months of age. The approximate size at first maturity is 4 cm. The individuals found migrating through the fishpass ranged in length from 1.5 to 13.9 cm.

Economic Importance: *Icha* is a very common and available at all retail fish markets. The species is preferred by poor people because of the low price. Fishermen get a higher price when *icha* is sold in dried form.

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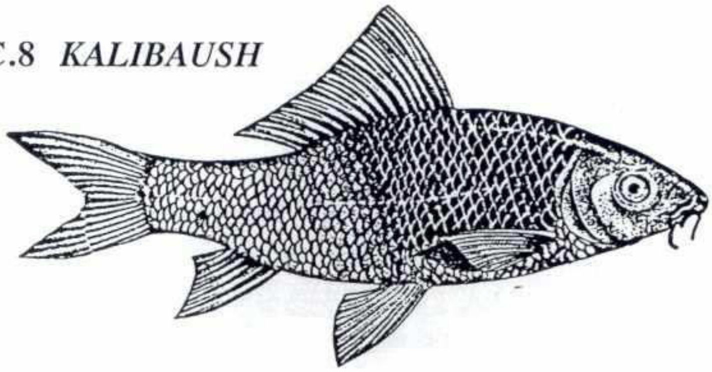
C.8 *KALIBAUSH*



Labeo calbasu

Species: Labeo calbasu **(Hamilton)**

Family: Cyprinidae

Standard name: *Kalibaush*

Other name: *Baush, Kalabaush, Kalia, Kailara*

Status in Northeast Region: It is one of the major carp of Bangladesh, and common in the Northeast Region. It is most abundant in *beel*s and *haor*s, and is also reared and cultured in ponds.

Preferred Habitat: It is a freshwater fish species present all over the country. *Kalibaush* prefers a bottom layer with a clay surface. It takes shelter in *duar*s in the river and *katha*s in the *haor* during the dry season. During the early monsoon season, they start migrating from their overwintering grounds to environments suitable for breeding and feeding.

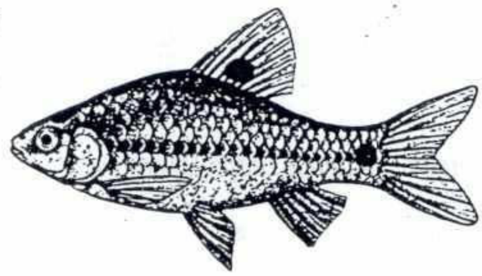
Feeding: *Kalibaush* is a bottom feeding species, preferring plankton, algae, and decomposed vegetation.

Migration and Reproduction: The beginning of the flash flood season is the main period for their breeding migration. They begin searching for environments suitable to breed and graze. *Kalibaush* spawns during the period April-August. They prefer less flashy rivers and connecting channels of the *haor*. In the Sylhet region, *kalibaush* breeds in the Tanguar and Matian Haor area. Juveniles of *kalibaush* are present in this area during the monsoon season.

Growth: In open water, the first year growth rate is 600 gm in weight and 37 cm in length. This species reaches maturity at a size of 28 cm, after about one year. The biggest specimen recorded from the Kushiyara River was at Machukhali in October 1993. It was 4,500 g in weight and 63 cm in length. The individuals migrating through the fishpass ranged in length from 2.2 to 51.0 cm.

Economic Importance: *Kalibaush* is one of the commercially important species in Northeast Region of Bangladesh. This species is also being exported.

C.9 *PUTI*



Puntius sophore

Species: Puntius sophore (Hamilton)

Family: Cyprinidae Standard name: *Jati puti*

Other names: *Jati puti, Vadi puti, Roa puti*

Status in Northeast Region: *Puti* is very common in the Northeast Region, prevalent in rivers, *haor*s, *beel*s, and ponds. Kawadighi Haor is renowned for this species.

Preferred Habitat: It is most abundant during the rainy season. It prefers clear shallow waters and inundated paddy fields. This species is also common in closed water bodies.

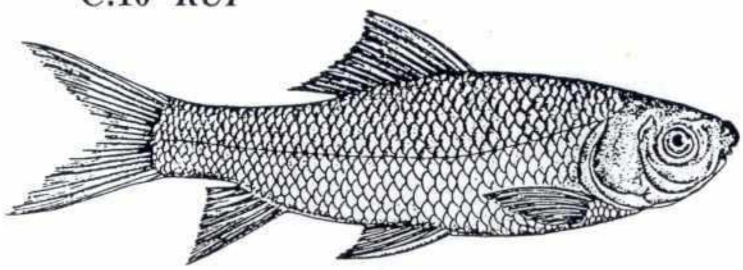
Feeding: *Puti* is a mid-level and bottom feeder, preferring plankton, aquatic plants, algae, and decomposed vegetation.

Migration and Reproduction: With the occurrence of the first monsoon floods, they start migrating towards shallow clear water for breeding and grazing. The breeding period of *puti* is April-June. In males, a red band develops along the middle of either side during breeding season. In females, this band is less distinct.

Growth: It attains a maximum length of 15 cm. The size at first maturity is 6 cm in length. The individuals migrating through the fishpass ranged in length from 1.8 to 11.0 cm.

Economic Importance: This species is perennially available in every fish market. In the monsoon season, it has low market value due to its high abundance. It is a suitable fish for making *sidol* (fermented fish).

C.10 *RUI*



Species: Labeo rohita (Hamilton)

Family: Cyprinidae

Standard name: *Rui*

Other names: *Rohu, Ruhit, Rou*

Labeo rohita

Status in Northeast Region: *Rui* is the most commercially important native carp in the Northeast Region. This species was previously abundant in the Surma and Kushiyara Rivers, and also in Sunamgonj and Netrokona *haor* areas. Abundance of *rui* in these rivers is declining. This is likely due to industrial pollution, siltation, gradual destruction of the breeding grounds, overfishing, and other factors.

Preferred Habitat: It is found in almost all rivers, *haor*s and *beel*s of the Northeast Region. *Rui* is also extensively cultured in ponds. It takes shelter in *duar*s in the rivers and *katha*s in the *haor*s during the dry season. During the early monsoon season, they start migration from their overwintering ground to suitable breeding and grazing environments.

Feeding: *Rui* is a predominantly column feeder, preferring plankton, decayed higher aquatic plants, and decomposed vegetation. Fingerlings usually prefer zooplankton and vegetable debris.

Migration and Reproduction : April and May is the main migratory season. With the occurrence of the first flash flood, they start migrating to places suitable for breeding and grazing. *Rui* spawns during the period May-July. Spawning takes place in flash-flooded rivers and *haor* channels where there is current. In the Sylhet region, *rui* breeds in the upstream reaches of the Surma and Kushiyara Rivers. The species attains sexual maturity within 2 years. In the period 1994-96, *rui* spawn was observed during the early monsoon season in the Kushiyara River near Sherpur bridge. Some large brood fish (above 10 kg wt) carrying eggs were found in the Kushiyara River downstream of Sherpurghat on 17 May, 1994. This indicates that there are some carp breeding grounds in the Kushiyara River and adjacent areas.

Growth: In open water, the first year growth of this species is 700 g in weight and 41 cm in length. Their size at first maturity is 50 cm at about 2 years of age. The biggest specimen was seen in January 1995 at Sherpur fish market. It was 91 cm in length and 10.5 kg in weight. The individuals found migrating in the fishpass ranged in length from 3.5 to 51.2 cm.

Economic Importance: It is one of the most commercially important species in Bangladesh. It attains a higher price than any other fish because of the taste and of the value of its flesh as food. After processing at Ajmiriganj Fish Industry and Kuliarchar Cold Storage, *rui* from the Northeast Region is being exported to the UK, USA, and some Middle East countries.

Appendix D

FISHPASS SAMPLING DATA

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List of Tables

Table D.1: Visual Observations of Fish inside the Fishpass

Date	Time	Species	Approx. size (cm)	Pool no.	Inferred direction of migration	Observed by:
Year 1: 1995						
June 07, 1995	1700	Boal (1)	45	14	?	T. Alam (Biologist)
June 17, 1995	1400	Rita (2)	30	12	?	Guard
June 21, 1995	0700	Boal (1)	90	12	?	Local people and Guard
June 21, 1995	0700	Kalibaush (1)	45	12	?	Local People and Guard
June 26, 1995	1100	Kalibaush (1)	45	11	River to haor	T. Akbar (Biologist)
July 12, 1995	0900	Boal (1)	60	13	River to haor	T. Alam (Biologist) and Guard
July 17, 1995	1700	Kalibaush (2)	45	11	Haor to river	A. Rezzaque (Biologist) and A. Sarwar (CO)
August 02, 1995	2300	Boal (1)	90	14	?	T. Akbar (Biologist) and Guard
August 09, 1995	2100	Gonia (1)	40	08	?	N. Islam (PC), T. Akbar (Biologist), T. Alam (Biologist) and Guard
Sept. 12, 1995	0500	Kalibaush (1)	60	07	?	T. Alam (Biologist) and Local people
Sept. 16, 1995	2130	Carp (1) (could not be identified)	60	10	?	T. Akbar (Biologist) and Guard
Sept. 24, 1995	0700	Boal (1)	45	15	?	T. Akbar and Guard
Oct. 03, 1995	1500	Gonia (1)	40	13	?	Paul Farrow (visiting Dutch Consultant), A. Rezzaque and T. Akbar (Biologists)

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Year 2: 1996						
August 05, 1996	1800	Kalibaush (1)	45	10	River to haor	Nazmul Islam (PC) and all Biologists & COs
August 07, 1996	1730	Rui (1)	35	12	River to haor	T. Akbar and T.Alam (Biol)
August 11, 1996	1045	Kalibaus (2)	25	11	River to haor	Surveyor and Guard
August 13, 1996	1200	Boal (2)	60	2	River to haor	A. Razzaque and T. Alam (Biol.)
August 18, 1996	1030	Kalibaus (1)	35	2	?	Surveyor and Guard
August 19, 1996	1100	Shole (1)	20	3	River to Haor	A. Razzaque and T. Alam (Biol.)
August 19, 1996	1100	Kaikka (8)	15	2	River to haor	A. Razzaque and T. Alam (Biol.)
August 20, 1996	0900	Rui (1)	30	2	River to Haor	Local people and Guard
August 24, 1996	0945	Kalibaus (2)	28	5	Haor to River	Munir (CO) and Guard
August 28, 1996	1800	Bacha (3)	20	2	?	Salahuddin (Hydrologist), T. Akbar and T. Alam (Biol)
Sept. 02, 1996	0900	Kalibaush (1)	32	12	River to haor	T. Alam (Biol.), T. Akbar (Biol.) and Guard
Sept. 02, 1996	1130	Kalibaush (1)	30	14	?	Guard
Sept. 05, 1996	1200	Gonia (1)	25	15	River to haor	A. Razzaque, T. Alam (Biol.) and Guard
Sept. 09, 1996	1730	Boal (1)	45	13	River to haor	Guard
Sept. 12, 1996	1430	Kalibaush (1)	35	15	?	T. Alam (Biol.),A Razzaque (Biol.), Guard and local people
Sept. 14, 1996	1800	Kalibaush (1)	35	14	Haor to river	T. Alam (Biol.), A. Sarwar (CO), Z Rana (CO) and Guard
Sept. 19, 1996	1000	Boal (1)	50	15	River to haor	T. Akbar (Biol.) and Guard.
Oct. 02, 1996	1230	Mrigel (1)	31	11	River to haor	T.Alam (Biol.),A.Razzaque (Biol.) & Guard
Oct. 07, 1996	1730	Boal (1)	50	12	River to haor	T.Alam (Biol.), M.Islam (CO) and Guard
Oct. 14, 1996	1700	Kalibaush (1)	36	14	Haor to river	A. Razzaque, T.Akbar, T. Alam (Biol.), M. Islam (CO) & Guard
Oct. 16, 1996	1800	Kalibaush (1)	40	14	?	Nazmul Islam (PC), T. Akbar, T. Alam (Biol.), A.Sarwar (CO), Z. Rana (CO), M. Islam (CO)
Oct. 23, 1996	1000	Boal (1)	45	13	River to haor	A.Razzaque, T.Alam (Biol.), and Guard
Oct. 27, 1996	1300	Catla (1)	32	16	River to haor	A. Razzaque (Biol.), Guard and Local People

Year 3: 1997						
July 01, 1997	0800	Kalibaush (1)	35	14	?	T. Alam and S. Ali (Biologist)
July 07, 1997	1700	Boal (1)	50	11	?	F. Easmin, M. Islam (COs) and Guard
July 15, 1997	1800	Boal (1)	45	05	?	T. Alam (Biologist) and M. Islam (CO)
July 21, 1997	2000	Unidentified	?	15	?	S. Ali (Biologist) and Guard
July 27, 1997	1600	Rui (1)	45	15	?	T. Alam and S. Ali (Biologists)
August 02, 1997	2200	Boal (!)	80	13	?	T. Alam and A. Rezzaque (Biologists)
August 06, 1997	1530	Silver carp(1)	40	17	?	A. Rezzaque (Biologist) and Local people
August 11, 1997	0630	Boal (1)	65	14	?	A. Rezzaque, T. Alam and S. Ali (Biologists)
August 16, 1997	2000	Kalibaush (1)	35	16	?	Guard
August 17, 1997	1500	Rui (1)	40	08	?	T. Alam and S. Ali (Biologists)
August 23, 1997	0900	Gonia (1)	25	06	?	A. Rezzaque and S. Ali (Biologists)
August 27, 1997	1930	Boal (1)	70	10	?	S. Ali (Biologist) and Guard
August 30, 1997	0600	Kalibaush (1)	40	13	?	T. Alam (Biologist) and Guard
Sept. 03, 1997	1430	Boal (1)	60	15	?	A. Rezzaque and T. Alam (Biologists)

Table D.2: Fishpass sampling data

SET No	DATE	SAMPLING TIME Begin hr	End hr	Duration hrs	PERIOD Day	Nite	CHAMBER R/S	C/S	Fish no.	Icha no.	Total no.	Schools no.	Fish no. per hr	Icha no. per hr	Total no. per hr
Year 1: 1995															
1	95.05.24	11.0	12.0	1.0	1	0	0	1			2	0			
2	95.05.25	10.0	11.3	1.5	1	0	0	1			5	0			
3	95.05.27	11.0	11.3	0.5	1	0	0	1			1	0			
4	95.05.30	14.0	15.0	1.0	1	0	0	1			7	0			
5	95.05.31	16.0	17.0	1.0	1	0	0	1			8	0			
6	95.06.05	9.0	9.3	0.5	1	0	0	1			6	0			
7	95.06.06	10.0	10.3	0.5	1	0	0	1			2	0			
8	95.06.15	6.0	11.3	5.0	1	0	0	1			12	3			
9	95.06.16	5.3	8.3	3.0	1	0	0	1			58	2			
10	95.06.17	7.0	11.0	4.0	1	0	0	1			68	6			
11	95.06.18	5.0	8.3	3.5	1	0	0	1			131	4			
12	95.06.19	13.0	20.0	7.0	1	0	0	1			48	3			
13	95.06.20	6.0	12.0	6.0	1	0	0	1			39	3			
14	95.06.21	8.0	12.0	4.0	1	0	1	0			15	0			
15	95.06.21	14.0	18.3	4.5	1	0	0	1			36	3			
16	95.06.22	6.0	13.0	7.0	1	0	0	1			46	2			
17	95.06.23	9.0	12.0	3.0	1	0	1	0			5	0			
18	95.06.25	7.0	12.0	5.0	1	0	0	1			76	4			
19	95.06.25	12.0	18.0	6.0	1	0	0	1			42	1			
20	95.06.25	20.0	6.0	10.0	0	1	1	0			53	0			
21	95.06.26	8.3	18.0	9.5	1	0	0	1			75	0			
22	95.06.26	19.0	7.0	12.0	0	1	0	1			134	1			
23	95.06.28	7.0	19.3	12.5	1	0	0	1			27	1			
24	95.06.29	7.0	13.3	6.5	1	0	1	0			33	0			
25	95.06.30	12.0	18.0	6.0	1	0	1	0			38	0			
26	95.07.01	12.0	22.3	10.0	1	0	0	1			97	0			
27	95.07.02	7.0	12.0	5.0	1	0	0	1			46	6			
28	95.07.04	12.0	20.3	8.5	1	0	0	1			46	5			
29	95.07.04	23.0	8.0	9.0	0	1	0	1			45	3			
30	95.07.06	0.0	7.0	7.0	0	1	0	1			36	3			
31	95.07.07	13.0	17.0	4.0	1	0	0	1			40	3			
32	95.07.08	8.0	14.0	6.0	1	0	0	1			49	3			
33	95.07.09	9.0	15.0	6.0	1	0	0	1			43	3			
34	95.07.10	8.0	13.0	5.0	1	0	0	1			33	3			
35	95.07.11	10.0	17.0	7.0	1	0	0	1			7	2			
36	95.07.11	18.3	11.0	16.5	0	1	0	1			13	1			
37	95.07.13	7.0	10.0	3.0	1	0	1	0			4	2			
38	95.07.14	15.0	19.0	4.0	1	0	1	0			14	1			
39	95.07.15	12.2	15.0	2.8	1	0	1	0			12	1			
40	95.07.16	10.0	12.0	2.0	1	0	1	0			1	0			
41	95.07.17	15.0	17.3	2.5	1	0	1	0			7	2			
42	95.07.18	14.0	16.3	2.5	1	0	1	0			29	0			
43	95.07.19	17.0	19.3	2.5	1	0	1	0			9	3			
44	95.07.20	14.3	16.3	2.0	1	0	1	0			20	1			
45	95.07.22	9.0	11.0	2.0	1	0	1	0			20	1			
46	95.07.24	13.3	15.0	1.5	1	0	1	0			3	2			
47	95.07.26	7.0	14.3	7.5	1	0	1	0			16	3			
48	95.07.26	16.0	19.3	3.5	1	0	0	1			19	6			
49	95.07.26	20.0	8.0	12.0	0	1	0	1			52	5			
50	95.07.28	17.3	20.0	2.5	1	0	0	1			19	3			
51	95.07.31	10.0	16.0	6.0	1	0	0	1			23	2			
52	95.08.01	11.0	14.3	2.5	1	0	0	1			16	1			
53	95.08.01	15.0	19.0	4.0	1	0	0	1			24	4			
54	95.08.02	15.0	17.0	2.0	1	0	0	1			16	1			
55	95.08.03	16.0	19.0	3.0	1	0	0	1			20	3			
56	95.08.04	16.3	20.0	3.5	1	0	0	1			44	2			
57	95.08.05	6.3	9.0	2.5	1	0	0	1			14	1			
58	95.08.06	14.0	17.0	3.0	1	0	0	1			14	1			
59	95.08.08	13.3	17.0	3.5	1	0	1	0			19	1			
60	95.08.08	17.3	20.0	2.5	1	0	1	0			37	0			
61	95.08.09	7.0	10.3	3.5	1	0	1	0			22	1			
62	95.08.09	11.0	12.3	1.5	1	0	1	0			35	2			
63	95.08.11	14.3	17.3	3.0	1	0	1	0			3	2			

Table D.2: Fishpass sampling data

SET No	DATE	SAMPLING TIME Begin hr	End hr	Duration hrs	PERIOD Day	Nite	CHAMBER R/S	C/S	Fish no.	Icha no.	Total no.	Schools no.	Fish no. per hr	Icha no. per hr	Total no. per hr
64	95.08.12	12.0	14.0	2.0	1	0	1	0			34	1			
65	95.08.13	15.0	17.3	2.5	1	0	1	0			8	1			
66	95.09.06	18.0	19.0	1.0	1	0	1	0			11	1			
67	95.09.07	9.0	12.0	3.0	1	0	1	0			5	1			
68	95.09.08	14.3	18.0	3.5	1	0	1	0			14	1			
69	95.09.09	15.3	18.0	2.5	1	0	1	0			7	1			
70	95.09.11	17.0	18.3	1.5	1	0	1	0			9	1			
71	95.09.12	8.3	10.5	2.3	1	0	1	0			4	4			
72	95.09.13	14.0	16.3	2.5	1	0	1	0			10	3			
73	95.09.14	8.0	11.0	3.0	1	0	1	0			24	2			
74	95.09.15	15.0	17.3	2.5	1	0	1	0			25	1			
75	95.09.16	8.3	10.0	1.5	1	0	1	0			4	7			
76	95.09.17	14.0	17.0	3.0	1	0	1	0			8	4			
77	95.09.18	16.0	19.3	3.5	1	0	1	0			11	4			
78	95.09.19	7.3	9.3	2.0	1	0	1	0			5	1			
79	95.09.21	11.0	12.0	1.0	1	0	1	0			2	3			
80	95.09.21	15.3	16.3	1.0	1	0	1	0			11	3			
81	95.09.22	16.0	18.3	2.5	1	0	1	0			8	1			
82	95.09.23	16.3	19.0	2.5	1	0	1	0			5	2			
83	95.09.24	8.0	9.5	1.8	1	0	1	0			10	3			
84	95.09.29	14.3	17.3	3.0	1	0	1	0			5	1			
85	95.09.30	15.0	17.3	2.5	1	0	1	0			31	2			
86	95.10.01	11.0	14.0	3.0	1	0	1	0			11	1			
87	95.10.02	14.3	17.0	2.5	1	0	1	0			1	1			
88	95.10.03	15.0	18.0	3.0	1	0	1	0			6	1			
89	95.10.04	14.3	17.3	3.0	1	0	1	0			11	1			
90	95.10.14	14.0	16.0	2.0	1	0	1	0			3	1			
91	95.10.18	10.3	12.3	2.0	1	0	1	0			7	1			
92	95.10.18	12.5	14.5	2.0	1	0	0	1			5	4			
93	95.10.19	9.3	11.3	2.0	1	0	0	1			5	2			
94	95.10.19	12.0	15.0	3.0	1	0	1	0			7	1			
95	95.10.20	6.3	8.3	2.0	1	0	0	1			6	2			
96	95.10.22	12.0	14.0	2.0	1	0	0	1			6	2			
97	95.10.22	15.0	17.3	2.5	1	0	1	0			32	2			
98	95.10.23	7.0	10.0	3.0	1	0	0	1			14	2			
99	95.10.23	16.3	21.3	5.5	0	1	1	0			17	1			
100	95.10.24	9.0	12.0	3.0	1	0	1	0			11	2			
101	95.10.24	14.0	17.0	3.0	1	0	0	1			18	2			
102	95.10.25	8.0	12.0	4.0	1	0	1	0			4	2			
103	95.10.25	16.0	22.0	6.0	0	1	0	1			7	4			
104	95.10.26	6.0	10.3	4.5	1	0	0	1			7	3			
Totals for Year 1: 1995				403.75	96.00	8.00	54.00	50.00			2363.00	199.00			
								Year 2: 1996							
125	96.04.03	10.3	10.4	0.2	1			1	124	0	124		729.4	0.0	729.4
126	96.05.11	17.0	20.3	3.5		1		1	548	1750	2298		156.6	500.0	656.6
127	96.05.12	1.0	5.0	4.0		1		1	858	0	858		214.5	0.0	214.5
128	96.05.12a	12.0	14.0	2.0	1			1	753	230	983		376.5	115.0	491.5
129	96.05.13	12.5	14.0	1.3	1			1	752	0	752		601.6	0.0	601.6
130	96.05.15	18.0	21.0	3.0		1		1	3002	14000	17002		1,000.7	4,666.7	5,667.3
131	96.05.16	13.3	14.3	1.0	1			1	636	185	821		636.0	185.0	821.0
132	96.05.17	18.0	21.0	3.0		1		1	1517	0	1517		505.7	0.0	505.7
133	96.05.18	18.0	21.0	3.0		1		1	1319	6340	7659		439.7	2,113.3	2,553.0
134	96.05.20	13.3	15.3	2.0	1			1	487	0	487		243.5	0.0	243.5
135	96.05.20a	18.2	22.0	3.8		1		1	1069	3850	4919		285.1	1,026.7	1,311.7
136	96.05.21	18.3	22.3	4.0		1		1	552	2755	3307		138.0	688.8	826.8
137	96.05.22	18.2	19.5	1.5		1	1		13	13	26		8.7	8.7	17.3
138	96.05.23	9.0	12.3	3.5	1		1		9	0	9		2.6	0.0	2.6
139	96.05.24	18.0	22.0	4.0		1	1		3	0	3		0.8	0.0	0.8
140	96.05.25	18.0	24.0	6.0		1		1	164	128	292		27.3	21.3	48.7
141	96.05.26	18.3	22.3	2.0		1		1	136	168	304		68.0	84.0	152.0
142	96.05.28	7.0	9.0	2.0	1			1	79	0	79		39.5	0.0	39.5
143	96.05.28a	19.0	23.0	4.0		1		1	222	265	487		55.5	66.3	121.8
144	96.05.29	11.3	13.5	2.3	1			1	60	14	74		26.7	6.2	32.9

Table D.2: Fishpass sampling data

SET No	DATE	SAMPLING TIME Begin hr	End hr	Duration hrs	PERIOD Day	Nite	CHAMBER R/S	C/S	Fish no.	Icha no.	Total no.	Schools no.	Fish no. per hr	Icha no. per hr	Total no. per hr
145	96.05.30	9.0	12.0	3.0	1			1	290	0	290		96.7	0.0	96.7
146	96.05.30a	19.0	23.0	4.0		1		1	229	190	419		57.3	47.5	104.8
147	96.05.31	15.0	19.3	4.5	1			1	359	54	413		79.8	12.0	91.8
148	96.06.01	12.3	14.0	1.5	1			1	150	0	150		100.0	0.0	100.0
149	96.06.01a	18.5	22.5	4.0		1		1	268	1800	2068		67.0	450.0	517.0
150	96.06.02	19.0	23.0	4.0		1		1	421	2320	2741		105.3	580.0	685.3
151	96.06.03	18.3	22.3	4.0		1	1		48	0	48		12.0	0.0	12.0
152	96.06.04	13.0	16.0	3.0	1		1		29	0	29		9.7	0.0	9.7
153	96.06.05	9.0	11.0	2.0	1		1		10	0	10		5.0	0.0	5.0
154	96.06.06	17.0	22.3	5.5		1		1	388	720	1108		70.5	130.9	201.5
155	96.06.07	18.0	22.3	4.5		1		1	219	314	533		48.7	69.8	118.4
156	96.06.08	8.0	11.0	3.0	1			1	195	0	195		65.0	0.0	65.0
157	96.06.09	18.3	23.3	5.0		1		1	190	268	458		38.0	53.6	91.6
158	96.06.10	12.3	15.3	3.0	1		1		22	0	22		7.3	0.0	7.3
159	96.06.11	12.3	15.3	3.0	1			1	67	0	67		22.3	0.0	22.3
160	96.06.12	12.0	14.0	2.0	1			1	80	0	80		40.0	0.0	40.0
161	96.06.13	12.0	14.3	2.5	1			1	74	0	74		29.6	0.0	29.6
162	96.06.14	15.0	18.0	3.0	1		1		26	0	26		8.7	0.0	8.7
163	96.06.14 a	18.0	23.0	5.0		1		1	164	158	322		32.8	31.6	64.4
164	96.06.15	10.0	14.0	4.0	1			1	129	4	133		32.3	1.0	33.3
165	96.06.16	18.0	23.0	5.0		1	1		6	0	6		1.2	0.0	1.2
166	96.06.17	13.0	19.0	6.0	1			1	42	0	42		7.0	0.0	7.0
167	96.06.18	8.0	12.0	4.0	1		1		12	0	12		3.0	0.0	3.0
168	96.06.19	18.0	22.0	4.0		1		1	77	103	180		19.3	25.8	45.0
169	96.06.20	0.0	7.0	7.0		1	1		8	0	8		1.1	0.0	1.1
170	96.06.20 a	13.0	18.0	5.0	1		1		33	0	33		6.6	0.0	6.6
171	96.06.20 b	18.3	23.3	5.0		1		1	182	51	233		36.4	10.2	46.6
172	96.06.21	0.5	7.5	7.0		1		1	103	28	131		14.7	4.0	18.7
173	96.06.21 a	8.3	13.3	5.0	1			1	22	11	33		4.4	2.2	6.6
174	96.06.21 b	14.0	18.3	4.5	1			1	16	0	16		3.6	0.0	3.6
175	96.06.21 c	19.0	23.3	4.5		1		1	65	120	185		14.4	26.7	41.1
176	96.06.22	0.3	8.0	7.5		1		1	76	40	116		10.1	5.3	15.5
177	96.06.22 a	19.0	8.00(+1)	13.0		1	1		13	206	219		1.0	15.8	16.8
177s	96.06.22s	8.3	18.0	9.5	1			1s	72	0	72		7.6	0.0	7.6
178	96.06.23	10.0	18.0	8.0	1		1		18	0	18		2.3	0.0	2.3
179	96.06.23 a	19.0	6.30(+1)	11.5		1		1	136	108	244		11.8	9.4	21.2
180	96.06.24	9.0	17.0	8.0	1			1	80	20	100		10.0	2.5	12.5
181	96.06.24 a	21.0	7.00(+1)	10.0		1	1		14	70	84		1.4	7.0	8.4
182	96.06.25	9.0	15.0	6.0	1		1		30	0	30		5.0	0.0	5.0
183	96.06.25 a	21.0	8.0	11.0		1		1	43	22	65		3.9	2.0	5.9
184	96.06.26	12.0	17.0	5.0	1			1	84	0	84		16.8	0.0	16.8
185	96.06.26 a	11.0	7.0	8.0	1		1		29	10	39		3.6	1.3	4.9
186	96.06.27	9.0	17.0	8.0	1		1		40	0	40		5.0	0.0	5.0
187	96.06.27 a	19.0	8.00(+1)	13.0		1		1	189	35	224		14.5	2.7	17.2
188	96.06.28	12.0	15.0	3.0	1			1	44	0	44		14.7	0.0	14.7
189	96.06.28 a	20.0	6.00(+1)	10.0		1	1		28	33	61		2.8	3.3	6.1
190	96.06.29	10.0	16.0	6.0	1		1		28	0	28		4.7	0.0	4.7
191	96.06.29 a	20.0	7.00(+1)	11.0		1		1	261	73	334		23.7	6.6	30.4
192	96.06.30	11.0	16.0	5.0	1			1	92	0	92		18.4	0.0	18.4
193	96.06.30 a	20.0	7.00(+1)	11.0		1	1		39	19	58		3.5	1.7	5.3
194	96.07.01	12.0	17.0	5.0	1		1		1499	0	1499		299.8	0.0	299.8
195	96.07.01 a	19.0	7.00(+1)	12.0		1		1	7406	1455	8861		617.2	121.3	738.4
196	96.07.02	10.0	14.0	4.0	1			1	2194	859	3053		548.5	214.8	763.3
197	96.07.02 a	23.0	7.00(+1)	8.0		1	1		2210	1826	4036		276.3	228.3	504.5
198	96.07.03	9.0	17.0	8.0	1		1		1124	0	1124		140.5	0.0	140.5
199	96.07.03 a	23.0	5.00(+1)	6.0		1		1	6747	1216	7963		1,124.5	202.7	1,327.2
200	96.07.04	13.0	18.0	5.0	1			1	2089	1222	3311		417.8	244.4	662.2
201	96.07.04 a	22.0	5.00(+1)	7.0		1	1		1039	949	1988		148.4	135.6	284.0
202	96.07.05	10.0	16.0	6.0	1		1		797	0	797		132.8	0.0	132.8
203	96.07.05 a	22.0	6.00(+1)	8.0		1		1	5858	1226	7084		732.3	153.3	885.5
204	96.07.06	11.0	17.0	6.0	1			1	2955	0	2955		492.5	0.0	492.5
205	96.07.06 a	23.0	5.00(+1)	6.0		1	1		1396	1250	2646		232.7	208.3	441.0
206	96.07.08	2.0	6.0	4.0		1		1	698	217	915		174.5	54.3	228.8
207	96.07.08 a	21.0	1.00(+1)	4.0		1	1		1448	842	2290		362.0	210.5	572.5
208	96.07.09	13.0	15.0	2.0	1		1		286	0	286		143.0	0.0	143.0
209	96.07.10	4.0	7.0	3.0		1	1		217	223	440		72.3	74.3	146.7

Table D.2: Fishpass sampling data

SET	DATE	SAMPLING	TIME		PERIOD		CHAMBER		Fish	Icha	Total	Schools	Fish	Icha	Total
No		Begin	End	Duration	Day	Nite			no.	no.	no.	no.	no. per hr	no. per hr	no. per hr
		hr	*hr*	*hrs*			*R/S*	*C/S*							
210	96.07.10 a	10.3	13.0	2.5	1			1	325	0	325		130.0	0.0	130.0
211	96.07.11	3.0	7.0	4.0		1		1	1313	243	1556		328.3	60.8	389.0
212	96.07.11 a	11.0	14.0	3.0	1		1		265	0	265		88.3	0.0	88.3
213	96.07.11 b	22.0	1.00(+1)	3.0		1		1	1128	829	1957		376.0	276.3	652.3
214	96.07.13	3.0	7.0	4.0		1		1	1483	750	2233		370.8	187.5	558.3
215	96.07.13 a	10.0	13.0	3.0	1			1	2073	324	2397		691.0	108.0	799.0
216	96.07.14	0.3	5.0	4.5		1		1	2026	1444	3470		450.2	320.9	771.1
217	96.07.14 a	18.0	22.0	4.0		1	1		145	0	145		36.3	0.0	36.3
218	96.07.15	10.0	12.0	2.0	1		1		110	0	110		55.0	0.0	55.0
219	96.07.16	1.0	5.0	4.0		1		1	139	857	996		34.8	214.3	249.0
220	96.07.16 a	13.0	16.0	3.0	1			1	102	122	224		34.0	40.7	74.7
221	96.07.17	3.0	6.0	3.0		1		1	380	0	380		126.7	0.0	126.7
222	96.07.17 a	12.3	15.3	3.0	1		1		16	0	16		5.3	0.0	5.3
223	96.07.18	18.0	22.0	4.0		1		1	204	177	381		51.0	44.3	95.3
224	96.07.18 a	10.0	12.0	2.0	1			1	171	0	171		85.5	0.0	85.5
225	96.07.19	4.0	7.0	3.0		1	1		29	25	54		9.7	8.3	18.0
226	96.07.19 a	13.0	16.0	3.0	1		1		28	12	40		9.3	4.0	13.3
227	96.07.20	2.0	5.0	3.0		1		1	239	0	239		79.7	0.0	79.7
228	96.07.20 a	12.0	14.0	2.0	1			1	169	0	169		84.5	0.0	84.5
229	96.07.21	19.0	22.3	3.5		1	1		102	77	179		29.1	22.0	51.1
230	96.07.22	3.0	6.0	3.0		1	1		89	189	278		29.7	63.0	92.7
231	96.07.23	5.0	8.0	3.0	1			1	126	117	243		42.0	39.0	81.0
232	96.07.24	21.0	24.0	3.0		1		1	124	179	303		41.3	59.7	101.0
233	96.07.24 a	10.0	12.0	2.0	1		1		9	5	14		4.5	2.5	7.0
234	96.07.25	7.0	10.0	3.0	1			1	110	11	121		36.7	3.7	40.3
235	96.07.25 a	17.3	20.3	3.0		1		1	239	169	408		79.7	56.3	136.0
236	96.07.26	14.0	17.0	3.0	1		1		17	0	17		5.7	0.0	5.7
237	96.07.27	3.0	7.0	4.0		1		1	344	475	819		86.0	118.8	204.8
238	96.07.28	9.0	12.0	3.0	1			1	299	0	299		99.7	0.0	99.7
239	96.07.28 a	22.0	1.0	3.0		1	1		24	47	71		8.0	15.7	23.7
240	96.07.29	12.0	15.3	3.5	1		1		61	0	61		17.4	0.0	17.4
241	96.07.29 a	22.0	0.3	2.5		1	1		33	15	48		13.2	6.0	19.2
242	96.07.30	11.0	13.0	2.0	1			1	96	0	96		48.0	0.0	48.0
243	96.07.31	20.0	24.0	4.0		1		1	118	177	295		29.5	44.3	73.8
244	96.08.01	10.0	12.0	2.0	1		1		55	0	55		27.5	0.0	27.5
245	96.08.01 a	20.0	22.3	2.5		1	1		24	0	24		9.6	0.0	9.6
246	96.08.02	3.0	7.0	4.0		1		1	193	119	312		48.3	29.8	78.0
247	96.08.02 a	14.0	16.0	2.0	1		1		12	0	12		6.0	0.0	6.0
248	96.08.03	7.0	10.3	3.5	1		1		17	0	17		4.9	0.0	4.9
249	96.08.03 a	19.0	22.0	3.0		1	1		21	0	21		7.0	0.0	7.0
250	96.08.04	2.0	5.3	3.5		1	1		50	0	50		14.3	0.0	14.3
251	96.08.05	18.3	22.0	3.5		1	1		49	9	58		14.0	2.6	16.6
252	96.08.06	2.0	6.0	4.0		1	1		38	13	51		9.5	3.3	12.8
253	96.08.07	9.0	13.0	4.0	1		1		30	0	30		7.5	0.0	7.5
254	96.08.08	17.0	20.0	3.0		1	1		34	7	41		11.3	2.3	13.7
254s	96.08.08s	17.0	20.0	3.0		1		1s	60	57	117		20.0	19.0	39.0
255	96.08.09	18.0	22.0	4.0		1	1		36	6	42		9.0	1.5	10.5
255s	96.08.10s	11.0	14.0	3.0	1			1s	158	0	158		52.7	0.0	52.7
255ss	96.08.10ss	17.0	20.0	3.0		1		1s	163	46	209		54.3	15.3	69.7
256	96.08.11	17.0	20.3	3.5		1	1		104	5	109		29.7	1.4	31.1
257	96.08.12	2.3	6.3	4.0		1	1		36	13	49		9.0	3.3	12.3
257s	96.08.12s	21.3	24.0	2.5		1		1s	219	144	363		87.6	57.6	145.2
258	96.08.13	23.3	2.0	3.5		1	1		25	19	44		7.1	5.4	12.6
258ss	96.08.13s	6.0	9.0	3.0		1		1s	167	0	167		55.7	0.0	55.7
259	96.08.14	11.0	13.0	2.0	1		1		50	0	50		25.0	0.0	25.0
259s	96.08.14s	17.0	22.0	5.0		1		1s	182	77	259		36.4	15.4	51.8
259ss	96.08.15s	9.0	11.0	2.0	1			1s	194	0	194		97.0	0.0	97.0
260	96.08.16	3.0	6.3	3.5		1	1		27	40	67		7.7	11.4	19.1
261	96.08.16 a	16.3	20.0	3.5		1	1		46	0	46		13.1	0.0	13.1
261s	96.08.17s	2.0	5.0	3.0		1		1s	95	72	167		31.7	24.0	55.7
261ss	96.08.17s	23.0	5.0	6.0		1		1s	167	23	190		27.8	3.8	31.7
262	96.08.18	21.0	24.0	3.0		1	1		34	25	59		11.3	8.3	19.7
262s	96.08.19s	17.0	20.3	3.5		1		1s	391	145	536		111.7	41.4	153.1
263	96.08.20	16.3	20.3	4.0		1	1		55	70	125		13.8	17.5	31.3
264	96.08.21	2.3	5.0	2.5		1	1		30	7	37		12.0	2.8	14.8
265	96.08.21 a	9.0	12.0	3.0	1		1		31	0	31		10.3	0.0	10.3

Table D.2: Fishpass sampling data

SET	DATE	SAMPLING	TIME		PERIOD		CHAMBER		Fish	Icha	Total	Schools	Fish	Icha	Total
No		Begin	End	Duration	Day	Nite			no.	no.	no.	no.	no. per hr	no. per hr	no. per hr
		hr	*hr*	*hrs*			*R/S*	*C/S*							
266	96.08.22	11.0	14.3	3.5	1		1		22	0	22		6.3	0.0	6.3
266s	96.08.23s	8.0	10.3	2.5	1			1s	206	0	206		82.4	0.0	82.4
266ss	96.08.23ss	13.3	16.0	2.5	1			1s	150	0	150		60.0	0.0	60.0
267	96.08.24	20.0	23.0	3.0	1		1		46	6	52		15.3	2.0	17.3
268	96.08.25	3.0	5.3	2.5		1	1		9	0	9		3.6	0.0	3.6
268s	96.08.26s	18.3	21.3	3.0		1		1s	130	0	130		43.3	0.0	43.3
269	96.08.27	19.0	22.3	3.0		1	1		26	17	43		8.7	5.7	14.3
270	96.08.28	17.0	20.0	3.0		1	1		51	0	51		17.0	0.0	17.0
270s	96.08.29s	7.0	11.0	4.0	1			1s	126	0	126		31.5	0.0	31.5
271	96.08.30	13.0	16.3	3.5	1		1		41	0	41		11.7	0.0	11.7
272	96.08.31	9.0	12.0	3.0	1		1		31	0	31		10.3	0.0	10.3
273	96.09.01	21.0	24.0	3.0		1	1		33	17	50		11.0	5.7	16.7
273s	96.09.02s	9.0	12.3	3.5	1			1s	129	0	129		36.9	0.0	36.9
274	96.09.03	19.0	22.0	3.0		1	1		36	4	40		12.0	1.3	13.3
275	96.09.04	3.0	6.0	3.0		1	1		26	0	26		8.7	0.0	8.7
275s	96.09.04s	15.0	18.0	3.0	1			1s	96	0	96		32.0	0.0	32.0
276	96.09.05	3.0	6.0	3.0		1	1		20	16	36		6.7	5.3	12.0
277	96.09.05 a	13.0	16.0	3.0	1		1		35	0	35		11.7	0.0	11.7
277s	96.09.06s	3.0	6.0	3.0		1		1s	105	72	177		35.0	24.0	59.0
277ss	96.09.06ss	17.0	20.0	3.0		1		1s	109	0	109		36.3	0.0	36.3
278	96.09.07	3.3	6.3	3.0		1	1		22	13	35		7.3	4.3	11.7
279	96.09.07 a	18.3	21.3	3.0		1	1		27	0	27		9.0	0.0	9.0
279s	96.09.08s	2.0	5.0	3.0		1		1s	47	75	122		15.7	25.0	40.7
280	96.09.09	9.0	12.3	3.5	1		1		45	0	45		12.9	0.0	12.9
281	96.09.10	18.0	22.3	4.5		1	1		72	19	91		16.0	4.2	20.2
282	96.09.11	15.0	18.3	3.5	1		1		36	0	36		10.3	0.0	10.3
282s	96.09.11s	4.0	7.3	3.5		1		1s	147	177	324		42.0	50.6	92.6
283	96.09.12	11.3	14.3	3.0	1		1		30	0	30		10.0	0.0	10.0
284	96.09.13	2.3	5.3	3.0		1	1		54	19	73		18.0	6.3	24.3
284s	96.09.13s	12.3	15.3	3.0	1			1s	99	0	99		33.0	0.0	33.0
285	96.09.14	18.3	21.0	2.5		1	1		102	0	102		40.8	0.0	40.8
285s	96.09.15s	10.0	12.3	2.5	1			1s	287	0	287		114.8	0.0	114.8
286	96.09.16	15.3	18.0	2.5	1		1		109	0	109		43.6	0.0	43.6
286s	96.09.16s	3.0	7.0	4.0		1		1s	367	110	477		91.8	27.5	119.3
287	96.09.17	4.0	7.3	3.5		1	1		73	4	77		20.9	1.1	22.0
287s	96.09.18s	6.0	8.0	2.0	1			1s	235	52	287		117.5	26.0	143.5
288	96.09.19	17.0	21.0	4.0		1	1		93	0	93		23.3	0.0	23.3
289	96.09.20	3.0	7.0	4.0		1	1		91	0	91		22.8	0.0	22.8
289s	96.09.20s	18.0	21.0	3.0		1		1s	221	0	221		73.7	0.0	73.7
290	96.09.21	1.0	5.0	4.0		1	1		87	0	87		21.8	0.0	21.8
291	96.09.22	5.0	7.3	2.5	1		1		131	0	131		52.4	0.0	52.4
292	96.09.23	18.3	21.3	3.0		1	1		7	3	10		2.3	1.0	3.3
293	96.09.24	11.0	14.0	3.0	1		1		60	0	60		20.0	0.0	20.0
293s	96.09.24s	8.0	11.0	3.0	1			1s	248	0	248		82.7	0.0	82.7
293ss	96.09.24ss	14.3	17.3	3.0	1			1s	247	0	247		82.3	0.0	82.3
294	96.09.25	0.3	4.3	4.0		1	1		111	3	114		27.8	0.8	28.5
295	96.09.25 a	15.0	18.0	3.0	1		1		18	0	18		6.0	0.0	6.0
295s	96.09.26s	1.0	5.0	4.0		1		1s	211	0	211		52.8	0.0	52.8
295ss	96.09.26ss	18.3	21.3	3.0		1		1s	199	17	216		66.3	5.7	72.0
296	96.09.27	10.3	13.3	3.0	1		1		193	1	194		64.3	0.3	64.7
297	96.09.27 a	20.0	23.0	3.0		1	1		107	7	114		35.7	2.3	38.0
297s	96.09.28s	7.0	10.0	3.0	1			1s	229	0	229		76.3	0.0	76.3
297ss	96.09.28ss	18.3	21.3	3.0		1		1s	32	5	37		10.7	1.7	12.3
298	96.09.29	4.0	7.0	3.0		1	1		152	11	163		50.7	3.7	54.3
299	96.09.29 a	15.0	18.0	3.0	1		1		88	0	88		29.3	0.0	29.3
299s	96.09.30s	7.0	10.0	3.0	1			1s	327	0	327		109.0	0.0	109.0
299ss	96.09.30ss	18.0	20.0	2.0		1		1s	162	0	162		81.0	0.0	81.0
300	96.10.01	9.0	11.0	2.0	1		1		94	0	94		47.0	0.0	47.0
300s	96.10.02s	14.0	16.0	2.0	1			1s	59	0			29.5	0.0	0.0
301	96.10.03	19.0	21.3	2.5		1	1		46	0	46		18.4	0.0	18.4
301s	96.10.04s	22.0	24.0	2.0		1		1s	31	9	40		15.5	4.5	20.0
302	96.10.05	3.0	6.0	3.0		1	1		54	18	72		18.0	6.0	24.0
302s	96.10.05s	15.0	16.3	1.5	1			1s	38	0	38		25.3	0.0	25.3
303	96.10.06	7.0	9.0	2.0	1		1		13	3	16		6.5	1.5	8.0
303s	96.10.07s	11.0	13.0	2.0	1			1s	21	0	21		10.5	0.0	10.5
304	96.10.08	15.0	17.0	2.0	1		1		17	0	17		8.5	0.0	8.5

Table D.2: Fishpass sampling data

SET	DATE	SAMPLING TIME			PERIOD		CHAMBER		Fish	Icha	Total	Schools	Fish	Icha	Total
No		Begin	End	Duration	Day	Nite			no.	no.	no.	no.	no. per hr	no. per hr	no. per hr
		hr	*hr*	*hrs*			*R/S*	*C/S*							
305	96.10.09	17.3	19.3	2.0		1	1		5	2	7		2.5	1.0	3.5
305s	96.10.09s	1.0	3.3	2.5		1		1s	15	17	32		6.0	6.8	12.8
305ss	96.10.10ss	4.3	6.3	2.0		1		1s	30	13	43		15.0	6.5	21.5
306	96.10.11	9.0	11.0	2.0	1		1		12	0	12		6.0	0.0	6.0
306s	96.10.12s	13.0	15.0	2.0	1			1s	32	0	32		16.0	0.0	16.0
307	96.10.13	22.0	24.0	2.0		1	1		10	9	19		5.0	4.5	9.5
307s	96.10.14s	11.3	13.3	2.0	1			1s	22	0	22		11.0	0.0	11.0
308	96.10.15	0.3	2.3	2.0		1	1		5	7	12		2.5	3.5	6.0
309	96.10.18	10.0	12.3	2.5	1			1	42	0	42		16.8	0.0	16.8
309s	96.10.19s	15.0	17.3	2.5	1		1s		18	0	18		7.2	0.0	7.2
310	96.10.20	8.0	10.0	2.0	1			1	32	0	32		16.0	0.0	16.0
311	96.10.21	17.3	20.0	2.5		1		1	21	7	28		8.4	2.8	11.2
311s	96.10.21s	2.3	5.0	2.5		1	1s		22	4	26		8.8	1.6	10.4
311ss	96.10.22ss	6.0	8.0	2.0	1		1s		15	3	18		7.5	1.5	9.0
312	96.10.23	7.0	9.0	2.0	1			1	22	0	22		11.0	0.0	11.0
313	96.10.31	9.3	12.0	2.5	1			1	25	0	25		10.0	0.0	10.0
313s	96.11.01s	6.0	8.3	2.5	1		1s		24	7	31		9.6	2.8	12.4
314	96.11.02	18.0	20.3	2.5		1		1	36	4	40		14.4	1.6	16.0
314s	96.11.03s	4.0	6.3	2.5		1	1s		5	3	8		2.0	1.2	3.2
315	96.11.04	17.3	22.3	5.0		1		1	105	36	141		21.0	7.2	28.2
316	96.11.05	17.3	22.2	4.8		1		1	83	25	108		17.5	5.3	22.7
316s	96.11.05s	7.3	10.3	3.0	1		1s		67	0	67		22.3	0.0	22.3
Totals for Year 2: 1996 =				905	109	131	113	127	77,649	55,716	133,306		85.8	61.6	147.4
Year 3: 1997															
317	97.05.22	17.0	19.3	2.5	1			1	3008	1620	4628		1,203.2	648.0	1,851.2
318	97.05.23	8.3	11.0	2.5	1			1	3026	15	3041		1,210.4	6.0	1,216.4
319	97.05.23	18.0	20.3	2.5		1	1		72	17	89		28.8	6.8	35.6
320	97.05.24	8.3	11.0	2.5	1		1		76	0	76		30.4	0.0	30.4
321	97.05.24	21.0	23.3	2.5		1		1	3770	2681	6451		1,508.0	1,072.4	2,580.4
322	97.05.25	7.3	10.0	2.5	1		1		238	0	238		95.2	0.0	95.2
323	97.05.25	18.3	21.0	2.5		1	1		50	19	69		20.0	7.6	27.6
324	97.05.26	11.0	13.3	2.5	1			1	1132	0	1132		452.8	0.0	452.8
325	97.05.26	19.0	21.3	2.5		1		1	3254	2270	5524		1,301.6	908.0	2,209.6
326	97.05.27	8.0	10.3	2.5	1		1		89	0	89		35.6	0.0	35.6
327	97.05.27	20.3	23.0	2.5		1	1		58	37	95		23.2	14.8	38.0
328	97.05.28	14.0	16.3	2.5	1			1	133	0	133		53.2	0.0	53.2
329	97.05.29	3.0	5.3	2.5		1		1	3337	2476	5813		1,334.8	990.4	2,325.2
330	97.05.29	18.0	20.0	2.0		1	1		57	47	104		28.5	23.5	52.0
331	97.05.30	11.0	14.0	3.0	1		1		42	0	42		14.0	0.0	14.0
332	97.05.30	20.3	23.0	2.5		1		1	4001	3250	7251		1,600.4	1,300.0	2,900.4
333	97.05.31	7.0	9.3	2.5	1			1	734	0	734		293.6	0.0	293.6
334	97.05.31	21.0	23.3	2.5		1		1	3322	3635	6957		1,328.8	1,454.0	2,782.8
335	97.06.01	12.0	14.3	2.5	1		1		69	0	69		27.6	0.0	27.6
336	97.06.02	3.0	5.3	2.5		1	1		29	0	29		11.6	0.0	11.6
337	97.06.03	2.3	5.3	2.5		1		1	3385	280	3665		1,354.0	112.0	1,466.0
338	97.06.03	14.3	17.0	2.5	1		1		27	0	27		10.8	0.0	10.8
339	97.06.04	2.0	5.0	3.0		1	1		295	246	541		98.3	82.0	180.3
340	97.06.04	13.0	15.3	2.5	1			1	2333	0	2333		933.2	0.0	933.2
341	97.06.05	3.0	5.3	2.5		1		1	3823	2660	6483		1,529.2	1,064.0	2,593.2
342	97.06.05	16.0	18.3	2.5	1		1		40	3	43		16.0	1.2	17.2
343	97.06.06.	3.3	6.0	2.5		1	1		123	47	170		49.2	18.8	68.0
344	97.06.06	15.0	17.3	2.5	1			1	2904	36	2940		1,161.6	14.4	1,176.0
345	97.06.07	2.3	5.3	3.0		1		1	2656	2940	5596		885.3	980.0	1,865.3
346	97.06.07	16.3	19.0	2.5	1		1		49	4	53		19.6	1.6	21.2
347	97.06.08	1.0	4.0	3.0		1	1		123	210	333		41.0	70.0	111.0
348	97.06.08	11.0	13.3	2.5	1			1	492	0	492		196.8	0.0	196.8
349	97.06.08	20.3	23.0	2.5		1		1	282	168	450		112.8	67.2	180.0
350	97.06.09	10.0	12.3	2.5	1			1	255	126	381		102.0	50.4	152.4
351	97.06.10	17.3	20.0	2.5		1		1	2079	76	2155		831.6	30.4	862.0
352	97.06.11	3.0	6.0	3.0		1		1	904	41	945		301.3	13.7	315.0
353	97.06.12	6.0	8.3	2.5	1		1		79	0	79		31.6	0.0	31.6
354	97.06.12	15.3	18.0	2.5	1			1	1732	0	1732		692.8	0.0	692.8
355	97.06.13	2.3	5.0	2.5		1		1	779	0	779		311.6	0.0	311.6

Table D.2: Fishpass sampling data

SET	DATE	SAMPLING	TIME		PERIOD		CHAMBER		Fish	Icha	Total	Schools	Fish	Icha	Total
No		Begin	End	Duration	Day	Nite			no.	no.	no.	no.	no. per hr	no. per hr	no. per hr
		hr	*hr*	*hrs*			*R/S*	*C/S*							
356	97.06.13	20.3	23.0	2.5		1	1		37	20	57		14.8	8.0	22.8
357	97.06.14	16.3	19.0	2.5	1			1	202	0	202		80.8	0.0	80.8
358	97.06.15	7.0	9.3	2.5	1			1	447	0	447		178.8	0.0	178.8
359	97.06.16	14.0	16.3	2.5	1		1		18	0	18		7.2	0.0	7.2
360	97.06.17	16.0	18.3	2.5	1			1	1137	0	1137		454.8	0.0	454.8
361	97.06.18	5.3	8.0	2.5	1			1	1512	892	2404		604.8	356.8	961.6
362	97.06.19	6.0	9.0	3.0	1		1		29	5	34		9.7	1.7	11.3
363	97.06.19	14.3	17.0	2.5	1		1		122	0	122		48.8	0.0	48.8
364	97.06.20	5.3	8.0	2.5	1			1	894	58	952		357.6	23.2	380.8
365	97.06.20	20.3	23.0	2.5		1		1	876	0	876		350.4	0.0	350.4
366	97.06.21	9.0	11.3	2.5	1		1		49	0	49		19.6	0.0	19.6
367	97.06.22	2.3	5.0	2.5		1	1		434	198	632		173.6	79.2	252.8
368	97.06.22	15.0	17.3	2.5	1			1	873	0	873		349.2	0.0	349.2
369	97.06.23	6.3	9.0	2.5	1		1		6	0	6		2.4	0.0	2.4
370	97.06.24	2.0	4.3	2.5		1		1	420	107	527		168.0	42.8	210.8
371	97.06.24	19.0	21.3	2.5		1		1	1156	889	2045		462.4	355.6	818.0
372	97.06.25	11.0	13.3	2.5	1		1		22	0	22		8.8	0.0	8.8
373	97.06.25	21.0	23.3	2.5		1		1	224	61	285		89.6	24.4	114.0
374	97.06.26	10.3	13.3	3.0	1			1	262	0	262		87.3	0.0	87.3
375	97.06.26	18.0	21.0	3.0		1		1	81	12	93		27.0	4.0	31.0
376	97.06.27	7.0	9.3	2.5	1			1	69	12	81		27.6	4.8	32.4
377	97.06.28	9.0	12.0	3.0	1		1		22	0	22		7.3	0.0	7.3
378	97.06.29	4.0	6.3	2.5		1		1	1579	1690	3269		631.6	676.0	1,307.6
379	97.06.29	15.3	18.0	2.5	1			1	149	0	149		59.6	0.0	59.6
380	97.06.30	7.0	9.3	2.5	1			1	861	0	861		344.4	0.0	344.4
381	97.06.30	19.0	21.3	2.5		1		1	796	48	844		318.4	19.2	337.6
382	97.07.01	10.0	12.0	2.0	1			1	524	0	524		262.0	0.0	262.0
383	97.07.02	19.0	21.3	2.5		1	1		28	1	29		11.2	0.4	11.6
384	97.07.03	3.0	5.3	2.5		1		1	1121	1240	2361		448.4	496.0	944.4
385	97.07.03	15.3	18.0	2.5	1			1	972	0	972		388.8	0.0	388.8
386	97.07.04	8.0	10.3	2.5	1		1		31	0	31		12.4	0.0	12.4
387	97.07.05	6.0	8.3	2.5	1			1	1409	8	1417		563.6	3.2	566.8
388	97.07.05	20.3	23.0	2.5		1		1	1321	420	1741		528.4	168.0	696.4
389	97.07.06	18.0	20.3	2.5		1		1	737	262	999		294.8	104.8	399.6
390	97.07.06	21.3	24.0	2.5		1	1		38	18	56		15.2	7.2	22.4
391	97.07.07	12.0	14.3	2.5	1			1	1155	0	1155		462.0	0.0	462.0
392	97.07.08	20.3	23.0	2.5		1		1	1805	640	2445		722.0	256.0	978.0
393	97.07.08	8.3	11.0	2.5	1		1		40	0	40		16.0	0.0	16.0
394	97.07.09	9.0	11.3	2.5	1			1	2126	11	2137		850.4	4.4	854.8
395	97.07.10	19.0	24.0	5.0		1		1	279	67	346		55.8	13.4	69.2
396	97.07.11	1.0	6.0	5.0		1		1	201	1145	1346		40.2	229.0	269.2
397	97.07.11	7.0	12.0	5.0	1			1	774	0	774		154.8	0.0	154.8
398	97.07.11	13.0	18.0	5.0	1			1	2868	0	2868		573.6	0.0	573.6
399	97.07.11	19.0	24.0	5.0		1	1		11	11	22		2.2	2.2	4.4
400	97.07.12	1.0	6.0	5.0		1	1		10	29	39		2.0	5.8	7.8
401	97.07.12	13.0	18.0	5.0	1		1		37	0	37		7.4	0.0	7.4
402	97.07.12	19.0	24.0	5.0		1	1		29	11	40		5.8	2.2	8.0
403	97.07.13	17.0	19.3	2.5	1			1	1052	452	1504		420.8	180.8	601.6
404	97.07.14	9.0	11.3	2.5	1		1		14	0	14		5.6	0.0	5.6
405	97.07.14	19.0	21.3	2.5		1		1	1748	532	2280		699.2	212.8	912.0
406	97.07.15	12.0	15.0	3.0	1			1	1355	0	1355		451.7	0.0	451.7
407	97.07.16	2.3	5.3	3.0		1		1	1667	1430	3097		555.7	476.7	1,032.3
408	97.07.16	19.3	22.3	3.0		1	1		7	13	20		2.3	4.3	6.7
409	97.07.17	10.0	12.3	2.5	1			1	2427	0	2427		970.8	0.0	970.8
410	97.07.17	21.3	24.0	2.5		1		1	2420	870	3290		968.0	348.0	1,316.0
411	97.07.18	15.3	18.0	2.5	1		1		40	0	40		16.0	0.0	16.0
412	97.07.19	1.0	4.0	3.0		1		1	1601	2230	3831		533.7	743.3	1,277.0
413	97.07.19	12.3	15.0	2.5	1			1	224	3	227		89.6	1.2	90.8
414	97.07.20	2.3	5.3	3.0		1	1		87	67	154		29.0	22.3	51.3
415	97.07.20	11.3	14.0	2.5	1			1	1954	0	1954		781.6	0.0	781.6
416	97.07.21	3.3	6.0	2.5		1		1	1103	1216	2319		441.2	486.4	927.6
417	97.07.21	15.0	17.3	2.5	1		1		24	0	24		9.6	0.0	9.6
418	97.07.22	8.0	10.3	2.5	1			1	1994	7	2001		797.6	2.8	800.4
419	97.07.22	19.3	22.0	2.5		1		1	1466	652	2118		586.4	260.8	847.2
420	97.07.23	9.0	11.3	2.5	1			1	2491	3	2494		996.4	1.2	997.6
421	97.07.23	20.0	22.3	2.5		1	1		9	17	26		3.6	6.8	10.4

Table D.2: Fishpass sampling data

SET	DATE	SAMPLING	TIME		PERIOD		CHAMBER		Fish	Icha	Total	Schools	Fish	Icha	Total
No		Begin	End	Duration	Day	Nite			no.	no.	no.	no.	no. per hr	no. per hr	no. per hr
		hr	*hr*	*hrs*			*R/S*	*C/S*							
422	97.07.24	11.0	13.3	2.5	1			1	2341	0	2341		936.4	0.0	936.4
423	97.07.24	21.0	23.3	2.5		1		1	1608	1536	3144		643.2	614.4	1,257.6
424	97.07.25	13.0	15.3	2.5	1		1		51	0	51		20.4	0.0	20.4
425	97.07.25	19.3	22.0	2.5		1		1	2109	937	3046		843.6	374.8	1,218.4
426	97.07.26	6.3	9.0	2.5	1			1	1598	0	1598		639.2	0.0	639.2
427	97.07.26	21.0	23.3	2.5		1	1		17	17	34		6.8	6.8	13.6
428	97.07.27	3.0	5.3	2.5		1		1	1068	1476	2544		427.2	590.4	1,017.6
429	97.07.27	15.0	18.0	3.0	1			1	1735	3	1738		578.3	1.0	579.3
430	97.07.28	3.0	5.3	2.5		1	1		19	27	46		7.6	10.8	18.4
431s	97.07.28	13.0	15.3	2.5	1			1s	1313	0	1313		525.2	0.0	525.2
432	97.07.29	7.0	9.3	2.5	1		1		24	0	24		9.6	0.0	9.6
433	97.07.29	20.0	22.3	2.5		1	1		14	15	29		5.6	6.0	11.6
434s	97.07.30	10.0	12.3	2.5	1			1s	1173	0	1173		469.2	0.0	469.2
435	97.07.31	3.0	6.0	3.0		1	1		16	19	35		5.3	6.3	11.7
436s	97.07.31	13.0	15.3	2.5	1			1s	778	0	778		311.2	0.0	311.2
437	97.08.01	11.0	13.3	2.5	1		1		30	0	30		12.0	0.0	12.0
438s	97.08.03	21.3	24.0	2.5		1		1s	49	23	72		19.6	9.2	28.8
439	97.08.04	7.0	9.3	2.5	1		1		32	12	44		12.8	4.8	17.6
440	97.08.04	18.0	20.3	2.5		1	1		20	9	29		8.0	3.6	11.6
441s	97.08.05	12.0	14.3	2.5	1			1s	77	0	77		30.8	0.0	30.8
442	97.08.06	3.3	6.0	2.5		1	1		27	18	45		10.8	7.2	18.0
443	97.08.06	13.0	15.3	2.5	1		1		28	0	28		11.2	0.0	11.2
444s	97.08.07	19.0	21.3	2.5		1		1s	90	49	139		36.0	19.6	55.6
445	97.08.08	9.3	12.0	2.5	1		1		33	0	33		13.2	0.0	13.2
446	97.08.08	21.3	24.0	2.5		1	1		21	21	42		8.4	8.4	16.8
447s	97.08.09	9.0	11.3	2.5	1			1s	111	0	111		44.4	0.0	44.4
448	97.08.10	3.0	5.3	2.5		1	1		20	24	44		8.0	9.6	17.6
449	97.08.10	15.0	17.3	2.5	1		1		41	0	41		16.4	0.0	16.4
450s	97.08.11	18.0	20.3	2.5		1		1s	59	47	106		23.6	18.8	42.4
451	97.08.12.	10.0	12.3	2.5	1		1		17	0	17		6.8	0.0	6.8
452	97.08.12	20.3	23.0	2.5		1	1		15	11	26		6.0	4.4	10.4
453s	97.08.13	13.0	15.3	2.5	1			1s	547	0	547		218.8	0.0	218.8
454	97.08.14	6.0	8.3	2.5	1		1		20	0	20		8.0	0.0	8.0
455	97.08.14	18.3	21.0	2.5		1	1		15	11	26		6.0	4.4	10.4
456s	97.08.15	2.3	5.3	3.0		1		1s	142	159	301		47.3	53.0	100.3
457	97.08.16	8.0	10.3	2.5	1		1		39	0	39		15.6	0.0	15.6
458	97.08.16	20.0	22.3	2.5		1	1		13	4	17		5.2	1.6	6.8
459s	97.08.17	9.0	11.3	2.5	1			1s	120	0	120		48.0	0.0	48.0
460	97.08.19	2.0	5.0	3.0		1	1		26	9	35		8.7	3.0	11.7
461	97.08.19	12.0	14.3	2.5	1		1		28	0	28		11.2	0.0	11.2
462s	97.08.20	19.0	21.3	2.5		1		1s	76	27	103		30.4	10.8	41.2
463	97.08.21	11.3	14.0	2.5	1		1		25	0	25		10.0	0.0	10.0
464	97.08.21	21.3	24.0	2.5		1	1		12	9	21		4.8	3.6	8.4
465s	97.08.22	10.0	12.3	2.5	1			1s	115	2	117		46.0	0.8	46.8
466	97.08.23	8.0	10.3	2.5	1		1		38	0	38		15.2	0.0	15.2
467	97.08.23	18.3	21.0	2.5		1	1		14	11	25		5.6	4.4	10.0
468s	97.08.24	3.0	5.3	2.5		1		1s	67	28	95		26.8	11.2	38.0
469	97.08.25	2.3	5.0	2.5		1	1		38	8	46		15.2	3.2	18.4
470	97.08.25	11.0	13.3	2.5	1		1		25	0	25		10.0	0.0	10.0
471s	97.08.26	14.0	16.3	2.5	1			1s	209	0	209		83.6	0.0	83.6
472	97.08.27	6.0	8.3	2.5	1		1		43	0	43		17.2	0.0	17.2
473	97.08.27	19.3	22.0	2.5		1	1		22	7	29		8.8	2.8	11.6
474s	97.08.28	11.0	13.3	2.5	1			1s	112	0	112		44.8	0.0	44.8
475s	97.08.29	2.3	5.3	3.0		1		1s	50	29	79		16.7	9.7	26.3
476	97.08.29	14.3	17.0	2.5	1		1		48	0	48		19.2	0.0	19.2
477	97.08.30	9.3	11.0	2.5	1		1		36	0	36		14.4	0.0	14.4
478	97.08.30	19.0	21.3	2.5		1	1		19	9	28		7.6	3.6	11.2
479s	97.08.31	6.3	9.0	2.5	1			1s	86	3	89		34.4	1.2	35.6
480	97.08.31	15.0	17.3	2.5	1		1		34	0	34		13.6	0.0	13.6
481	97.09.01	3.0	5.3	2.5		1	1		25	17	42		10.0	6.8	16.8
482s	97.09.01	21.0	23.3	2.5		1		1s	30	14	44		12.0	5.6	17.6
483	97.09.02	7.0	9.3	2.5	1		1		24	0	24		9.6	0.0	9.6
484	97.09.02	19.0	21.3	2.5		1	1		17	11	28		6.8	4.4	11.2
485s	97.09.03	9.0	11.3	2.5	1			1s	66	0	66		26.4	0.0	26.4
486	97.09.04	11.0	13.3	2.5	1		1		22	11	33		8.8	4.4	13.2
487	97.09.05	7.0	9.3	2.5	1		1		23	13	36		9.2	5.2	14.4

Table D.2: Fishpass sampling data

SET	DATE	SAMPLING	TIME		PERIOD		CHAMBER		Fish	Icha	Total	Schools	Fish	Icha	Total
No		Begin	End	Duration	Day	Nite			no.	no.	no.	no.	no. per hr	no. per hr	no. per hr
		hr	*hr*	*hrs*			*R/S*	*C/S*							
488	97.09.06	21.0	23.3	2.5		1	1		29	11	40		11.6	4.4	16.0
Totals for Year 3: 1997 =				459	92	80	81	91	115,122	42,888	158,010		251.1	93.5	344.6

Note :

'a', 'b', and 'c' = All these codes are used simply to allow correct cronological sorting by "Microsoft Office".
's' and 'ss' = Direction of migration (Refer to page 51, Volume 1, Main Report)

Table D.3: Fish traffic estimates using pooled mean method

Year 1: 1995		
Total samples	104	
Actual operational hours	3,744	
Mean combined traffic per hr	55	
Total combined traffic	206,446	(uncorrected)
Total combined traffic	412,892	(corrected, x2)
Year2: 1996		
Total samples	240	
Actual operational hours	4,399	
Mean fish per hr	86	
Fish traffic	377,536	
Mean icha per hr	62	
Icha traffic	270,896	
Mean combined traffic per hr	147	
Total combined traffic	648,145	(uncorrected)
Total combined traffic	1,296,290	(corrected, x2)
Year 3: 1997		
Total samples	172	
Actual operational hours	2,609	
Mean fish per hr	251	
Fish traffic	655,078	
Mean icha per hr	94	
Icha traffic	244,045	
Mean combined traffic per hr	345	
Total combined traffic	899,123	(uncorrected)
Total combined traffic	1,798,246	(corrected, x2)

Table D.4: Weight of fish traffic through fishpass during Year 2 (1996)

	Direction of Migration: RIVER to HAOR							Direction of Migration: HAOR to RIVER							Total	
Species	No per *hr*	Length *median* (cm)	Weight median *(g)*	Wt per hr *(g)*	AOP *(hr)*	Subtotal *(kg)*	% *subtotal*	No per *hr*	Length *median* (cm)	Weight median *(g)*	Wt per hr *(g)*	AOP *(hr)*	Subtotal *(kg)*	% *subtotal*	*(kg)*	% *Total*
Icha	190.59	5.1	2.0	381.2	4,399	1,677	15.7%	22.42	4.9	1.4	30.3	4,399	133	4.4%	1,810	13.2%
Boal	1.94	35.8	150.0	291.3	4,399	1,281	12.0%	0.39	38.2	195.0	75.8	4,399	334	11.0%	1,615	11.8%
Mrigel	0.69	30.0	350.0	242.1	4,399	1,065	10.0%						0	0.0%	1,065	7.8%
Chanda	68.04	4.9	2.4	159.9	4,399	703	6.6%	20.54	5.0	2.4	49.3	4,399	217	7.1%	920	6.7%
Golda chingri	5.87	13.0	22.0	129.2	4,399	568	5.3%	1.92	14.1	30.0	57.7	4,399	254	8.4%	822	6.0%
Batashi	25.45	8.6	4.2	106.9	4,399	470	4.4%	13.00	8.2	3.6	46.8	4,399	206	6.8%	676	4.9%
Kalibaush	1.38	19.6	88.0	121.7	4,399	535	5.0%	0.50	16.4	47.0	23.4	4,399	103	3.4%	638	4.6%
Air	6.68	13.9	12.5	83.5	4,399	367	3.4%	5.79	12.5	9.0	52.1	4,399	229	7.6%	596	4.3%
Tengra	24.73	6.4	3.6	89.0	4,399	392	3.7%	2.11	7.0	4.5	9.5	4,399	42	1.4%	433	3.2%
Chapila	8.97	7.5	5.7	51.1	4,399	225	2.1%	7.45	7.4	5.6	41.7	4,399	184	6.1%	409	3.0%
Gonia	5.00	13.0	18.0	90.0	4,399	396	3.7%						0	0.0%	396	2.9%
Bacha	2.14	13.9	19.0	40.6	4,399	179	1.7%	1.55	16.0	31.5	48.8	4,399	215	7.1%	393	2.9%
Mola	22.92	6.4	2.6	59.6	4,399	262	2.5%	8.05	6.1	2.4	19.3	4,399	85	2.8%	347	2.5%
Cheka	1.03	15.5	62.2	63.8	4,399	281	2.6%	0.50	4.3	2.0	1.0	4,399	4	0.1%	285	2.1%
Foli	0.90	16.1	29.0	26.2	4,399	115	1.1%	0.83	19.1	42.0	35.0	4,399	154	5.1%	269	2.0%
Kazoli	9.12	9.4	4.6	42.0	4,399	185	1.7%	4.22	9.0	4.4	18.6	4,399	82	2.7%	266	1.9%
Lachu	1.60	13.9	26.0	41.6	4,399	183	1.7%	0.79	13.0	22.0	17.4	4,399	77	2.5%	260	1.9%
Bheda	4.99	8.8	9.6	47.9	4,399	211	2.0%	0.45	8.7	8.8	4.0	4,399	17	0.6%	228	1.7%
Baim	2.72	17.9	14.0	38.1	4,399	168	1.6%	1.90	13.0	5.4	10.2	4,399	45	1.5%	213	1.5%
Puti	7.72	5.7	4.1	31.6	4,399	139	1.3%	3.77	5.6	4.0	15.1	4,399	66	2.2%	206	1.5%
Rui	0.89	14.6	25.0	22.3	4,399	98	0.9%	1.13	12.4	18.0	20.3	4,399	89	2.9%	187	1.4%
Chela	7.40	8.3	3.8	28.1	4,399	124	1.2%	3.49	8.2	3.7	12.9	4,399	57	1.9%	180	1.3%
Kholisha	2.31	6.1	4.8	11.1	4,399	49	0.5%	1.90	8.4	10.6	20.1	4,399	89	2.9%	137	1.0%
Potka	2.65	6.0	6.8	18.1	4,399	79	0.7%	1.92	5.7	6.0	11.5	4,399	51	1.7%	130	0.9%
Ilish	0.36	20.7	74.0	26.7	4,399	118	1.1%						0	0.0%	118	0.9%
Bailla	3.16	8.0	6.2	19.6	4,399	86	0.8%	0.56	7.0	4.5	2.5	4,399	11	0.4%	97	0.7%
Kaikka	1.48	13.8	5.6	8.3	4,399	36	0.3%	1.94	15.0	7.0	13.6	4,399	60	2.0%	96	0.7%
Chirka baim	5.40	9.4	3.6	19.4	4,399	85	0.8%	0.52	9.5	4.0	2.1	4,399	9	0.3%	95	0.7%
Taki	0.76	12.3	20.0	15.2	4,399	67	0.6%	0.44	10.5	12.0	5.3	4,399	23	0.8%	90	0.7%
Rani	2.92	6.5	4.5	13.1	4,399	58	0.5%	1.52	6.3	4.1	6.2	4,399	27	0.9%	85	0.6%
Dhela	4.82	5.3	2.5	11.8	4,399	52	0.5%	1.96	5.1	2.2	4.3	4,399	19	0.6%	71	0.5%
Pabda	1.07	11.6	13.0	14.0	4,399	61	0.6%						0	0.0%	61	0.4%
Bamosh	1.17	30.6	10.5	12.2	4,399	54	0.5%	0.25	28.8	6.4	1.6	4,399	7	0.2%	61	0.4%
Gulsha	2.63	11.4	4.6	12.1	4,399	53	0.5%	0.27	11.4	4.6	1.2	4,399	5	0.2%	59	0.4%
Shing	1.67	9.6	3.7	6.2	4,399	27	0.3%	1.01	11.4	6.5	6.6	4,399	29	1.0%	56	0.4%
Jainzza	1.74	6.1	2.3	4.0	4,399	18	0.2%	3.37	5.7	2.2	7.4	4,399	33	1.1%	50	0.4%
Bata						0	0.0%	0.62	11.9	16.0	9.9	4,399	44	1.4%	44	0.3%
Boicha	4.28	4.9	2.3	9.8	4,399	43	0.4%						0	0.0%	43	0.3%
Gutum	2.35	7.3	2.6	6.1	4,399	27	0.3%	0.82	7.3	2.5	2.1	4,399	9	0.3%	36	0.3%
Magur	0.33	15.4	23.0	7.5	4,399	33	0.3%	0.23	6.0	2.5	0.6	4,399	3	0.1%	35	0.3%
Darkina	4.09	5.2	1.5	6.1	4,399	27	0.3%	0.82	7.0	2.0	1.6	4,399	7	0.2%	34	0.2%
Ketchki	11.37	4.2	0.5	5.7	4,399	25	0.2%	3.37	4.4	0.6	2.0	4,399	9	0.3%	34	0.2%
Bagair	1.92	5.6	2.0	3.8	4,399	17	0.2%						0	0.0%	17	0.1%
Poa	0.33	9.9	10.6	3.5	4,399	16	0.1%						0	0.0%	16	0.1%
Garua	0.26	11.5	12.0	3.1	4,399	14	0.1%						0	0.0%	14	0.1%
Naptani	0.65	5.6	2.4	1.6	4,399	7	0.1%	0.08	5.8	2.7	0.2	4,399	1	0.03%	8	0.1%
Napit koi	1.31	4.2	0.7	0.9	4,399	4	0.04%	0.75	4.4	0.8	0.6	4,399	3	0.1%	7	0.05%
Kotibacha	0.40	8.2	3.7	1.5	4,399	7	0.1%						0	0.00%	7	0.05%
Koi	0.50	4.4	1.5	0.8	4,399	3	0.03%						0	0.00%	3	0.02%
Shole	0.50	5.1	1.2	0.6	4,399	3	0.02%						0	0.00%	3	0.02%
Matibangra						0	0.0%	0.23	6.0	2.5	0.6	4,399	3	0.1%	3	0.02%
Total						10,690	100.0%						3,032	100.0%	13,722	100.0%

Table D.5: Species composition of traffic through fishpass during Year 2 (1996) and Year 3 (1996)

Year 2: 1996			Year 3: 1997		
Species	No. of specimens	%	Species	No. of specimens	%
Icha	54,452	43.8%	Chanda	84,671	53.6%
Chanda	36,556	29.4%	Icha	42,888	27.1%
Mola	9,009	7.2%	Chela	7,927	5.0%
Chapila	3,982	3.2%	Puti	5,254	3.3%
Batashi	3,301	2.7%	Batashi	3,132	2.0%
Puti	3,098	2.5%	Bacha	2,555	1.6%
Chela	1,742	1.4%	Golda chingri	2,250	1.4%
Tengra	1,442	1.2%	Mola	1,768	1.1%
Golda chingri	993	0.8%	Bailla	1,040	0.7%
Air	966	0.8%	Chapila	895	0.6%
Dhela	919	0.7%	Dhela	822	0.5%
Kazoli	803	0.6%	Tengra	785	0.5%
Bacha	772	0.6%	Gulsha	750	0.5%
Ketchki	758	0.6%	Air	410	0.3%
Bailla	737	0.6%	Gutum	403	0.3%
Rani	556	0.4%	Potka	326	0.2%
Potka	477	0.4%	Kaikka	324	0.2%
Bheda	463	0.4%	Ketchki	294	0.2%
Gutum	443	0.4%	Chirka baim	198	0.1%
Shing	319	0.3%	Bheda	179	0.1%
Gulsha	277	0.2%	Rani	147	0.1%
Chirka	247	0.2%	Kholisha	141	0.1%
Baim	234	0.2%	Taki	137	0.1%
Kaikka	202	0.2%	Bamosh	124	0.1%
Jainzza	189	0.2%	Boicha	118	0.1%
Darkina	168	0.1%	Jainzza	117	0.1%
Boicha	145	0.1%	Darkina	105	0.1%
Naptani	96	0.1%	Naptani	58	0.04%
Meni	95	0.1%	Cheka	25	0.02%
Gilachaki	93	0.1%	Shing	22	0.01%
Buritengra	91	0.1%	Bagair	17	0.01%
Lachu	81	0.1%	Baim	17	0.01%
Kalibaush	79	0.1%	Kazoli	15	0.01%
Kholisha	77	0.1%	Lachu	14	0.01%
Boal	62	0.05%	Kalibaush	9	0.01%
Bagair	55	0.04%	Matibangra	9	0.01%
Taki	52	0.04%	Foli	8	0.01%
Rui	48	0.04%	Tara baim	8	0.01%
Bamosh	42	0.03%	Ilish	6	0.004%
Gonia	42	0.03%	Napit koi	6	0.004%
Pabda	36	0.03%	Magur	5	0.003%
Foli	35	0.03%	Poa	5	0.003%
Napit koi	26	0.02%	Boal	4	0.003%
Gila chanda	24	0.02%	Gonia	4	0.003%
Cheka	18	0.01%	Khorsula	4	0.003%
Chata	17	0.01%	Silvercarp	3	0.002%
Mrigel	11	0.01%	Bata	2	0.001%
Kotibacha	9	0.01%	Mrigel	2	0.001%
Ilish	7	0.01%	Pabda	2	0.001%
Matibangra	6	0.005%	Boga	1	0.001%
Bata	5	0.004%	Garua	1	0.001%
Garua	3	0.002%	Kanpona	1	0.001%
Magur	3	0.002%	Rui	1	0.001%
Titputi	3	0.002%	Shole	1	0.001%
Koi	2	0.002%	TOTAL =	158,010	100.0%
Ghagot	1	0.001%			
Koi bandi	1	0.001%			
Poa	1	0.001%			
Shole	1	0.001%			
TOTAL	124,372	100.0%			

Table D.6: Length characteristics of species recorded in fishpass

Species	Maximum size of species (cm)	Size at first maturity (cm)	Age at first maturity (years)	Smallest size recorded in fishpass sampling (cm)	Largest size recorded in fishpass sampling (cm)
Bagair	180.0	50.0	5	4.0	14.0
Boal	180.0	50.0	1	8.7	73.0
Bamosh	118.0	50.0	1	7.0	47.1
Ghagot	112.0	45.0	3	6.5	6.5
Air	94.0	45.0	2	4.3	33.0
Rui	90.0	50.0	2	3.5	51.2
Mrigel	84.0	45.0	2	6.2	44.0
Baim	75.0	40.0	1	4.7	55.0
Gonia	61.0	23.0	1	2.1	30.0
Ilish	53.0	40.0	1	16.5	25.0
Kalibaush	51.0	25.0	2	2.2	51.0
Shole	40.0	28.0	1	5.1	7.1
Foli	35.0	22.0	1	5.0	27.8
Garua	35.0	18.0	1	11.0	17.3
Lachu	32.0	18.0	1	3.0	21.9
Bailla	30.0	15.0	1	3.3	27.8
Magur	30.0	18.0	1	12.1	21.8
Cheka	29.1	12.0	1	3.3	29.1
Pabda	28.0	14.0	1	6.2	24.7
Shing	27.0	13.0	1	4.5	23.6
Taki	27.0	15.0	1	5.2	25.0
Bacha	26.0	17.0	1	2.9	24.8
Kaikka	26.0	15.0	1	5.0	22.0
Gulsha	25.0	12.0	1	3.7	24.2
Chirka baim	24.8	10.0	1	3.8	24.8
Golda	23.0	15.0	1	4.4	21.2
Koi	22.0	17.0	1	4.1	4.7
Bata	20.0	12.0	1	3.6	18.9
Bheda	20.0	8.0	1	3.0	16.9
Chapila	20.0	10.0	1	2.0	19.2
Poa	19.0	10.0	1	2.5	9.9
Meni	16.9	4.0	1	3.0	16.9
Kazoli	15.0	7.0	1	2.0	12.8
Mola	15.0	4.0	1	1.0	9.9
Puti	15.0	6.0	1	1.8	13.0
Rani	15.0	7.0	1	2.0	11.2
Tengra	15.0	7.0	1	0.8	15.0
Chela	14.0	5.0	1	1.0	13.9
Icha	13.9	4.0	0.5	1.0	13.9
Potka	13.2	5.0	1	2.8	12.0
Kotibacha	12.7	8.0	1	6.0	12.7
Gutum	12.0	5.0	1	3.0	12.0
Batashi	11.3	4.5	1	2.1	11.3
Kholisha	10.8	4.0	1	2.3	10.8
Dhela	10.2	5.0	1	2.4	10.2
Darkina	10.2	4.0	1	1.0	10.2
Chanda	10.0	4.0	0.25	1.0	8.0
Ketchki	9.5	3.5	1	1.0	9.5
Jainzza	9.1	5.0	1	2.1	9.1
Buritengra	9.0	5.0	1	6.8	7.5
Boicha	8.0	3.5	1	2.0	6.8
Matibangra	8.0	3.0	1	4.9	7.3
Naptani	7.2	4.0	1	2.0	7.2
Koibandi	7.0	5.0	1	3.1	6.1

Table D.7: Occurence of fish species in fishpass as a function of water velocity at vertical slot

Year 2: 1996								
	Water velocity ranges at vertical slot (m/s)							
	0.00-0.99	1.00-1.24	1.25-1.49	1.50-1.74	1.75-1.99	2.00-2.24	2.25-2.50	2.25-2.50
	COUNTERCURRENT SWIMMING							*CONCURRENT*
Air		1						1
Bacha	1	1	1	1	1	1	1	1
Bagair								
Bailla	1	1	1			1		1
Baim	1	1	1	1				1
Bamosh						1		
Bata	1							
Batashi	1	1	1			1		1
Bheda	1	1	1					1
Boal		1						1
Boicha								1
Chanda	1	1	1	1	1	1	1	1
Chapila	1	1	1			1		1
Cheka		1	1					1
Chela	1	1	1			1		1
Chirka baim	1	1	1					1
Darkina			1			1	1	1
Dhela	1	1	1	1		1		1
Foli	1	1			1			1
Garua								1
Golda chingri	1	1						1
Gonia								1
Gulsha		1						1
Gutum	1	1	1	1		1	1	1
Icha	1	1	1	1		1	1	1
Ilish								
Jainzza	1	1				1		1
Kaikka	1	1	1					1
Kalibaush	1	1	1					1
Kazoli	1	1						1
Ketchki	1	1						1
Kholisha								1
Koi								
Kotibacha								1
Lachu	1	1	1	1			1	1
Magur								
Matibangra		1	1					
Mola	1	1	1	1	1	1		1
Mrigel		1	1					
Napit koi	1	1						
Naptani		1						1
Pabda								1
Poa								1
Potka	1	1	1	1				1
Puti	1	1	1	1	1	1	1	1
Rani	1	1	1	1	1	1	1	1
Rui		1		1				1
Shing	1	1	1	1		1	1	1
Shole								
Taki	1	1				1		1
Tengra	1	1				1		1
TOTAL	**29**	**36**	**24**	**13**	**6**	**18**	**9**	**41**

Table D.7: Occurence of fish species in fishpass as a function of water velocity at vertical slot

Year 3: 1997							
	Water velocity ranges at vertical slot (m/s)						
	0.00-0.99	**1.00-1.24**	**1.25-1.49**	**1.50-1.74**	**1.75-1.99**		**1.75-1.99**
	COUNTERCURRENT SWIMMING						*CONCURRENT*
Air			1				1
Bacha	1	1	1	1	1		1
Bagair							1
Bailla	1	1	1	1			1
Baim							1
Bamosh			1				1
Bata							1
Batashi		1	1	1	1		1
Bheda	1						1
Boal							
Boicha				1			1
Chanda	1	1	1	1	1		1
Chapila	1		1	1	1		1
Cheka			1				1
Chela	1	1	1	1	1		1
Chirka baim	1	1	1	1			1
Darkina			1				1
Dhela	1	1	1	1	1		1
Foli							1
Garua							
Golda chingri			1				1
Gonia							
Gulsha	1		1				1
Gutum	1	1	1				1
Icha	1	1	1	1	1		1
Ilish							1
Jainzza		1		1	1		1
Kaikka	1		1	1	1		1
Kalibaush							
Kazoli				1			1
Ketchki		1		1	1		1
Kholisha							1
Koi							
Kotibacha							
Lachu	1						1
Magur							
Matibangra							1
Mola	1	1	1	1			1
Mrigel							
Napit koi							
Naptani		1		1	1		1
Pabda							
Poa							1
Potka			1	1	1		1
Puti	1	1	1	1	1		1
Rani	1	1	1	1	1		
Rui							
Shing							1
Shole							1
Taki	1			1			1
Tara baim			1	1	1		
Tengra	1	1	1				1
TOTAL	**18**	**16**	**23**	**21**	**15**		**39**

Table D.8: Species composition of traffic through fishpass during monsoon flood surges in Year 2 (1996)

Species composition in numbers

MONSOON FLOOD No. 1		MONSOON FLOOD No. 3		MONSOON FLOOD No. 3	
Direction of migration: river to haor		Direction of migration: river to haor		Direction of migration: haor to river	
Period: 9 May to 26 May 1996		Period: 29 June to 16 July 1996		Period: 29 June to 15 July 1996	
Chanda	49.2%	Chanda	51.7%	Chanda	59.6%
Batashi	11.0%	Mola	17.0%	Mola	10.4%
Tengra	4.5%	Chapila	5.7%	Chapila	8.4%
Mola	4.5%	Batashi	4.3%	Puti	5.5%
Bheda	3.8%	Puti	4.0%	Batashi	3.5%
Puti	2.7%	Chela	2.2%	Chela	3.0%
Ketchki	2.6%	Dhela	1.7%	Dhela	1.7%
Chela	2.2%	Tengra	1.7%	**Golda chingri**	**1.2%**
Chirka baim	2.1%	Kazoli	1.7%	Bacha	1.2%
Air	**2.0%**	**Air**	**1.5%**	Rani	1.0%
Golda chingri	**1.9%**	Ketchki	1.4%	Potka	0.9%
Chapila	1.7%	Bailla	1.1%	**Air**	**0.7%**
Bailla	1.6%	**Golda chingri**	**1.0%**	Kazoli	0.6%
Gutum	1.5%	Rani	0.8%	Ketchki	0.5%
Boicha	1.4%	Bheda	0.5%	Jainzza	0.5%
Dhela	1.1%	Gulsha	0.5%	Gutum	0.4%
Darkina	0.9%	Potka	0.4%	Baim	0.2%
Potka	0.8%	Bacha	0.4%	Bailla	0.2%
Bacha	0.7%	Shing	0.3%	Tengra	0.2%
Gulsha	0.6%	Kaikka	0.2%	**Kalibaush**	**0.1%**
Kaikka	0.5%	Gutum	0.2%	**Rui**	**0.1%**
Baim	0.5%	Naptani	0.2%	**Boal**	**0.05%**
Boal	**0.3%**	Darkina	0.2%	Napit koi	0.04%
Shing	0.3%	Baim	0.2%	Cheka	0.03%
Gonia	**0.3%**	Chirka baim	0.1%	Chirka baim	0.02%
Kholisha	0.3%	Jainzza	0.1%	Gulsha	0.01%
Kalibaush	**0.3%**	**Rui**	**0.1%**	Kaikka	0.01%
Rani	0.2%	**Gonia**	**0.1%**	Matibangra	0.01%
Lachu	0.1%	Lachu	0.1%	TOTAL	100.0%
Cheka	0.1%	Napit koi	0.1%		
Taki	0.1%	**Bagair**	**0.1%**		
Foli	0.1%	Bamosh	0.1%		
Naptani	0.05%	Taki	0.1%		
Pabda	0.04%	**Kalibaush**	**0.1%**		
Jainzza	0.03%	Pabda	0.04%		
Shole	**0.01%**	Foli	0.03%		
Ghagot	**0.01%**	**Mrigel**	**0.03%**		
Garua	0.01%	Cheka	0.02%		
Poa	0.01%	**Ilish**	**0.02%**		
Kazoli	0.01%	**Boal**	**0.02%**		
Rui	**0.01%**	Magur	0.004%		
TOTAL	100.0%	TOTAL	100.0%		

Table D.9: Species composition of traffic through fishpass during monsoon flood surges in Year 3 (1997)

Species composition in numbers

MONSOON FLOOD No. 1		MONSOON FLOOD No. 2		MONSOON FLOOD No. 1		MONSOON FLOOD No. 2	
River to Haor movement		River to Haor movement		Haor to River movement		Haor to River movement	
22 May to 31 May 97		3 June to 13 June 97		23 May to 1 June 97		3 June to 13 June 97	
Chanda	69.42%	Chanda	73.86%	Chanda	44.69%	Chanda	74.45%
Batashi	6.05%	Puti	6.72%	Puti	13.85%	Bacha	5.40%
Chela	4.55%	**Golda chingri**	**4.10%**	Bacha	8.98%	Ketchki	4.60%
Puti	4.20%	Batashi	3.82%	Ketchki	8.72%	Puti	4.05%
Bacha	2.31%	Bacha	2.53%	Chela	8.44%	Chela	3.91%
Golda chingri	**2.29%**	Bailla	1.37%	Batashi	4.17%	Batashi	3.25%
Bailla	1.93%	Chela	1.01%	Mola	2.22%	Chapila	1.94%
Mola	1.16%	Chapila	0.95%	Chapila	2.12%	Kaikka	0.55%
Chapila	1.03%	Dhela	0.94%	Jainzza	1.99%	Bailla	0.43%
Kaikka	0.93%	Tengra	0.87%	Dhela	1.19%	Dhela	0.43%
Tengra	0.86%	Mola	0.84%	Potka	0.99%	Naptani	0.38%
Gulsha	0.83%	Gulsha	0.58%	Bailla	0.67%	Rani	0.26%
Gutum	0.69%	**Air**	**0.47%**	Kaikka	0.54%	Jainzza	0.12%
Dhela	0.67%	Ketchki	0.27%	Rani	0.26%	Potka	0.12%
Ketchki	0.40%	Potka	0.25%	Tara baim	0.26%	Tara baim	0.12%
Air	**0.38%**	Kaikka	0.19%	Boicha	0.13%	TOTAL =	100.00%
Potka	0.30%	Bheda	0.16%	Kazoli	0.13%		
Bheda	0.29%	Bamosh	0.15%	Chirka baim	0.13%		
Taki	0.27%	Gutum	0.13%	TOTAL =	100.00%		
Kholisha	0.26%	Darkina	0.13%				
Chirka baim	0.25%	Taki	0.12%				
Boicha	0.22%	Jainzza	0.11%				
Jainzza	0.19%	Kholisha	0.07%				
Darkina	0.17%	Boicha	0.07%				
Naptani	0.09%	Naptani	0.06%				
Bamosh	0.07%	Chirka baim	0.05%				
Cheka	0.03%	**Bagair**	**0.03%**				
Bagair	**0.03%**	Poa	0.02%				
Lachu	0.03%	Cheka	0.02%				
Shing	0.02%	Baim	0.01%				
Baim	0.02%	Shing	0.01%				
Ilish	**0.02%**	Foli	0.01%				
Kazoli	0.02%	Matibangra	0.01%				
Napit koi	0.01%	Kazoli	0.01%				
Tara baim	0.01%	**Boal**	**0.005%**				
Boal	**0.004%**	Rani	0.005%				
Bata	0.004%	Bata	0.005%				
Gonia	**0.004%**	**Ilish**	**0.005%**				
Kanpona	0.004%	Lachu	0.005%				
TOTAL =	100.00%	**Shole**	**0.005%**				
		Gonia	**0.004%**				
		TOTAL =	100.00%				

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Table D.10: Diurnal variation in traffic rates through fishpass

Diurnal Period	Sampling Time	Migration Rates (no per hr) Fish	*Icha*	*Total*	Set No.	Date
Year 2: 1996						
Direction of Movement: RIVER TO HAOR						
Nite	18.30-23.30	36.4	10.2	46.6	171	96.06.20
Nite	00.45-07.45	14.7	4.0	18.7	172	96.06.21
Day	08.30-13.30	4.4	2.2	6.6	173	96.06.21
Day	14.00-18.30	3.6	0.0	3.6	174	96.06.21
Nite	19.00-23.30	14.4	26.7	41.1	175	96.06.21
Nite	00.30-08.00	10.1	5.3	15.5	176	96.06.22
Year 3: 1997						
Direction of Movement: RIVER TO HAOR						
Nite	19.00-24.00	55.80	13.40	69.20	395	97.07.10
Nite	1.00-6.00	40.20	229.00	269.20	396	97.07.11
Day	7.00-12.00	154.80	0.00	154.80	397	97.07.11
Day	13.00-18.00	573.60	0.00	573.60	398	97.07.11
Direction of Movement: HAOR TO RIVER						
Nite	19.00-24.00	2.20	2.20	4.40	399	97.07.11
Nite	1.00-6.00	2.00	5.80	7.80	400	97.07.12
Day	13.00-18.00	7.40	0.00	7.40	401	97.07.12
Nite	19.00-24.00	5.80	2.20	8.00	402	97.07.12

Table D.11: Difference between daytime and nitetime traffic rates through fishpass during Year 2 (1996)

Direction of migration: RIVER to HAOR							
units = no. per hr							
FISH				ICHA			
Set Couplet	Difference *a-b*	Day *a*	Nite *b*	Set Couplet	Difference *a-b*	Day *a*	Nite *b*
127/128	162.0	376.5	214.5	127/128	115.0	115.0	0.0
130/131	-364.7	636.0	1000.7	130/131	185.0	185.0	0.0
131/132	130.3	636.0	505.7	131/132	185.0	185.0	0.0
134/135	-1068.2	243.5	1311.7	134/135	0.0	0.0	0.0
142/143	-16.0	39.5	55.5	142/143	-66.3	0.0	66.3
143/144	-28.8	26.7	55.5	143/144	-60.1	6.2	66.3
145/146	39.4	96.7	57.3	145/146	-47.5	0.0	47.5
146/147	22.5	79.8	57.3	146/147	-35.5	12.0	47.5
148/149	33.0	100.0	67.0	148/149	-450.0	0.0	450.0
155/156	16.3	65.0	48.7	155/156	-69.8	0.0	69.8
156/157	27.0	65.0	38.0	156/157	-53.6	0.0	53.6
161/163	-3.2	29.6	32.8	161/163	-31.6	0.0	31.6
163/164	-0.5	32.3	32.8	163/164	-30.6	1.0	31.6
172/173	-10.3	4.4	14.7	172/173	-1.8	2.2	4.0
174/175	-10.8	3.6	14.4	174/175	-26.7	0.0	26.7
176/177s	-2.5	7.6	10.1	176/177s	-5.3	0.0	5.3
177s/179	-4.2	7.6	11.8	177s/179	-9.4	0.0	9.4
179/180	-1.8	10.0	11.8	179/180	-6.9	2.5	9.4
180/183	6.1	10.0	3.9	180/183	0.5	2.5	2.0
183/184	12.9	16.8	3.9	183/184	-2.0	0.0	2.0
184/187	2.3	16.8	14.5	184/187	-2.7	0.0	2.7
187/188	0.2	14.7	14.5	187/188	-2.7	0.0	2.7
188/191	-9.0	14.7	23.7	188/191	-6.6	0.0	6.6
191/192	-5.3	18.4	23.7	191/192	-6.6	0.0	6.6
192/195	-598.8	18.4	617.2	192/195	-121.3	0.0	121.3
195/196	-68.7	548.5	617.2	195/196	93.5	214.8	121.3
196/199	576.0	1124.5	548.5	196/199	-12.1	202.7	214.8
199/200	-706.7	417.8	1124.5	199/200	41.7	244.4	202.7
200/203	-314.5	417.8	732.3	200/203	91.1	244.4	153.3
203/204	-239.8	492.5	732.3	203/204	-153.3	0.0	153.3
210/211	-198.3	130.0	328.3	210/211	-60.8	0.0	60.8
214/215	320.2	691.0	370.8	214/215	-79.5	108.0	187.5
215/216	-240.8	450.2	691.0	215/216	212.9	320.9	108.0
219/220	-0.8	34.0	34.8	219/220	-173.6	40.7	214.3
220/221	-92.7	34.0	126.7	220/221	40.7	40.7	0.0
223/224	34.5	85.5	51.0	223/224	-44.3	0.0	44.3
227/228	4.8	84.5	79.7	227/228	0.0	0.0	0.0
231/232	0.7	42.0	41.3	231/232	-20.7	39.0	59.7
232/234	-4.6	36.7	41.3	232/234	-56.0	3.7	59.7
234/235	-43.0	36.7	79.7	234/235	-52.6	3.7	56.3
237/238	13.7	99.7	86.0	237/238	-118.8	0.0	118.8
242/243	18.5	48.0	29.5	242/243	-44.3	0.0	44.3
255s/255ss	-1.6	52.7	54.3	255s/255ss	-15.3	0.0	15.3
259s/259ss	60.6	97.0	36.4	259s/259ss	-15.4	0.0	15.4
285s/286s	23.0	114.8	91.8	285s/286s	-27.5	0.0	27.5
297s/297ss	65.6	76.3	10.7	297s/297ss	-1.7	0.0	1.7
299s/299ss	28.0	109.0	81.0	299s/299ss	0.0	0.0	0.0
301s/302s	9.8	25.3	15.5	301s/302s	-4.5	0.0	4.5
310/311	7.6	16.0	8.4	310/311	-2.8	0.0	2.8

Table D.12: Difference between daytime and nitetime traffic rates through fishpass during Year 3 (1997)

Direction of Movement: RIVER TO HAOR						
units= no. per hr						
	FISH			ICHA		
Set Couplet	Difference	Day	Nite	Difference	Day	Nite
	a-b	*a*	*b*	*a-b*	*a*	*b*
324/325	-849	453	1302	-908	0	908
333/334	-1035	294	1329	-1454	0	1454
348/349	84	197	113	-67	0	67
364/365	7	358	350	23	23	0
374/375	60	87	27	-4	0	4
378/379	-572	60	632	-676	0	676
380/381	26	344	318	-19	0	19
384/385	-60	389	448	-496	0	496
387/388	35	564	528	-165	3	168
409/410	3	971	968	-348	0	348
412/413	-444	90	534	-742	1	743
418/419	211	798	586	-258	3	261
422/423	293	936	643	-614	0	614
428/429	151	578	427	-589	1	590

Appendix E

MIGRATION RECORDS OF INDIVIDUAL FISH SPECIES

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E.1 GENERAL RESULTS

Quantitative information about fish traffic through the fishpass is based mainly on regular sampling with cages and other devices in the R/S and C/S observation chambers. Additional information was obtained from visual observations of the surface of the pools, but this was not done in a regular systematic manner. The visual observation results (Appendix D, Table D.1) are therefore entirely coincidental and subject to some error of identification and size estimation.

It is also clear from a sampling exercise for fish spawn and hatchlings with a small-mesh savarjal that these are very abundant during the premonsoon and probably also early monsoon. The mesh size of the cage is too large to sample spawn and hatchlings, so this size group is entirely unrepresented in the sampling data.

The number of specimens of main fish groups recorded during fishpass sampling are indicated in Table E.1.

Table E.1: Total numbers of specimens of main fish groups recorded in fishpass samples

Group	Year 1 1995	Year 2 1996	Year 3 1997	Total	% of Total
Carp	610	297	36	943	0.3%
Large catfish	52	1,087	431	1,568	0.5%
Other large species	215	352	148	715	0.2%
Giant freshwater prawn	61	1,012	2,250	3,323	1.1%
Small cyprinids	6,528	17,606	15,876	40,010	12.8%
Small catfish	342	7,517	7,146	15,005	4.8%
Other small fish species	12,847	49,523	89,049	151,110	48.3%
Small prawns	1,885	55,715	42,888	100,488	32.1%
TOTAL	**22,540**	**133,109**	**157,824**	**313,162**	**100%**

Small species were by far the most abundant specimens in fish samples (98.0%). The most common group was the category 'other small fish species' (48.3%), due mainly to large numbers of *chanda*. Small prawns were the second largest group (32.1%), followed by small cyprinids (12.8%) and small catfish (4.8%).

Large species constituted 2.0% of fishpass samples. Giant freshwater prawn were the most common large species (1.1%), followed by large catfish (0.5%), carp (0.3%) and other large species (0.2%).

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E.2 CARP

E.2.1 Summary of Carp Migration

The total numbers of specimens of carp species recorded in the fishpass are presented in Table E.2.

Table E.2: Total numbers of specimens of carp species recorded in fishpass samples

Species	Year 1 1995	Year 2 1996	Year 3 1997	Total	% of Total
Lachu	124	91	14	229	24.3%
Kalibaush	117	94	9	220	23.3%
Gonia	142	42	4	188	19.9%
Rui	103	51	1	155	16.4%
Bata	114	5	2	121	12.8%
Mrigel	10	14	2	26	0.3%
Silver carp	0	0	3	3	0.1%
Boga	0	0	1	1	0.1%
Catla	0	0	0	0	-
Mohasol	0	0	0	0	-
Nandina	0	0	0	0	-
Angrot	0	0	0	0	-
Kalabata	0	0	0	0	-
Carpio	0	0	0	0	-
Longu	0	0	0	0	-
TOTAL	**610**	**297**	**36**	**943**	**100%**

The most frequently recorded species were *lachu* (24.3%) and *kalibaush* (23.3%). Somewhat less frequent were *gonia* (19.9%), *rui* (16.4%) and *bata* (12.8%).

Infrequently recorded carp were *mrigel* (0.3%), silver carp (0.1%) and *boga* (0.1%).

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E.2.2 *Lachu*

Monthly sampling data on numbers of specimens and size range is presented in Table E.3.

Table E.3: Fishpass sampling results for the carp *lachu*

Species: LACHU				
	River to Haor Movement		Haor to River Movement	
Month	No of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
Aug	16	3-4.5	-	-
Sept	-	-	102	5.9-6.3
Oct	-	-	6	6.3-6.8
Year 2: 1996				
April	-	-	-	-
May	12	11.0-16.1	1	17.7
June	3	16.5-19.2	5	4.1-18.1
July	29	4.5-18.6	14	10.5-14.2
Aug	9	13.5-14.7	8	6.9-21.9
Sept	7	14.3-16.6	2	12.8-13.1
Oct	-	-	-	-
Nov	1	10.6	-	-
Year 3: 1997				
May	7	19.0-19.7	-	-
June	3	3.4-13.2	-	-
July	1	13.3	-	-
Aug	1	14.3	1	14.8
Sept	-	-	1	11.3

LFM = 17 cm ML = 25 cm

Migration patterns over 3 years were as follows:

- Year 1: *Lachu* fingerlings were recorded during the middle and late monsoon. Migration direction was river to haor during the mid-monsoon, and haor to river during the late monsoon.
- Year 2: Large juveniles and adults were present throughout the monsoon, and movement was in both directions. Fingerlings occurred in the mid-monsoon season, suggesting that spawning occurs during the early flood season.
- Year 3: Traffic during the early and middle monsoon was from river to haor. Fish migrating during the early monsoon were adults, while those of the mid-monsoon were fingerlings and juveniles. During the late monsoon a few juveniles moved from haor to river.

E.2.3 *Kalibaush*

Monthly sampling data on numbers of specimens and size range is presented in Table E.4.

Table E.4: Fishpass sampling results for the carp *kalibaush*

Species: KALIBAUSH				
Month	River to Haor Movement		Haor to River Movement	
	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	26	2.3-14	1	11.2
Aug	24	2.2-11	14	7.3-11.7
Sept	-	-	21	8.1-23.9
Oct	3	19.3-22	28	10.3-23.8
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	36	3.8-29.0	-	-
June	1	4.2	-	-
July	24	13.2-51.0	15	12.5-22.3
Aug	13	12.4-19.5	1	16.2
Sept	3	17.4-27.4	-	-
Oct	1	22.3	-	-
Nov	-	-	-	-
Year 3: 1997				
May	-	-	-	-
June	-	-	-	-
July	8	5.2-28.7	-	-
Aug	1	14	-	-
Sept	-	-	-	-

LFM = 28 cm ML = 63 cm

Migration patterns over 3 years were as follows:

- Year 1: Fingerlings and juveniles moved mainly from river to haor during the mid-monsoon. Late monsoon traffic consisted mainly of juveniles and subadults moving from haor to river. Visual observations of large adult kalibaush were made in June, July and September.
- Year 2: Fingerlings moved from river to haor in the early monsoon. Juveniles, subadults and large adults moved river to haor during the mid-monsoon and late monsoon. Some counter-traffic from haor to river of juveniles and subadults took place during the mid-monsoon. Visual observations were made of subadults and adults in August, September and October.
- Year 3: Fingerling, juveniles and adults were recorded moving river to haor during the mid-monsoon. Visual observations were made of adults in July and August.

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E.2.4 *Gonia*

Monthly sampling data on numbers of specimens and size range is presented in Table E.5.

Table E.5: Fishpass sampling results for the carp *gonia*

Species: Gonia				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1996				
May	1	30	-	-
June	1	15	-	-
July	10	4.5-6	-	-
Aug	-	-	10	4.8-9
Sept	-	-	110	8.3-9.9
Oct	8	8.7-13	2	13.4-15
Year 2: 1996				
April	-	-	-	-
May	14	22.0-23.6	-	-
June	-	-	-	-
July	28	3.9-18.9	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	1	5.2	-	-
June	2	2.1-5.5	-	-
July	1	12.8	-	-
Aug	-	-	-	-
Sept	-	-	-	-

LFM = 23 cm ML = 40 cm

Migration patterns over 3 years were as follows:

- Year 1: Subadult and adult gonia moved from river to haor during the pre-monsoon. Fingerlings moved river to haor during the early monsoon. Most mid and late monsoon traffic consisted of fingerlings and juveniles moving from haor to river. Visual observation was made of large adult gonia in August and October.
- Year 2: All traffic was river to haor, with adults moving during the early monsoon, and fingerlings and juveniles moving during mid-monsoon. Visual observations were made of one adult in September.
- Year 3: All traffic was river to haor, and consisted of fingerlings and juveniles during the early and mid monsoon. Visual observation was made of one adult in August.

E.2.5 *Rui*

Monthly sampling data on numbers of specimens and size range is presented in Table E.6.

Table E.6: Fishpass sampling results for the carp *rui*

Species: RUI				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	36	5-12	29	3-10.5
August	6	5-6.5	31	8.3-11.5
September	-	-	1	10.7
October	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	1	3.5	-	
June	2	4.7-5.8	-	-
July	36	4.6-17.5	9	11.5-13.2
Aug	2	28.3-28.7	-	-
Sept	1	51.2	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	-	-	-	-
June	1	5.0	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-

LFM = 50 cm ML = 91 cm

Migration patterns over 3 years were as follows:

- Year 1: Fingerlings moved in both direction during the mid-monsoon.
- Year 2: Fingerlings and juveniles moved mainly river to haor during the early and mid-monsoon, although there was some counter-traffic. An adult was recorded moving river to haor in the late monsoon. Visual observations were made of subadults in August.
- Year 3: A single fingerling was recorded moving river to haor during the early monsoon. Visual observation was made of subadults in July and August.

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E.2.6 *Bata*

Monthly sampling data on numbers of specimens and size range is presented in Table E.6.

Table E.7: Fishpass sampling results for the carp *bata*

Species: BATA				
Month	River to Haor Movement		Haor to River Movement	
	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
Aug	2	3.6-4.2	-	-
Sept	-	-	4	5.9-13.6
Oct	106	5.7-12.1	2	9.1-10.6
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
Aug	-	-	5	4.3-16.2
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	1	14.6	-	-
June	1	18.9	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-

LFM = ? cm ML = 61 cm

Migration patterns over 3 years were as follows:

- Year 1: Fingerlings and juveniles moved in both directions during the mid and late monsoon.
- Year 2: Fingerling and juveniles were recorded moving haor to river during the mid monsoon.
- Year 3: Juveniles were recorded moving river to haor during early monsoon.

E.2.7 *Mrigel*

Monthly sampling data on numbers of specimens and size range is presented in Table E.8.

Table E.8: Fishpass sampling results for the carp *mrigel*

Species: MRIGEL				
Month	River to Haor Movement		Haor to River Movement	
	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	8	15.5-17
Oct	-	-	2	15.9-18.2
Year 2: 1996				
April	-	-	-	-
May	-	-	-	-
June	-	-	-	-
July	11	27.5-29.5	-	-
Aug	-	-	-	-
Sept	2	24.6-44.0	-	-
Oct	-	-	-	-
Nov	1	23.0	-	-
Year 3: 1997				
May	-	-	-	-
June	1	6.8	-	-
July	1	6.2	-	-
Aug	-	-	-	-
Sept	-	-	-	-

LFM = 38 cm ML = 80 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles were recorded moving haor to river during the late monsoon.
- Year 2: Juveniles and adults were recorded moving river to haor during the mid and late monsoon. Visual observation was made of one subadult in October.
- Year 3: Fingerlings were recorded moving river to haor during the early and mid monsoon.

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E.2.8 Carp Rarely Present in Fishpass or Absent

The following species were rarely found in the fishpass.

- Silver Carp: During Year 3, juveniles and adults (3 specimens) of this non-indigenous Chinese carp were recorded moving river to haor in the mid-monsoon. Visual observation was made of one adult in August.

- Boga: During Year 3, a single fingerling was recorded moving river to haor during the mid-monsoon.

- Catla: LFM = 43 cm, ML = 90. During Year 2, visual observation was made of a subadult in October.

The following species were not recorded in the fishpass, but occur in the area:

- Mohasol: were recorded from the area by NERP or by FAP17.

- Nandina: were recorded from the area by NERP or by FAP17.

- Angrot: were recorded from the area by NERP or by FAP17.

- Kalabata: Rare in region.

- Longu: Rare in region.

- Carpio: The non-indigenous common carp (*carpio*) is the most abundant carp in the *haor*. It has been observed spawning in the Karadair Khal fish sanctuary, but has never been sampled from the fishpass.

E.3 LARGE CATFISH

E.3.1 Summary of Large Catfish Migration

The total numbers of specimens of large catfish species recorded in the fishpass are presented in Table E.9.

Table E.9: Total numbers of specimens of large catfish species recorded in fishpass samples

Species	Year 1 1995	Year 2 1996	Year 3 1997	Total	% of Total
Air	42	967	410	1,417	90.4%
Boal	4	65	4	73	4.7%
Bagair	0	55	17	72	4.6%
Rita	6	0	0	6	0.4%
Pangas	0	0	0	0	-
Silond	0	0	0	0	-
TOTALS	52	1,087	431	1,568	100%

The most frequently recorded species was *air*. *Boal* and *bagair* were infrequent, and *rita* was rare.

E.3.2 *Air*

Monthly sampling data on numbers of specimens and size range is presented in Table E.10.

Table E.10: Fishpass sampling results for the large catfish *air*

Species: AIR				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	25	6.0-24	1	11.3
July	16	6.0-14		
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	298	4.3-16.2	-	-
June	75	6.4-21.2	-	-
July	530	9.2-30.3	64	9.5-17.7
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	98	9-18.5	-	-
June	200	9.6-33.0	17	15-21
July	93	11-29.6	-	-
Aug	2	15.3-23	-	-
Sept	-	-	-	-

LFM = 50 cm ML = 90 cm

Migration patterns over 3 years were as follows:

- Year 1: Fingerlings and juveniles moved mainly river to haor during the early and mid monsoon.
- Year 2: Fingerlings and juveniles moved mainly river to haor during the early and mid monsoon, although some counter-traffic was recorded during the mid monsoon. There was a general tendency for median length to increase over time for river to haor migration (Figure E.1).
- Year 3: Fingerlings and juveniles moved mainly river to haor during the early and mid monsoon, although some counter-traffic of juveniles was recorded during the early monsoon.

E.3.3 *Boal*

Monthly sampling data on numbers of specimens and size range is presented in Table E.11.

Table E.11: Fishpass sampling results for the large catfish *boal*

Species: BOAL				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	1	52	-	-
June	2	36	1	36
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	47	8.7-25.2	-	-
June	-	-	-	-
July	10	28.6-39.2	5	34.3-41.5
Aug	3	48.7-56.2	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	1	26	-	-
June	1	24.5	-	-
July	2	19.7-73	-	-
Aug	-	-	-	-
Sept	-	-	-	-

LFM = 50 cm ML = 180 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles and one adult were recorded moving river to haor during the pre- and early monsoon, while one juvenile moved in the opposite direction during early monsoon. Visual observation was made of subadults and adults in June, July, August and September.
- Year 2: Fingerlings and juveniles moved river to haor during the early monsoon. Juveniles, subadults and adults moved river to haor during the mid monsoon, while some juveniles and subadults moved in the opposite direction. Visual observations were made of subadults and adults in August, September and October.
- Year 3: Juveniles and one adult moved river to haor during the early and mid monsoon. Visual observations were made of subadults and adults in July, August and September.

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E.3.4 *Bagair*

Monthly sampling data on numbers of specimens and size range is presented in Table E.12.

Table E.12: Fishpass sampling results for the large catfish *bagair*

Species: BAGAIR				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	-	-	-	-
June	1	6.3	-	-
July	54	5-5.6	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	7	4-6.3	-	-
June	9	4.1-14	-	-
July	1	4.8	-	-
Aug	-	-	-	-
Sept	-	-	-	-

LFM = 80 cm   ML = 180 cm

Migration patterns over 3 years were as follows:

- Year 1: No *bagair* were recorded. No visual observations were made.
- Year 2: Fingerlings were recorded moving river to haor during the early and mid monsoon.
- Year 3: Fingerlings and juveniles were recorded moving river to haor during the early and mid monsoon.

E.3.5 Large Catfish Rarely Present in Fishpass or Absent

The following species were rarely found in the fishpass:

- Rita: LFM = 33 cm; ML = 55 cm. During Year 1, a small number of subadults and adults were recorded during the premonsoon and early monsoon moving river to haor. Visual observation was made of two subadults during the early monsoon.

The following species were not recorded in the fishpass, but occur in the area:

- Pangas: Extremely rare in area.

- Silond: Extremely rare in area.

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E.4 OTHER LARGE FISH SPECIES

E.4.1 Summary of Migration of Other Large Fish Species

The total numbers of specimens of large fish species recorded in the fishpass are presented in Table E.13.

Table E.13: Total numbers of specimens of large fish species recorded in fishpass samples

Species	Year 1 1995	Year 2 1996	Year 3 1997	Total	% of Total
Baim	147	302	17	466	65.2%
Bamosh	48	42	124	214	29.9%
Chitol	19	0	0	19	2.7%
Ilish	0	7	6	13	1.8%
Shole	1	1	1	3	0.4%
Kuchia	0	0	0	0	-
Cheng	0	0	0	0	-
Gozar	0	0	0	0	-
Shakush	0	0	0	0	-
TOTALS	215	352	148	715	100%

The most frequently recorded species was *baim* (65.2%) followed by *bamosh* (29.9%).

Infrequently recorded species were *chitol* (2.7%), *ilish* (1.8%) and *shole* (0.4%).

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E.4.2 *Baim*

Monthly sampling data on numbers of specimens and size range is presented in Table E.14.

Table E.14: Fishpass sampling results for the large spiny eel *baim*

Species: BAIM				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	1	15	-	-
June	23	4.7-15	2	13.1-16
July	107	5.2-11	1	16.7
August	-	-	2	5.1-8.5
September	-	-	2	7-9.1
October	2	27.3-32.2	7	5.2-7.9
Year 2: 1996				
April	-	-	-	-
May	70	7.3-55	-	-
June	22	6.9-39.2	2	12.2-13.8
July	50	9.1-32.4	37	7-28.6
Aug	-	-	2	11.7-13.7
Sept	59	6.8-16.4	52	8.8-17.7
Oct	2	10.6-15.1	6	8.8-13.2
Nov	-	-	-	-
Year 3: 1997				
May	4	24.6-48.2	-	-
June	7	18-54	-	-
July	6	14.4-52.1	-	-
Aug	-	-	-	-
Sept	-	-	-	-

LFM = 38 cm ML = 80 cm

Migration patterns over 3 years were as follows:

- Year 1: River to haor movement consisted of fingerlings and juveniles during the pre-, early and mid monsoon, and subadults during the late monsoon. Haor to river movement consisted of fingerlings and juveniles during the early, mid and late monsoon.
- Year 2: Fingerlings, juveniles, subadults and adults were recorded moving river to haor during the early and mid monsoon. Some countertraffic of fingerlings and juveniles was recorded during the early and mid monsoon. Fingerlings and juveniles were recorded moving in both direction during the late monsoon.
- Year 3: Juveniles, subadults and adults were recorded moving river to haor during the early and mid monsoon.

E.4.3 *Bamosh*

Monthly sampling data on numbers of specimens and size range is presented in Table E.15.

Table E.15: Fishpass sampling results for the small freshwater eel *bamosh*

Species: BAMOSH				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	24	7-23	-	-
July	5	12.9-21	-	-
August	17	7.7-15	-	-
September	-	-	2	14.1-18
October	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	16	24.1-36.3	-	-
June	2	32.6-38	1	28.8
July	23	21.3-29.7	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	17	19-47.1	-	-
June	69	10.7-46.5	1	15
July	37	14.1-29.6	-	-
Aug	-	-	-	-
Sept	-	-	-	-

- Year 1: Fingerlings and juveniles moved river to haor during the early and mid monsoon. A few fingerlings and juveniles moved haor to river during the late monsoon.
- Year 2: Juveniles and subadults moved mainly river to haor during the early and mid monsoon.
- Year 3: Juveniles, subadults and adults moved mainly river to haor during the early and mid monsoon.

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E.4.4 Other Large Fish Species Rarely Present in Fishpass or Absent

The following species were rarely found in the fishpass:

- Chitol: LFM = 43 cm, ML = 100 cm. During Year 1, juvenile chitol were recorded moving from river to haor during the early monsoon, while juveniles were recorded moving haor to river during the mid monsoon.

- Shole: LFM = 30 cm, ML = 75 cm. During Year 1, a single fingerling was recorded moving from river to haor during the early monsoon. During Year 2, *a* single fingerling was recorded moving from river-to-*haor* during the early monsoon. Visual observation was made of a juvenile in August. During Year 3, a fingerling was recorded moving river to haor during the early monsoon.

- Ilish: LFM = 28 cm, ML = 45 cm. During Year 2, juveniles and subadults were recorded moving river to haor during the mid-monsoon. During Year 3, juveniles and subadults were recorded moving river to haor during the early monsoon.

The following species were not recorded in the fishpass, but occur in the area:

- Kuchia: Uncommon in the area.

- Cheng: Uncommon in the area.

- Gozar: Rare in the river, but common in haor.

- Shakush: Extremely rare in area.

E.5 GIANT FRESHWATER PRAWN

Totals for 3 year are presented in Table E.16.

Table E.16: Total numbers of specimens of the giant river prawn *golda chingri* recorded in fishpass samples

Species	Year 1: 1995	Year 2: 1996	Year 3: 1997	Total
Golda chingri	61	1,012	2,250	3,323

Monthly sampling data on numbers of specimens and size range is presented in Table E.17.

Table E.17: Fishpass sampling results for the large giant river prawn *golda chingri*

Species: GOLDA CHINGRI				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	44	10-18	-	-
July	17	7.4-20	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	334	7.1-18.1	-	-
June	95	6-19.3	-	-
July	409	8-16.9	97	7.2-17.3
Aug	58	8-16.6	14	9.3-18.6
Sept	4	13.8-14.3	1	16.8
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	589	4.7-18.2	-	-
June	1268	4.4-21.2	25	6-20
July	353	6.2-20.9	1	19.1
Aug	9	13.5-18	-	-
Sept	-	-	5	14.7-18.3

LFM = 15 cm ML = 27 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles, subadults and adults moved river to haor during the early and mid monsoon.
- Year 2: Juveniles, subadults and adults moved river to haor during the early monsoon. Juveniles and adults moved in both directions during the mid and late monsoon. There was a general tendency for median length to increase over time for river to haor migration (Figure E.2).

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- Year 3: Juveniles, subadults and adults moved river to haor during the early and mid monsoon. Juveniles, subadults and adults moved haor to river during the early, mid and late monsoon.

E.6 SMALL CYPRINIDS

E.6.1 Summary of Migration of Small Cyprinids

The total numbers of specimens of small cyprinid fish (minnows, barbs, rasboras and their relatives) species recorded in the fishpass are presented in Table E.18.

Table E.18: Total numbers of specimens of small cyprinid fish species recorded in fishpass samples

Species	Year 1 1995	Year 2 1996	Year 3 1997	Total	% of Total
Mola	2,305	10,209	1,768	14,282	35.7%
Chela	2,285	2,147	7,927	12,359	30.9%
Puti	1,041	3,735	5,254	10,030	25.1%
Dhela	159	1,333	822	2,314	5.8%
Darkina	738	182	105	1,025	2.6%
Chebli	-	-	-	-	-
Barali	-	-	-	-	-
Piali	-	-	-	-	-
Kashkhaira	-	-	-	-	-
TOTALS	6,528	17,606	15,876	40,010	100%

The most frequently recorded species were *mola* (35.7%), *chela* (30.9%) and *puti* (25.1%).

Infrequently recorded were *dhela* (5.8%) and *darkina* (2.6%).

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E.6.2 *Mola*

Monthly sampling data on numbers of specimens and size range is presented in Table E.19.

Table E.19: Fishpass sampling results for the small cyprinid fish *mola*

Species: MOLA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	6	6	-	-
June	414	1.7-5	7	2.5-4
July	1100	1-6.1	28	2.1-4
August	133	2-6.7	211	2.2-6.8
September	-	-	406	5.8-7.8
October	-	-	-	-
Year 2: 1996				
April	2	3.8-5.1	-	-
May	627	3.8-9.9	-	-
June	242	3.6-9.3	19	7.1-8.9
July	6615	3.8-8.7	1067	4.2-9.2
Aug	479	4.1-7.8	127	4.1-8.1
Sept	534	3.1-9.9	356	3.4-9.3
Oct	64	4-7.7	65	4-7.5
Nov	8	4.2-8	4	4-7.1
Year 3: 1997				
May	298	4.5-8.3	17	4.3-7.2
June	431	3.4-8.1	18	4-6.2
July	881	3.4-8.6	6	6.6-7.7
Aug	76	4.4-8.5	28	4.8-8.3
Sept	4	4.8-8.2	9	4.8-9.2

LFM = 4.5 cm ML = 9.9 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles and adults moved river to haor during the pre-, early and mid monsoon. Juveniles moved haor to river during the mid monsoon, while juveniles and adults moved haor to river during the late monsoon.
- Year 2: Juveniles and adults moved river to haor during the entire monsoon season. There was a tendency for larger fish to move during the early monsoon, and smaller fish to move during the mid and late monsoon (Figure E.3). Subadults and adults moved haor to river during the mid and late monsoon.
- Year 3: Juveniles and adults moved river to haor during the early, mid and late monsoon. Subadults and adults moved river to haor during the early, mid and late monsoon.

E.6.3 *Chela*

Monthly sampling data on numbers of specimens and size range is presented in Table E.20.

Table E.20: Fishpass sampling results for the small cyprinid fish *chela*

Species: CHELA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	526	2-8	18	3-8
July	400	1-10.3	102	4-12.5
August	22	2.9-10	3	5-12
September	-	-	414	4.7-11.1
October	700	4.5-10.8	100	4.7-5.9
Year 2: 1996				
April	1	6.8	-	-
May	288	4.8-13.9	1	9.1
June	145	5.1-12.1	27	5.3-9.2
July	768	4.3-12.6	372	5.4-11.7
Aug	311	4.2-12.1	91	4.7-12
Sept	53	5-10.2	46	5.1-11.7
Oct	22	6.4-12.2	-	-
Nov	22	5.5-11.6	-	-
Year 3: 1997				
May	1169	4-10.2	59	4.1-12.6
June	484	2.7-12.6	191	3.4-9.2
July	5097	4.1-13.1	166	4.2-13.9
Aug	553	4.3-10.1	156	4.7-12.1
Sept	13	4.9-8.7	39	4.8-9.1

LFM = 5.5 cm ML = 15.0 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles and adults moved in both directions during the early, mid and late monsoon.
- Year 2: Subadults and adults moved river to haor throughout the monsoon season. Subadults and adults moved haor to river during the early, mid and late monsoon.
- Year 3: Juveniles and adults moved river to haor throughout the early, mid and late monsoon. Juveniles and adults moved haor to river during the early, mid and late monsoon.

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E.6.4 *Puti*

Monthly sampling data on numbers of specimens and size range is presented in Table E.21.

Table E.21: Fishpass sampling results for the small cyprinid fish *puti*

Species: PUTI				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	6	5	-	-
June	131	1.8-13	9	4-8.1
July	65	2-10	233	2.6-8
August	19	2.4-4	17	1-6.6
September	-	-	436	5.4-9.9
October	114	2.8-10.5	11	5.3-9.3
Year 2: 1996				
April	-	-	-	-
May	442	3.3-10.3	2	3.3-4
June	191	3.1-8.8	67	3.3-8.3
July	1735	2.3-9.6	539	2.5-9.1
Aug	235	3.6-8	48	4-8.3
Sept	267	4-8.4	92	4.2-8.3
Oct	63	4.1-8.5	18	5.1-8.5
Nov	35	3.2-9.3	4.1	4.1
Year 3: 1997				
May	1080	2.4-9.2	101	3.1-8.5
June	1698	3.1-10.5	57	3.2-10.5
July	1882	4.3-9.8	22	5.7-9.3
Aug	240	4.8-11	130	4.7-11
Sept	34	5.1-9.2	10	4.3-10.5

LFM = 6.0 cm ML = 15.0 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles and adults moved in river to haor throughout the monsoon season. Juveniles and adults moved haor to river during the early, mid and late monsoon.
- Year 2: Juveniles and adults moved in both directions during the early, mid and late monsoon.
- Year 3: Juveniles and adults moved in both directions during the early, mid and late monsoon.

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E.6.5 *Dhela*

Monthly sampling data on numbers of specimens and size range is presented in Table E.22.

Table E.22: Fishpass sampling results for the small cyprinid *dhela*

Species: DHELA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	15	7	2	7-9
July	122	2.4-5	5	4-5.5
August	3	2.9-4.5	-	-
September	-	-	6	4.1-6.9
October	2	8.1-8.3	4	8-8.3
Year 2: 1996				
April	-	-	-	-
May	104	3.7-7.1	-	-
June	42	3.9-7.5	5	4.2-7.2
July	582	3.1-9	180	4.2-7.1
Aug	114	3.6-6.1	50	3.6-6.2
Sept	144	4-8.2	78	3.8-8.4
Oct	8	4.9-6.4	22	4.1-9.1
Nov	4	4.7-10.2	-	-
Year 3: 1997				
May	172	3.1-8	9	3.2-8.1
June	310	3-8	33	3.4-5.8
July	230	3-8.1	13	3.4-7.5
Aug	23	4.8-8.2	25	3.5-8.2
Sept	3	4.2-4.8	4	4.8-6.1

Migration patterns over 3 years were as follows:

- Year 1: Adults moved river to haor during the early monsoon and during the late monsoon, while juveniles moved river to haor during the mid monsoon. Adults moved haor to river during the early monsoon, juveniles during the mid monsoon and both size classes during the late monsoon.
- Year 2: Juveniles and adults moved in both directions during the early, mid and late monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon, but only juveniles moved during the late monsoon. Juveniles and adults moved haor to river during the early, mid and late monsoon.

2-2-4

E.6.6 *Darkina*

Monthly sampling data on numbers of specimens and size range is presented in Table E.23.

Table E.23: Fishpass sampling results for the small cyprinid *darkina*

Species: DARKINA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	327	1.5-6	-	-
July	410	1-4	-	-
Aug	-	-	-	-
Sept	-	-	1	4.8
Oct	-	-	-	-
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	90	3.2-6	1	4.3
June	7	5.6-7.8	2	6.3-6.4
July	59	4.2-6.1	-	-
Aug	-	-	-	-
Sept	14		9	6-10.2
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	44	3.9-5.6	-	-
June	48	4-8.7	1	4.3
July	12	3.8-5.9	-	-
Aug	-	-	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: Juveniles and adults moved river to haor during the early and mid monsoon. One adult moved haor to river during the late monsoon.
- Year 2: Juveniles and adults moved in both directions during the early, mid and late monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon. A single juvenile moved haor to river during the early monsoon.

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E.6.7 Other Small Cyprinids Absent from Fishpass

The following species were not recorded in the fishpass, but occur in the area: *chebli*, *barali*, *piali*, *kashkhaira*.

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E.7 SMALL CATFISH

E.7.1 Summary of Migration of Small Catfish

The total numbers of specimens of small catfish species recorded in the fishpass are presented in Table E.24.

Table E.24: Total numbers of specimens of small catfish species recorded in fishpass samples

Species	Year 1 1995	Year 2 1996	Year 3 1997	Total	% of Total
Batashi	135	3,302	3,132	6,569	43.8%
Bacha	58	899	2,305	3,262	21.7%
Tengra	20	1,545	785	2,350	15.7%
Gulsha	7	291	750	1,048	7.0%
Kazoli	104	851	2	957	6.4%
Shing	1	377	22	400	2.7%
Jainzza	0	189	117	306	2.0%
Chaka	17	19	25	61	0.4%
Pabda	0	36	2	38	0.3%
Magur	0	3	5	8	0.1%
Garua	0	3	1	4	0.03%
Kotibacha	0	2	0	2	0.01%
Muribacha	0	0	0	0	-
Kani pabda	0	0	0	0	-
Ghagla	0	0	0	0	-
Lia	0	0	0	0	-
Kauwa	0	0	0	0	-
Kutakanti	0	0	0	0	-
Gang tengra	0	0	0	0	-
Bashpata	0	0	0	0	-
TOTALS	342	7,517	7,146	15,005	100%

The most frequently recorded species were *batashi* (43.8%), *bacha* (21.7%) and *tengra* (15.7%).

Less frequent species were *gulsha* (7.0%), *kazoli* (6.4%), *shing* (2.7%) and *jainzza* (2.0%). Rare species were *chaka* (0.4%), *pabda* (0.3%), *magur* (0.1%), *garua* (0.03%) and *kotibacha* (0.01%).

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E.7.2 *Batashi*

Monthly sampling data on numbers of specimens and size range is presented in Table E.25.

Table E.25: Fishpass sampling results for the small catfish *batashi*

Species: BATASHI				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	10	2.1-4	-	-
July	116	3-7	-	-
August	6	7.1	-	-
September	-	-	-	-
October	-	-	3	6.5-9.5
Year 2: 1996				
April	-	-	-	-
May	1341	6.7-11.3	-	-
June	138	7.2-9.6	14	7.8-8.6
July	1468	5.8-10.5	340	6.3-10.5
Aug	-	-	-	-
Sept	-	-	-	-
Oct	1	8.7	-	-
Nov	-	-	-	-
Year 3: 1997				
May	1556	6.9-9.5	31	5.7-9.3
June	1269	3.4-10	37	3.5-9.4
July	211	3.3-9.6	17	6.2-10
Aug	4	6.2-8.3	2	5.2-8.8
Sept	-	-	5	6.1-7.3

LFM = 5.5 cm ML = 11.3 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved river to haor during the early monsoon, and juveniles and adults during mid monsoon. Adults moved haor to river during late monsoon.
- Year 2: Adults moved in both directions during early and mid monsoon. One adult moved river to haor during the late monsoon. There was a general tendency for length to remain constant throughout the monsoon for river to haor migration (Figure E.4).
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon. juveniles and adults moved haor to river during the early and mid monsoon, and adults moved during the late monsoon.

E.7.3 *Bacha*

Monthly sampling data on numbers of specimens and size range is presented in Table E.26.

Table E.26: Fishpass sampling results for the small catfish *bacha*

Species: BACHA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	22	3-14	-	-
July	14	4-13	4	6.4-14.7
August	2	8.8-8.8	7	3.1-15.6
September	-	-	8	12.7-18.1
October	-	-	1	16.2
Year 2: 1996				
April	-	-	-	-
May	78	3-15.7	16	9.8-19.8
June	69	7.7-20.2	59	4.2-22
July	230	8.1-21.2	239	9.8-22.5
Aug	101	9-21.5	70	10.1-23.6
Sept	4	13.5-17.9	30	12.8-18.7
Oct	-	-	3	16.4-22.7
Nov	-	-	-	-
Year 3: 1997				
May	595	6-12.1	61	6-12.1
June	1030	2.9-18.4	100	4.9-14
July	551	5.9-19.3	90	7.6-24.8
Aug	70	7.4-20.1	43	10.5-19.2
Sept	10	14.3-18.3	5	14.7-19.2

LFM = 17.0 cm ML = 30.0 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved river to haor during the early and mid monsoon. Fingerlings, juveniles and subadults moved haor to river during the mid monsoon, and subadults and adults moved late monsoon.
- Year 2: Juveniles and adults moved in both directions during the early, mid and late monsoon. There was a general tendency for length to increase over time for river to haor migration (Figure E.5). Visual observation was made of adults in August.
- Year 3: Fingerlings, juveniles and adults moved river to haor during the early, mid and late monsoon. Juveniles moved haor to river during the early monsoon, while juveniles and adults moved during mid and late monsoon.

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E.7.4 *Tengra*

Monthly sampling data on numbers of specimens and size range is presented in Table E.27.

Table E.27: Fishpass sampling results for the small catfish *tengra*

Species: TENGRA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	1	13	-	-
July	4	3-4.6	-	-
August	-	-	12	5.1-5.3
September	-	-	2	8.5-9.6
October	1	9.8	-	-
Year 2: 1996				
April	91	6.8-7.5	-	-
May	611	4.2-10.3	-	-
June	107	3.9-9.8	1	4.5
July	667	4.4-9.6	52	4.9-10.7
Aug	-	-	4	4.9-6.2
Sept	-	-	2	7.7-8.1
Oct	-	-	7	5-10.2
Nov	-	-	3	5.6-6.9
Year 3: 1997				
May	221	4.8-11.6	-	-
June	254	3.1-14	1	6.8
July	240	4.8-11.9	-	-
Aug	55	0.8-12.1	14	5.4-15
Sept	-	-	-	-

LFM = 9.0 cm   ML = 15.0 cm

Migration patterns over 3 years were as follows:

- Year 1: One adult moved river to haor during the early monsoon, while juveniles moved during the mid monsoon and one adult during the late monsoon. Juveniles moved haor to river during the mid monsoon and subadults and adults during the late monsoon.
- Year 2: Juveniles and adults moved river to haor during the pre-, early and mid monsoon. There was a general tendency for smaller fish to move during the early and mid monsoon and larger fish to move during the late monsoon (Figure E.6). Juveniles and a few adults moved haor to river during the early, mid and late monsoon.
- Year 3: Fingerlings, juveniles and adults moved river to haor during the early and mid monsoon. One juvenile moved haor to river during early monsoon, and juveniles and adults moved haor to river early and mid monsoon.

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E.7.5 *Gulsha*

Monthly sampling data on numbers of specimens and size range is presented in Table E.28.

Table E.28: Fishpass sampling results for the small catfish *gulsha*

Species: GULSHA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	7	5.2-6.5	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
Year 2: 1996				
April	1	7.5	-	-
May	84	4.2-21	-	-
June	19	6.1-24.2	-	-
July	171	6-13.6	1	9
Aug	14	9.8-11.7	1	13.7
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	214	3.9-12.6	-	-
June	223	3.7-16.5	4	7-9.6
July	274	4.2-19.6	2	11.9-13.5
Aug	32	10.2-15.2	1	11.5
Sept	-	-	-	-

LFM = 11.0 cm ML = 24.2 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved river to haor during the mid monsoon.
- Year 2: One juvenile moved river to haor during the pre-monsoon. Juveniles and adults moved river to haor during the early and mid monsoon. One subadult and one adult moved haor to river during the mid monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon. Juveniles moved haor to river during the early monsoon, and adults moved during the mid monsoon.

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E.7.6 *Kazoli*

Monthly sampling data on numbers of specimens and size range is presented in Table E.29.

Table E.29: Fishpass sampling results for the small catfish *kazoli*

Species: KAZOLI				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	5	2-8	-	-
June	25	3.5-10	-	-
July	62	2-8	-	-
Aug	-	-	12	4.5-9.6
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	1	11.5	-	-
June	19	5.6-11.3	-	-
July	555	5.1-12.7	99	5.3-11.6
Aug	68	6.7-12.3	109	6.5-12
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	4	11.8-12.8	1	12.5
June	6	7.1-12.6	1	12
July	3	7.8-12.8	-	-
Aug	-	-	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: Juveniles and adults moved river to haor during early and mid monsoon. Juveniles and adults moved haor to river during the mid monsoon.
- Year 2: Juveniles and adults moved river to haor during the early and mid monsoon. Juveniles and adults moved haor to river during the mid monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon. Adults moved haor to river during the early monsoon.

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E.7.7 *Shing*

Monthly sampling data on numbers of specimens and size range is presented in Table E.30.

Table E.30: Fishpass sampling results for the small catfish *shing*

Species: SHING				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	1	4.5	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	77	5.6-11.2	2	6.3-6.3
June	64	4.5-10.4	8	5.7-16.8
July	130	5.4-23.6	-	-
Aug	18	11.1-13.4	1	9.7
Sept	27	7.6-16.4	40	8.3-17.8
Oct	-	-	9	11.3-17.2
Nov	1	10.8	-	-
Year 3: 1997				
May	5	17-23.4	-	-
June	6	5.8-23.1	-	-
July	9	10.7-16.5	-	-
Aug	2	14.0-17.8	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: One juveniles moved river to haor during the early monsoon.
- Year 2: Juveniles and adults moved in both directions during the early, mid and late monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon.

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E.7.8 *Jainzza*

Monthly sampling data on numbers of specimens and size range is presented in Table E.31.

Table E.31: Fishpass sampling results for the small catfish *jainzza*

Species: JAINZZA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	9	3.5-7.6	1	4.2
June	17	5.1-9.1	2	6.8-6.9
July	77	4.7-8.8	83	4.7-6.9
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	48	4-7.1	11	4.2-7.1
June	43	2.1-7.8	4	4.2-8.4
July	10	3.1-7.3	-	-
Aug	1	6.4	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: No individuals were recorded.
- Year 2: Juveniles and adults moved river to haor during the early and mid monsoon. Juveniles moved haor to river during the early and mid monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon. Juveniles and adults move haor to river during the early monsoon.

E.7.9 Other Small Catfish Less Frequently Present in Fishpass or Absent

The following species were rarely found in the fishpass:

- Chaka: During Year 1, juveniles and adults moved river to haor during the early and mid monsoon. During Year 2, juveniles and adults moved river to haor during the early monsoon, juveniles during the mid monsoon, and one adult during the late monsoon. Juveniles moved haor to river during the mid monsoon. During Year 3, juveniles and adults moved river to haor during early monsoon, and adults during the mid monsoon. One juvenile moved haor to river during the early monsoon.

- Pabda: LFM = 14 cm, ML = 25 cm. During Year 2, juveniles and adults moved river to haor during the early and mid monsoon. During Year 3, adults moved river to haor during the mid monsoon.

- Magur: During Year 2, juveniles and adults moved river to haor during the early and mid monsoon. During Year 3, adults moved river to haor during the mid monsoon.

- Garua: LFM = 16 cm, ML = 25 cm. During Year 2, juveniles moved river to haor during the early monsoon. During Year 3, one adult moved river to haor during the mid monsoon.

- Kotibacha: During Year 2, juveniles moved river to haor during the early monsoon.

The following species were not recorded in the fishpass, but occur in the area: *muribacha, kani pabda, ghagla, lia, kauwa, kutakanti, gang tengra and bashpata.*

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E.8 OTHER SMALL FISH SPECIES

E.8.1 Summary of Migration of Other Small Fish Species

The total numbers of specimens of other small fish species recorded in the fishpass are presented in Table E.32.

Table E.32: Total numbers of specimens of other small fish species recorded in fishpass samples

Species	Year 1 1995	Year 2 1996	Year 3 1997	Total	% of Total
Chanda	8,465	40,699	84,671	133,835	88.4%
Chapila	306	4,212	895	5,413	3.6%
Ketchki	1,551	778	294	2,623	1.7%
Bailla	370	791	1,040	2,201	1.5%
Kaikka	726	241	324	1,291	0.9%
Potka	317	511	326	1,154	0.8%
Rani	288	678	147	1,113	0.7%
Gutum	8	524	403	935	0.6%
Bheda	6	603	179	788	0.5%
Boicha	207	162	118	487	0.3%
Chirka baim	201	2	198	401	0.3%
Naptani	110	96	58	264	0.2%
Poa	234	1	5	240	0.2%
Kholisha	0	77	141	218	0.1%
Taki	0	58	137	195	0.1%
Foli	45	40	9	94	0.1%
Napitkoi	0	29	6	35	0.02%
Matibangra	12	6	9	27	0.02%
Tarabaim	1	0	8	9	0.01%
Khorsula	0	0	4	4	0.003%
Koi	0	2	0	2	0.001%
Kanpona	0	0	1	1	0.001%
Ekthuita	0	0	0	0	-
Kothota	0	0	0	0	-
Pahari gutum	0	0	0	0	-
Putul	0	0	0	0	-
Koiputi	0	0	0	0	-
Gonichapila	0	0	0	0	-
Koitor	0	0	0	0	-
Nuna bailla	0	0	0	0	-
Kanpona	0	0	0	0	-
Bata (mullet)	0	0	0	0	-
Dari	0	0	0	0	-
Chouka	0	0	0	0	-
Kharu		0	0	0	-
TOTALS	12,847	49,510	88,973	151,330	100%

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The most frequently recorded species was *chanda* (88.4%).

Less frequently recorded species were *chapila* (3.6%), *ketchki* (1.7%), *bailla* (1.5%), *kaikka* (0.9%), *potka* (0.8%) and *rani* (0.7%).

Species that were comparatively infrequent or rare were *gutum, bheda, boicha, chirka baim, naptani, poa, kholisha, taki, foli, napitkoi, matibangra, tarabaim khorsula* and *koi*.

E.8.2 *Chanda*

Monthly sampling data on numbers of specimens and size range is presented in Table E.33.

Table E.33: Fishpass sampling results for the small cyprinid fish *chanda*

Species: CHANDA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	962	1-8	46	1.5-5
July	1432	1-4	916	1.5-5.2
August	800	2-4.6	600	2.1-4.7
September	-	-	1809	2.7-7.4
October	800	2.5-7.3	1100	2.4-7.5
Year 2: 1996				
April	28	4.1-5.4	-	-
May	6672	3.5-7.8	-	-
June	1829	2.5-7.1	175	3.2-6.2
July	20559	2.8-6.8	6492	3.5-6.7
Aug	918	2.9-6.3	430	2.1-7.4
Sept	2063	3-9.7	948	2.8-7.9
Oct	201	3.8-6.6	167	3.1-6.5
Nov	134	3.2-6.5	83	4.1-6.7
Year 3: 1997				
May	17852	2.4-6.2	289	2.5-6.3
June	24507	1.9-7	981	2.1-6.1
July	39735	2.2-7.5	195	3-6.8
Aug	737	4-7.5	308	4-7.1
Sept	18	4.2-5.2	49	4.1-5.5

LFM = 4.0 cm ML = 10.0 cm

Migration patterns over 3 years were as follows:

- Year 1: Fingerlings, juveniles and adults moved in both directions during early mid and late monsoon.
- Year 2: Fingerlings, juveniles and adults moved in both directions during early mid and late monsoon.
- Year 3: Fingerlings, juveniles and adults moved in both directions during early mid and late monsoon.

E.8.3 *Chapila*

Monthly sampling data on numbers of specimens and size range is presented in Table E.34.

Table E.34: Fishpass sampling results for the small sardine *chapila*

Species: CHAPILA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	126	2-11	-	-
July	70	2-12	-	-
August	8	2.6-4.9	-	-
September	-	-	-	-
October	-	-	102	4.2-8
Year 2: 1996				
April	-	-	-	-
May	265	3.7-13.2	-	-
June	351	3.7-15	25	3.6-12.1
July	2371	3-12.2	923	4.2-14.2
Aug	128	4-7.9	26	4-8.1
Sept	73	5-15	21	4.1-16.6
Oct	12	5.2-7.4	-	-
Nov	14	6.3-11.2	3	6-8.4
Year 3: 1997				
May	265	4.6-12.7	15	5-12.8
June	375	3.8-14	26	5.2-12
July	195	4.4-12.2	1	11.2
Aug	7	8.1-16	9	12.8-17
Sept	-	-	2	16.3-19.2

LFM = 11.0 cm   ML = 19.2 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles and adults moved river to haor during the early and mid monsoon. Juveniles moved haor to river during the late monsoon.
- Year 2: Juveniles and adults moved in both directions during the early, mid and late monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon. Juveniles and adults moved haor to river during the early and mid monsoon, while adults moved during mid and late monsoon.

E.8.4 *Ketchki*

Monthly sampling data on numbers of specimens and size range is presented in Table E.35.

Table E.35: Fishpass sampling results for the small sardine *ketchki*

Species: KETCHKI				
Month	River to Haor Movement		Haor to River Movement	
	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	533	1-4	-	-
July	418	1-3.9	200	2-5.3
Aug	300	2-4.1	100	9-9.5
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	220	2.9-5.6	-	-
June	22	3.5-5	1	4.8
July	439	3.6-5.8	73	3.2-4.1
Aug	20	4.5-4.6	3	4.3-4.9
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	104	3.2-4.3	62	3.3-4.9
June	71	2-4.4	34	2-4.5
July	23	3.1-4.6	-	-
Aug	-	-	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: Smaller fish moved river to haor during the early and mid monsoon. Small and large fish moved haor to river during the mid monsoon.
- Year 2: Smaller fish moved in both directions during the early and mid monsoon.
- Year 3: Smaller fish moved in both directions during the early and mid monsoon

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E.8.5 *Bailla*

Monthly sampling data on numbers of specimens and size range is presented in Table E.36.

Table E.36: Fishpass sampling results for the small goby *bailla*

Species: BAILLA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	17	4-16	3	4.5-6
July	233	3.3-11	4	3.4-6.5
August	-	-	4	5.9-7.1
September	-	-	109	5.3-13.2
October	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	257	4.8-19.2	-	-
June	34	4.5-11.6	2	4.1-5.8
July	397	4.4-22.9	15	5.1-10
Aug	17	6.2-16.4	13	4.9-13.2
Sept	45	4.7-13.2	9	4.1-11.2
Oct	2	7.8-10.1	-	-
Nov	-	-	-	-
Year 3: 1997				
May	496	4-18.7	5	15.6-18
June	369	3.3-27.8	13	3.5-16.4
July	105	3.6-18.4	8	4.2-17.6
Aug	26	6.7-17.5	4	11.5-14
Sept	10	8.3-15.2	4	14.7-19.3

Migration patterns over 3 years were as follows:

- Year 1: Fingerlings and juveniles moved in both directions during the early and mid monsoon. Juveniles moved haor to river during the late monsoon.
- Year 2: Juveniles and adults moved river to haor during the early and mid monsoon, and juveniles moved during the late monsoon. Fingerlings and juveniles moved haor to river during the early, mid and late monsoon.
- Year 3: Fingerlings, juveniles and adults moved river to haor during the early and mid monsoon, and juveniles and adults moved during the late monsoon. Fingerlings, juveniles and adults moved haor to river during the early mid and late monsoon.

E.8.6 *Kaikka*

Monthly sampling data on numbers of specimens and size range is presented in Table E.37.

Table E.37: Fishpass sampling results for the small needlefish *kaikka*

Species: KAIKKA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	35	6-21	11	9-19
July	25	5.5-14.7	-	-
August	5	7.5-10.2	17	7.1-16
September	-	-	519	8-22.7
October	108	8.7-17	6	8.7-18
Year 2: 1996				
April	-	-	-	-
May	79	5.5-19.8	-	-
June	13	5-19.6	-	-
July	107	5.9-22	1	22
Aug	-	-	-	-
Sept	13	8.9-20.1	28	10-17.8
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	240	11-21.3	4	11.6-21.3
June	58	10.6-22	10	11.1-21.2
July	11	19.1-21.6	-	-
Aug	-	-	1	23
Sept	-	-	-	-

LFM = 18.0 cm ML = 25.0 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles and adults moved river to haor during the early monsoon, and juveniles and subadults moved during the mid and late monsoon. Juveniles and adults moved haor to river during the early, mid and late monsoon.
- Year 2: Juveniles and adults moved river to haor during the early, mid and late monsoon. One adult moved haor to river during the mid monsoon, and juveniles and subadults moved during the late monsoon. Visual observations were made of subadults in August. (*Kaikka* was frequently observed in pools so the visual observation record is incomplete).
- Year 3: Juveniles, subadults and adults moved river to haor during the early and mid monsoon. Juveniles and adults moved haor to river during the early and mid monsoon.

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E.8.7 *Potka*

Monthly sampling data on numbers of specimens and size range is presented in Table E.38.

Table E.38: Fishpass sampling results for the small pufferfish *potka*

Species: POTKA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	3	5-5.5	-	-
August	-	-	3	3-3.5
September	-	-	305	3.8-5.9
October	2	5.4-5.8	4	4.9-5.9
Year 2: 1996				
April	-	-	-	-
May	88	4.5-9.3	-	-
June	109	4.2-7.2	2	5.2-6.1
July	149	4.1-7.7	90	5.5-6.2
Aug	-	-	-	-
Sept	25	3.3-8.9	47	2.8-9.1
Oct	-	-	1	6.2
Nov	-	-	-	-
Year 3: 1997				
May	78	4-7.1	7	5.1-6.9
June	101	3.8-12	8	5.1-6
July	131	4-6.4	1	5.7
Aug	-	-	-	-
Sept	-	-	-	-

LFM = ? cm ML = 12.0 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved in both direction during mid and late monsoon.
- Year 2: Juveniles moved in both direction during early, mid and late monsoon.
- Year 3: Juveniles moved in both direction during early and mid monsoon. Adults moved river to haor during early monsoon.

E.8.8 *Rani*

Monthly sampling data on numbers of specimens and size range is presented in Table E.39.

Table E.39: Fishpass sampling results for the small loach *rani*

Species: RANI				
	River to Haor Movement		Haor to River Movement	
Month	**No. of Specimens**	**Size Range (cm)**	**No. of Specimens**	**Size Range (cm)**
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	4	3.5-5.2	2	2.1-3
August	4	2.5-4	3	3-3.8
September	-	-	133	3.9-8.7
October	121	4.8-10.8	21	4.7-8.8
Year 2: 1996				
April	-	-	-	-
May	35	4.2-9	1	6.5
June	9	4.3-10.9	6	5.8-8.5
July	345	3.2-8.5	102	4.2-7.7
Aug	54	4-8.8	13	6.1-7.6
Sept	73	4.7-10.2	35	4.2-8.6
Oct	2	6.7-7.2	2	5.9-7.8
Nov	1	4.2	-	-
Year 3: 1997				
May	-	-	2	8.4-8.9
June	23	2-7.2	4	3.5-7.4
July	73	4.4-11.2	11	5.2-9.6
Aug	17	4.2-9.2	13	5.1-6.9
Sept	-	-	4	5.4-5.8

LFM = 7.5 cm   ML = 12.0 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved in both directions during mid monsoon. Juveniles and adults moved in both direction during late monsoon.
- Year 2: Juveniles and adults moved in both directions during early, mid and late monsoon. There was a general tendency for larger fish to move during the early and late monsoon for river to haor migration, and smaller fish to move during the mid monsoon (Figure E.7).
- Year 3: Juveniles and adults moved in both directions during early and mid monsoon. Juveniles moved haor to river during late monsoon.

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E.8.9 *Gutum*

Monthly sampling data on numbers of specimens and size range is presented in Table E.40.

Table E.40. Fishpass sampling results for the small loach *gutum*

Species: GUTUM				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	7	3-6	-	-
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	1	7.1
Year 2: 1996				
April	-	-	-	-
May	164	5.2-11.2	-	-
June	105	4.8-11.1	15	4.7-11.3
July	113	5.3-10.3	23	6.1-6.3
Aug	30	5.9-8.3	10	6.4-8.4
Sept	35	6.6-9.2	14	5.5-10.6
Oct	8	5.9-12	2	6.7-8.1
Nov	3	6.5-9.1	2	8.1-9
Year 3: 1997				
May	177	5.7-9.7	-	-
June	70	5-10.7	1	5.4
July	103	6-10	3	7.3-8.7
Aug	28	5.3-10.5	18	5.7-9.2
Sept	1	9.8	2	6.9-7.3

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved river to haor during the early monsoon. One juvenile moved haor to river during late monsoon.
- Year 2: Juveniles and adults moved in both directions during the early, mid and late monsoon.
- Year 3: Juveniles and adults moved in both directions during the early, mid and late monsoon

E.8.10 *Bheda*

Monthly sampling data on numbers of specimens and size range is presented in Table E.41.

Table E.41: Fishpass sampling results for the small leaffish *bheda*

Species: BHEDA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	5	3-7	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	1	7.8
Year 2: 1996				
April	-	-	-	-
May	296	4.9-14	-	-
June	70	4.2-16.9	-	-
July	190	4.9-15.1	-	-
Aug	19	5-8.2	2	5.1-11.3
Sept	24	4.1-10.7	2	9.2-10.1
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	74	5-9.5	-	-
June	43	4.8-12.7	-	-
July	60	5.6-14.8	-	-
Aug	-	-	2	14-15
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved river to haor during the mid monsoon. One juvenile moved haor to river during the late monsoon.
- Year 2: Juveniles and adults moved river to haor during the early, mid and late monsoon. Juveniles and adults moved haor to river during the mid and late monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon. Adults moved haor to river during the mid monsoon.

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E.8.11 *Boicha*

Monthly sampling data on numbers of specimens and size range is presented in Table E.42.

Table E.42: Fishpass sampling results for the small gouramy *boicha*

Species: BOICHA				
Month	River to Haor Movement		Haor to River Movement	
	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	107	3-4	-	-
July	100	2-3	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	120	3.6-6.8	-	-
June	42	4.5-6.8	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	56	3.1-4.1	1	4.5
June	41	2-5.4	-	-
July	20	3.1-5.4	-	-
Aug	-	-	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved river to haor during the early and mid monsoon.
- Year 2: Juveniles moved river to haor during the early and mid monsoon.
- Year 3: Juveniles moved river to haor during the early and mid monsoon. One juvenile moved in the opposite direction during early monsoon.

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E.8.12 *Chirka baim*

Monthly sampling data on numbers of specimens and size range is presented in Table E.43.

Table E.43: Fishpass sampling results for the small spiny eel *chirka baim*

Species: CHIRKA BAIM				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
August	-	-	-	-
September	-	-	200	6.7-10.1
October	-	-	1	7.3
Year 2: 1996				
April	-	-	-	-
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	1	10.7
Oct	-	-	1	7.6
Nov	-	-	-	-
Year 3: 1997				
May	65	3.8-15.6	1	9.4
June	17	7.8-18.5	-	-
July	52	9-24.8	10	9.5-14.1
Aug	25	9.5-18.3	24	10.5-17
Sept	3	10.2-14	1	14.7

LFM = 14.0 cm ML = 25.0 cm

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved haor to river during the late monsoon.
- Year 2: Juveniles moved haor to river during the late monsoon.
- Year 3: Juveniles and adults moved river to haor during the early, mid and late monsoon. One juvenile move haor to river during early monsoon, while juveniles and adults moved during mid monsoon, and one adult moved late monsoon.

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E.8.13 *Naptani*

Monthly sampling data on numbers of specimens and size range is presented in Table E.44.

Table E.44: Fishpass sampling results for the small gouramy *naptani*

Species: NAPTANI				
Month	**River to Haor Movement**		**Haor to River Movement**	
	No. of Specimens	**Size Range (cm)**	**No. of Specimens**	**Size Range (cm)**
Year 1: 1995				
May	-	-	-	-
June	110	3-6	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	14	4.3-6.9	-	-
June	1	5.6	1	5.8
July	80	3-7.2	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	24	4.8-6.1	3	5-6.9
June	21	2-6.6	3	2.3-5.4
July	7	3.2-7	-	-
Aug	-	-	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: Juveniles moved river to haor during early monsoon.
- Year 2: Juveniles moved river to haor during early and mid monsoon. On juvenile move haor to river during early monsoon.
- Year 3: Juveniles moved in both direction during early monsoon. Juveniles moved river to haor during mid monsoon.

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E.8.14 *Poa*

Monthly sampling data on numbers of specimens and size range is presented in Table E.45.

Table E.45: Fishpass sampling results for the small croaker *poa*

Species: POA				
Month	River to Haor Movement		Haor to River Movement	
	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	232	2.5-8.0	-	-
July	2	3-4.2	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	1	9.9	-	-
June	-	-	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	-	-	-	-
June	5	5-6.2	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- <u>Year 1</u>: Juveniles moved river to haor during the early and mid monsoon.
- <u>Year 2</u>: One juveniles moved river to haor during the early monsoon.
- <u>Year 3</u>: Juveniles moved river to haor during the early monsoon.

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E.8.15 *Kholisha*

Monthly sampling data on numbers of specimens and size range is presented in Table E.46.

Table E.46: Fishpass sampling results for the small gouramy *kholisha*

Species: KHOLISHA				
Month	River to Haor Movement		Haor to River Movement	
	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	47	3.3-7	-	-
June	19	5.7-8.1	-	-
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	11	6.2-10.8
Oct	-	-	-	-
Nov	-	-	-	-
Year 3: 1997				
May	68	3.1-5.2	-	-
June	32	2.3-8.6	-	-
July	41	3.1-9.2	-	-
Aug	-	-	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: No fish recorded.
- Year 2: Juveniles and adults moved river to haor during the early monsoon. Juveniles and adults moved haor to river during the late monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon.

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E.8.16 *Taki*

Monthly sampling data on numbers of specimens and size range is presented in Table E.47.

Table E.47: Fishpass sampling results for the small snakehead *taki*

Species: TAKI				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
Year 2: 1996				
April	-	-	-	-
May	19	7.8-24.7	-	-
June	5	7.1-14.3	-	-
July	20	10.9-18	-	-
Aug	-	-	2	10.7-16.1
Sept	2	8.7-13.4	8	6.8-14.7
Oct	1	11.2	1	6.9
Nov	-	-	-	-
Year 3: 1997				
May	70	6-18	1	7.1
June	36	5.5-17.6	-	-
July	29	5.2-22.7	-	-
Aug	1	25	-	-
Sept	-	-	-	-

Migration patterns over 3 years were as follows:

- Year 1: No fish recorded.
- Year 2: Juveniles and adults moved river to haor during the early and mid monsoon, and juveniles during the late monsoon. Juveniles and adults moved haor to river during the mid and late monsoon.
- Year 3: Juveniles and adults moved river to haor during the early and mid monsoon. One juvenile moved haor to river during the early monsoon.

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E.8.17 Other Small Fish Species Less Frequently Present in Fishpass or Absent

The following species were rarely found in the fishpass:

- Foli: LFM = 21.0 cm, ML = 27.8 cm. During Year 1, juveniles and adults moved river to haor during the early monsoon. Juveniles moved haor to river during early monsoon. During Year 2, juveniles and adults moved river to haor during the early monsoon, while juveniles moved during mid monsoon and subadults during late monsoon. Subadults and adults moved haor to river during mid monsoon.

- Napitkoi: During Year 2, juveniles moved river to haor during early, mid and late monsoon. Juveniles moved haor to river during mid monsoon. During Year 3, juveniles moved river to haor during early and mid monsoon.

- Matibangra: During Year 1, juveniles moved river to haor during early and mid monsoon. Juveniles moved haor to river during late monsoon.. During Year 2, juveniles moved haor to river during early and mid monsoon. During Year 3, juveniles moved river to haor during early and mid monsoon.

- Tarabaim: LFM = 14.0 cm, ML = 28.2 cm. During Year 1, one subadult moved haor to river during the late monsoon. No fish were recorded during Year 2. During Year 3, juveniles moved river to haor during the early monsoon and adults during the mid monsoon. Juveniles and adults moved haor to river during the early monsoon.

- Khorsula: No fish were recorded during Years 1 and 2. During Year 3, juveniles moved river to haor during the mid monsoon.

- Koi: No fish were recorded during Years 1 and 3. During Year 2, juveniles moved river to haor during the early monsoon.

- Kanpona: No fish were recorded during Years 1 and 2. During Year 3, one adult moved river to haor during the early monsoon.

The following species were not recorded in the fishpass, but occur in the area: *ekthuita, kothota, pahari gutum, putul, koiputi, gonichapila, koitor, nuna bailla, bata* (mullet), *dari, chouka* and *kharu*.

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E.9 SMALL PRAWNS

Totals for three year are as presented in Table E.48.

Table E.48: Total numbers of specimens of the small prawns *icha* recorded in fishpass samples

Species	Year 1: 1995	Year 2: 1996	Year 3: 1997	Total
icha	1,885	55,715	42,888	100,488

Monthly sampling data on numbers of specimens and size range is presented in Table E.49.

Table E.49: Fishpass sampling results for the small prawns *icha*

Species: ICHA				
	River to Haor Movement		Haor to River Movement	
Month	No. of Specimens	Size Range (cm)	No. of Specimens	Size Range (cm)
Year 1: 1995				
May	-	-	-	-
June	308	4.5-10	35	1-9
July	436	1-6.5	200	1.5-6
August	400	2.6-4.2	-	-
September	-	-	206	2.8-13
October	200	4.5-6	100	3.9-4.9
Year 2: 1996				
April	-	-	-	-
May	29,929	3.2-13.9	13	3-5.2
June	6,195	2.6-11.6	338	3-6.1
July	12,069	3.1-7	5,460	2.7-7.8
Aug	683	3-6.6	237	2.7-8.3
Sept	508	3.5-9.3	116	3.1-9.2
Oct	46	3.9-8.2	46	3-7.5
Nov	65	2.5-11.2	10	3.9-6.1
Year 3: 1997				
May	15,947	2.3-5.1	120	3-5.7
June	10,096	2.3-11	733	2.9-11
July	15,140	2.5-7.3	245	3-6.8
Aug	367	3-8.9	163	4.1-8.8
Sept	14	4.8-6.9	63	3.1-8.3

LFM = 4.0 cm ML = 13.9 cm

Migration patterns over 3 years were as follows:

- Year 1: Adults moved river to haor during early monsoon, while juveniles and adults moved during mid monsoon, and adults moved during late monsoon. Juveniles and adults moved haor to river during early, mid and late monsoon.
- Year 2: Juveniles and adults moved in both directions during the early, mid and late monsoon.
- Year 3: Juveniles and adults moved in both directions during the early, mid and late monsoon.

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Figure E.1: Change in body length of *air* sampled in fishpass during Year 2 (1996)

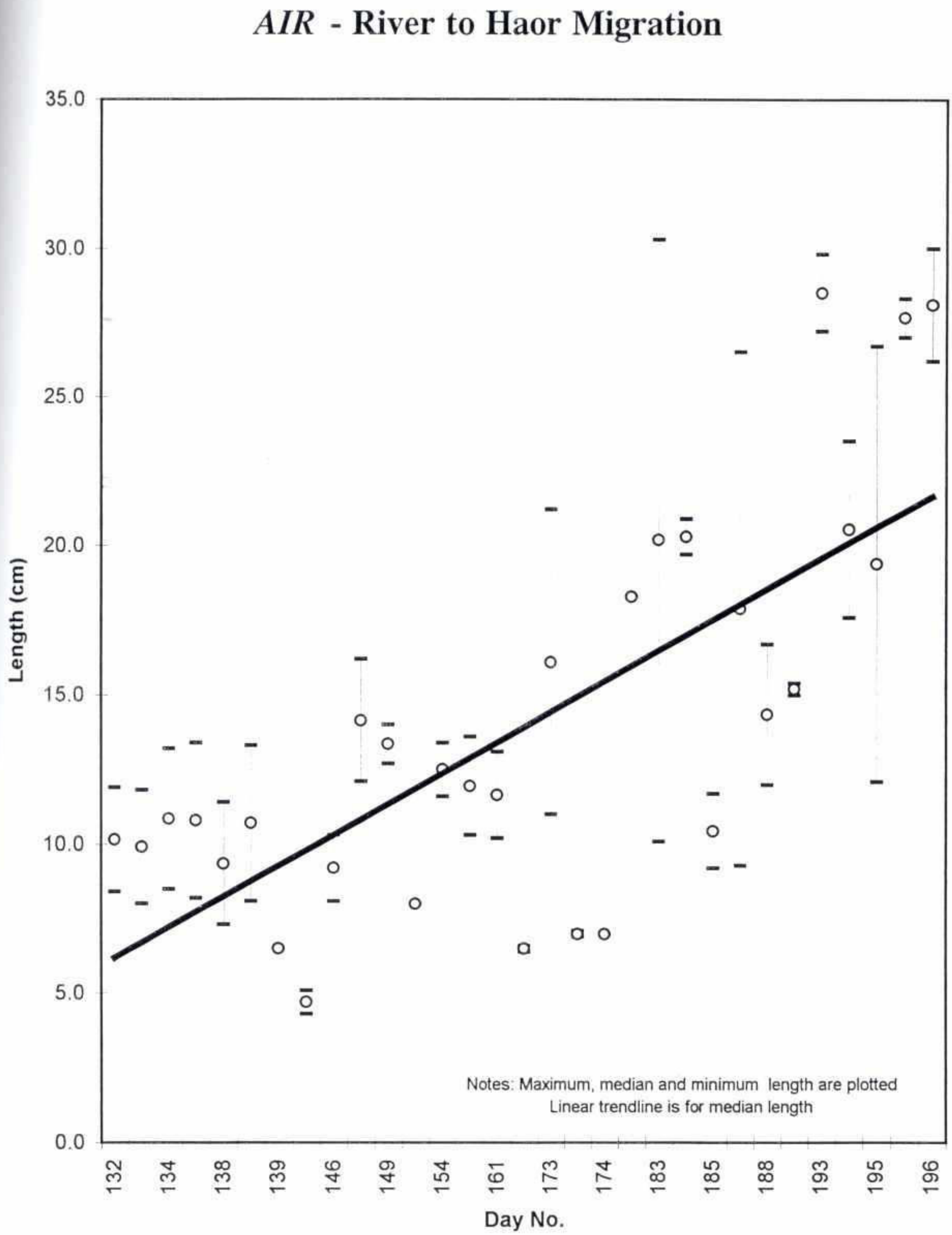


Figure E.2: Change in body length of *golda chingri* sampled in fishpass during Year 2 (1996)

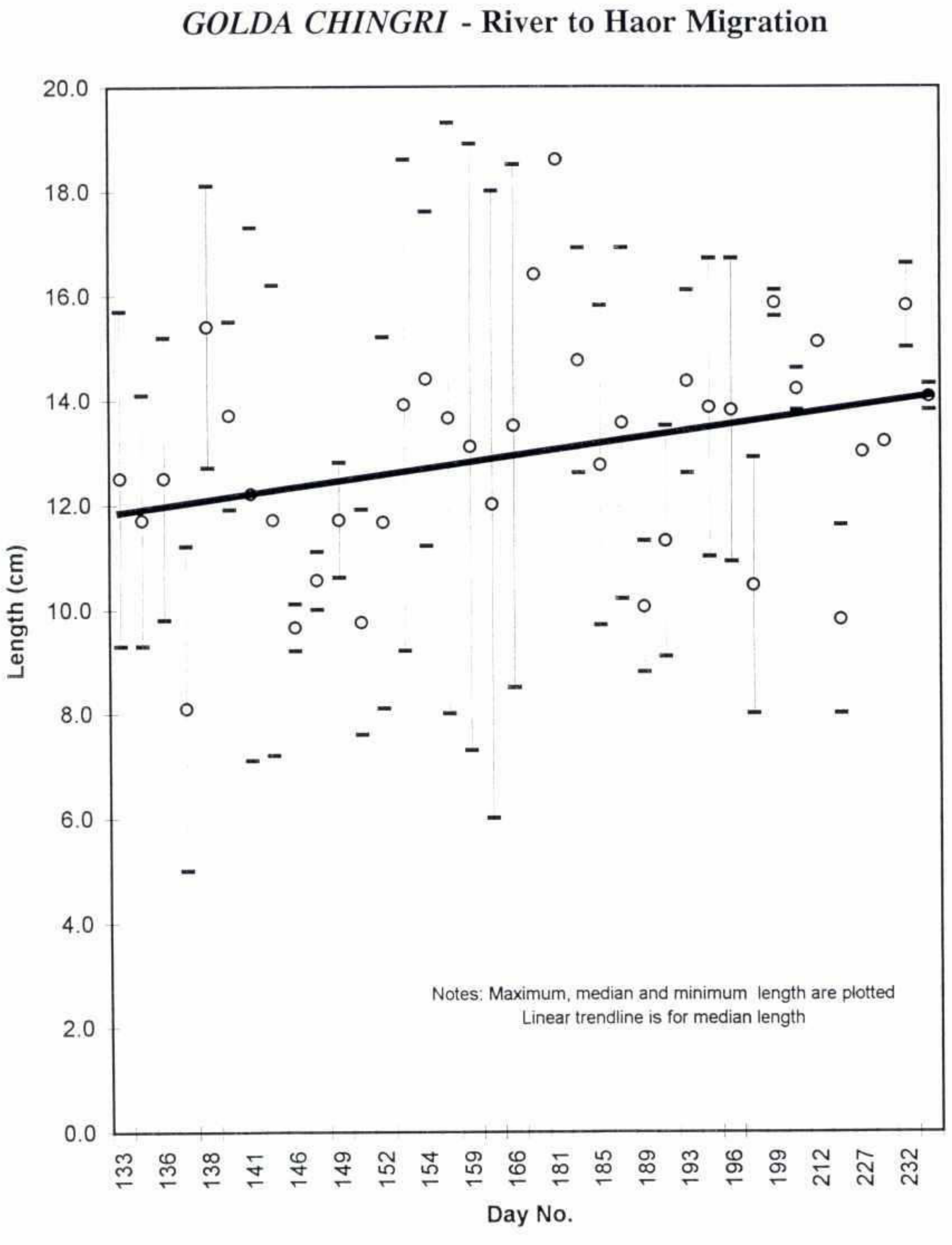


Figure E.3: Change in body length of *mola* sampled in fishpass during Year 2 (1996)

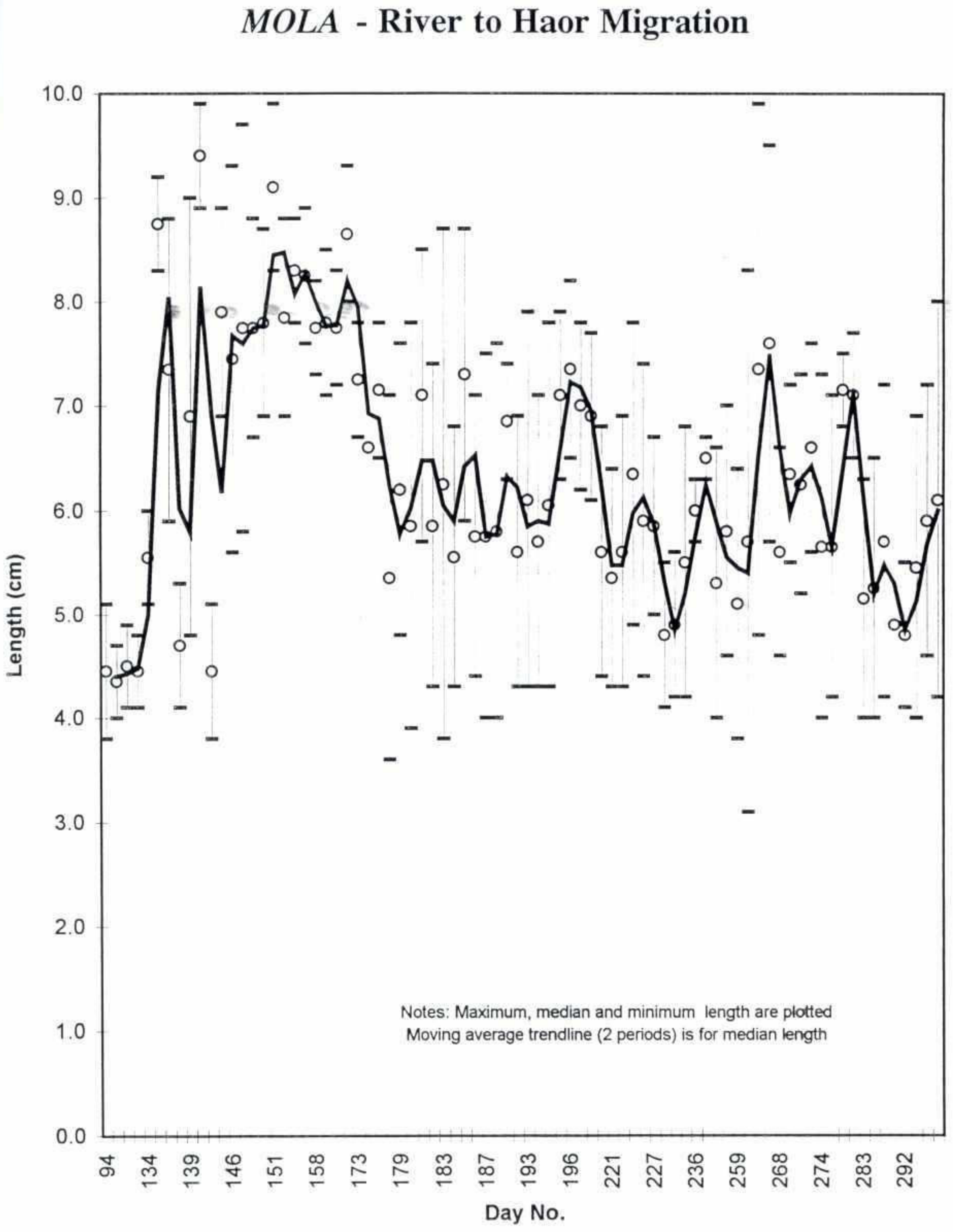


Figure E.4: Change in body length of *batashi* sampled in fishpass during Year 2 (1996)

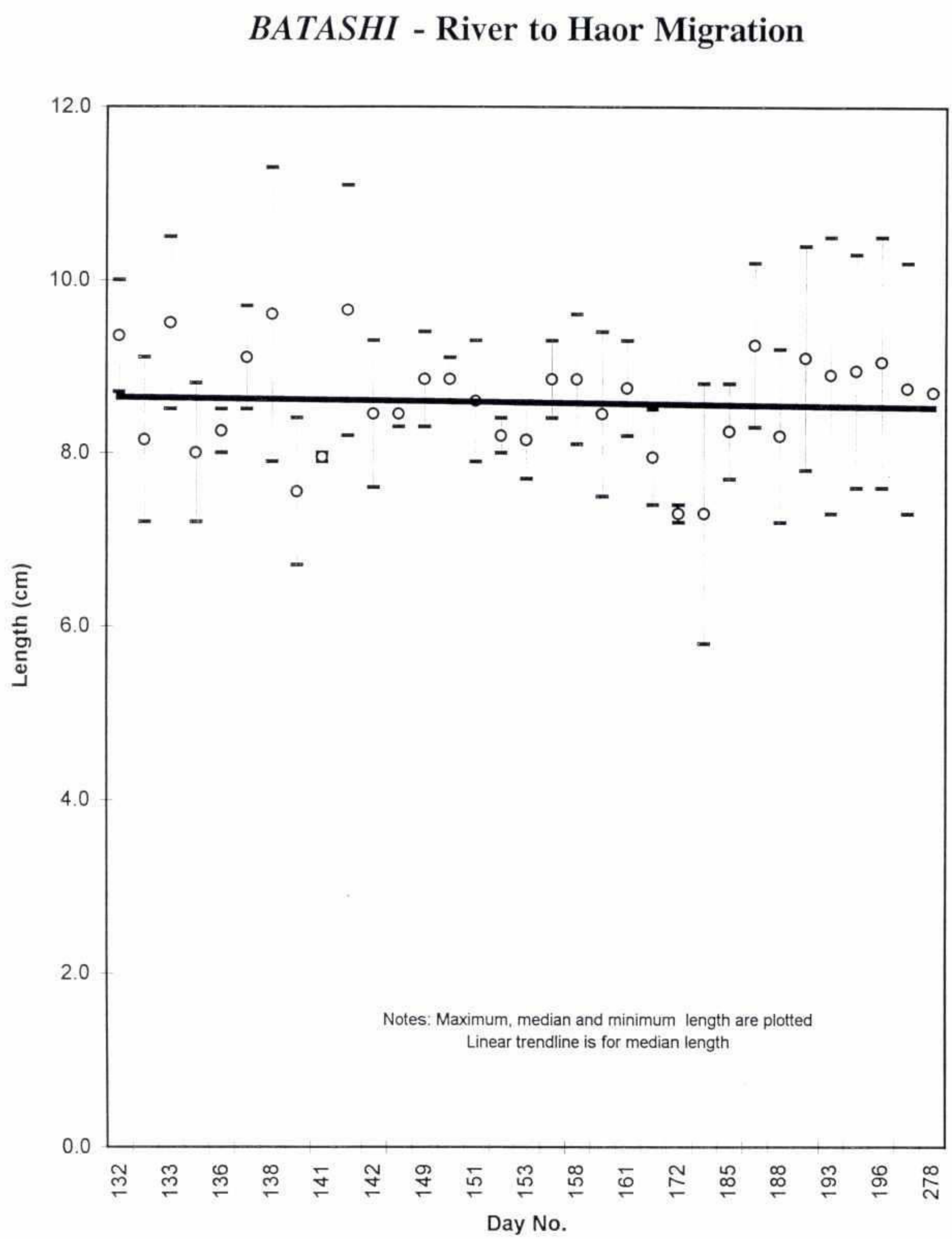


Figure E.5: Change in body length of *bacha* sampled in fishpass during Year 2 (1996)

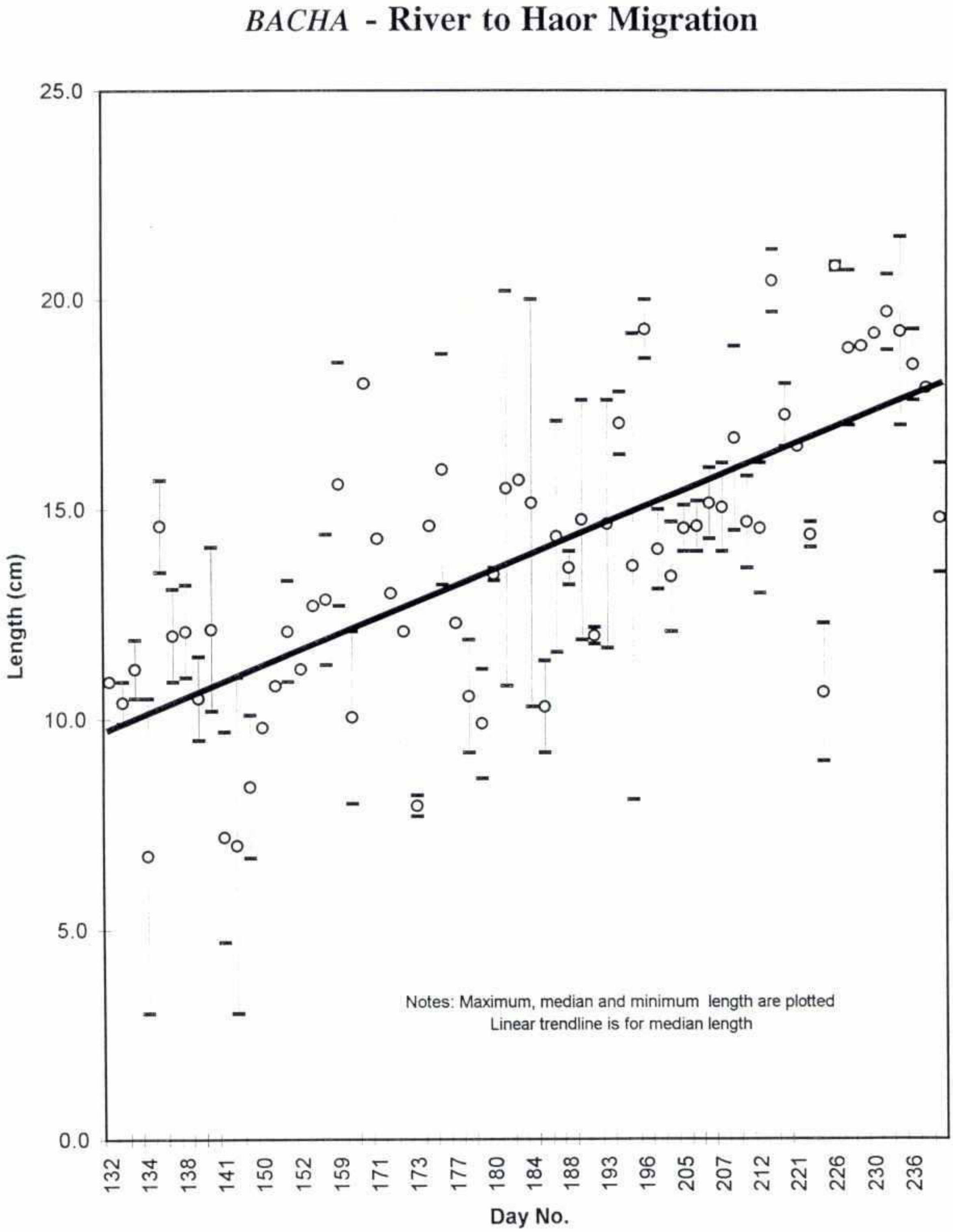


Figure E.6: Change in body length of *tengra* sampled in fishpass during Year 2 (1996)

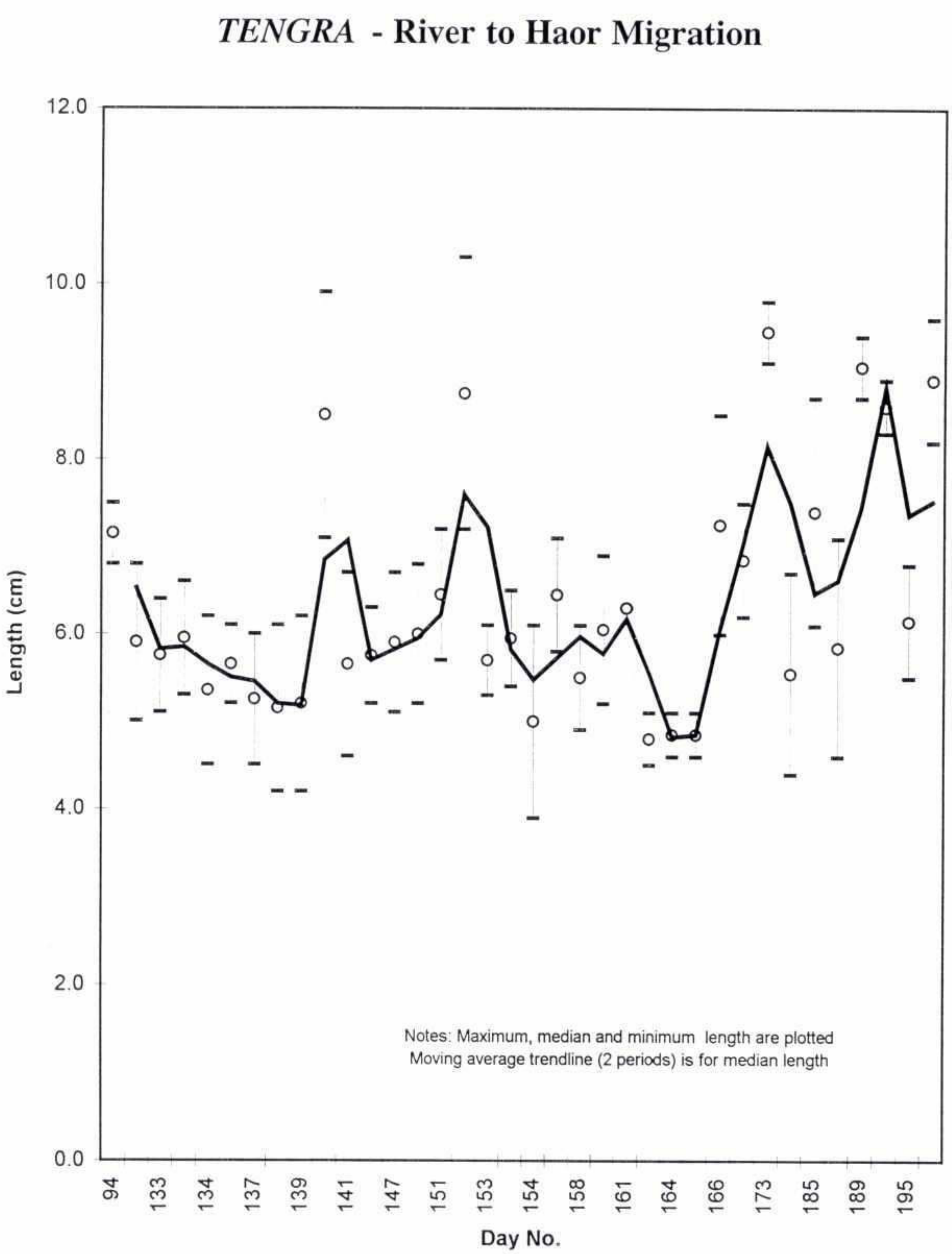
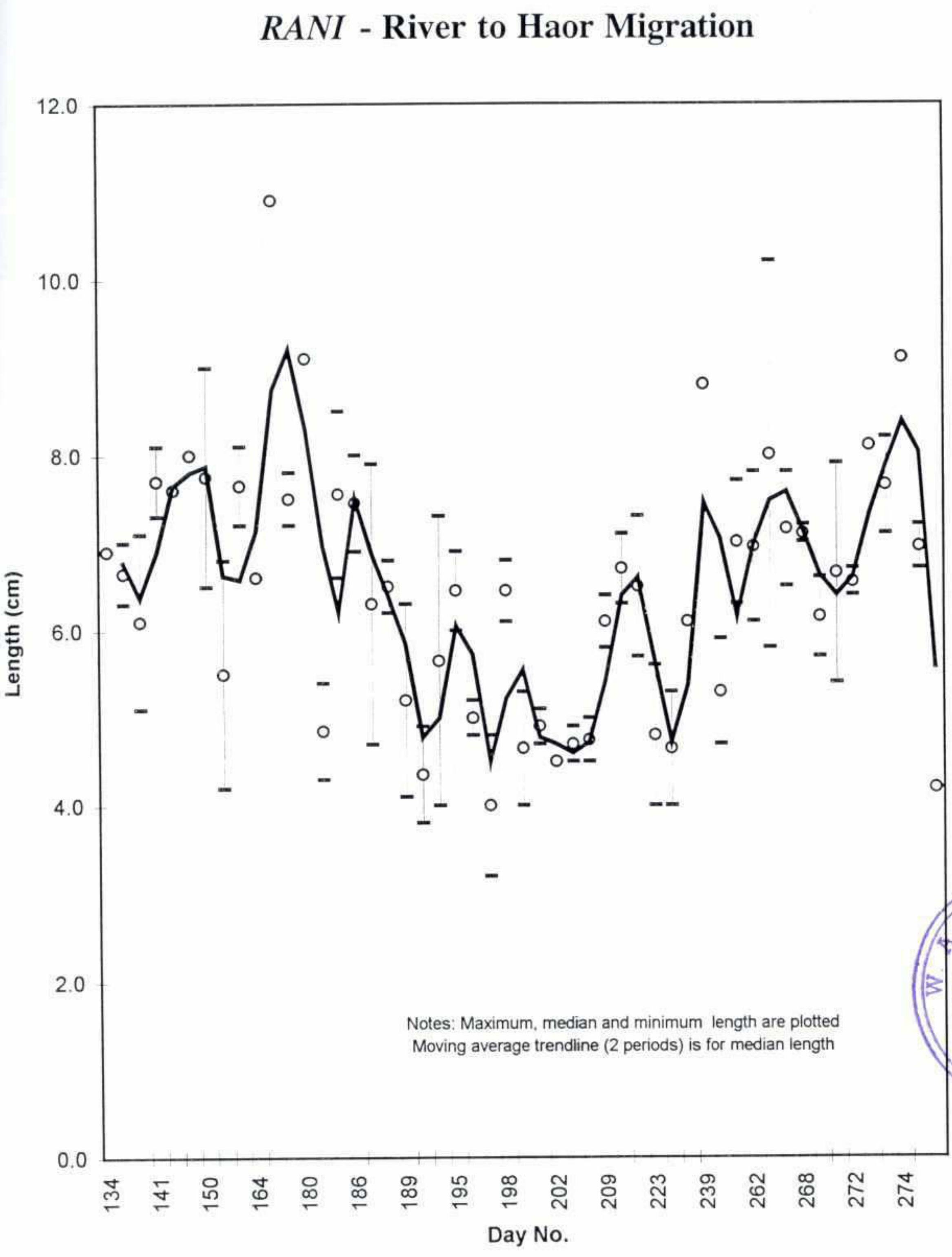


Figure E.7: Change in body length of *rani* sampled in fishpass during Year 2 (1996)



Appendix F

FISH PRODUCTION AND ABUNDANCE DATA

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Species	Monsoon Floodplain		Dry Season Beel		Haor Total	
	Quantity (tonne)	%	Quantity (tonne)	%	Quantity (tonne)	%
Icha	33.9	10.8	3.6	15.4	37.5	11.1
Puti	27.9	8.9	1.2	5.4	29.2	8.7
Chanda	22.3	7.1	1.5	6.6	23.8	7.1
Bheda	12.1	3.9	0.7	3.2	12.9	3.8
Taki	11.8	3.8	0.8	3.2	12.5	3.7
Kholisha	11.5	3.7	0.4	1.9	11.9	3.5
Tengra	10.8	3.4	0.8	3.3	11.5	3.4
Chapila	10.0	3.2	1.1	4.7	11.1	3.3
Boal	9.8	3.1	1.1	4.7	10.9	3.2
Chela	9.2	3.0	0.2	1.1	9.5	2.8
Kaikka	8.2	2.6	0.4	1.6	8.6	2.6
Air	7.6	2.4	1.0	4.3	8.5	2.5
Baim	6.7	2.1	0.7	3.1	7.4	2.2
Carpio	5.7	1.8	0.7	2.9	6.4	1.9
Shing	5.9	1.9	0.5	2.2	6.4	1.9
Foli	5.1	1.6	0.9	3.7	6.0	1.8
Koi	5.6	1.8	0.3	1.5	5.9	1.8
Mola	4.3	1.4	0.4	1.8	4.8	1.4
Gozar	3.5	1.1	1.0	4.4	4.5	1.3
Bailla	3.8	1.2	0.6	2.6	4.4	1.3
Shole	3.0	1.0	0.4	1.8	3.4	1.0
Magur	1.1	0.3	0.1	0.5	1.2	0.4
Kalibaush	1.0	0.3	0.1	0.4	1.1	0.3
Gonia	0.6	0.2	0.1	0.6	0.7	0.2
Rui	0.5	0.2	0.0	0.2	0.5	0.2
Others	91.9	29.3	4.4	19.0	96.4	28.6
TOTAL	313.5	100.0	23.3	100.0	336.8	100.0

Table F.2: Catch composition from Kawadighi Haor during hydrological year 1993

Species	Monsoon Floodplain		Dry Season Beel		Haor Total	
	Quantity (tonne)	%	Quantity (tonne)	%	Quantity (tonne)	%
Puti	88.0	15.4	11.8	5.2	99.8	12.5
Icha	52.4	9.2	46.1	20.1	98.6	12.3
Chapila	36.1	6.3	20.4	8.9	56.5	7.1
Chanda	35.1	6.1	9.6	4.2	44.7	5.6
Boal	20.9	3.7	14.0	6.1	34.9	4.4
Air	18.9	3.3	13.2	5.8	32.1	4.0
Mola	27.6	4.8	4.4	1.9	31.9	4.0
Carpio	18.3	3.2	11.5	5.0	29.8	3.7
Bheda	24.2	4.2	5.1	2.2	29.3	3.7
Taki	18.2	3.2	6.3	2.7	24.4	3.1
Tengra	16.8	2.9	7.1	3.1	23.9	3.0
Chela	19.8	3.5	2.9	1.3	22.7	2.8
Kholisha	17.0	3.0	3.2	1.4	20.2	2.5
Foli	12.1	2.1	7.8	3.4	19.9	2.5
Kaikka	16.8	2.9	2.4	1.1	19.2	2.4
Baim	11.8	2.1	5.5	2.4	17.2	2.2
Bailla	10.5	1.8	5.4	2.4	16.0	2.0
Shing	10.0	1.7	4.4	1.9	14.3	1.8
Gozar	4.7	0.8	8.5	3.7	13.2	1.6
Rui	6.6	1.2	5.0	2.2	11.6	1.5
Kalibaush	7.0	1.2	3.1	1.4	10.2	1.3
Mrigel	5.0	0.9	3.8	1.7	8.9	1.1
Gonia	6.3	1.1	2.5	1.1	8.8	1.1
Koi	6.3	1.1	1.8	0.8	8.1	1.0
Catla	4.6	0.8	2.8	1.2	7.5	0.9
Shole	4.1	0.7	3.3	1.5	7.4	0.9
Magur	0.5	0.1	0.5	0.2	1.0	0.1
Others	72.4	12.7	16.6	7.3	89.0	11.1
TOTAL	571.9	100.0	229.1	100.0	801.0	100.0

Table F.3: Catch composition from Kawadighi Haor during hydrological year 1994

Species	Monsoon Floodplain		Dry Season Beel		Haor Total	
	Quantity (tonne)	%	Quantity (tonne)	%	Quantity (tonne)	%
Puti	88.3	17.3	4.1	4.4	92.4	15.4
Icha	36.4	7.2	17.7	19.3	54.2	9.0
Chapila	28.0	5.5	7.5	8.2	35.5	5.9
Chanda	29.5	5.8	4.6	5.0	34.1	5.7
Mola	20.9	4.1	2.5	2.7	23.4	3.9
Bheda	19.1	3.8	2.5	2.8	21.6	3.6
Boal	14.6	2.9	5.4	5.9	20.0	3.3
Chela	17.0	3.3	1.7	1.8	18.6	3.1
Koi	16.3	3.2	1.6	1.8	17.9	3.0
Kaikka	14.3	2.8	1.8	1.9	16.0	2.7
Carpio	12.7	2.5	3.2	3.5	16.0	2.7
Kholisha	14.9	2.9	1.0	1.1	15.9	2.7
Taki	12.6	2.5	2.6	2.8	15.2	2.5
Tengra	12.2	2.4	2.6	2.9	14.9	2.5
Air	9.3	1.8	3.6	3.9	12.9	2.2
Foli	9.8	1.9	3.0	3.3	12.9	2.1
Baim	9.8	1.9	2.7	2.9	12.4	2.1
Shing	10.4	2.1	1.9	2.1	12.4	2.1
Bailla	6.1	1.2	1.9	2.1	8.0	1.3
Gozar	3.1	0.6	3.3	3.6	6.4	1.1
Shole	4.2	0.8	1.3	1.4	5.5	0.9
Kalibaush	3.8	0.8	1.0	1.1	4.8	0.8
Gonia	3.6	0.7	0.8	0.9	4.4	0.7
Magur	1.0	0.2	0.3	0.3	1.3	0.2
Rui	0.8	0.2	0.2	0.3	1.0	0.2
Others	110.7	21.7	13.0	14.1	123.6	20.6
TOTAL	509.5	100.0	91.8	100.0	601.3	100.0

Table F.4: Catch composition from Kawadighi Haor during Year 1 (1995)

Species	Monsoon Floodplain		Dry Season Beel		Haor Total	
	Quantity (tonne)	%	Quantity (tonne)	%	Quantity (tonne)	%
Puti	100.4	18.6	7.8	5.3	108.2	23.9
Icha	43.8	8.1	27.9	18.7	71.7	26.8
Chanda	39.9	7.4	7.0	4.7	46.9	12.1
Mola	28.2	5.2	5.7	3.8	33.9	9.0
Boal	17.3	3.2	14.3	9.6	31.6	12.8
Carpo	18.2	3.4	10.9	7.3	29.1	10.7
Chapila	23.7	4.4	4.4	2.9	28.0	7.3
Bheda	22.2	4.1	3.4	2.3	25.6	6.4
Chela	18.7	3.5	3.6	2.4	22.3	5.9
Kholisha	18.0	3.3	2.1	1.4	20.1	4.8
Kaikka	15.8	2.9	3.2	2.2	19.0	5.1
Taki	14.2	2.6	4.1	2.7	18.2	5.4
Air	12.0	2.2	5.9	3.9	17.8	6.1
Tengra	14.2	2.6	3.5	2.4	17.8	5.0
Koi	14.7	2.7	1.3	0.9	16.0	3.6
Foli	12.6	2.3	3.1	2.1	15.7	4.4
Baim	12.0	2.2	3.2	2.1	15.2	4.4
Baila	10.3	1.9	2.6	1.8	12.9	3.7
Shing	9.8	1.8	1.1	0.8	10.9	2.6
Kalibaus	7.7	1.4	2.6	1.8	10.3	3.2
Gonia	6.3	1.2	2.5	1.7	8.8	2.8
Gozar	4.4	0.8	3.6	2.4	7.9	3.2
Rui	3.9	0.7	3.5	2.4	7.4	3.1
Catla	0.7	0.1	6.1	4.1	6.8	4.2
Shole	4.0	0.7	1.9	1.3	5.9	2.0
Mrigal	1.8	0.3	1.6	1.0	3.4	1.4
Magur	1.2	0.2	0.7	0.5	1.9	0.7
Others	63.7	11.8	11.3	7.6	75.1	19.4
TOTAL	539.3	100.0	148.9	100.0	688.2	100.0

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Table F.5: Catch composition from Kawadighi Haor during Year 2 (1996)

Species	Monsoon Floodplain		Dry Season Beel		Haor Total	
	Quantity (tonne)	%	Quantity (tonne)	%	Quantity (tonne)	%
Icha	55.8	9.8	35.6	19.5	91.3	11.9
Puti	74.3	13.1	16.3	5.8	90.6	11.8
Chanda	43.7	7.7	10.3	5.6	53.9	7.0
Mola	31.2	5.5	5.8	3.2	37.0	4.8
Boal	19.6	3.5	16.6	9.1	36.2	4.7
Bheda	28.1	5.0	5.1	2.8	33.2	4.3
Chapila	26.8	4.7	4.2	2.3	30.9	4.0
Kholisha	21.3	3.8	5.9	2.1	27.1	3.5
Carpo	14.9	2.6	7.5	4.1	22.4	2.9
Air	14.2	2.5	6.8	3.8	21.0	2.7
Koi	17.6	3.1	3.2	1.1	20.8	2.7
Taki	15.6	2.8	4.6	2.5	20.2	2.6
Tengra	15.3	2.7	4.0	2.2	19.4	2.5
Chela	14.2	2.5	4.3	1.8	18.4	2.4
Baim	14.3	2.5	3.8	2.1	18.1	2.4
Kalibaus	13.3	2.4	4.2	2.3	17.5	2.3
Kaikka	9.6	1.7	5.8	1.7	15.4	2.0
Shing	12.6	2.2	2.5	1.4	15.1	2.0
Batashi	14.2	2.5	0.5	0.3	14.7	1.9
Gozar	5.7	1.0	7.3	2.8	12.9	1.7
Baila	8.5	1.5	2.7	1.5	11.2	1.5
Gutum	7.9	1.4	2.7	1.5	10.7	1.4
Foli	7.1	1.3	3.4	1.9	10.5	1.4
Shole	7.1	1.3	2.7	1.5	9.8	1.3
Dhela	6.8	1.2	1.5	0.9	8.4	1.1
Gulsha	4.3	0.8	3.8	1.6	8.1	1.1
Rui	1.2	0.2	6.7	3.7	8.0	1.0
Potka	6.8	1.2	1.2	0.6	8.0	1.0
Lachu	4.5	0.8	2.2	1.2	6.7	0.9
Gonia	3.2	0.6	3.2	1.8	6.4	0.8
Magur	4.3	0.8	1.4	0.8	5.7	0.7
Bata	3.4	0.6	1.5	0.9	5.0	0.6
Darkina	4.3	0.8	0.6	0.4	4.9	0.6
Golda	3.1	0.6	1.2	0.5	4.3	0.6
Catla	0.6	0.1	3.4	1.9	3.9	0.5
Rani	2.8	0.5	0.5	0.3	3.3	0.4
Boicha	0.0	0.0	3.0	1.7	3.0	0.4
Cheka	0.9	0.2	1.9	0.2	2.7	0.4
Mrigal	0.9	0.2	1.0	0.6	1.9	0.2
Pabda	0.0	0.0	0.5	0.3	0.5	0.1
Naptani	0.0	0.0	0.3	0.2	0.3	0.0
Bamosh	0.0	0.0	0.3	0.2	0.3	0.0
Others	27.4	4.8	0.0	0.0	27.4	3.6
TOTAL	567.0	100.0	200.1	100.0	767.1	100.0

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Table F.6: Catch composition from Kawadighi Haor during part of Year 3 (May to September 1997)

Species	Monsoon Floodplain	
	Quantity (tonne)	%
Puti	66.63	22.54
Icha	45.11	15.26
Bheda	39.20	13.26
Mola	24.89	8.42
Koi	23.50	7.95
Chanda	22.14	7.49
Chela	5.44	1.84
Kaikka	4.61	1.56
Taki	4.20	1.42
Baim	3.90	1.32
Potka	3.87	1.31
Carpo	3.64	1.23
Tengra	3.55	1.20
Boal	3.25	1.10
Baila	2.90	0.98
Batashi	2.90	0.98
Gutum	2.90	0.98
Kalibaus	2.90	0.98
Kholisha	2.90	0.98
Shing	2.90	0.98
Shole	2.87	0.97
Air	2.57	0.87
Gulsha	2.51	0.85
Lachu	2.31	0.78
Magur	2.13	0.72
Goldachingri	1.89	0.64
Gozar	1.57	0.53
Rani	1.24	0.42
Gonia	1.06	0.36
Mrigal	0.98	0.33
Darkina	0.62	0.21
Dhela	0.35	0.12
Bata	0.27	0.09
Chapila	0.27	0.09
Foli	0.27	0.09
Bacha	0.24	0.08
Bamosh	0.24	0.08
Rui	0.15	0.05
Cheka	0.12	0.04
Catla	0.06	0.02
Others	2.60	0.88
TOTAL	295.60	100.00

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Table F.7: Monthly catch rates for various fishing gears in Kawadighi Haor

Month Year	CPUE (kg)	No. of units operated	Hauls/day or Hooks/unit	Fishing days (no.)	Total catch (kg)
Konajal and Berjal (cpue units = catch per haul)					
Jul-94	1.00	55	8	20	8,800
Aug-94	1.50	70	8	28	23,520
Sep-94	2.25	80	8	25	36,000
Oct-94	2.00	75	8	25	30,000
Nov-94	3.00	20	8	15	7,200
Jul-95	1.40	40	8	20	8,960
Aug-95	1.65	76	8	28	28,090
Sep-95	2.00	105	8	25	42,000
Oct-95	2.25	70	8	25	31,500
Nov-95	2.50	25	8	15	7,500
Jul-96	1.35	77	8	20	16,632
Aug-96	1.19	121	8	28	32,254
Sep-96	1.35	157	8	25	42,390
Oct-96	1.85	160	8	25	59,200
May-97	0.00	0	0	0	0
Jun-97	0.00	0	0	0	0
Jul-97	1.00	9	8	25	1,800
Aug-97	1.50	12	8	25	3,600
Sep-97	3.00	18	8	25	10,800
Gillnet and Current jal (cpue units = catch per net per day)					
Jul-94	2.00	225		20	9,000
Aug-94	2.50	320		25	20,000
Sep-94	3.00	400		28	33,600
Oct-94	3.50	450		28	44,100
Nov-94	2.50	250		20	12,500
Jul-95	2.10	250		20	10,500
Aug-95	2.50	325		25	20,313
Sep-95	3.20	420		28	37,632
Oct-95	3.50	480		28	47,040
Nov-95	2.50	300		20	15,000
Jul-96	2.35	320		20	15,040
Aug-96	3.40	360		25	30,600
Sep-96	3.70	412		28	42,683
Oct-96	4.30	470		28	56,588
May-97	3.50	80		20	5,600
Jun-97	2.50	150		25	9,375
Jul-97	4.12	250		25	25,750
Aug-97	4.50	300		25	33,750
Sep-97	4.70	350		28	46,060
Thelajal and Pushnet (cpue unts = catch per net per day)					
Jul-94	0.50	500		20	5,000

Table F.7: Monthly catch rates for various fishing gears in Kawadighi Haor

Month Year	CPUE (kg)	No. of units operated	Hauls/day or Hooks/unit	Fishing days (no.)	Total catch (kg)
Aug-94	1.20	700		22	18,480
Sep-94	2.00	800		22	35,200
Oct-94	2.50	900		25	56,250
Nov-94	2.50	950		25	59,375
Jul-95	0.50	550		20	5,500
Aug-95	1.25	700		22	19,250
Sep-95	1.75	850		22	32,725
Oct-95	2.20	900		25	49,500
Nov-95	2.50	950		28	66,500
Jul-96	0.85	600		20	10,200
Aug-96	1.30	800		22	22,880
Sep-96	1.90	850		22	35,530
Oct-96	2.20	900		25	49,500
May-97	1.00	350		18	6,300
Jun-97	1.00	400		20	8,000
Jul-97	0.90	400		15	5,400
Aug-97	1.20	600		22	15,840
Sep-97	1.50	600		25	22,500
Hooks & Line (cpue units = catch per 100 hooks per day)					
Jul-94	0.25	150	700	20	5,250
Aug-94	0.50	200	700	22	15,400
Sep-94	0.75	275	700	22	31,763
Oct-94	0.75	300	700	20	31,500
Nov-94	0.30	100	700	15	3,150
Jul-95	0.25	175	700	20	6,125
Aug-95	0.75	200	700	22	23,100
Sep-95	1.00	275	700	22	42,350
Oct-95	0.50	250	700	20	17,500
Nov-95	0.30	80	700	15	2,520
Jul-96	0.40	190	700	20	10,640
Aug-96	0.60	225	700	24	22,680
Sep-96	0.80	280	700	26	40,768
Oct-96	1.10	260	700	24	48,048
Nov-96	0.00	0	0	0	0
May-97	0.00	0	0	0	0
Jun-97	1.36	100	600	20	16,320
Jul-97	0.60	120	600	20	8,640
Aug-97	0.78	200	600	22	20,592
Sep-97	0.80	250	600	22	26,400
Utherjal (cpue units = catch per net per day)					
Jul-94	1.50	10		15	225
Aug-94	2.00	15		20	600
Sep-94	2.50	20		25	1,250

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Table F.7: Monthly catch rates for various fishing gears in Kawadighi Haor

Month Year	CPUE (kg)	No. of units operated	Hauls/day or Hooks/unit	Fishing days (no.)	Total catch (kg)
Oct-94	3.00	30		25	2,250
Nov-94	3.00	25		20	1,500
Jul-95	1.50	12		20	360
Aug-95	2.20	18		25	990
Sep-95	2.50	25		25	1,563
Oct-95	3.20	30		28	2,688
Nov-95	3.00	28		22	1,848
Jul-96	1.50	14		20	420
Aug-96	2.50	18		25	1,125
Sep-96	2.70	22		25	1,485
Oct-96	3.25	28		28	2,548
May-97	0.00	0		0	0
Jun-97	0.00	0		0	0
Jul-97	0.00	0		0	0
Aug-97	2.00	5		20	200
Sep-97	2.70	12		25	810
Vashal jal (cpue units = catch per net per day)					
Jul-94	2.50	20		20	1,000
Aug-94	3.00	40		25	3,000
Sep-94	3.50	30		28	2,940
Oct-94	4.00	35		28	3,920
Nov-94	3.00	30		25	2,250
Jul-95	2.50	25		20	1,250
Aug-95	3.20	35		25	2,800
Sep-95	3.50	35		28	3,430
Oct-95	4.10	35		28	4,018
Nov-95	3.50	30		25	2,625
Jul-96	3.20	22		20	1,408
Aug-96	3.80	30		25	2,850
Sep-96	4.50	40		28	5,040
Oct-96	4.80	48		28	6,451
May-97	3.50	10		25	875
Jun-97	4.80	18		25	2,160
Jul-97	5.20	22		25	2,860
Aug-97	8.20	30		26	6,396
Sep-97	9.00	38		26	8,892
Chai Fish Trap (cpue units = catch per boat per day)					
Jul-94	0.70	25		25	438
Aug-94	1.26	45		28	1,588
Sep-94	1.50	45		28	1,890
Oct-94	1.00	25		20	500
Nov-94	0.15	5		10	8

Table F.7: Monthly catch rates for various fishing gears in Kawadighi Haor

Month Year	CPUE (kg)	No. of units operated	Hauls/day or Hooks/unit	Fishing days (no.)	Total catch (kg)
Jul-95	0.70	30		25	525
Aug-95	1.25	42		28	1,470
Sep-95	1.50	48		28	2,016
Oct-95	0.65	25		20	325
Nov-95	0.50	12		15	90
Jul-96	1.10	35		25	963
Aug-96	1.60	45		28	2,016
Sep-96	2.20	45		28	2,772
Oct-96	1.70	35		20	1,190
May-97	0.00	0		0	0
Jun-97	2.70	25		20	1,350
Jul-97	2.50	30		22	1,650
Aug-97	1.70	35		26	1,547
Sep-97	2.00	38		28	2,128

Table F.8: Beel production during Year 1 (Dec 95 to March 96)

Month	Gear used	Catch	Area
		(kg)	(ha)
Patasingra Beel			
Dec-95	Gill net (6 boats)	3,859	
(fishing	Tanaber(2)	4,812	
started on	Haturjal(4)	6,527	
Dec 18)	Garijal(1)	4,765	
"	Vashaljal(2)	1,906	
Jan-96	Gillnet(6 boats)	1,197	
"	Tanaber(2)	1,675	
"	Haturjal(2)	2,553	
"	Garijal(1)	2,755	
"	Vashaljal(2)	1,038	
"	Dol fishing	2,215	
Feb-96	Gillnet(4)	206	
"	Tanaber(1)	247	
"	Haturjal(2)	385	
"	Garijal(1)	871	
"	Vashaljal(1)	198	
Beel total =		35,209	233.8
Salkatua and Majerband Beels			
Jan-96	Gillnet(18 boats)	2,113	
(fishing	Tanaber(1)	4,050	
started on	Haturjal(7)	4,675	
Jan 3)	Castnet(10)	1,137	
"	Vashaljal(2)	1,530	
"	Garijal(1)	2,021	
"	Dol fishing	2,861	
Feb-96	Gillnet(12 boats)	464	
"	Tanaber(1)	1,002	
"	Haturjal(6)	2,082	
"	Castnet(4)	191	
"	Vashaljal(1)	465	
"	Garijal(1)	309	
Mar-96	Tanaber(1)	413	
"	Haturjal(4)	981	
"	Castnet(4)	66	
"	Vashaljal(1)	267	
"	Dewatering	1,079	
Beel total =		25,706	125.6

Table F.8: Beel production during Year 1 (Dec 95 to March 96)

Month	Gear used	Catch (kg)	Area (ha)
Rukha Beel			
Dec-95	Haturjal(2)	533	
"	Castnet(4)	76	
"	Gillnet(6 boats)	145	
"	Vashaljal(1)	61	
"	Dol fishing	453	
Jan-96	Haturjal(1)	158	
"	Castnet(2)	43	
"	Gillnet(3 boats)	129	
Feb-96	Dewatering	744	
Beel total =		2,342	5.8
Malagor Beel			
Dec-95	Garijal(1)	1,529	
(fishing started	Castnet(4)	147	
on Dec 20)	Haturjal(1)	294	
Jan-96	Garijal(1)	276	
"	Dewatering	917	
Beel total =		3,163	12.2
Akhali Gang			
Dec-95	Vashaljal(9)	768	
"	Garijal(1)	853	
"	Castnet(4)	86	
Jan-96	Vashaljal(9)	987	
"	Garijal(1)	1,098	
"	Castnet(4)	109	
"	Dol fishing	507	
Feb-96	Vashaljal(5)	407	
"	Garijal(1)	374	
"	Castnet(5)	32	
Mar-96	Vashaljal(2)	131	
"	Garijal(1)	112	
Gang total =		5,464	24.9
GRAND TOTALS =		**71,884**	**402.2**
Average production per hectare =		179	kg/ha
Total beel area =		833	ha
Total beel production =		148876	kg

Table F.9: Beel production during Year 2 (Dec 96 to March 97)

Month	Gear used	Catch (kg)	Area (ha)
Patasingra Beel			
Dec-96	Gill net (8 boats)	5,231	
(fishing	Tanaber(2)	5,520	
started on	Haturjal(4)	6,872	
Dec 18)	Garijal(1)	4,842	
"	Vashaljal(2)	2,886	
"	Thelajal(25)	820	
Jan-97	Gillnet(7 boats)	2,224	
"	Tanaber(2)	2,232	
"	Haturjal(2)	2,128	
"	Garijal(1)	3,572	
"	Vashaljal(2)	1,225	
"	Thelajal(30)	825	
"	Dol fishing	2,650	
Feb-97	Gillnet(4)	425	
"	Tanaber(1)	528	
"	Haturjal(2)	985	
"	Garijal(1)	872	
"	Vashaljal(1)	225	
"	Thelajal(20)	400	
Mar-97	Haturjal(2)	750	
"	Hand fishing(30 per.)	935	
Beel total =		46,147	233.8
Salkatua and Majerband Beels			
Jan-97	Gillnet(18 boats)	4,324	
(fishing	Tanaber(1)	3,875	
started on	Haturjal(7)	7,768	
Jan 3)	Castnet(10)	1,600	
"	Vashaljal(2)	1,720	
"	Garijal(1)	2,390	
"	Thela jal(15)	600	
"	Dol fishing	3,150	
Feb-97	Gillnet(12 boats)	1,465	
"	Tanaber(1)	1,500	
"	Haturjal(6)	2,565	
"	Castnet(4)	275	
"	Vashaljal(1)	350	
"	Garijal(1)	510	
"	Thelajal(18)	280	
Mar-97	Haturjal(4)	1,645	
"	Castnet(4)	122	
"	Vashaljal(1)	360	
"	Dewatering	2,080	
Beel total =		36,579	125.6

Table F.9: Beel production during Year 2 (Dec 96 to March 97)

Month	Gear used	Catch (kg)	Area (ha)
Rukha Beel			
Dec-96	Haturjal(2)	820	
"	Castnet(4)	130	
"	Gillnet(6 boats)	242	
"	Vashaljal(1)	72	
"	Dol fishing	866	
Jan-97	Haturjal(1)	385	
"	Castnet(2)	63	
Feb-97	Dewatering	925	
Beel total =		3,503	5.8
Malagor Beel			
Dec-96	Garijal(1)	1,542	
(fishing started	Castnet(4)	180	
Dec 20)	Haturjal(1)	310	
Jan-97	Garijal(1)	370	
"	Dewatering	915	
Beel total =		3,317	12.2
Akhali Gang			
Dec-96	Vashaljal(9)	750	
"	Garijal(1)	620	
"	Castnet(4)	110	
Jan-97	Vashaljal(9)	860	
"	Garijal(1)	715	
"	Castnet(4)	132	
"	Hand fishing(30)	825	
"	Dol fishing	840	
Feb-97	Vashaljal(5)	398	
"	Garijal(1)	350	
"	Castnet(5)	82	
"	Hand fishig(20)	620	
Mar-97	Vashaljal(2)	160	
"	Garijal(1)	106	
"	Handfishing(40 pers)	506	
Gang total =		7,074	24.9
GRAND TOTALS =		96,620	402.2
Average production per hectare =		240	kg/ha
Total beel area =		833	ha
Total beel production =		200,106	kg

Table F.10: Fish production in Kushiyara River from Nov 95 to Sep 97

Group	Species	Monthly Production																							Total (Year2: May96-Apr97)	
		Year 1						Year 2												Year 3					(kg)	(%)
		Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96	Jun 96	Jul 96	Aug 96	Sep 96	Oct 96	Nov 96	Dec 96	Jan 97	Feb 97	Mar 97	Apr 97	May 97	Jun 97	Jul 97	Aug 97	Sep 97		
Major carp	Rui	39.5	15.6	16.5	37.6	79.9	152.1	174.7	80.1	21.1	31.0	56.3	61.0	38.6	11.6	12.7	35.7	46.2	86.8	129.8	172.3	121.4	39.2	72.4	656	1.8%
"	Catla	0.0	5.2	2.7	3.6	6.7	12.2	14.0	3.1	0.0	1.0	1.4	1.5	0.0	0.0	6.1	2.6	6.1	7.2	14.4	4.1	2.3	0.0	2.2	43	0.1%
"	Kalibaush	27.1	23.5	18.6	41.2	94.2	136.9	157.2	66.8	26.3	29.0	47.9	51.8	17.6	13.1	19.2	29.5	72.6	99.7	121.4	51.8	24.1	21.2	52.5	631	1.7%
"	Mrigal	0.0	0.0	1.2	1.8	2.2	7.3	8.4	0.0	0.0	0.0	0.0	0.0	2.4	1.4	0.0	1.2	2.2	3.1	13.1	11.6	8.2	2.1	1.2	19	0.1%
a. Subtotal		66.6	44.3	39.0	84.1	183.0	308.5	354.2	149.9	47.4	61.0	105.6	114.3	58.6	26.2	38.1	69.0	127.2	196.9	278.8	239.8	156.1	62.5	128.3	1,348	3.6%
Introduced carp	Common carp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0%
"	Grass carp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0%
"	Silver carp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0%
b. Subtotal		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0%
Large catfish	Air	33.9	22.8	22.2	62.6	124.4	115.6	132.7	40.1	18.4	22.3	35.2	38.1	28.5	21.6	26.2	52.4	106.1	115.2	120.8	32.5	27.1	39.1	47.4	637	1.7%
and others	Boal	113.0	71.7	35.1	122.6	233.2	372.4	427.5	157.2	72.3	82.2	126.8	137.2	79.6	59.2	59.2	121.7	272.4	482.1	398.4	71.1	61.4	70.2	72.4	2,078	5.6%
"	Chitol	6.8	5.2	4.5	13.5	20.0	30.4	34.9	13.4	4.4	4.8	8.5	9.2	0.0	0.0	6.5	8.2	9.4	1.7	23.8	16.5	3.2	4.8	8.5	101	0.3%
"	Foli	4.5	3.3	3.9	15.0	35.5	36.5	41.9	15.3	7.0	3.9	5.6	6.1	4.2	5.1	3.7	10.8	29.1	27.5	43.9	14.1	7.4	2.1	3.5	160	0.4%
"	Gonia	3.4	2.0	0.0	4.5	4.4	15.2	17.5	0.4	0.0	2.9	4.2	4.6	3.4	0.0	5.4	4.0	9.2	16.4	1.2	1.9	0.0	2.3	4.1	68	0.2%
"	Lachu	45.2	26.1	12.9	37.6	81.3	127.8	146.7	80.1	31.6	34.8	56.3	61.0	46.2	32.5	12.7	29.4	36.1	68.1	57.2	64.2	37.2	164.2	78.4	636	1.7%
"	Ilish	350.2	97.7	33.0	153.9	453.0	754.5	936.1	705.8	359.6	448.9	653.5	676.9	325.2	72.4	31.1	72.4	352.4	760.2	746.7	779.2	440.2	452.5	693.4	5,395	14.5%
c. Subtotal		556.9	228.7	111.6	409.6	951.7	1,453.0	1,737.3	1,012.2	493.3	599.8	890.2	933.0	487.2	190.9	144.9	299.0	814.9	1,471.3	1,392.2	979.5	576.6	735.3	907.7	9,074	24.4%
A. Intertotal large finfish (a+b+c)		623.5	273.0	150.6	493.7	1,134.7	1,761.5	2,091.5	1,162.1	540.6	660.8	995.8	1,047.3	545.8	217.1	182.9	368.0	942.1	1,668.2	1,670.9	1,219.4	732.7	797.8	1,036.1	10,422	28.0%
Small catfish	Bacha	154.7	97.7	36.9	112.7	329.5	471.6	541.4	351.0	161.4	179.0	249.3	269.8	104.1	81.2	28.1	33.2	104.6	298.6	460.1	347.4	179.2	281.2	232.7	2,402	6.4%
"	Garua	186.4	106.9	43.2	96.6	325.1	502.0	506.5	352.5	179.6	198.3	260.6	312.5	92.4	71.2	32.5	31.4	99.8	246.1	472.2	346.1	167.1	241.4	228.9	2,383	6.4%
"	Rita	22.6	13.0	13.2	31.8	82.2	143.0	164.2	66.8	17.5	23.2	28.2	30.5	17.3	12.5	13.2	28.3	71.4	82.7	162.4	77.2	32.1	28.2	32.9	556	1.5%
"	Tengra	33.9	35.8	12.0	39.4	98.6	79.1	90.8	49.6	22.8	19.4	28.2	30.5	21.2	28.6	17.2	37.1	82.4	75.3	88.1	52.5	18.2	19.1	27.2	503	1.4%
"	Gulsha	28.2	32.6	13.2	34.0	77.7	91.3	104.8	47.7	20.2	13.6	19.7	21.3	26.6	31.2	11.1	29.2	81.3	90.8	111.4	30.9	21.5	12.6	19.8	498	1.3%
"	Batashi	33.9	15.6	15.6	31.3	68.0	116.8	134.1	55.3	25.4	29.0	42.3	45.7	14.6	9.2	9.1	10.7	32.5	64.6	136.7	82.4	72.4	18.4	21.4	473	1.3%
"	Kazoli	124.3	95.8	20.5	63.5	163.4	231.2	265.5	152.6	70.2	99.7	145.1	157.0	114.1	85.6	25.1	65.5	160.4	212.6	251.7	80.5	100.2	101.6	143.2	1,553	4.2%
d. Subtotal		584.0	397.4	154.6	409.3	1,144.4	1,635.0	1,807.3	1,075.5	497.1	562.1	773.3	867.4	390.4	319.6	136.4	235.4	632.5	1,070.8	1,682.7	1,017.1	590.7	702.6	706.2	8,368	22.5%
Other small species	Puti	61.0	32.6	17.4	52.8	91.5	99.8	114.6	62.6	28.8	29.0	42.3	45.7	58.2	30.1	15.2	54.1	72.1	89.9	116.1	62.8	29.2	28.5	44.1	643	1.7%
"	Chapila	79.1	48.9	24.6	59.9	127.0	156.4	179.5	105.3	48.4	58.1	84.5	91.5	61.4	29.8	18.6	42.3	107.2	129.8	784.6	107.3	52.5	58.8	82.7	956	2.6%
"	Chela	28.2	15.6	11.5	30.8	63.1	74.2	85.2	42.4	19.5	22.3	32.4	35.6	29.2	14.8	13.5	29.1	65.2	76.2	84.9	44.7	20.5	21.5	33.4	465	1.2%
"	Mola	39.5	22.8	11.6	29.5	76.4	115.6	132.7	72.5	31.6	29.0	42.3	45.7	33.2	24.3	17.1	36.2	57.7	113.2	129.9	74.5	30.9	29.5	39.8	635	1.7%
"	Dhela	18.1	10.4	3.2	12.5	33.3	51.7	59.4	32.4	14.9	15.5	22.5	24.4	18.0	9.9	3.4	13.1	31.5	51.4	58.8	32.7	14.9	15.5	23.6	296	0.8%
"	Bata	33.9	15.6	11.2	25.9	55.1	79.1	90.8	49.6	22.8	23.2	28.2	30.5	32.7	14.6	13.6	26.8	56.1	80.1	88.3	50.2	18.1	17.4	29.1	469	1.3%
"	Taki	14.7	15.0	10.2	26.8	57.7	43.8	50.3	17.2	7.9	8.7	12.7	13.7	9.2	11.1	10.4	27.1	56.8	42.8	58.5	18.1	6.5	7.1	6.6	268	0.7%
"	Ketchki	33.9	19.6	4.5	14.3	42.6	34.1	39.1	19.1	8.8	12.6	21.1	22.9	39.3	27.1	8.6	13.2	39.2	48.2	49.0	18.7	8.8	7.2	11.1	299	0.8%
"	Rani	26.0	15.0	9.6	28.6	74.6	108.3	124.4	45.8	19.3	22.3	32.4	35.1	23.9	15.4	9.7	27.9	75.5	107.2	125.0	43.1	18.9	21.4	33.0	539	1.4%
"	Poa	18.1	5.2	5.7	17.0	40.0	66.9	76.9	42.0	19.3	15.5	22.5	24.4	18.2	5.5	5.9	16.6	39.8	64.3	78.6	41.9	19.2	13.1	21.6	351	0.9%
"	Jainzza	79.1	35.2	22.2	61.5	158.1	219.1	251.5	137.3	63.1	61.9	90.1	97.6	81.4	34.8	21.4	62.4	159.1	221.7	252.8	131.3	66.4	62.1	88.9	1,283	3.4%
"	Khorsula	22.6	15.6	5.2	15.2	35.5	57.8	66.4	36.2	16.7	15.5	22.5	24.4	21.5	15.6	5.2	19.4	34.1	56.3	61.5	36.9	17.2	16.5	23.5	334	0.9%
"	Chanda	33.9	22.2	13.2	38.5	105.7	130.8	150.2	57.2	26.3	29.0	42.3	45.7	28.1	21.4	13.5	28.4	107.2	118.3	156.5	56.8	26.5	29.1	41.1	668	1.8%
"	Baim	16.9	11.1	8.8	27.2	53.3	51.7	59.4	21.0	9.7	9.7	21.3	22.9	17.1	10.8	8.7	28.4	53.2	50.2	60.4	18.1	9.7	9.7	22.4	312	0.8%
"	Matibangra	5.7	3.3	0.0	0.0	0.0	12.2	14.0	7.6	3.5	3.9	5.6	6.1	5.7	3.2	0.0	0.0	1.3	11.8	13.6	8.0	2.6	3.7	5.8	63	0.2%
"	Misc.	423.6	244.3	99.0	326.4	781.6	958.4	1,100.0	625.3	285.6	251.6	366.2	396.4	440.2	286.4	70.2	258.1	761.2	970.1	1,050.7	620.8	290.4	250.8	368.6	5,811	15.6%
e. Subtotal		934.1	532.3	257.9	767.0	1,796.0	2,260.0	2,595.0	1,373.4	626.0	607.7	889.0	962.5	917.4	555.0	235.1	683.3	1,717.4	2,231.7	3,169.5	1,366.1	632.5	592.2	875.5	13,393	35.9%
B. Intertotal small finfish (d+e)		1,518.1	929.7	412.6	1,176.4	2,940.4	3,895.0	4,402.3	2,448.9	1,123.1	1,169.8	1,662.3	1,829.9	1,307.8	874.6	371.5	918.7	2,349.8	3,302.5	4,852.3	2,383.2	1,223.2	1,294.8	1,581.7	21,761	58.4%
Prawns	Goldachingri	49.7	15.6	2.0	9.0	48.9	106.5	122.3	82.0	39.5	48.4	77.5	83.9	40.2	16.2	4.0	8.2	42.8	110.6	126.4	89.5	30.1	29.3	43.2	676	1.8%
"	Icha	67.8	84.7	34.8	110.0	317.5	322.5	370.3	122.1	50.9	56.1	81.7	88.4	62.4	81.2	34.8	112.6	315.2	320.7	358.9	133.1	48.5	56.5	80.9	1,696	4.6%
Total Prawns		117.5	100.3	36.8	119.0	366.4	429.0	492.6	204.1	90.3	104.5	159.2	172.3	102.6	97.4	38.9	120.8	358.0	431.3	485.3	222.6	78.6	85.8	124.1	2,372	6.4%
Summary Data	Finfish (A+B)	2,141.7	1,202.7	563.2	1,670.0	4,075.1	5,656.5	6,493.8	3,611.0	1,663.8	1,830.6	2,658.1	2,877.2	1,853.6	1,091.6	554.4	1,286.6	3,291.9	4,970.6	6,523.2	3,602.6	1,955.8	2,092.6	2,617.7	32,183	86.4%
"	Prawns	117.5	100.3	36.8	119.0	366.4	429.0	492.6	204.1	90.3	104.5	159.2	2,877.2	102.6	97.4	38.9	120.8	358.0	431.3	485.3	223.0	78.6	85.8	124.1	5,077	13.6%
GRAND TOTAL		2,259.2	1,303.0	600.0	1,789.0	4,441.5	6,085.5	6,986.4	3,815.1	1,754.1	1,935.1	2,817.2	5,754.5	1,956.2	1,189.0	593.3	1,407.4	3,649.9	5,401.9	7,008.5	3,825.6	2,034.4	2,178.3	2,741.8	37,260	100.0%

Table F.11: Index of abundance of fish species in Kawadighi Haor and Kushiyara River

ABUNDANCE																																				
KAWADIGHI HAOR																																				
	92								93												94															
	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a
Air	0	0	0	1	1	1	1	2	2	1	0	0	0	0	1	1	2	2	2	2	2	2	1	0	0	0	0	0	1	1	2	2	1	1	0	0
Bacha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bagair	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bailla	0	1	1	2	2	2	3	3	3	2	1	0	0	1	1	1	2	2	3	3	3	3	4	0	0	1	2	2	2	3	3	3	2	2	1	1
Baim	1	1	1	2	2	2	2	3	3	2	1	0	0	1	1	2	2	3	3	3	3	3	1	0	0	1	1	1	2	2	2	2	2	1	1	0
Bamosh	0	0	0	0	0	0	1	2	2	0	0	0	0	0	1	1	1	1	2	2	2	1	0	0	0	0	1	1	1	1	2	2	1	1	0	0
Bata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Batashi	0	0	1	2	2	2	1	2	2	0	0	0	0	1	1	2	2	2	2	2	1	0	0	0	0	0	0	1	1	1	2	2	1	0	0	0
Bheda	0	1	1	2	2	3	2	2	2	1	0	0	0	1	1	2	3	3	3	2	2	2	1	0	0	1	3	3	3	3	2	2	1	1	1	1
Boal	1	1	1	2	2	3	3	3	3	1	0	0	1	1	1	2	2	3	3	3	3	2	1	1	1	1	2	2	3	2	3	3	2	1	1	1
Boicha	0	0	0	1	2	2	3	3	3	2	1	0	0	0	1	1	2	2	3	3	3	2	1	0	0	0	1	1	2	2	3	3	3	2	0	0
Carpio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2	1	0	0	0	0	0	0	0	0	0	2	1	1	0	0
Catla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Chaka	0	1	1	1	1	2	2	3	3	1	0	0	0	1	1	1	2	2	2	3	2	2	1	0	0	1	1	1	1	2	2	2	2	1	0	0
Chanda	2	2	3	3	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3	3	3	2	2	1	2	2	3	3	3	3	3	3	3	3	2	2
Chapila	0	0	0	1	1	1	1	2	2	0	0	0	0	0	0	1	2	2	2	3	3	2	1	0	0	1	2	2	3	3	3	2	3	2	1	0
Chela	1	2	3	3	3	3	3	3	3	2	1	1	1	1	2	3	3	3	3	3	3	2	1	0	0	1	3	2	2	2	3	3	2	1	0	0
Cirka baim	1	2	2	3	2	2	3	3	2	1	1	1	1	2	2	2	2	3	3	3	2	1	1	1	1	1	2	2	2	3	3	3	2	1	1	1
Chitol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Darkina	1	2	2	2	2	2	2	2	1	0	1	1	1	2	2	3	3	2	2	2	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1	1
Dhela	0	0	1	2	2	2	2	2	1	1	0	0	0	0	1	2	2	2	3	3	2	1	0	0	0	1	2	2	1	1	1	1	2	1	1	1
Foli	0	0	1	1	1	2	2	2	2	1	0	0	0	1	1	1	2	2	3	3	2	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Garua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golda chingri	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Gonia	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gozar	0	0	1	1	2	2	2	2	2	1	0	0	0	0	1	1	2	2	3	3	3	2	1	0	0	0	2	2	2	2	3	3	3	2	1	1
Gulsha	0	0	0	0	0	1	2	2	1	0	0	0	0	0	0	1	1	1	2	2	2	0	0	0	0	1	1	1	1	1	2	2	2	1	0	0
Gutum	1	1	1	1	1	2	3	3	3	2	1	0	0	1	1	1	1	2	3	3	3	2	1	0	0	1	1	1	1	2	2	3	3	1	0	0
Icha	2	2	2	2	2	3	3	3	3	3	2	1	1	1	2	2	2	3	3	3	3	3	2	1	1	1	2	2	2	3	3	3	3	2	1	1
Ilish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kaikka	1	1	1	1	1	2	2	2	2	1	0	0	1	1	1	1	2	2	3	3	3	1	0	0	1	1	2	2	3	3	3	3	3	3	2	1
Kalibaush	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	1	2	2	2	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Kazoli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kechki	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Kholisa	1	1	1	2	2	2	3	3	2	0	0	1	1	1	1	2	2	3	3	3	2	1	0	1	1	2	3	3	3	3	2	2	2	1	1	1
Koi	0	0	1	1	2	2	2	2	1	1	0	0	0	0	1	1	2	2	2	1	1	0	0	0	0	1	2	3	3	3	2	1	2	0	0	0
Lachu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Magur	0	0	0	0	1	1	2	2	2	1	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	1	2	2	3	2	2	2	2	2	0	0
Matibangra	0	0	1	1	1	2	1	0	0	0	0	0	0	0	1	1	1	2	2	1	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
Mola	1	1	2	2	2	2	2	3	3	1	1	0	1	1	1	1	2	2	3	3	3	1	0	0	1	1	1	1	2	3	2	2	2	2	1	1
Mrigel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Naptani	0	1	1	2	2	2	2	2	2	1	0	0	0	1	1	1	2	2	2	2	2	1	0	0	0	1	1	1	1	1	2	2	2	1	0	0
Poa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potka	1	1	1	2	2	2	2	3	2	1	0	0	1	1	2	2	3	3	3	3	2	1	0	0	1	1	2	2	2	3	3	3	2	1	1	1
Puti	1	1	2	3	3	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3	2	1	0	1	1	2	2	3	3	3	3	3	3	2	1	1
Rani	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1	1	2	1	1	1	1	1	0	0
Rita	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rui	0	0	0	1	1	1	1	2	1	0	0	0	0	0	0	0	1	2	2	3	2	1	0	0	0	0	0	0	0	1	1	1	1	1	1	2
Shing	1	1	1	1	1	2	2	2	2	2	1	0	1	1	1	1	2	2	2	2	3	2	1	0	1	1	2	2	3	3	2	2	2	1	1	1
Shole	0	1	1	1	1	2	2	3	3	2	1	0	0	1	1	1	2	2	2	3	3	2	1	0	0	1	2	2	2	2	2	3	3	2	1	1
Taki	1	1	1	2	3	3	3	3	3	2	2	1	1	1	1	1	2	3	3	2	2	2	1	1	2	2	3	3	3	3	2	2	2	1	1	1
Tara baim	1	1	1	2	2	2	3	3	3	2	1	1	1	1	1	2	2	3	3	3	3	2	1	1	1	1	1	2	2	2	2	3	3	2	1	1
Tengra	0	1	1	2	2	2	3	3	2	1	0	0	0	1	1	2	2	3	3	3	2	1	0	0	0	1	2	2	3	2	2	1	3	1	1	1
ABUNDANCE IN																																				

Table F.11: Index of abundance of fish species in Kawadighi Haor and Kushiyara River

ABUNDANCE																													
KAWADIGHI HAOR																													
	95								96												97								
	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s
Air	0	1	1	1	1	2	1	1	2	2	0	1	2	1	1	1	2	2	2	2	2	2	0	0	0	1	2	2	2
Bacha	0	0	1	2	2	1	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0	0	1	1	1	1
Bagair	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1	1
Bailla	1	1	1	1	1	2	2	3	3	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
Baim	0	1	2	2	2	3	2	2	2	3	1	2	2	2	2	2	2	3	2	2	2	3	1	1	0	1	1	1	1
Bamosh	2	2	2	1	1	1	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
Bata	0	1	2	2	3	2	1	1	0	0	0	0	1	2	2	2	1	1	1	1	0	0	0	0	0	0	1	1	1
Batashi	1	1	1	1	2	2	1	2	1	1	0	0	2	2	2	1	1	1	1	1	2	1	0	0	0	1	1	2	1
Bheda	1	2	2	3	3	3	2	3	2	2	1	2	2	2	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3
Boal	1	1	1	2	3	3	3	3	3	3	1	2	2	2	2	2	3	3	2	2	2	1	1	1	1	1	1	1	1
Boicha	0	1	1	2	2	2	2	2	3	2	1	1	2	2	2	3	3	3	0	0	0	0	1	0	1	1	1	1	1
Carpio	0	0	1	2	2	3	2	3	3	2	1	1	2	2	2	1	2	1	2	2	2	1	0	0	2	2	1	1	1
Catla	0	0	0	0	0	0	2	1	2	1	0	0	1	1	1	1	2	2	1	1	1	0	0	0	0	0	1	0	0
Chaka	0	1	2	1	2	2	1	1	2	2	2	2	1	2	1	1	1	2	0	0	1	1	1	1	1	1	1	1	1
Chanda	3	3	3	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Chapila	0	1	1	1	1	1	2	3	3	2	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
Chela	0	0	0	3	2	2	3	3	2	1	1	2	3	3	3	3	1	1	3	3	2	2	1	1	1	1	1	1	2
Cirka baim	1	1	2	2	2	3	2	2	2	1	2	2	2	2	2	2	3	3	1	1	1	1	2	1	1	2	1	1	1
Chitol	0	0	1	1	1	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Darkina	1	1	2	2	2	2	2	2	1	1	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	2	1	1
Dhela	1	2	2	2	2	2	2	2	2	1	1	1	1	2	2	2	2	1	1	1	1	1	1	1	2	2	2	1	1
Foli	0	0	1	1	2	2	2	2	3	2	1	1	1	2	2	2	2	2	1	1	1	1	1	0	1	1	1	1	1
Garua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golda chingri	1	1	1	1	1	1	0	1	1	0	0	0	1	1	1	1	2	0	1	0	1	1	1	1	1	1	1	1	1
Gonia	0	1	1	2	2	3	1	1	1	0	0	0	1	1	1	1	1	1	0	0	1	0	0	0	0	0	1	1	1
Gozar	1	1	1	2	2	2	2	2	3	2	2	1	1	1	1	1	2	2	3	3	3	3	2	1	1	1	2	2	1
Gulsha	0	0	0	0	0	1	1	2	1	1	0	0	1	1	2	2	2	1	2	2	2	1	1	1	1	1	1	1	1
Gutum	1	1	1	1	1	2	3	3	3	2	2	1	2	2	2	2	3	3	1	1	1	2	2	2	2	2	2	1	1
Icha	1	1	2	2	2	2	3	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Ilish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
Kaikka	1	1	1	2	2	3	2	3	3	1	2	2	2	3	3	3	3	2	2	2	2	2	2	1	1	2	1	2	1
Kalibaush	1	1	1	2	2	3	2	2	2	1	1	0	1	1	2	2	2	2	2	3	1	1	0	0	1	1	1	1	1
Kazoli	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	1	1	0
Kechki	0	1	1	0	0	0	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1
Kholisa	1	1	2	3	3	3	3	3	2	1	2	2	2	2	3	3	3	3	3	3	3	3	2	2	2	2	3	3	3
Koi	0	0	2	3	2	1	2	2	2	1	1	1	1	0	1	2	3	3	1	1	2	3	2	1	1	1	3	3	3
Lachu	0	0	1	2	2	2	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1
Magur	0	0	0	1	2	2	1	1	2	1	1	0	0	0	1	2	2	2	1	1	1	1	1	0	0	1	1	1	1
Matibangra	0	1	1	2	2	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0
Mola	1	1	2	3	3	3	2	3	3	1	1	1	2	3	2	3	3	3	2	2	3	2	2	2	2	2	2	3	2
Mrigel	0	0	0	1	1	2	1	1	0	0	0	0	0	1	1	1	1	1	0	1	1	1	0	0	0	0	1	1	1
Naptani	0	1	2	2	2	2	2	2	2	1	1	1	2	2	1	1	2	1	1	1	1	1	1	1	1	1	2	1	1
Poa	0	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Potka	1	2	2	2	2	2	3	3	3	2	2	2	3	2	3	3	3	3	1	2	2	1	1	1	2	2	0	2	2
Puti	1	2	3	3	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Rani	0	0	0	2	2	2	1	2	1	0	0	0	1	1	2	1	1	1	2	2	1	1	1	1	0	0	1	1	1
Rita	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rui	2	2	2	1	2	2	2	2	2	1	0	0	1	1	1	1	2	2	1	2	2	1	0	1	1	0	1	1	1
Shing	1	1	2	2	2	2	2	2	3	2	2	2	1	2	2	3	3	3	2	2	1	1	1	1	1	1	1	2	1
Shole	1	1	1	2	3	3	2	2	3	2	2	2	1	1	1	2	2	2	3	3	3	3	2	0	0	0	2	2	2
Taki	1	1	2	2	3	3	3	3	3	2	2	2	2	2	3	3	3	3	3	3	3	3	3	2	2	2	3	2	2
Tara baim	1	1	1	1	2	3	2	2	3	2	2	2	2	1	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1
Tengra	1	1	1	1	2	2	2	2	2	1	1	1	1	2	2	2	2	2	3	3	2	2	0	2	2	2	3	3	2
ABUNDANCE IN																													

Table F.11: Index of abundance of fish species in Kawadighi Haor and Kushiyara River

KUSHIYARA RIVER	92								93												94															
	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a
Air	1	1	1	1	2	2	2	2	2	1	1	1	1	1	2	2	2	2	3	3	3	2	1	1	1	1	1	1	1	1	2	2	2	2	1	1
Bacha	0	1	2	3	3	2	1	1	1	0	0	0	1	1	2	3	3	2	1	1	1	1	1	0	1	1	2	2	2	3	2	1	1	1	1	1
Bagair	0	0	0	0	0	1	2	1	2	1	0	0	0	0	0	0	1	1	1	2	2	1	0	0	0	0	0	0	0	0	1	1	2	2	1	0
Baila	1	1	2	2	2	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1
Baim	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bamosh	0	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2
Bata	0	0	1	1	1	1	2	1	1	1	1	1	1	1	2	2	2	3	3	2	2	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
Batashi	0	1	2	2	2	1	2	2	2	0	0	0	0	1	2	3	3	2	2	1	1	0	0	0	0	1	1	1	2	2	2	2	1	0	0	0
Bheda	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1
Boal	2	1	1	1	1	2	2	2	3	2	1	1	2	1	1	1	2	2	2	3	3	2	1	1	1	2	1	1	2	2	3	2	2	2	2	3
Boicha	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Carpio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Catla	1	0	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	0	0	0
Chaka	1	1	1	0	0	0	0	1	2	1	0	0	0	1	1	0	0	0	1	2	2	1	0	0	1	1	1	0	0	1	1	1	2	1	0	0
Chanda	1	1	1	2	2	2	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1
Chapila	1	1	1	2	2	2	2	1	1	1	1	1	1	2	2	2	3	3	2	1	1	1	1	1	2	2	2	2	2	2	2	2	1	1	1	2
Chela	2	2	2	3	3	3	3	2	2	2	1	1	2	2	3	3	3	3	3	2	1	1	1	1	2	2	2	2	1	1	1	1	1	1	1	2
Chirka baim	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	2	2	1	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	1
Chitol	0	1	1	1	1	1	1	2	2	1	0	0	0	1	1	1	1	2	2	1	2	1	0	0	0	1	1	1	1	2	1	1	1	1	1	1
Darkina	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0
Dhela	1	1	2	2	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	2	2	2	1	1	1	1	2	2	1	1
Foli	0	0	0	0	0	1	1	2	2	1	0	0	0	0	0	0	0	1	1	1	2	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0
Garua	1	1	2	2	3	3	2	1	1	1	1	1	1	1	2	2	3	3	2	1	1	1	1	1	1	2	1	1	2	2	2	1	1	1	1	1
Golda chingri	0	1	1	1	2	2	1	1	0	0	0	0	0	1	1	2	2	2	1	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Gonia	1	1	0	0	0	1	1	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	0	0	0	1
Gozar	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	2	1	0	0	1	1	3	1	0	0
Gulsha	0	0	0	0	1	1	2	1	1	1	0	0	0	0	0	1	1	1	2	2	2	1	0	0	0	0	0	0	1	1	2	2	1	0	0	0
Gutum	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	1	1	0	0
Icha	1	1	1	1	2	2	2	3	2	1	1	1	1	1	1	1	2	2	2	3	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1
Ilish	1	2	3	3	3	2	1	0	0	0	1	1	1	2	3	3	3	2	1	0	0	0	0	1	1	2	2	2	3	3	1	0	0	0	0	1
Kaikka	2	2	2	2	2	2	2	2	1	1	2	2	2	2	2	2	2	2	2	1	1	1	2	2	2	2	2	2	1	1	2	2	1	1	1	1
Kalibaush	1	1	1	1	1	1	2	2	2	1	1	0	1	1	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
Kazoli	1	2	3	3	3	3	2	1	1	1	1	1	2	2	3	3	3	3	2	1	1	1	1	1	1	2	2	2	2	3	3	1	1	1	2	2
Kechki	1	2	3	3	3	2	1	0	0	0	0	1	1	2	3	3	2	1	1	0	0	0	1	1	2	2	3	3	2	2	1	0	0	0	1	2
Kholisa	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Koi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1
Lachu	1	1	2	3	3	3	2	1	1	0	0	1	1	2	2	2	3	3	3	1	1	0	0	0	1	2	1	1	1	2	2	2	1	1	1	2
Magur	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0
Matibangra	1	2	2	2	2	2	2	2	1	1	1	1	1	2	2	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2	2	2	1	1	1	1
Mola	1	1	1	2	2	3	3	1	1	1	1	1	1	2	2	2	2	3	3	3	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1
Mrigel	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Naptani	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Poa	1	1	2	2	2	2	1	0	0	0	0	0	1	1	2	3	2	2	1	0	0	0	0	0	1	1	2	2	2	1	1	1	1	1	2	2
Potka	0	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	1	1
Puti	1	1	1	1	2	2	2	2	1	1	1	1	1	2	2	1	2	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1
Rani	1	1	2	2	2	2	1	1	1	1	1	1	1	1	2	3	3	2	1	1	1	1	1	1	2	2	1	1	2	1	1	1	1	1	1	1
Rita	1	3	3	2	1	0	0	0	0	0	0	1	2	3	3	1	0	0	0	0	0	1	1	2	3	3	1	1	0	0	0	0	0	1	2	3
Rui	1	2	1	1	1	1	1	0	1	0	1	1	1	1	2	1	1	2	1	0	1	0	0	1	1	2	2	2	1	1	2	2	2	1	1	2
Shing	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Shole	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	0
Taki	1	1	1	1	1	1	1	2	2	1	1	1	0	0	1	1	1	1	1	2	2	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1
Tara baim	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
Tengra	1	1	0	0	1	1	1	2	1	1	1	1	1	1	1	0	1	1	1	1	2	1	1	1	1	1	1	1	0	0	1	2	1	1	0	1

Table F.11: Index of abundance of fish species in Kawadighi Haor and Kushiyara River

KUSHIYARA RIVER	95								96												97								
	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s
Air	1	1	1	1	2	2	2	2	2	1	1	1	1	2	1	2	2	2	1	0	1	0	1	0	1	1	1	1	1
Bacha	2	2	3	3	3	2	2	1	1	1	1	1	2	2	3	3	3	2	3	3	2	2	3	2	3	3	3	3	3
Bagair	0	0	0	0	1	2	1	1	2	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	1	1	1	0
Baila	1	2	2	2	1	1	2	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	2	1	1	1	1
Baim	0	0	0	1	1	1	2	2	2	2	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1	0	1
Bamosh	2	1	1	1	0	0	1	0	0	0	0	1	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1	1	1
Bata	2	1	1	2	2	2	2	1	1	1	1	2	2	2	2	2	2	1	1	1	0	0	0	0	0	1	1	1	1
Batashi	1	1	1	1	1	2	2	1	1	1	1	2	2	3	2	1	1	1	1	1	1	1	1	1	2	2	1	1	1
Bheda	1	1	1	1	2	2	1	1	1	1	1	1	2	2	1	1	1	2	0	0	1	1	1	1	1	1	1	0	0
Boal	3	1	1	1	2	3	3	2	2	1	2	3	3	1	1	2	2	3	0	0	0	0	1	1	1	1	1	1	1
Boicha	0	0	0	1	1	0	0	0	1	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1
Carpio	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Catla	1	0	0	0	1	1	1	0	0	0	0	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
Chaka	0	0	1	1	0	0	1	1	1	1	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0
Chanda	1	1	1	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
Chapila	2	1	1	2	2	2	2	1	1	1	1	2	2	2	1	1	2	2	1	1	2	1	2	2	3	3	1	1	1
Chela	2	2	2	2	2	1	1	1	1	1	1	1	2	3	3	2	2	2	1	1	2	2	1	2	2	1	2	1	2
Chirka baim	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1	0	0	0	2	2	1
Chitol	0	0	0	0	2	2	1	2	2	1	1	2	2	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0
Darkina	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1
Dhela	1	1	1	2	2	2	1	1	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2	1	1
Foli	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0
Garua	2	2	2	3	2	1	2	1	1	1	1	1	2	2	3	3	3	2	1	1	0	1	2	1	1	2	2	2	2
Golda chingri	1	1	2	2	1	1	1	1	1	1	1	2	3	3	3	2	2	1	1	0	0	1	1	1	1	1	1	1	1
Gonia	2	1	0	0	1	2	1	1	0	0	0	1	2	1	1	1	1	2	1	1	0	0	0	0	0	2	1	1	0
Gozar	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Gulsha	0	0	0	0	1	1	1	1	2	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	2	1	1	1
Gutum	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	1	1
Icha	1	1	1	1	1	2	2	2	2	2	2	2	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1
Ilish	2	3	3	3	2	1	1	1	0	0	0	1	2	3	3	3	3	2	3	3	0	1	3	3	3	3	3	3	3
Kaikka	2	2	1	1	2	2	2	2	1	0	0	0	1	1	1	1	2	2	0	0	0	1	1	1	1	1	1	1	1
Kalibaush	2	1	1	1	2	2	1	1	2	1	1	2	2	1	1	1	2	2	0	0	0	0	0	0	0	0	1	0	0
Kazoli	3	3	3	3	3	2	2	1	1	1	1	1	2	2	3	3	3	2	3	3	3	2	3	3	3	3	3	3	3
Kechki	2	3	3	3	2	1	1	0	0	0	1	1	1	2	3	3	3	3	2	2	3	2	2	3	3	3	3	2	3
Kholisa	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0
Koi	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Lachu	2	1	1	2	3	3	2	1	1	1	1	1	2	2	2	2	1	3	1	2	3	2	2	2	2	1	1	1	2
Magur	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Matibangra	1	2	2	2	2	2	1	1	1	1	1	2	2	2	2	1	1	2	1	1	1	1	1	1	0	1	1	1	1
Mola	1	2	3	3	3	2	2	1	1	1	2	2	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
Mrigel	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
Naptani	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	1
Poa	2	2	3	1	1	1	1	0	0	0	0	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1
Potka	1	1	1	1	1	1	2	2	2	2	3	3	3	2	2	2	2	2	1	1	1	1	1	1	2	1	1	1	1
Puti	1	2	1	1	2	2	2	1	1	1	1	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
Rani	2	2	3	3	2	2	2	1	1	1	1	2	2	2	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1
Rita	3	2	1	1	0	0	1	0	1	1	2	3	3	2	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0
Rui	2	1	1	1	1	2	2	1	2	2	1	1	3	3	2	1	1	2	1	1	1	1	0	0	1	2	1	1	1
Shing	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0
Shole	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Taki	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	1	1	1	1	1	1	1	1
Tara baim	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1
Tengra	0	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	0	1	1	1	1	1	1

Appendix G

HYDRAULIC, HYDROLOGY AND WATER QUALITY DATA

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Table G.1: Monthly Rainfall at Chandbagh (R-104)

year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1961	-10,000	-10,000	-241	132	399	535	332	228	328	177	0	0	-2,373
1962	0	43	0	124	359	773	372	524	164	159	0	0	2,517
1963	0	-10,000	93	172	827	692	368	333	328	255	0	0	-3,069
1964	10	9	138	446	540	899	649	289	380	299	12	0	3,670
1965	0	30	44	168	289	676	570	631	715	138	253	0	3,514
1966	51	0	48	409	522	1,219	312	416	179	257	35	32	3,478
1967	38	0	88	414	371	513	418	358	457	30	0	0	2,687
1968	12	0	42	208	464	656	857	396	302	71	21	0	3,029
1969	22	0	111	229	209	666	408	718	113	123	15	0	2,613
1970	42	49	33	274	229	818	692	348	367	357	19	0	3,229
1971	6	14	54	262	380	366	349	413	432	300	88	0	2,664
1972	0	33	-44	347	415	573	621	436	168	113	36	0	-2,786
1973	6	121	2	365	546	637	312	337	274	0	85	90	2,776
1974	0	5	129	571	494	747	585	319	269	115	21	0	3,254
1975	0	4	37	450	915	346	638	538	296	153	98	0	3,474
1976	0	20	200	224	463	1,076	547	522	307	126	105	0	3,589
1977	4	15	163	612	687	528	325	427	133	314	34	16	3,257
1978	0	0	19	143	662	296	488	237	205	23	0	0	2,073
1979	1	8	94	82	204	638	553	248	431	32	7	44	2,341
1980	0	29	55	404	648	416	462	233	475	229	0	0	2,950
1981	26	53	91	313	519	214	489	475	319	19	0	0	2,517
1982	0	30	70	186	302	515	470	497	242	190	9	0	2,511
1983	17	29	309	436	531	651	414	831	484	148	0	78	3,927
1984	17	0	20	220	1,209	377	463	472	598	375	25	22	3,798
1985	2	50	148	452	313	1,311	394	238	726	41	0	0	3,675
1986	7	9	23	444	253	285	883	349	394	312	195	0	3,155
1987	0	8	134	429	136	988	705	660	303	174	9	3	3,548
1988	0	84	111	277	1,115	578	483	856	379	268	169	27	4,346
1989	9	19	6	256	682	521	785	502	640	329	0	0	3,749
1990	0	28	123	630	439	381	512	333	455	247	65	4	3,217
1991	19	50	76	498	1,197	716	340	303	473	219	0	126	4,017
1992	0	44	133	154	421	384	462	411	232	191	0	2	2,434
1993	5	18	5	349	711	974	1,155	-10,000	-10,000	-10,000	-10,000	-10,000	-3,217
num.	32	31	31	33	33	33	33	32	32	32	32	32	29
min.	0	0	0	82	136	214	312	228	113	0	0	0	2,073
mean	9	26	84	324	529	635	528	434	362	181	41	14	3,173
max.	51	121	309	630	1,209	1,311	1,155	856	726	375	253	126	4,346

NOTE: Negative value indicates partial period
-10,000 indicates missing period
Partial months are included in annual total indicated with -
Partial periods are excluded from summary statistics (min, mean, and max)

Table G.2: Monthly Rainfall at Langla (R-117)

year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1961	-10,000	17	229	147	379	375	201	400	365	159	0	0	-2,271
1962	11	47	30	164	332	644	374	480	95	202	-10,000	-10,000	-2,380
1963	0	5	142	141	533	638	373	389	264	399	31	0	2,913
1964	6	35	195	477	512	556	535	231	261	245	29	0	3,082
1965	0	57	65	157	306	508	399	433	350	68	102	10	2,455
1966	27	0	69	196	342	598	414	309	255	301	21	37	2,570
1967	20	0	162	319	311	472	382	395	380	51	1	0	2,493
1968	43	11	92	302	529	506	792	320	278	136	24	0	3,033
1969	28	0	158	259	249	528	314	618	98	128	19	0	2,400
1970	20	89	32	242	228	663	599	248	268	161	12	0	2,562
1971	10	10	139	234	369	295	243	362	207	132	33	0	2,035
1972	0	7	70	266	316	451	562	391	98	93	0	0	2,254
1973	19	93	19	356	759	534	350	486	278	90	130	94	3,207
1974	3	0	158	369	440	724	496	311	-213	-10,000	-28	8	-2,748
1975	0	16	0	285	609	370	345	430	299	83	43	0	2,480
1976	0	12	34	271	291	1,162	353	456	376	44	65	0	3,064
1977	8	75	127	743	578	520	174	484	84	283	38	14	3,126
1978	0	5	23	135	699	464	517	187	206	40	7	0	2,283
1979	3	3	94	147	178	485	468	228	413	104	15	58	2,195
1980	3	5	56	274	564	463	366	374	250	219	0	3	2,578
1981	17	66	140	416	467	225	539	599	311	0	0	5	2,784
1982	0	100	32	312	282	458	440	438	133	58	24	0	2,277
1983	33	46	320	442	707	667	369	681	384	231	8	41	3,928
1984	3	0	11	158	1,225	379	281	397	570	349	2	11	3,385
1985	7	36	222	362	260	1,158	414	337	634	26	0	10	3,465
1986	8	2	38	403	247	293	525	277	322	324	211	2	2,651
1987	9	0	66	403	202	1,078	387	557	237	102	16	0	3,057
1988	0	45	72	280	810	532	390	716	403	152	90	32	3,522
1989	0	52	4	29	468	589	569	505	423	572	0	2	3,213
1990	0	30	146	423	487	395	207	333	706	245	107	7	3,086
1991	18	69	73	477	1,077	680	261	290	286	239	0	138	3,608
1992	0	116	164	118	458	254	283	448	202	218	0	0	2,261
1993	28	386	79	270	790	-775	928	-10,000	-10,000	-10,000	-10,000	-10,000	-3,257
num.	32	33	33	33	33	32	33	32	31	31	30	31	29
min.	0	0	0	29	178	225	174	187	84	0	0	0	2,035
mean	10	44	99	290	485	552	420	410	304	176	34	15	2,826
max.	43	386	320	743	1,225	1,162	928	716	706	572	211	138	3,928

NOTE: Negative value indicates partial period
-10,000 indicates missing period
Partial months are included in annual total indicated with -
Partial periods are excluded from summary statistics (min, mean, and max)

Table G.3: Monthly Rainfall at Moulvibazar (R-122)

year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1961	-10,000	0	407	131	351	389	300	292	355	157	0	0	-2,381
1962	11	30	1	148	252	541	406	485	111	162	0	0	2,147
1963	0	0	139	-10,000	373	644	389	275	208	262	0	0	-2,290
1964	4	60	117	395	381	552	623	302	250	253	15	0	2,949
1965	0	64	62	105	274	567	463	513	237	37	66	7	2,394
1966	39	0	35	195	369	505	365	552	415	244	50	53	2,822
1967	53	0	141	318	285	350	390	317	482	104	2	0	2,442
1968	14	20	118	260	488	551	-658	283	339	25	39	0	-2,796
1969	6	105	105	331	280	522	389	528	111	105	13	0	2,496
1970	27	67	28	157	182	708	724	367	312	230	43	0	2,845
1971	6	-6	-10,000	-10,000	-145	365	358	348	333	114	83	0	-1,758
1972	1	26	51	219	190	529	568	382	137	54	3	5	2,163
1973	21	163	21	326	565	611	536	501	213	28	55	88	3,126
1974	3	7	28	320	375	547	469	283	189	135	17	0	2,372
1975	0	0	0	266	441	333	365	375	196	58	57	0	2,091
1976	0	20	53	206	528	1,261	584	310	325	160	36	0	3,484
1977	12	88	10	801	617	697	355	468	90	289	34	0	3,461
1978	0	6	25	268	841	448	271	171	396	72	0	0	2,498
1979	0	10	87	100	153	678	475	300	401	50	1	29	2,285
1980	0	2	122	275	597	375	468	323	322	179	0	0	2,664
1981	0	34	96	-10,000	-10,000	-10,000	-10,000	-10,000	-10,000	-10,000	-10,000	-10,000	-129
1982	-10,000	-10,000	-10,000	202	235	531	432	629	193	4	10	0	-2,236
1983	25	27	261	345	654	361	387	716	351	186	0	36	3,346
1984	0	0	12	134	1,236	390	339	316	523	135	4	0	3,089
1985	13	22	191	256	218	836	295	155	427	29	2	3	2,445
1986	0	2	0	252	189	200	416	262	283	381	131	0	2,115
1987	0	3	48	284	170	779	534	440	210	151	17	9	2,644
1988	0	33	75	353	883	460	373	667	207	214	67	0	3,331
1989	3	1	4	199	376	250	428	463	487	386	0	0	2,595
1990	0	10	201	388	590	428	355	562	467	280	43	5	3,329
1991	9	102	27	-10,000	-10,000	-10,000	-10,000	-10,000	-10,000	-10,000	-10,000	-10,000	-138
1992	-10,000	-10,000	-10,000	63	437	217	290	281	291	91	2	0	-1,671
1993	34	114	100	382	843	757	773	-10,000	-10,000	-10,000	-10,000	-10,000	-3,002
num.	30	30	30	29	30	31	30	30	30	30	30	30	24
min.	0	0	0	63	153	200	271	155	90	4	0	0	2,091
mean	9	34	85	265	446	528	437	396	295	152	26	8	2,714
max.	53	163	407	801	1,236	1,261	773	716	523	386	131	88	3,484

NOTE: Negative value indicates partial period
-10,000 indicates missing period
Partial months are included in annual total indicated with -
Partial periods are excluded from summary statistics (min, mean, and Maximum)

Table G.4: Computed Velocities at Vertical Slots (Year 1)

Observation No.	Snap 1	Snap 2	Snap 3	Snap 4	Snap 5	Snap 6	Snap 7	Snap 8	Snap 9	Snap 10
Observation Date	Jul 07,95	Jul. 28,95	Aug. 08,95	Aug. 18,95	Sep. 01,95	Sep. 22,95	Sep. 30,95	Oct. 14,95	Oct. 20,95	Oct. 27,95
R/S WL (m PWD)	9.0	8.5	8.3	9.2	9.1	8.2	8.4	8.1	7.5	6.5
C/S WL (m PWD)	8.1	8.3	8.6	8.9	9.0	8.6	8.6	8.3	8.0	7.4
Head Diff. (m)	0.9	0.2	−0.3	0.3	0.1	−0.4	−0.2	−0.2	−0.4	−0.9
Slot No.	Average Maximum Velocity (m/sec)									
1	1.6	0.6	0.3	0.8	0.5	1.4	0.7	0.7	1.1	2.0
2	1.6	0.6	0.3	0.8	0.5	1.3	0.7	0.6	1.0	1.8
3	1.6	0.5	0.3	0.8	0.5	1.2	0.6	0.6	1.0	1.6
4	1.5	0.5	0.3	0.8	0.5	1.0	0.6	0.6	0.9	1.5
5	1.5	0.5	0.2	0.7	0.5	1.0	0.6	0.5	0.9	1.3
6	1.4	0.5	0.2	0.7	0.4	0.9	0.6	0.5	0.8	1.2
7	1.3	0.5	0.2	0.7	0.4	0.8	0.5	0.5	0.8	1.0
8	1.3	0.5	0.2			0.7	0.5	0.4	0.7	0.9
9	1.2	0.5	0.2			0.7	0.5	0.4	0.7	0.8
10	1.1	0.4	0.2			0.6	0.4	0.4	0.7	0.8
11	1.0	0.4						0.3	0.6	0.7
12	0.8	0.4						0.3	0.6	0.6
13									0.6	0.6
14									0.5	0.6
15										0.6
16										0.6

Notes :

1. Positive head difference indicates flow from R/S to C/S

2. Negative head difference indicates flow from C/S to R/S

3. [shaded] *Indicates Vertical slot submerged*

Table G.5: Computed Velocities at Vertical Slots (Year 2)

Direction of Flow :R/S to C/S

Measurement No.	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16
Date	May 18,96	May 25,96	Jun 01,96	Jun 08,96	Jun 16,96	Jun 22,96	Jun 30,96	JUl 06,96	Jul 13,96	Jul 20,96	Jul 28,96	Aug 03,96	Aug 18,96	Aug 25,96	Sep 08,96
R/S WL (m PWD)	8.2	7.6	8.1	8.6	7.8	7.5	7.4	9.0	9.0	9.0	8.8	8.7	8.7	8.9	8.5
C/S WL (m PWD)	5.1	5.5	6.0	6.8	6.6	6.7	6.9	8.1	8.2	8.2	8.2	8.3	8.4	8.5	8.5
Head Diff. (m)	3.1	2.1	2.2	1.8	1.2	0.8	0.4	0.9	0.9	0.8	0.6	0.4	0.3	0.4	0.1
Slot No.	Velocity (m/sec)														
1	2.0	2.1	2.1	1.5	1.5	1.2	0.8	1.1	1.0	1.0	0.9	0.9	0.7	0.9	0.4
2	2.0	2.0	2.1	1.5	1.5	1.2	0.8	1.1	0.9	1.0	0.9	0.8	0.7	0.8	0.4
3	2.0	2.0	2.1	1.4	1.5	1.2	0.8	1.1	0.9	1.0	0.9	0.8	0.6	0.8	0.4
4	2.1	2.0	2.1	1.4	1.5	1.2	0.7	1.1	0.9	1.0	0.8	0.8	0.6	0.8	0.3
5	2.1	2.0	2.0	1.4	1.5	1.2	0.7	1.1	0.9	0.9	0.8	0.8	0.6	0.7	0.3
6	2.1	2.0	2.0	1.4	1.4	1.2	0.7	1.0	0.9	0.9	0.8	0.8	0.6	0.7	0.3
7	2.1	2.0	2.0	1.3	1.4	1.2	0.7	1.0	0.9	0.9	0.8	0.7	0.6	0.7	0.3
8	2.2	2.0	2.0	1.3	1.4	1.2	0.6	1.0	0.8	0.8	0.7	0.7	0.5	0.6	0.3
9	2.2	2.0	2.0	1.3	1.3	1.1	0.6	0.9	0.8	0.8	0.7	0.7	0.5	0.6	0.3
10	2.2	2.0	2.0	1.3	1.3	1.1	0.6	0.9	0.8	0.7	0.6	0.7	0.5	0.6	0.3
11	2.2	2.0	1.9	1.3	1.2	1.0	0.5	0.8	0.8		0.6	0.6			
12	2.3	1.9	1.9	1.3	1.2	1.0	0.5	0.8							
13	2.3	1.9	1.9	1.3	1.1	0.9	0.5	0.7							
14	2.3	1.9	1.8	1.2	1.0	0.9	0.5	0.7							
15	2.3	1.9	1.8	1.2	1.0	0.8	0.4	0.6							
16	2.4	1.9	1.8	1.2	0.9	0.8	0.4	0.5							

Direction of Flow :C/S to R/S

Measurement No.	13	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Date	Aug 11,96	Sep 10,96	Sep 15,96	Sep 16,96	Sep 19,96	Sep 21,96	Sep 24,96	Sep 27,96	Sep 30,96	Oct 04,96	Oct 08,96	Oct 11,96	Oct 18,96	Oct 22,96	Oct 25,96
R/S WL (m PWD)	8.3	8.4	8.0	7.5	7.4	7.3	8.1	8.0	7.9	7.7	8.1	7.9	7.1	6.6	6.2
C/S WL (m PWD)	8.3	8.5	8.4	7.9	7.9	7.9	8.5	8.4	8.4	8.2	8.3	8.2	7.9	7.7	7.5
Head Diff. (m)	0.0	0.0	0.3	0.4	0.5	0.6	0.4	0.5	0.4	0.5	0.2	0.3	0.8	1.1	1.3
Slot No.	Velocity (m/sec)												1	2	3
1	0.2	0.3	0.9	1.0	1.3	1.4	1.3	1.4	1.4	1.5	0.7	1.2	2.0	2.2	2.7
2	0.1	0.3	0.9	1.0	1.3	1.4	1.3	1.4	1.4	1.5	0.7	1.2	2.0	2.2	2.5
3	0.1	0.3	0.9	1.0	1.3	1.4	1.3	1.4	1.4	1.5	0.7	1.2	1.9	2.2	2.3
4	0.1	0.3	0.9	1.0	1.3	1.3	1.3	1.3	1.4	1.5	0.7	1.2	1.9	2.1	2.1
5	0.1	0.3	0.8	1.0	1.3	1.3	1.2	1.3	1.3	1.5	0.6	1.1	1.9	2.0	1.9
6	0.1	0.3	0.8	0.9	1.2	1.2	1.2	1.3	1.3	1.4	0.6	1.1	1.9	2.0	1.8
7	0.1	0.3	0.8	0.9	1.2	1.2	1.1	1.2	1.2	1.4	0.6	1.0	1.9	1.9	1.6
8	0.1	0.3	0.7	0.8	1.2	1.1	1.0	1.1	1.1	1.3	0.6	1.0	1.9	1.8	1.5
9	0.1	0.3	0.7	0.8	1.1	1.0	1.0	1.1	1.0	1.3	0.5	0.9	1.8	1.7	1.4
10	0.1	0.3	0.6	0.7	1.1	0.9	0.9	1.0	1.0	1.2	0.5	0.8	1.8	1.5	1.2
11	0.1		0.6	0.6	1.0	0.8	0.8	0.9	0.9	1.1	0.5	0.8	1.7	1.4	1.1
12										1.0	0.5	0.7	1.6	1.3	1.0
13													1.4	1.1	0.9
14													1.3	1.0	0.8
15														0.8	0.7
16														0.8	0.7

Indicates vertical slots submerged

Table G.6 : Water Level and Velocity Data for Year 1 (1995)

Year 1995	Day	C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Slot Velocity (m/sec)	Location
01-Mar-95	60	3.60	3.52	-0.08	---	---
02-Mar-95	61	3.60	3.52	-0.08	---	---
03-Mar-95	62	3.60	3.52	-0.08	---	---
04-Mar-95	63	3.61	3.52	-0.09	---	---
05-Mar-95	64	3.61	3.52	-0.09	---	---
06-Mar-95	65	3.61	3.52	-0.09	---	---
07-Mar-95	66	3.60	3.52	-0.08	---	---
08-Mar-95	67	3.60	3.52	-0.08	---	---
09-Mar-95	68	3.60	3.52	-0.08	---	---
10-Mar-95	69	3.60	3.52	-0.08	---	---
11-Mar-95	70	3.60	3.52	-0.08	---	---
12-Mar-95	71	3.60	3.52	-0.08	---	---
13-Mar-95	72	3.59	3.51	-0.08	---	---
14-Mar-95	73	3.58	3.50	-0.08	---	---
15-Mar-95	74	3.58	3.49	-0.09	---	---
16-Mar-95	75	3.38	2.66	-0.72	---	---
17-Mar-95	76	3.22	2.50	-0.72	---	---
18-Mar-95	77	3.22	2.50	-0.72	---	---
19-Mar-95	78	3.21	2.49	-0.72	---	---
20-Mar-95	79	3.21	2.49	-0.72	---	---
21-Mar-95	80	3.21	2.49	-0.72	---	---
22-Mar-95	81	3.20	2.49	-0.71	---	---
23-Mar-95	82	3.20	2.49	-0.71	---	---
24-Mar-95	83	3.20	2.49	-0.71	---	---
25-Mar-95	84	3.19	2.49	-0.70	---	---
26-Mar-95	85	3.18	2.49	-0.69	---	---
27-Mar-95	86	3.18	2.49	-0.69	---	---
28-Mar-95	87	3.18	2.49	-0.69	---	---
29-Mar-95	88	3.17	2.49	-0.68	---	---
30-Mar-95	89	3.18	2.50	-0.68	---	---
31-Mar-95	90	3.19	2.51	-0.68	---	---
01-Apr-95	91	3.51	3.21	-0.30	---	---
02-Apr-95	92	3.64	3.26	-0.38	---	---
03-Apr-95	93	3.66	3.34	-0.32	---	---
04-Apr-95	94	3.66	3.36	-0.30	---	---
05-Apr-95	95	3.66	3.36	-0.30	---	---
06-Apr-95	96	3.66	3.37	-0.29	---	---
07-Apr-95	97	3.66	3.36	-0.30	---	---
08-Apr-95	98	3.66	3.33	-0.33	---	---
09-Apr-95	99	3.64	3.31	-0.33	---	---
10-Apr-95	100	3.64	3.31	-0.33	---	---
11-Apr-95	101	3.64	3.32	-0.32	---	---
12-Apr-95	102	3.68	3.36	-0.32	---	---
13-Apr-95	103	4.06	3.39	-0.67	---	---
14-Apr-95	104	4.05	3.38	-0.67	---	---
15-Apr-95	105	4.03	3.38	-0.65	---	---
16-Apr-95	106	3.98	3.38	-0.60	---	---
17-Apr-95	107	4.00	3.38	-0.62	---	---
18-Apr-95	108	4.06	3.71	-0.35	---	---
19-Apr-95	109	4.08	3.76	-0.32	---	---
20-Apr-95	110	4.04	3.73	-0.31	---	---
21-Apr-95	111	3.95	3.70	-0.25	---	---
22-Apr-95	112	3.89	3.67	-0.22	---	---
23-Apr-95	113	3.82	3.62	-0.20	---	---
24-Apr-95	114	3.74	3.57	-0.17	---	---

mm8

Table G.6 : Water Level and Velocity Data for Year 1 (1995)

Year 1995	Day	C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Slot Velocity (m/sec)	Location
25-Apr-95	115	3.70	3.54	-0.16	---	---
26-Apr-95	116	3.64	3.48	-0.16	---	---
27-Apr-95	117	3.61	3.44	-0.17	---	---
28-Apr-95	118	3.59	3.41	-0.18	---	---
29-Apr-95	119	3.54	3.36	-0.18	---	---
30-Apr-95	120	3.52	3.33	-0.19	---	---
01-May-95	121	3.51	3.35	-0.16	---	---
02-May-95	122	3.49	3.33	-0.16	---	---
03-May-95	123	3.50	3.35	-0.15	---	---
04-May-95	124	3.51	3.38	-0.13	---	---
05-May-95	125	3.52	3.41	-0.11	---	---
06-May-95	126	3.91	3.91	0.00	---	---
07-May-95	127	3.95	3.95	0.00	---	---
08-May-95	128	4.02	4.10	0.08	---	---
09-May-95	129	4.16	4.18	0.02	---	---
10-May-95	130	4.19	4.20	0.01	---	---
11-May-95	131	4.20	4.22	0.02	---	---
12-May-95	132	4.32	4.33	0.01	---	---
13-May-95	133	4.32	4.32	0.00	---	---
14-May-95	134	4.32	4.30	-0.02	---	---
15-May-95	135	4.31	4.21	-0.10	---	---
16-May-95	136	4.34	4.13	-0.21	---	---
17-May-95	137	4.43	4.19	-0.24	---	---
18-May-95	138	4.78	4.78	0.00	---	---
19-May-95	139	5.03	6.86	1.83	1.880	Slot 1
20-May-95	140	5.15	7.49	2.34	2.171	Slot 16
21-May-95	141	5.24	7.48	2.24	2.122	Slot 1
22-May-95	142	5.26	7.53	2.27	2.139	Slot 1
23-May-95	143	5.31	7.54	2.23	2.116	Slot 1
24-May-95	144	5.36	7.37	2.01	1.988	Slot 1
25-May-95	145	5.36	7.27	1.91	1.929	Slot 1
26-May-95	146	5.38	7.16	1.78	1.849	Slot 1
27-May-95	147	5.46	6.86	1.40	1.601	Slot 1
28-May-95	148	5.46	6.66	1.20	1.459	Slot 1
29-May-95	149	5.47	6.55	1.08	1.370	Slot 1
30-May-95	150	5.47	6.36	0.89	1.220	Slot 1
31-May-95	151	5.50	6.24	0.74	1.092	Slot 1
01-Jun-95	152	5.50	6.06	0.56	0.924	Slot 1
02-Jun-95	153	5.52	5.96	0.44	0.799	Slot 1
03-Jun-95	154	5.54	5.96	0.42	0.777	Slot 1
04-Jun-95	155	5.56	6.04	0.48	0.842	Slot 1
05-Jun-95	156	5.57	6.12	0.55	0.914	Slot 1
06-Jun-95	157	5.60	6.13	0.53	0.894	Slot 1
07-Jun-95	158	5.60	6.04	0.44	0.799	Slot 1
08-Jun-95	159	5.64	6.02	0.38	0.732	Slot 1
09-Jun-95	160	5.65	6.03	0.38	0.732	Slot 1
10-Jun-95	161	5.63	6.20	0.57	0.934	Slot 1
11-Jun-95	162	5.63	6.32	0.69	1.047	Slot 1
12-Jun-95	163	5.64	6.66	1.02	1.324	Slot 1
13-Jun-95	164	5.66	6.56	0.90	1.228	Slot 1
14-Jun-95	165	5.74	6.84	1.10	1.385	Slot 1
15-Jun-95	166	5.86	7.10	1.24	1.488	Slot 1
16-Jun-95	167	5.90	7.28	1.38	1.587	Slot 1
17-Jun-95	168	6.61	7.87	1.26	1.503	Slot 1
18-Jun-95	169	7.05	8.42	1.37	1.580	Slot 1

Table G.6 : Water Level and Velocity Data for Year 1 (1995)

Year 1995	Day	C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Slot Velocity (m/sec)	Location
19-Jun-95	170	7.30	8.76	1.46	1.641	Slot 1
20-Jun-95	171	7.50	9.02	1.52	1.682	Slot 1
21-Jun-95	172	7.57	9.12	1.55	1.701	Slot 1
22-Jun-95	173	7.66	9.14	1.48	1.655	Slot 1
23-Jun-95	174	7.71	9.08	1.37	1.580	Slot 1
24-Jun-95	175	7.73	9.04	1.31	1.538	Slot 1
25-Jun-95	176	7.75	9.00	1.25	1.495	Slot 1
26-Jun-95	177	7.78	8.94	1.16	1.430	Slot 1
27-Jun-95	178	7.76	8.88	1.12	1.400	Slot 1
28-Jun-95	179	7.77	8.77	1.00	1.308	Slot 1
29-Jun-95	180	7.75	8.77	1.02	1.324	Slot 1
30-Jun-95	181	7.75	8.77	1.02	1.324	Slot 1
01-Jul-95	182	7.76	8.78	1.02	1.324	Slot 1
02-Jul-95	183	7.75	8.76	1.01	1.316	Slot 1
03-Jul-95	184	7.73	8.73	1.00	1.308	Slot 1
04-Jul-95	185	7.78	8.78	1.00	1.308	Slot 1
05-Jul-95	186	7.99	8.96	0.97	1.284	Slot 1
06-Jul-95	187	8.05	9.06	1.01	1.316	Slot 1
07-Jul-95	188	8.08	9.08	1.00	1.308	Slot 1
08-Jul-95	189	8.09	9.08	0.99	1.300	Slot 1
09-Jul-95	190	8.10	9.06	0.96	1.276	Slot 1
10-Jul-95	191	8.14	9.05	0.91	1.236	Slot 1
11-Jul-95	192	8.17	9.04	0.87	1.203	Slot 1
12-Jul-95	193	8.21	9.04	0.83	1.170	Slot 1
13-Jul-95	194	8.22	9.00	0.78	1.127	Slot 1
14-Jul-95	195	8.22	8.96	0.74	1.092	Slot 1
15-Jul-95	196	8.23	8.94	0.71	1.065	Slot 1
16-Jul-95	197	8.23	8.90	0.67	1.029	Slot 1
17-Jul-95	198	8.24	8.88	0.64	1.001	Slot 1
18-Jul-95	199	8.23	8.85	0.62	0.982	Slot 1
19-Jul-95	200	8.26	8.78	0.52	0.884	Slot 1
20-Jul-95	201	8.28	8.78	0.50	0.863	Slot 1
21-Jul-95	202	8.28	8.83	0.55	0.914	Slot 1
22-Jul-95	203	8.30	8.83	0.53	0.894	Slot 1
23-Jul-95	204	8.28	8.75	0.47	0.832	Slot 1
24-Jul-95	205	8.27	8.66	0.39	0.743	Slot 1
25-Jul-95	206	8.25	8.56	0.31	0.648	Slot 1
26-Jul-95	207	8.24	8.53	0.29	0.622	Slot 1
27-Jul-95	208	8.26	8.52	0.26	0.583	Slot 1
28-Jul-95	209	8.26	8.47	0.21	0.513	Slot 1
29-Jul-95	210	8.28	8.47	0.19	0.483	Slot 1
30-Jul-95	211	8.28	8.43	0.15	0.419	Slot 1
31-Jul-95	212	8.28	8.40	0.12	0.367	Slot 1
01-Aug-95	213	8.28	8.39	0.11	0.348	Slot 1
02-Aug-95	214	8.30	8.52	0.22	0.527	Slot 1
03-Aug-95	215	8.30	8.55	0.25	0.569	Slot 1
04-Aug-95	216	8.30	8.53	0.23	0.542	Slot 1
05-Aug-95	217	8.31	8.47	0.16	0.436	Slot 1
06-Aug-95	218	8.40	8.48	0.08	0.287	Slot 1
07-Aug-95	219	8.44	8.45	0.01	0.083	Slot 1
08-Aug-95	220	8.55	8.39	-0.16	-0.630	Slot 1
09-Aug-95	221	8.56	8.36	-0.20	-0.739	Slot 1
10-Aug-95	222	8.57	8.34	-0.23	-0.817	Slot 1
11-Aug-95	223	8.57	8.32	-0.25	-0.867	Slot 1
12-Aug-95	224	8.56	8.27	-0.29	-0.964	Slot 1

Table G.6 : Water Level and Velocity Data for Year 1 (1995)

Year 1995	Day	C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Slot Velocity (m/sec)	Location
13-Aug-95	225	8.63	8.42	-0.21	-0.765	Slot 1
14-Aug-95	226	8.75	8.82	0.07	0.265	Slot 1
15-Aug-95	227	8.85	9.00	0.15	0.419	Slot 1
16-Aug-95	228	8.85	9.11	0.26	0.583	Slot 1
17-Aug-95	229	8.86	9.14	0.28	0.609	Slot 1
18-Aug-95	230	8.88	9.18	0.30	0.635	Slot 1
19-Aug-95	231	8.90	9.29	0.39	0.743	Slot 1
20-Aug-95	232	8.96	9.32	0.36	0.709	Slot 1
21-Aug-95	233	9.00	9.36	0.36	0.709	Slot 1
22-Aug-95	234	9.00	9.33	0.33	0.673	Slot 1
23-Aug-95	235	8.99	9.30	0.31	0.648	Slot 1
24-Aug-95	236	9.03	9.30	0.27	0.596	Slot 1
25-Aug-95	237	9.08	9.26	0.18	0.467	Slot 1
26-Aug-95	238	9.08	9.28	0.20	0.498	Slot 1
27-Aug-95	239	9.06	9.26	0.20	0.498	Slot 1
28-Aug-95	240	9.05	9.20	0.15	0.419	Slot 1
29-Aug-95	241	9.04	9.18	0.14	0.402	Slot 1
30-Aug-95	242	9.03	9.16	0.13	0.385	Slot 1
31-Aug-95	243	9.02	9.12	0.10	0.329	Slot 1
01-Sep-95	244	9.02	9.12	0.10	0.329	Slot 1
02-Sep-95	245	9.03	9.10	0.07	0.265	Slot 1
03-Sep-95	246	9.05	9.14	0.09	0.308	Slot 1
04-Sep-95	247	9.05	9.13	0.08	0.287	Slot 1
05-Sep-95	248	9.04	9.04	0.00	0.000	Slot 1
06-Sep-95	249	9.03	8.98	-0.05	-0.274	Slot 1
07-Sep-95	250	9.00	8.90	-0.10	-0.450	Slot 1
08-Sep-95	251	8.99	8.87	-0.12	-0.513	Slot 1
09-Sep-95	252	8.97	8.84	-0.13	-0.543	Slot 1
10-Sep-95	253	8.98	8.91	-0.07	-0.349	Slot 1
11-Sep-95	254	8.96	8.81	-0.15	-0.602	Slot 1
12-Sep-95	255	8.93	8.78	-0.15	-0.602	Slot 1
13-Sep-95	256	8.89	8.76	-0.13	-0.543	Slot 1
14-Sep-95	257	8.86	8.69	-0.17	-0.658	Slot 1
15-Sep-95	258	8.82	8.60	-0.22	-0.791	Slot 1
16-Sep-95	259	8.78	8.53	-0.25	-0.867	Slot 1
17-Sep-95	260	8.74	8.44	-0.30	-0.988	Slot 1
18-Sep-95	261	8.76	8.49	-0.27	-0.916	Slot 1
19-Sep-95	262	8.75	8.44	-0.31	-1.012	Slot 1
20-Sep-95	263	8.71	8.34	-0.37	-1.148	Slot 1
21-Sep-95	264	8.69	8.21	-0.48	-1.384	Slot 1
22-Sep-95	265	8.63	8.18	-0.45	-1.321	Slot 1
23-Sep-95	266	8.6	8.16	-0.44	-1.300	Slot 1
24-Sep-95	267	8.68	8.26	-0.42	-1.257	Slot 1
25-Sep-95	268	8.68	8.23	-0.45	-1.321	Slot 1
26-Sep-95	269	8.68	8.21	-0.47	-1.363	Slot 1
27-Sep-95	270	8.7	8.26	-0.44	-1.300	Slot 1
28-Sep-95	271	8.66	8.26	-0.40	-1.214	Slot 1
29-Sep-95	272	8.64	8.25	-0.39	-1.192	Slot 1
30-Sep-95	273	8.62	8.38	-0.24	-0.842	Slot 1
01-Oct-95	274	8.60	8.34	-0.26	-0.892	Slot 1
02-Oct-95	275	8.61	8.37	-0.24	-0.842	Slot 1
03-Oct-95	276	8.60	8.38	-0.22	-0.791	Slot 1
04-Oct-95	277	8.56	8.31	-0.25	-0.867	Slot 1
05-Oct-95	278	8.53	8.26	-0.27	-0.916	Slot 1
06-Oct-95	279	8.51	8.24	-0.27	-0.916	Slot 1

Table G.6 : Water Level and Velocity Data for Year 1 (1995)

Year 1995	Day	C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Slot Velocity (m/sec)	Location
07-Oct-95	280	8.47	8.22	-0.25	-0.867	Slot 1
08-Oct-95	281	8.45	8.22	-0.23	-0.817	Slot 1
09-Oct-95	282	8.46	8.36	-0.10	-0.450	Slot 1
10-Oct-95	283	8.45	8.30	-0.15	-0.602	Slot 1
11-Oct-95	284	8.43	8.28	-0.15	-0.602	Slot 1
12-Oct-95	285	8.39	8.26	-0.13	-0.543	Slot 1
13-Oct-95	286	8.39	8.18	-0.21	-0.765	Slot 1
14-Oct-95	287	8.26	8.06	-0.20	-0.739	Slot 1
15-Oct-95	288	8.25	8.00	-0.25	-0.867	Slot 1
16-Oct-95	289	8.19	7.90	-0.29	-0.964	Slot 1
17-Oct-95	290	8.13	7.81	-0.32	-1.035	Slot 1
18-Oct-95	291	8.04	7.69	-0.35	-1.103	Slot 1
19-Oct-95	292	8.00	7.54	-0.46	-1.342	Slot 1
20-Oct-95	293	7.94	7.46	-0.48	-1.384	Slot 1
21-Oct-95	294	7.90	7.37	-0.53	-1.485	Slot 1
22-Oct-95	295	7.86	7.23	-0.63	-1.681	Slot 1
23-Oct-95	296	7.78	7.16	-0.62	-1.662	Slot 1
24-Oct-95	297	7.70	7.04	-0.66	-1.738	Slot 1
25-Oct-95	298	7.63	6.84	-0.79	-1.977	Slot 1
26-Oct-95	299	7.56	6.73	-0.83	-2.048	Slot 1
27-Oct-95	300	7.45	6.56	-0.89	-2.153	Slot 1
28-Oct-95	301	7.37	6.44	-0.93	-2.222	Slot 1
29-Oct-95	302	7.28	6.35	-0.93	-2.222	Slot 1
30-Oct-95	303	7.24	6.25	-0.99	-2.323	Slot 1
31-Oct-95	304	7.18	6.15	-1.03	-2.390	Slot 1

m

Table G.7: Water Level and Velocity Data for Year 2 (1996)

Year 1996	Day	C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Slot Velocity (m/sec)	Location
01-Mar-96	61	3.97	3.53	-0.44	---	---
02-Mar-96	62	4.08	3.58	-0.50	---	---
03-Mar-96	63	4.09	3.58	-0.51	---	---
04-Mar-96	64	4.05	3.56	-0.49	---	---
05-Mar-96	65	4.05	3.55	-0.50	---	---
06-Mar-96	66	4.00	3.53	-0.47	---	---
07-Mar-96	67	3.97	3.50	-0.47	---	---
08-Mar-96	68	3.94	3.46	-0.48	---	---
09-Mar-96	69	3.86	3.40	-0.46	---	---
10-Mar-96	70	3.81	3.37	-0.44	---	---
11-Mar-96	71	3.77	3.34	-0.43	---	---
12-Mar-96	72	3.67	3.30	-0.37	---	---
13-Mar-96	73	3.91	3.36	-0.55	---	---
14-Mar-96	74	4.20	3.46	-0.74	---	---
15-Mar-96	75	4.86	5.16	0.30	---	---
16-Mar-96	76	4.44	5.86	1.42	1.614	Slot 1
17-Mar-96	77	4.59	6.08	1.49	1.662	Slot 1
18-Mar-96	78	4.47	6.15	1.68	1.786	Slot 1
19-Mar-96	79	4.26	5.98	1.72	1.811	Slot 1
20-Mar-96	80	4.36	5.87	1.51	1.675	Slot 1
21-Mar-96	81	4.16	5.67	1.51	1.675	Slot 1
22-Mar-96	82	4.21	5.44	1.23	---	---
23-Mar-96	83	4.21	5.06	0.85	---	---
24-Mar-96	84	4.16	4.81	0.65	---	---
25-Mar-96	85	4.56	4.56	0.00	---	---
26-Mar-96	86	4.68	4.46	-0.22	---	---
27-Mar-96	87	4.61	4.36	-0.25	---	---
28-Mar-96	88	4.58	4.61	0.03	---	---
29-Mar-96	89	4.46	6.01	1.55	1.701	Slot 1
30-Mar-96	90	4.86	6.53	1.67	1.779	Slot 1
31-Mar-96	91	4.81	6.98	2.17	2.082	Slot 1
01-Apr-96	92	4.76	7.31	2.55	2.229	Slot 16
02-Apr-96	93	4.73	7.56	2.83	2.306	Slot 16
03-Apr-96	94	4.56	7.68	3.12	2.386	Slot 16
04-Apr-96	95	4.76	7.70	2.94	2.337	Slot 16
05-Apr-96	96	4.58	7.71	3.13	2.389	Slot 16
06-Apr-96	97	4.66	7.67	3.01	2.356	Slot 16
07-Apr-96	98	5.01	7.57	2.56	2.232	Slot 16
08-Apr-96	99	4.96	7.46	2.50	2.215	Slot 16
09-Apr-96	100	4.96	7.30	2.34	2.171	Slot 16
10-Apr-96	101	4.36	7.15	2.79	2.295	Slot 16
11-Apr-96	102	4.71	7.06	2.35	2.174	Slot 16
12-Apr-96	103	4.88	6.76	1.88	1.910	Slot 1
13-Apr-96	104	4.46	6.56	2.10	2.041	Slot 1
14-Apr-96	105	4.38	6.36	1.98	1.971	Slot 1
15-Apr-96	106	4.34	6.16	1.82	1.873	Slot 1
16-Apr-96	107	4.26	5.90	1.64	1.760	Slot 1
17-Apr-96	108	4.31	5.56	1.25	1.495	Slot 1
18-Apr-96	109	4.29	5.48	1.19	1.452	Slot 1
19-Apr-96	110	4.24	5.30	1.06	---	---
20-Apr-96	111	4.18	5.14	0.96	---	---
21-Apr-96	112	4.30	4.98	0.68	---	---
22-Apr-96	113	4.26	5.08	0.82	---	---

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Table G.7: Water Level and Velocity Data for Year 2 (1996)

Year 1996	Day	C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Slot Velocity (m/sec)	Location
23-Apr-96	114	4.30	5.29	0.99	---	---
24-Apr-96	115	4.81	5.34	0.53	---	---
25-Apr-96	116	4.81	5.45	0.64	---	---
26-Apr-96	117	4.92	5.48	0.56	0.924	Slot 1
27-Apr-96	118	4.61	5.61	1.00	1.308	Slot 1
28-Apr-96	119	4.69	5.69	1.00	1.308	Slot 1
29-Apr-96	120	4.71	5.71	1.00	1.308	Slot 1
30-Apr-96	121	4.71	5.69	0.98	1.292	Slot 1
01-May-96	122	4.56	5.51	0.95	1.268	Slot 1
02-May-96	123	4.71	5.50	0.79	1.135	Slot 1
03-May-96	124	4.71	5.52	0.81	1.153	Slot 1
04-May-96	125	4.81	5.50	0.69	1.047	Slot 1
05-May-96	126	4.76	5.50	0.74	1.092	Slot 1
06-May-96	127	4.71	5.52	0.81	1.153	Slot 1
07-May-96	128	4.71	5.50	0.79	1.135	Slot 1
08-May-96	129	4.66	5.50	0.84	1.178	Slot 1
09-May-96	130	4.61	5.48	0.87	1.203	Slot 1
10-May-96	131	4.61	5.92	1.31	1.538	Slot 1
11-May-96	132	4.62	6.43	1.81	1.867	Slot 1
12-May-96	133	4.61	6.60	1.99	1.977	Slot 1
13-May-96	134	4.61	6.85	2.24	2.122	Slot 1
14-May-96	135	4.71	7.23	2.52	2.221	Slot 16
15-May-96	136	5.06	8.03	2.97	2.345	Slot 16
16-May-96	137	4.98	8.15	3.17	2.400	Slot 16
17-May-96	138	5.16	8.26	3.10	2.381	Slot 16
18-May-96	139	5.12	8.24	3.12	2.386	Slot 16
19-May-96	140	5.56	8.22	2.66	2.259	Slot 16
20-May-96	141	5.34	8.20	2.86	2.314	Slot 16
21-May-96	142	5.37	8.10	2.73	2.279	Slot 16
22-May-96	143	5.48	8.09	2.61	2.245	Slot 16
23-May-96	144	5.54	7.92	2.38	2.182	Slot 16
24-May-96	145	5.46	7.74	2.28	2.145	Slot 1
25-May-96	146	5.48	7.53	2.05	2.012	Slot 1
26-May-96	147	5.46	7.56	2.10	2.041	Slot 1
27-May-96	148	5.44	7.38	1.94	1.947	Slot 1
28-May-96	149	5.48	7.46	1.98	1.971	Slot 1
29-May-96	150	5.53	7.57	2.04	2.006	Slot 1
30-May-96	151	5.72	7.70	1.98	1.971	Slot 1
31-May-96	152	5.82	8.04	2.22	2.111	Slot 1
01-Jun-96	153	6.00	8.12	2.12	2.053	Slot 1
02-Jun-96	154	6.17	8.44	2.27	2.139	Slot 1
03-Jun-96	155	6.40	8.58	2.18	2.088	Slot 1
04-Jun-96	156	6.52	8.63	2.11	2.047	Slot 1
05-Jun-96	157	6.60	8.60	2.00	1.983	Slot 1
06-Jun-96	158	6.70	8.67	1.97	1.965	Slot 1
07-Jun-96	159	6.83	8.67	1.84	1.886	Slot 1
08-Jun-96	160	6.87	8.61	1.74	1.824	Slot 1
09-Jun-96	161	6.88	8.52	1.64	1.760	Slot 1
10-Jun-96	162	6.85	8.44	1.59	1.728	Slot 1
11-Jun-96	163	6.80	8.34	1.54	1.695	Slot 1
12-Jun-96	164	6.76	8.24	1.48	1.655	Slot 1
13-Jun-96	165	6.78	8.08	1.30	1.531	Slot 1
14-Jun-96	166	6.77	7.98	1.21	1.466	Slot 1

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Table G.7: Water Level and Velocity Data for Year 2 (1996)

Year 1996	Day	C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Slot Velocity (m/sec)	Location
15-Jun-96	167	6.74	7.88	1.14	1.415	Slot 1
16-Jun-96	168	6.68	7.80	1.12	1.400	Slot 1
17-Jun-96	169	6.65	7.70	1.05	1.347	Slot 1
18-Jun-96	170	6.66	7.61	0.95	1.268	Slot 1
19-Jun-96	171	6.69	7.52	0.83	1.170	Slot 1
20-Jun-96	172	6.68	7.61	0.93	1.252	Slot 1
21-Jun-96	173	6.70	7.54	0.84	1.178	Slot 1
22-Jun-96	174	6.70	7.48	0.78	1.127	Slot 1
23-Jun-96	175	6.74	7.50	0.76	1.109	Slot 1
24-Jun-96	176	6.79	7.55	0.76	1.109	Slot 1
25-Jun-96	177	6.82	7.56	0.74	1.092	Slot 1
26-Jun-96	178	6.84	7.53	0.69	1.047	Slot 1
27-Jun-96	179	6.85	7.51	0.66	1.019	Slot 1
28-Jun-96	180	6.85	7.44	0.59	0.953	Slot 1
29-Jun-96	181	6.86	7.41	0.55	0.914	Slot 1
30-Jun-96	182	6.89	7.39	0.50	0.863	Slot 1
01-Jul-96	183	7.06	7.43	0.37	0.720	Slot 1
02-Jul-96	184	7.35	8.03	0.68	1.038	Slot 1
03-Jul-96	185	7.61	8.51	0.90	1.228	Slot 1
04-Jul-96	186	7.81	8.85	1.04	1.339	Slot 1
05-Jul-96	187	7.99	8.98	0.99	1.300	Slot 1
06-Jul-96	188	8.10	9.02	0.92	1.244	Slot 1
07-Jul-96	189	8.13	9.03	0.90	1.228	Slot 1
08-Jul-96	190	8.15	9.02	0.87	1.203	Slot 1
09-Jul-96	191	8.15	9.01	0.86	1.195	Slot 1
10-Jul-96	192	8.15	9.00	0.85	1.186	Slot 1
11-Jul-96	193	8.15	9.02	0.87	1.203	Slot 1
12-Jul-96	194	8.15	9.02	0.87	1.203	Slot 1
13-Jul-96	195	8.14	9.00	0.86	1.195	Slot 1
14-Jul-96	196	8.12	8.96	0.84	1.178	Slot 1
15-Jul-96	197	8.16	8.96	0.80	1.144	Slot 1
16-Jul-96	198	8.18	8.98	0.80	1.144	Slot 1
17-Jul-96	199	8.22	8.95	0.73	1.083	Slot 1
18-Jul-96	200	8.20	8.94	0.74	1.092	Slot 1
19-Jul-96	201	8.20	8.93	0.73	1.083	Slot 1
20-Jul-96	202	8.22	8.95	0.73	1.083	Slot 1
21-Jul-96	203	8.23	8.95	0.72	1.074	Slot 1
22-Jul-96	204	8.22	8.93	0.71	1.065	Slot 1
23-Jul-96	205	8.22	8.92	0.70	1.056	Slot 1
24-Jul-96	206	8.22	8.91	0.69	1.047	Slot 1
25-Jul-96	207	8.22	8.91	0.69	1.047	Slot 1
26-Jul-96	208	8.23	8.98	0.75	1.101	Slot 1
27-Jul-96	209	8.22	8.88	0.66	1.019	Slot 1
28-Jul-96	210	8.21	8.79	0.58	0.943	Slot 1
29-Jul-96	211	8.21	8.73	0.52	0.884	Slot 1
30-Jul-96	212	8.21	8.69	0.48	0.842	Slot 1
31-Jul-96	213	8.23	8.78	0.55	0.914	Slot 1
01-Aug-96	214	8.23	8.78	0.55	0.914	Slot 1
02-Aug-96	215	8.25	8.74	0.49	0.853	Slot 1
03-Aug-96	216	8.27	8.72	0.45	0.810	Slot 1
04-Aug-96	217	8.29	8.62	0.33	0.673	Slot 1
05-Aug-96	218	8.38	8.62	0.24	0.556	Slot 1
06-Aug-96	219	8.39	8.63	0.24	0.556	Slot 1

Table G.7: Water Level and Velocity Data for Year 2 (1996)

Year 1996	Day	C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Slot Velocity (m/sec)	Location
29-Sep-96	273	8.41	7.98	-0.43	-1.279	Slot 1
30-Sep-96	274	8.37	7.93	-0.44	-1.300	Slot 1
01-Oct-96	275	8.35	7.95	-0.40	-1.214	Slot 1
02-Oct-96	276	8.31	7.90	-0.41	-1.236	Slot 1
03-Oct-96	277	8.28	7.81	-0.47	-1.363	Slot 1
04-Oct-96	278	8.25	7.75	-0.50	-1.425	Slot 1
05-Oct-96	279	8.23	7.78	-0.45	-1.321	Slot 1
06-Oct-96	280	8.27	7.99	-0.28	-0.941	Slot 1
07-Oct-96	281	8.28	8.05	-0.23	-0.817	Slot 1
08-Oct-96	282	8.29	8.06	-0.23	-0.817	Slot 1
09-Oct-96	283	8.26	7.98	-0.28	-0.941	Slot 1
10-Oct-96	284	8.23	7.92	-0.31	-1.012	Slot 1
11-Oct-96	285	8.20	7.85	-0.35	-1.103	Slot 1
12-Oct-96	286	8.20	7.78	-0.42	-1.257	Slot 1
13-Oct-96	287	8.13	7.66	-0.47	-1.363	Slot 1
14-Oct-96	288	8.10	7.61	-0.49	-1.404	Slot 1
15-Oct-96	289	8.03	7.45	-0.58	-1.584	Slot 1
16-Oct-96	290	7.97	7.26	-0.71	-1.831	Slot 1
17-Oct-96	291	7.93	7.13	-0.80	-1.994	Slot 1
18-Oct-96	292	7.90	7.08	-0.82	-2.030	Slot 1
19-Oct-96	293	7.88	7.01	-0.87	-2.118	Slot 1
20-Oct-96	294	7.85	6.97	-0.88	-2.135	Slot 1
21-Oct-96	295	7.82	6.94	-0.88	-2.135	Slot 1
22-Oct-96	296	7.70	6.62	-1.08	-2.473	Slot 1
23-Oct-96	297	7.63	6.54	-1.09	-2.489	Slot 1
24-Oct-96	298	7.55	6.36	-1.19	-2.650	Slot 1
25-Oct-96	299	7.48	6.21	-1.27	-2.777	Slot 1
26-Oct-96	300	7.41	6.11	-1.30	-2.824	Slot 1
27-Oct-96	301	7.34	5.96	-1.38	-2.947	Slot 1
28-Oct-96	302	7.30	5.92	-1.38	-2.947	Slot 1
29-Oct-96	303	7.36	6.07	-1.29	-2.808	Slot 1
30-Oct-96	304	7.37	6.38	-0.99	-2.323	Slot 1
31-Oct-96	305	7.35	6.64	-0.71	-1.831	Slot 1

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Table G.8: Water Level and Velocity Data for Year 3 (1997)

Year 1997		C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Velocity (m/sec)	Location
27-Apr-97	117	4.01	3.67	-0.34	---	---
28-Apr-97	118	3.93	3.60	-0.33	---	---
29-Apr-97	119	3.82	3.54	-0.28	---	---
30-Apr-97	120	3.74	3.47	-0.27	---	---
01-May-97	121	3.65	3.40	-0.25	---	---
02-May-97	122	3.58	3.34	-0.24	---	---
03-May-97	123	3.51	3.31	-0.20	---	---
04-May-97	124	3.43	3.36	-0.07	---	---
05-May-97	125	3.65	3.63	-0.02	---	---
06-May-97	126	3.68	3.61	-0.07	---	---
07-May-97	127	3.69	3.61	-0.08	---	---
08-May-97	128	3.75	3.68	-0.07	---	---
09-May-97	129	3.88	3.80	-0.08	---	---
10-May-97	130	4.08	3.94	-0.14	---	---
11-May-97	131	4.30	4.12	-0.18	---	---
12-May-97	132	4.56	4.76	0.20	---	---
13-May-97	133	4.68	4.81	0.13	---	---
14-May-97	134	4.72	4.83	0.11	---	---
15-May-97	135	4.76	4.84	0.08	---	---
16-May-97	136	4.82	4.85	0.03	---	---
17-May-97	137	4.85	4.87	0.02	---	---
18-May-97	138	4.87	4.88	0.01	---	---
19-May-97	139	4.65	4.88	0.23	---	---
20-May-97	140	4.66	4.88	0.22	---	---
21-May-97	141	4.70	5.56	0.86	1.195	Slot 1
22-May-97	142	5.06	6.57	1.51	1.675	Slot 1
23-May-97	143	5.19	6.70	1.51	1.675	Slot 1
24-May-97	144	5.23	6.80	1.57	1.715	Slot 1
25-May-97	145	5.29	6.86	1.57	1.715	Slot 1
26-May-97	146	5.28	6.87	1.59	1.728	Slot 1
27-May-97	147	5.33	6.84	1.51	1.675	Slot 1
28-May-97	148	5.32	6.80	1.48	1.655	Slot 1
29-May-97	149	5.33	6.80	1.47	1.648	Slot 1
30-May-97	150	5.35	6.81	1.46	1.641	Slot 1
31-May-97	151	5.36	6.79	1.43	1.621	Slot 1
01-Jun-97	152	5.36	6.79	1.43	1.621	Slot 1
02-Jun-97	153	5.46	7.23	1.77	1.842	Slot 1
03-Jun-97	154	5.70	7.53	1.83	1.880	Slot 1
04-Jun-97	155	5.92	7.60	1.68	1.786	Slot 1
05-Jun-97	156	5.98	7.61	1.63	1.754	Slot 1
06-Jun-97	157	6.10	7.66	1.56	1.708	Slot 1
07-Jun-97	158	6.11	7.79	1.68	1.786	Slot 1
08-Jun-97	159	6.10	7.86	1.76	1.836	Slot 1
09-Jun-97	160	6.45	7.84	1.39	1.594	Slot 1
10-Jun-97	161	6.58	7.76	1.18	1.445	Slot 1
11-Jun-97	162	6.59	7.75	1.16	1.430	Slot 1
12-Jun-97	163	6.72	7.69	0.97	1.284	Slot 1
13-Jun-97	164	6.82	7.68	0.86	1.195	Slot 1
14-Jun-97	165	6.86	7.66	0.80	1.144	Slot 1
15-Jun-97	166	6.84	7.61	0.77	1.118	Slot 1
16-Jun-97	167	6.83	7.61	0.78	1.127	Slot 1
17-Jun-97	168	6.84	7.61	0.77	1.118	Slot 1
18-Jun-97	169	6.85	7.62	0.77	1.118	Slot 1
19-Jun-97	170	6.87	7.68	0.81	1.153	Slot 1
20-Jun-97	171	6.88	7.66	0.78	1.127	Slot 1
21-Jun-97	172	6.91	7.86	0.95	1.268	Slot 1
22-Jun-97	173	6.98	7.97	0.99	1.300	Slot 1

Table G.8: Water Level and Velocity Data for Year 3 (1997)

Year 1997		C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Velocity (m/sec)	Location
23-Jun-97	174	6.99	8.08	1.09	1.377	Slot 1
24-Jun-97	175	7.01	8.34	1.33	1.552	Slot 1
25-Jun-97	176	7.01	8.34	1.33	1.552	Slot 1
26-Jun-97	177	7.01	8.34	1.33	1.552	Slot 1
27-Jun-97	178	7.04	8.38	1.34	1.559	Slot 1
28-Jun-97	179	7.06	8.34	1.28	1.517	Slot 1
29-Jun-97	180	7.07	8.28	1.21	1.466	Slot 1
30-Jun-97	181	7.10	8.29	1.19	1.452	Slot 1
01-Jul-97	182	7.20	8.29	1.09	1.377	Slot 1
02-Jul-97	183	7.26	8.24	0.98	1.292	Slot 1
03-Jul-97	184	7.29	8.18	0.89	1.220	Slot 1
04-Jul-97	185	7.31	8.12	0.81	1.153	Slot 1
05-Jul-97	186	7.35	8.09	0.74	1.092	Slot 1
06-Jul-97	187	7.36	8.08	0.72	1.074	Slot 1
07-Jul-97	188	7.36	8.05	0.69	1.047	Slot 1
08-Jul-97	189	7.40	8.04	0.64	1.001	Slot 1
09-Jul-97	190	7.43	8.04	0.61	0.972	Slot 1
10-Jul-97	191	7.45	8.04	0.59	0.953	Slot 1
11-Jul-97	192	7.52	8.16	0.64	1.001	Slot 1
12-Jul-97	193	7.86	8.92	1.06	1.355	Slot 1
13-Jul-97	194	7.94	9.09	1.15	1.422	Slot 1
14-Jul-97	195	8.01	9.15	1.14	1.415	Slot 1
15-Jul-97	196	8.08	9.21	1.13	1.408	Slot 1
16-Jul-97	197	8.09	9.22	1.13	1.408	Slot 1
17-Jul-97	198	8.09	9.22	1.13	1.408	Slot 1
18-Jul-97	199	8.09	9.22	1.13	1.408	Slot 1
19-Jul-97	200	8.08	9.20	1.12	1.400	Slot 1
20-Jul-97	201	8.10	9.17	1.07	1.362	Slot 1
21-Jul-97	202	8.13	9.15	1.02	1.324	Slot 1
22-Jul-97	203	8.14	9.15	1.01	1.316	Slot 1
23-Jul-97	204	8.14	9.11	0.97	1.284	Slot 1
24-Jul-97	205	8.15	9.08	0.93	1.252	Slot 1
25-Jul-97	206	8.15	9.10	0.95	1.268	Slot 1
26-Jul-97	207	8.16	9.15	0.99	1.300	Slot 1
27-Jul-97	208	8.16	9.22	1.06	1.355	Slot 1
28-Jul-97	209	8.15	9.30	1.15	1.422	Slot 1
29-Jul-97	210	8.18	9.29	1.11	1.393	Slot 1
30-Jul-97	211	8.19	9.28	1.09	1.377	Slot 1
31-Jul-97	212	8.19	9.28	1.09	1.377	Slot 1
01-Aug-97	213	8.19	9.26	1.07	1.362	Slot 1
02-Aug-97	214	8.19	9.18	0.99	1.300	Slot 1
03-Aug-97	215	8.25	9.07	0.82	1.161	Slot 1
04-Aug-97	216	8.24	8.99	0.75	1.101	Slot 1
05-Aug-97	217	8.22	8.88	0.66	1.019	Slot 1
06-Aug-97	218	8.19	8.76	0.57	0.934	Slot 1
07-Aug-97	219	8.13	8.76	0.63	0.991	Slot 1
08-Aug-97	220	8.09	8.70	0.61	0.972	Slot 1
09-Aug-97	221	8.08	8.62	0.54	0.904	Slot 1
10-Aug-97	222	8.16	8.55	0.39	0.743	Slot 1
11-Aug-97	223	8.17	8.57	0.40	0.755	Slot 1
12-Aug-97	224	8.26	8.62	0.36	0.709	Slot 1
13-Aug-97	225	8.35	8.66	0.31	0.648	Slot 1
14-Aug-97	226	8.40	8.74	0.34	0.685	Slot 1
15-Aug-97	227	8.42	8.77	0.35	0.697	Slot 1
16-Aug-97	228	8.42	8.77	0.35	0.697	Slot 1
17-Aug-97	229	8.41	8.76	0.35	0.697	Slot 1
18-Aug-97	230	8.41	8.75	0.34	0.685	Slot 1

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Table G.8: Water Level and Velocity Data for Year 3 (1997)

Year 1997		C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Velocity (m/sec)	Location
19-Aug-97	231	8.41	8.75	0.34	0.685	Slot 1
20-Aug-97	232	8.43	8.76	0.33	0.673	Slot 1
21-Aug-97	233	8.45	8.78	0.33	0.673	Slot 1
22-Aug-97	234	8.49	8.71	0.22	0.527	Slot 1
23-Aug-97	235	8.46	8.70	0.24	0.556	Slot 1
24-Aug-97	236	8.52	8.47	-0.05	-0.274	Slot 1
25-Aug-97	237	8.52	8.46	-0.06	-0.312	Slot 1
26-Aug-97	238	8.50	8.32	-0.18	-0.685	Slot 1
27-Aug-97	239	8.49	8.26	-0.23	-0.817	Slot 1
28-Aug-97	240	8.48	8.11	-0.37	-1.148	Slot 1
29-Aug-97	241	8.48	8.05	-0.43	-1.279	Slot 1
30-Aug-97	242	8.47	7.90	-0.57	-1.565	Slot 1
31-Aug-97	243	8.45	7.82	-0.63	-1.681	Slot 1
01-Sep-97	244	8.43	7.90	-0.53	-1.485	Slot 1
02-Sep-97	245	8.42	7.90	-0.52	-1.465	Slot 1
03-Sep-97	246	8.42	7.86	-0.56	-1.545	Slot 1
04-Sep-97	247	8.41	8.12	-0.29	-0.964	Slot 1
05-Sep-97	248	8.41	8.14	-0.27	-0.916	Slot 1
06-Sep-97	249	8.44	8.28	-0.16	-0.630	Slot 1
07-Sep-97	250	8.46	8.22	-0.24	-0.842	Slot 1
08-Sep-97	251	8.46	8.30	-0.16	-0.630	Slot 1
09-Sep-97	252	8.46	8.36	-0.10	-0.450	Slot 1
10-Sep-97	253	8.45	8.37	-0.08	-0.384	Slot 1
11-Sep-97	254	8.44	8.34	-0.10	-0.450	Slot 1
12-Sep-97	255	8.50	8.29	-0.21	-0.765	Slot 1
13-Sep-97	256	8.51	8.26	-0.25	-0.867	Slot 1
14-Sep-97	257	8.53	8.36	-0.17	-0.658	Slot 1
15-Sep-97	258	8.54	8.33	-0.21	-0.765	Slot 1
16-Sep-97	259	8.54	8.31	-0.23	-0.817	Slot 1
17-Sep-97	260	8.54	8.28	-0.26	-0.892	Slot 1
18-Sep-97	261	8.54	8.30	-0.24	-0.842	Slot 1
19-Sep-97	262	8.65	8.28	-0.37	-1.148	Slot 1
20-Sep-97	263	8.86	8.36	-0.50	-1.425	Slot 1
21-Sep-97	264	8.96	8.50	-0.46	-1.342	Slot 1
22-Sep-97	265	8.96	8.46	-0.50	-1.425	Slot 1
23-Sep-97	266	8.93	8.42	-0.51	-1.445	Slot 1
24-Sep-97	267	8.94	8.63	-0.31	-1.012	Slot 1
25-Sep-97	268	8.88	8.57	-0.31	-1.012	Slot 1
26-Sep-97	269	8.86	8.55	-0.31	-1.012	Slot 1
27-Sep-97	270	8.88	8.60	-0.28	-0.941	Slot 1
28-Sep-97	271	8.95	8.84	-0.11	-0.482	Slot 1
29-Sep-97	272	8.94	8.87	-0.07	-0.349	Slot 1
30-Sep-97	273	8.96	8.96	0.00	0.000	Slot 1
01-Oct-97	274	8.96	9.10	0.14	0.402	Slot 1
02-Oct-97	275	8.95	9.05	0.10	0.329	Slot 1
03-Oct-97	276	8.94	9.00	0.06	0.242	Slot 1
04-Oct-97	277	8.92	8.95	0.03	0.160	Slot 1
05-Oct-97	278	8.91	8.89	-0.02	-0.142	Slot 1
06-Oct-97	279	8.88	8.83	-0.05	-0.274	Slot 1
07-Oct-97	280	8.85	8.75	-0.10	-0.450	Slot 1
08-Oct-97	281	8.81	8.67	-0.14	-0.573	Slot 1
09-Oct-97	282	8.79	8.65	-0.14	-0.573	Slot 1
10-Oct-97	283	8.76	8.57	-0.19	-0.713	Slot 1
11-Oct-97	284	8.71	8.50	-0.21	-0.765	Slot 1
12-Oct-97	285	8.66	8.42	-0.24	-0.842	Slot 1
13-Oct-97	286	8.60	8.31	-0.29	-0.964	Slot 1
14-Oct-97	287	8.56	8.10	-0.46	-1.342	Slot 1

Table G.8: Water Level and Velocity Data for Year 3 (1997)

Year 1997		C/S WL (m PWD)	R/S WL (m PWD)	Head Diff. (m)	Maximum Velocity (m/sec)	Location
15-Oct-97	288	8.50	7.94	-0.56	-1.545	Slot 1
16-Oct-97	289	8.44	7.86	-0.58	-1.584	Slot 1
17-Oct-97	290	8.38	7.62	-0.76	-1.923	Slot 1
18-Oct-97	291	8.32	7.43	-0.89	-2.153	Slot 1
19-Oct-97	292	8.26	7.32	-0.94	-2.239	Slot 1
20-Oct-97	293	8.18	7.23	-0.95	-2.256	Slot 1

Table G.9 Daily Discharge Computation for (1995)

DAY	TIME	MAY				JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER			
		C/S (m PWD)	R/S (m PWD)	Head Diff. (m)	Discharge (m^3/s)	C/S (m PWD)	R/S (m PWD)	Head Diff. (m)	Discharge (m^3/s)	C/S (m PWD)	R/S (m PWD)	Head Diff. (m)	Discharge (m^3/s)	C/S (m PWD)	R/S (m PWD)	Head Diff. (m)	Discharge (m^3/s)	C/S (m PWD)	R/S (m PWD)	Head Diff. (m)	Discharge (m^3/s)	C/S (m PWD)	R/S (m PWD)	Head Diff. (m)	Discharge (m^3/s)
1	07:00	3.5	3.4			5.5	6.1	0.6	0.2	7.8	8.8	1.0	1.1	8.3	8.4	0.1	0.4	9.0	9.1	0.1	0.5	8.6	8.3	-0.3	1.0
	17:00	3.5	3.3			5.5	6.1	0.5	0.1	7.8	8.8	1.0	1.1	8.3	8.4	0.1	0.4	9.0	9.1	0.1	0.5	8.6	8.3	-0.3	1.0
2	07:00	3.5	3.3			5.5	6.0	0.4	0.1	7.8	8.8	1.0	1.0	8.3	8.5	0.2	0.5	9.0	9.1	0.1	0.4	8.6	8.4	-0.2	1.0
	17:00	3.5	3.3			5.5	6.0	0.4	0.1	7.7	8.8	1.0	1.1	8.3	8.5	0.2	0.5	9.0	9.1	0.1	0.5	8.6	8.4	-0.2	0.9
3	07:00	3.5	3.4			5.5	6.0	0.4	0.1	7.7	8.7	1.0	1.0	8.3	8.6	0.3	0.6	9.1	9.1	0.1	0.4	8.6	8.4	-0.2	0.9
	17:00	3.5	3.4			5.5	6.0	0.4	0.1	7.7	8.7	1.0	1.0	8.3	8.6	0.3	0.6	9.1	9.2	0.1	0.5	8.6	8.4	-0.2	0.9
4	07:00	3.5	3.4			5.6	6.0	0.5	0.1	7.8	8.8	1.0	1.1	8.3	8.5	0.2	0.5	9.1	9.1	0.1	0.4	8.6	8.3	-0.3	0.9
	17:00	3.5	3.4			5.6	6.1	0.5	0.1	7.9	8.8	0.9	1.0	8.3	8.5	0.2	0.5	9.1	9.1	0.1	0.3	8.5	8.3	-0.3	0.9
5	07:00	3.5	3.4			5.6	6.1	0.5	0.2	8.0	9.0	1.0	1.1	8.3	8.5	0.2	0.5	9.0	9.0	0.0		8.5	8.3	-0.3	1.0
	17:00	3.5	3.4			5.6	6.1	0.6	0.2	8.0	9.0	0.9	1.1	8.3	8.4	0.1	0.4	9.0	9.0	-0.0	0.8	8.5	8.3	-0.3	1.0
6	07:00	3.9	3.9			5.6	6.1	0.5	0.2	8.1	9.1	1.0	1.1	8.4	8.5	0.1	0.3	9.0	9.0	-0.1	0.8	8.5	8.2	-0.3	1.0
	17:00	3.9	3.9			5.6	6.1	0.5	0.2	8.1	9.1	1.0	1.2	8.4	8.5	0.1	0.4	9.0	8.9	-0.1	0.9	8.5	8.2	-0.3	0.9
7	07:00	4.0	4.0			5.6	6.0	0.4	0.1	8.1	9.1	1.0	1.1	8.4	8.5	0.0	0.1	9.0	8.9	-0.1	0.9	8.5	8.2	-0.3	0.9
	17:00	4.0	4.0			5.6	6.0	0.4	0.1	8.1	9.1	1.0	1.2	8.4	8.4	-0.0	0.6	9.0	8.9	-0.1	0.9	8.5	8.2	-0.2	0.9
8	07:00	4.0	4.1			5.6	6.0	0.4	0.1	8.1	9.1	1.0	1.1	8.6	8.4	-0.2	0.8	9.0	8.9	-0.1	0.9	8.5	8.2	-0.2	0.9
	17:00	4.0	4.1			5.6	6.0	0.4	0.1	8.1	9.1	1.0	1.1	8.6	8.4	-0.2	0.9	9.0	8.9	-0.1	0.9	8.5	8.2	-0.3	0.9
9	07:00	4.2	4.2			5.7	6.0	0.4	0.1	8.1	9.1	1.0	1.1	8.6	8.4	-0.2	0.9	9.0	8.8	-0.1	0.9	8.5	8.4	-0.1	0.7
	17:00	4.2	4.2			5.6	6.2	0.5	0.2	8.1	9.1	0.9	1.1	8.6	8.4	-0.2	0.9	9.0	8.8	-0.2	1.0	8.5	8.3	-0.1	0.7
10	07:00	4.2	4.2			5.6	6.2	0.6	0.2	8.1	9.1	0.9	1.1	8.6	8.3	-0.2	0.9	9.0	8.9	-0.1	0.8	8.5	8.3	-0.1	0.8
	17:00	4.2	4.2			5.6	6.2	0.6	0.2	8.2	9.0	0.9	1.1	8.6	8.3	-0.3	1.0	9.0	8.9	-0.1	0.9	8.4	8.3	-0.2	0.8
11	07:00	4.2	4.2			5.6	6.3	0.7	0.2	8.2	9.0	0.9	1.1	8.6	8.3	-0.3	1.0	9.0	8.8	-0.1	1.0	8.4	8.3	-0.2	0.7
	17:00	4.2	4.3			5.6	6.5	0.9	0.3	8.2	9.0	0.8	1.1	8.6	8.3	-0.3	1.0	8.9	8.8	-0.1	0.9	8.4	8.3	-0.1	0.7
12	07:00	4.3	4.3			5.6	6.7	1.0	0.4	8.2	9.0	0.8	1.1	8.6	8.3	-0.3	1.0	8.9	8.8	-0.2	1.0	8.4	8.3	-0.1	0.7
	17:00	4.3	4.3			5.6	6.7	1.0	0.4	8.2	9.0	0.8	1.1	8.6	8.3	-0.3	1.0	8.9	8.8	-0.1	0.9	8.4	8.3	-0.1	0.7
13	07:00	4.3	4.3			5.7	6.6	0.9	0.3	8.2	9.0	0.8	1.0	8.6	8.4	-0.2	0.9	8.9	8.8	-0.1	0.9	8.4	8.2	-0.2	0.8
	17:00	4.3	4.3			5.7	6.6	0.9	0.3	8.2	9.0	0.8	1.0	8.7	8.6	-0.1	0.7	8.9	8.7	-0.1	0.9	8.4	8.2	-0.2	0.8
14	07:00	4.3	4.3			5.7	6.8	1.1	0.5	8.2	9.0	0.7	1.0	8.8	8.8	0.1	0.4	8.9	8.7	-0.2	1.0	8.3	8.1	-0.2	0.7
	17:00	4.3	4.3			5.8	7.1	1.2	0.6	8.2	9.0	0.7	1.0	8.8	8.9	0.1	0.4	8.9	8.7	-0.2	1.0	8.3	8.1	-0.2	0.7
15	07:00	4.3	4.2			5.9	7.1	1.2	0.6	8.2	8.9	0.7	1.0	8.9	9.0	0.1	0.5	8.8	8.6	-0.2	1.0	8.3	8.0	-0.3	0.8
	17:00	4.3	4.2			5.9	7.2	1.3	0.6	8.2	8.9	0.7	0.9	8.9	9.1	0.2	0.6	8.8	8.6	-0.2	1.0	8.2	8.0	-0.3	0.8
16	07:00	4.3	4.1			5.9	7.3	1.4	0.7	8.2	8.9	0.7	0.9	8.9	9.1	0.3	0.7	8.8	8.5	-0.3	1.1	8.2	7.9	-0.3	0.8
	17:00	4.3	4.1			5.6	7.5	1.8	0.8	8.2	8.9	0.7	0.9	8.9	9.1	0.3	0.7	8.8	8.5	-0.3	1.1	8.2	7.9	-0.3	0.8
17	07:00	4.4	4.2			6.6	7.9	1.3	0.8	8.2	8.9	0.6	0.9	8.9	9.1	0.3	0.7	8.7	8.4	-0.3	1.1	8.1	7.8	-0.3	0.8
	17:00	4.5	4.2			6.9	8.2	1.3	1.0	8.2	8.9	0.6	0.9	8.9	9.2	0.3	0.8	8.8	8.5	-0.2	1.0	8.1	7.8	-0.3	0.8
18	07:00	4.8	4.8			7.1	8.4	1.4	1.1	8.2	8.9	0.6	0.9	8.9	9.2	0.3	0.7	8.8	8.5	-0.3	1.1	8.0	7.7	-0.3	0.8
	17:00	4.9	5.0			7.2	8.6	1.4	1.1	8.2	8.8	0.6	0.9	8.9	9.2	0.3	0.7	8.8	8.5	-0.3	1.1	8.0	7.6	-0.4	0.9
19	07:00	5.0	6.9	1.8	0.6	7.3	8.8	1.5	1.2	8.3	8.8	0.5	0.8	8.9	9.3	0.4	0.8	8.8	8.4	-0.3	1.2	8.0	7.5	-0.5	0.9
	17:00	5.1	7.3	2.2	0.8	7.4	8.9	1.5	1.3	8.3	8.8	0.5	0.8	8.9	9.3	0.4	0.8	8.7	8.4	-0.3	1.2	8.0	7.5	-0.5	0.9
20	07:00	5.2	7.5	2.3	0.9	7.5	9.0	1.5	1.3	8.3	8.8	0.5	0.8	9.0	9.3	0.4	0.8	8.7	8.3	-0.4	1.3	7.9	7.5	-0.5	0.9
	17:00	5.2	7.5	2.3	0.9	7.5	9.1	1.5	1.4	8.3	8.8	0.5	0.8	9.0	9.4	0.4	0.8	8.7	8.3	-0.4	1.4	7.9	7.4	-0.5	0.9
21	07:00	5.2	7.5	2.2	0.9	7.6	9.1	1.5	1.4	8.3	8.8	0.6	0.8	9.0	9.4	0.4	0.8	8.7	8.2	-0.5	1.5	7.9	7.4	-0.5	1.0
	17:00	5.4	7.5	2.2	0.9	7.6	9.2	1.6	1.4	8.3	8.9	0.6	0.9	9.0	9.4	0.4	0.8	8.7	8.2	-0.5	1.5	7.9	7.3	-0.6	1.0
22	07:00	5.3	7.5	2.3	0.9	7.7	9.1	1.5	1.4	8.3	8.8	0.5	0.8	9.0	9.3	0.3	0.8	8.6	8.2	-0.4	1.4	7.9	7.2	-0.6	1.1
	17:00	5.3	7.5	2.2	0.9	7.6	9.1	1.5	1.3	8.3	8.8	0.5	0.8	9.0	9.3	0.3	0.8	8.6	8.2	-0.4	1.4	7.8	7.2	-0.6	1.1
23	07:00	5.3	7.5	2.2	0.9	7.7	9.1	1.4	1.3	8.3	8.8	0.5	0.8	9.0	9.3	0.3	0.8	8.6	8.2	-0.4	1.3	7.8	7.2	-0.6	1.0
	17:00	5.4	7.5	2.1	0.8	7.7	9.1	1.4	1.3	8.3	8.7	0.4	0.7	9.0	9.3	0.3	0.7	8.6	8.2	-0.5	1.4	7.7	7.1	-0.6	1.0
24	07:00	5.4	7.4	2.0	0.8	7.7	9.0	1.3	1.3	8.3	8.7	0.4	0.7	9.0	9.3	0.3	0.7	8.7	8.3	-0.4	1.3	7.7	7.0	-0.7	1.0
	17:00	5.4	7.4	2.0	0.8	7.7	9.0	1.3	1.3	8.3	8.6	0.4	0.7	9.1	9.3	0.2	0.6	8.7	8.3	-0.4	1.3	7.7	7.0	-0.7	0.9
25	07:00	5.4	7.3	1.9	0.7	7.8	9.0	1.3	1.2	8.3	8.6	0.3	0.6	9.1	9.3	0.2	0.6	8.7	8.2	-0.5	1.4	7.6	6.8	-0.8	1.1
	17:00	5.4	7.3	1.9	0.7	7.8	9.0	1.2	1.2	8.3	8.6	0.3	0.6	9.1	9.3	0.2	0.6	8.7	8.2	-0.5	1.4	7.6	6.8	-0.8	1.1
26	07:00	5.4	7.2	1.8	0.7	7.8	8.9	1.2	1.2	8.2	8.5	0.3	0.6	9.1	9.3	0.2	0.6	8.7	8.2	-0.5	1.5	7.6	6.7	-0.8	1.0
	17:00	5.4	7.1	1.6	0.6	7.8	8.9	1.2	1.2	8.2	8.5	0.3	0.6	9.1	9.3	0.2	0.7	8.7	8.2	-0.5	1.5	7.5	6.7	-0.8	1.0
27	07:00	5.5	6.9	1.4	0.5	7.8	8.9	1.1	1.1	8.3	8.5	0.3	0.6	9.1	9.3	0.2	0.6	8.7	8.3	-0.4	1.4	7.5	6.6	-0.9	0.9
	17:00	5.5	6.8	1.4	0.5	7.7	8.9	1.1	1.1	8.3	8.5	0.2	0.5	9.1	9.2	0.2	0.6	8.7	8.3	-0.4	1.3	7.4	6.5	-0.9	0.9
28	07:00	5.5	6.7	1.2	0.4	7.8	8.8	1.0	1.0	8.3	8.5	0.2	0.5	9.1	9.2	0.1	0.6	8.7	8.3	-0.4	1.3	7.4	6.5	-0.9	0.9
	17:00	5.5	6.6	1.2	0.4	7.8	8.8	1.0	1.1	8.3	8.5	0.2	0.5	9.0	9.2	0.1	0.5	8.7	8.3	-0.4	1.3	7.4	6.4	-0.9	0.9
29	07:00	5.5	6.6	1.1	0.4	7.8	8.8	1.0	1.1	8.3	8.5	0.2	0.5	9.0	9.2	0.1	0.5	8.6	8.3	-0.4	1.3	7.3	6.4	-0.9	0.8
	17:00	5.5	6.5	1.1	0.3	7.8	8.8	1.0	1.1	8.3	8.5	0.2	0.5	9.0	9.2	0.1	0.5	8.6	8.3	-0.3	1.1	7.3	6.4	-0.9	0.7
30	07:00	5.5	6.4	0.9	0.3	7.8	8.8	1.0	1.1	8.3	8.4	0.2	0.4	9.0	9.2	0.1	0.5	8.6	8.4	-0.2	1.0	7.3	6.3	-1.0	0.7
	17:00	5.5	6.3	0.9	0.3	7.8	8.8	1.0	1.1	8.3	8.4	0.1	0.4	9.0	9.1	0.1	0.5	8.6	8.4	-0.3	1.0	7.2	6.3	-1.0	0.7
31	07:00	5.5	6.2	0.7	0.2					8.3	8.4	0.1	0.4	9.0	9.1	0.1	0.5					7.2	6.2	-1.0	0.7
	17:00	5.5	6.2	0.7	0.2					8.3	8.4	0.1	0.4	9.0	9.1	0.1	0.5					7.2	6.2	-1.0	0.6

Note :

Positive Head Difference Indicates Flow from R/S to C/S
Negative Head Difference Indicates Flow from C/S to R/S

Table G.10: Daily Discharge Computation (1996)

Table G.10: Daily Discharge Computation (1996)

DAY	TIME	MARCH				APRIL				MAY				JUNE			
		C/S	R/S	Head Diff	Discharge	C/S	R/S	Head Diff	Discharge	C/S	R/S	Head Diff	Discharge	C/S	R/S	Head Diff	Discharge
		(m PWD)	(m PWD)	(m)	(m³/s)	(m PWD)	(m PWD)	(m)	(m³/s)	(m PWD)	(m PWD)	(m)	(m³/s)	(m PWD)	(m PWD)	(m)	(m³/s)
1	07:00	4.1	3.6			4.8	7.3	2.5	0.9	4.6	5.6	1.0	0.0	6.0	8.1	2.1	1.1
	17:00	4.1	3.6			4.6	7.4	2.8	0.9	4.7	5.5	0.8	0.0	6.1	8.2	2.1	1.2
2	07:00	4.1	3.6			4.7	7.5	2.9	1.0	4.7	5.5	0.8	0.0	6.2	8.4	2.2	1.3
	17:00	4.1	3.6			4.6	7.6	3.0	1.0	4.7	5.5	0.8	0.0	6.3	8.5	2.2	1.3
3	07:00	4.1	3.6			4.6	7.7	3.1	1.1	4.7	5.5	0.8	0.0	6.4	8.6	2.2	1.3
	17:00	4.1	3.6			4.6	7.7	3.1	1.1	4.8	5.5	0.7	0.0	6.4	8.6	2.2	1.4
4	07:00	4.0	3.6			4.8	7.7	2.9	1.1	4.8	5.5	0.7	0.0	6.5	8.6	2.1	1.4
	17:00	4.0	3.6			4.6	7.7	3.1	1.1	4.7	5.5	0.8	0.0	6.5	8.6	2.1	1.3
5	07:00	4.0	3.6			4.6	7.7	3.1	1.1	4.8	5.5	0.7	0.0	6.6	8.6	2.0	1.3
	17:00	4.0	3.6			4.7	7.7	3.0	1.1	4.8	5.5	0.8	0.0	6.7	8.6	2.0	1.3
6	07:00	4.0	3.6			4.7	7.7	3.0	1.1	4.7	5.5	0.8	0.0	6.7	8.7	2.0	1.3
	17:00	4.0	3.6			4.6	7.7	3.0	1.1	4.7	5.5	0.8	0.0	6.8	8.7	1.9	1.3
7	07:00	3.9	3.6			5.0	7.6	2.6	1.0	4.7	5.5	0.8	0.0	6.8	8.7	1.8	1.3
	17:00	3.9	3.4			4.5	7.5	3.1	1.0	4.7	5.5	0.8	0.0	6.8	8.6	1.8	1.3
8	07:00	3.9	3.4			4.5	7.5	3.0	1.0	4.7	5.5	0.8	0.0	6.9	8.6	1.7	1.2
	17:00	3.8	3.4			4.4	7.4	3.1	1.0	4.6	5.5	0.9	0.0	6.9	8.6	1.7	1.2
9	07:00	3.8	3.4			5.0	7.3	2.3	0.8	4.6	5.5	0.9	0.0	6.9	8.5	1.6	1.2
	17:00	3.8	3.4			4.5	7.2	2.8	0.8	4.9	5.5	0.6	0.0	6.9	8.5	1.6	1.2
10	07:00	3.8	3.4			4.4	7.2	2.8	0.8	4.6	5.9	1.3	0.2	6.9	8.4	1.6	1.1
	17:00	3.8	3.4			4.5	7.1	2.6	0.8	4.6	6.0	1.4	0.2	6.8	8.4	1.6	1.1
11	07:00	3.8	3.3			4.7	7.1	2.4	0.7	4.6	6.4	1.8	0.4	6.8	8.3	1.6	1.1
	17:00	3.8	3.3			4.9	7.0	2.1	0.6	4.6	6.5	1.9	0.4	6.8	8.3	1.6	1.1
12	07:00	3.7	3.3			4.9	6.8	1.9	0.6	4.6	6.6	2.0	0.6	6.8	8.2	1.5	1.0
	17:00	3.7	3.3			4.6	6.7	2.1	0.5	4.6	6.6	2.0	0.6	6.8	8.2	1.4	1.0
13	07:00	3.8	3.4			4.5	6.6	2.1	0.5	4.6	6.9	2.2	0.6	6.8	8.1	1.3	0.9
	17:00	4.2	3.4			4.4	6.5	2.2	0.5	4.6	6.9	2.3	0.7	6.8	8.1	1.3	0.9
14	07:00	4.2	3.6			4.4	6.4	2.0	0.4	4.7	7.2	2.5	0.8	6.8	8.0	1.2	0.9
	17:00	4.2	3.6			4.4	6.3	2.0	0.4	5.1	7.6	2.4	0.9	6.8	8.0	1.2	0.9
15	07:00	4.9	5.2			4.3	6.2	1.8	0.3	5.1	8.0	2.9	1.3	6.7	7.9	1.1	0.8
	17:00	4.9	5.5			4.3	6.0	1.8	0.2	5.2	8.2	3.0	1.3	6.7	7.8	1.1	0.8
16	07:00	4.4	5.9	1.4	0.1	4.3	5.9	1.6	0.2	5.0	8.2	3.2	1.4	6.7	7.8	1.1	0.8
	17:00	4.3	6.0	1.7	0.2	4.3	5.8	1.6	0.1	5.0	8.2	3.1	1.3	6.7	7.8	1.1	0.8
17	07:00	4.5	6.1	1.6	0.2	4.3	5.6	1.3	0.0	5.2	8.3	3.1	1.4	6.7	7.7	1.0	0.7
	17:00	4.4	6.1	1.7	0.3	4.3	5.5	1.3	0.0	5.1	8.3	3.1	1.4	6.7	7.7	1.0	0.7
18	07:00	4.5	6.1	1.7	0.3	4.3	5.5	1.2	0.0	5.1	8.2	3.1	1.4	6.7	7.6	1.0	0.7
	17:00	4.2	6.1	1.9	0.2	4.3	5.4			5.1	8.2	3.1	1.4	6.7	7.6	0.9	0.6
19	07:00	4.3	6.0	1.7	0.2	4.2	5.3			5.5	8.2	2.7	1.3	6.7	7.6	0.8	0.6
	17:00	4.2	6.0	1.8	0.2	4.2	5.2			5.5	8.2	2.7	1.3	6.7	7.6	0.9	0.6
20	07:00	4.4	5.9	1.5	0.2	4.2	5.1			5.3	8.2	2.9	1.3	6.7	7.6	0.9	0.7
	17:00	4.3	5.7	1.5	0.1	4.2	5.0			5.5	8.2	2.6	1.3	6.7	7.6	0.9	0.6
21	07:00	4.2	5.7	1.5	0.1	4.3	5.0			5.5	8.2	2.7	1.3	6.7	7.6	0.8	0.6
	17:00	4.4	5.5	1.1	0.0	4.3	5.0			5.3	8.2	2.9	1.3	6.7	7.5	0.8	0.6
22	07:00	4.2	5.4			4.3	5.1			5.5	8.1	2.6	1.2	6.7	7.5	0.8	0.6
	17:00	4.2	5.4			4.3	5.1			5.5	8.1	2.6	1.2	6.7	7.5	0.7	0.6
23	07:00	4.2	5.1			4.3	5.3			5.5	7.9	2.4	1.1	6.7	7.5	0.8	0.6
	17:00	4.2	5.0			4.3	5.3			5.5	7.9	2.3	1.1	6.8	7.6	0.8	0.6
24	07:00	4.2	4.8			4.3	5.3			5.5	7.9	2.4	1.1	6.8	7.6	0.8	0.6
	17:00	4.2	4.7			4.2	5.4			5.5	7.8	2.3	1.1	6.8	7.6	0.8	0.6
25	07:00	4.6	4.6			4.8	5.5			5.5	7.7	2.2	1.0	6.8	7.6	0.7	0.6
	17:00	4.6	4.6			4.8	5.4			5.5	7.7	2.2	0.9	6.8	7.6	0.7	0.6
26	07:00	4.7	4.5			4.9	5.5	0.6	0.0	5.5	7.6	2.1	0.9	6.8	7.5	0.7	0.6
	17:00	4.6	4.4			4.9	5.5	0.7	0.0	5.5	7.5	2.1	0.9	6.8	7.6	0.7	0.6
27	07:00	4.6	4.4			4.7	5.6	0.9	0.0	5.5	7.4	1.9	0.8	6.9	7.6	0.7	0.6
	17:00	4.6	4.6			4.7	5.6	0.9	0.0	5.5	7.4	1.8	0.8	6.9	7.5	0.6	0.5
28	07:00	4.6	5.2			4.7	5.7	1.0	0.1	5.5	7.5	2.0	0.8	6.9	7.4	0.6	0.5
	17:00	4.6	5.7	1.1	0.1	4.8	5.7	0.9	0.1	5.5	7.5	2.0	0.8	6.9	7.4	0.6	0.5
29	07:00	4.6	6.0	1.5	0.2	4.7	5.7	1.0	0.1	5.5	7.5	2.0	0.9	6.9	7.4	0.5	0.5
	17:00	4.6	6.1	1.6	0.3	4.7	5.7	1.0	0.1	5.6	7.5	1.9	0.9	6.9	7.4	0.5	0.5
30	07:00	4.9	6.6	1.7	0.4	4.7	5.7	1.0	0.1	5.7	7.7	2.0	0.9	6.9	7.4	0.5	0.5
	17:00	4.6	6.7	2.1	0.5	4.6	5.7	1.0	0.1	5.9	7.8	2.0	1.0	6.9	7.4	0.5	0.5
31	07:00	4.8	7.0	2.2	0.7					5.8	8.0	2.2	1.1				
	17:00	4.6	7.1	2.5	0.8					5.8	8.0	2.2	1.1				

DAY	TIME	JULY				AUGUST				SEPTEMBER				OCTOBER			
		C/S	R/S	Head Diff	Discharge	C/S	R/S	Head Diff	Discharge	C/S	R/S	Head Diff	Discharge	C/S	R/S	Head Diff	Discharge
		(m PWD)	(m PWD)	(m)	(m³/s)	(m PWD)	(m PWD)	(m)	(m³/s)	(m PWD)	(m PWD)	(m)	(m³/s)	(m PWD)	(m PWD)	(m)	(m³/s)
1	07:00	7.1	7.4	0.4	0.4	8.2	8.8	0.6	0.8	8.5	8.7	0.2	0.5	8.4	8.0	-0.4	1.1
	17:00	7.2	7.5	0.3	0.4	8.2	8.8	0.6	0.8	8.5	8.7	0.2	0.5	8.3	7.9	-0.4	1.1
2	07:00	7.4	8.0	0.7	0.7	8.3	8.7	0.5	0.8	8.5	8.7	0.2	0.5	8.3	7.9	-0.4	1.1
	17:00	7.6	8.3	0.8	0.8	8.3	8.7	0.5	0.8	8.5	8.7	0.2	0.5	8.3	7.9	-0.4	1.1
3	07:00	7.6	8.6	0.9	0.9	8.3	8.7	0.4	0.7	8.4	8.6	0.2	0.5	8.3	7.8	-0.5	1.2
	17:00	7.8	8.7	0.9	1.0	8.3	8.7	0.4	0.7	8.4	8.6	0.2	0.5	8.3	7.8	-0.5	1.1
4	07:00	7.8	8.9	1.0	1.1	8.3	8.6	0.3	0.6	8.4	8.6	0.2	0.5	8.3	7.8	-0.5	1.2
	17:00	7.9	8.9	1.0	1.1	8.3	8.6	0.3	0.6	8.4	8.6	0.2	0.5	8.2	7.7	-0.5	1.2
5	07:00	8.0	9.0	1.0	1.1	8.4	8.6	0.2	0.6	8.4	8.6	0.2	0.5	8.2	7.8	-0.4	1.1
	17:00	8.1	9.0	1.0	1.1	8.4	8.6	0.2	0.6	8.4	8.5	0.1	0.4	8.2	7.9	-0.4	1.0
6	07:00	8.1	9.0	0.9	1.1	8.4	8.6	0.2	0.6	8.4	8.5	0.1	0.4	8.3	7.9	-0.3	0.9
	17:00	8.1	9.0	0.9	1.1	8.4	8.6	0.2	0.6	8.4	8.5	0.1	0.4	8.3	8.0	-0.3	0.9
7	07:00	8.1	9.0	0.9	1.1	8.4	8.6	0.2	0.6	8.5	8.5	0.1	0.4	8.3	8.1	-0.2	0.8
	17:00	8.1	9.0	0.9	1.1	8.4	8.5	0.2	0.6	8.5	8.5	0.1	0.4	8.3	8.1	-0.2	0.7
8	07:00	8.2	9.0	0.9	1.1	8.4	8.5	0.1	0.4	8.5	8.5	0.1	0.4	8.3	8.1	-0.2	0.8
	17:00	8.2	9.0	0.9	1.1	8.4	8.5	0.1	0.4	8.5	8.5	0.1	0.4	8.3	8.0	-0.3	0.8
9	07:00	8.2	9.0	0.9	1.1	8.4	8.4	0.1	0.3	8.4	8.5	0.1	0.3	8.3	8.0	-0.3	0.8
	17:00	8.2	9.0	0.9	1.1	8.4	8.4	0.0	0.3	8.4	8.4	0.0	0.2	8.3	8.0	-0.3	0.9
10	07:00	8.2	9.0	0.9	1.0	8.3	8.4	0.0	0.3	8.5	8.4	-0.0	0.6	8.2	7.9	-0.3	0.9
	17:00	8.2	9.0	0.9	1.0	8.3	8.4	0.0	0.2	8.4	8.4	-0.0	0.6	8.2	7.9	-0.3	0.9
11	07:00	8.2	9.0	0.9	1.1	8.3	8.3	-0.0	0.6	8.4	8.4	-0.1	0.7	8.2	7.9	-0.3	0.9
	17:00	8.2	9.0	0.9	1.1	8.3	8.3	0.0	0.2	8.4	8.3	-0.1	0.7	8.2	7.8	-0.4	0.9
12	07:00	8.1	9.0	0.9	1.1	8.3	8.4	0.0	0.3	8.4	8.3	-0.2	0.7	8.2	7.8	-0.4	1.0
	17:00	8.1	9.0	0.9	1.1	8.3	8.4	0.1	0.3	8.4	8.3	-0.2	0.8	8.2	7.8	-0.4	1.0
13	07:00	8.1	9.0	0.9	1.1	8.3	8.4	0.1	0.4	8.4	8.2	-0.2	0.8	8.1	7.7	-0.5	1.0
	17:00	8.1	9.0	0.9	1.0	8.3	8.4	0.1	0.4	8.4	8.2	-0.3	0.9	8.1	7.6	-0.5	1.0
14	07:00	8.1	9.0	0.8	1.0	8.3	8.5	0.1	0.4	8.4	8.1	-0.3	0.9	8.1	7.6	-0.5	1.1
	17:00	8.1	9.0	0.9	1.0	8.3	8.5	0.2	0.5	8.4	8.1	-0.3	0.9	8.1	7.6	-0.5	1.1
15	07:00	8.2	9.0	0.8	1.0	8.3	8.5	0.2	0.5	8.4	8.0	-0.3	1.0	8.0	7.5	-0.5	1.2
	17:00	8.2	9.0	0.8	1.0	8.3	8.5	0.2	0.5	8.4	8.0	-0.4	1.0	8.0	7.3	-0.7	1.3
16	07:00	8.2	9.0	0.8	1.0	8.3	8.5	0.2	0.5	8.3	7.9	-0.4	1.1	8.0	7.3	-0.7	1.3
	17:00	8.2	9.0	0.8	1.0	8.3	8.5	0.2	0.6	8.3	7.9	-0.4	1.1	8.0	7.2	-0.8	1.4
17	07:00	8.2	9.0	0.7	1.0	8.3	8.6	0.3	0.6	8.3	7.8	-0.5	1.2	7.9	7.1	-0.8	1.4
	17:00	8.2	9.0	0.7	1.0	8.4	8.7	0.3	0.6	8.3	7.8	-0.5	1.2	7.9	7.1	-0.8	1.4
18	07:00	8.2	8.9	0.7	1.0	8.4	8.7	0.3	0.6	8.3	7.8	-0.5	1.3	7.9	7.1	-0.8	1.4
	17:00	8.2	8.9	0.8	1.0	8.5	8.7	0.3	0.6	8.4	7.8	-0.6	1.3	7.9	7.1	-0.8	1.4
19	07:00	8.2	8.9	0.7	1.0	8.5	8.8	0.3	0.6	8.4	7.8	-0.6	1.3	7.9	7.0	-0.9	1.5
	17:00	8.2	8.9	0.7	1.0	8.5	8.8	0.3	0.7	8.4	7.8	-0.6	1.4	7.9	7.0	-0.9	1.5
20	07:00	8.2	9.0	0.7	1.0	8.6	8.8	0.3	0.7	8.3	7.8	-0.6	1.4	7.9	7.0	-0.9	1.5
	17:00	8.2	9.0	0.8	1.0	8.5	8.8	0.3	0.7	8.3	7.8	-0.6	1.4	7.8	7.0	-0.9	1.5
21	07:00	8.2	9.0	0.7	1.0	8.5	8.8	0.3	0.7	8.4	7.8	-0.6	1.4	7.8	6.9	-0.9	1.4
	17:00	8.2	9.0	0.7	1.0	8.5	8.8	0.3	0.7	8.4	7.9	-0.5	1.3	7.8	6.9	-0.9	1.4
22	07:00	8.2	8.9	0.7	1.0	8.5	8.9	0.3	0.7	8.4	8.0	-0.5	1.2	7.7	6.6	-1.1	1.5
	17:00	8.2	8.9	0.7	1.0	8.5	8.9	0.3	0.7	8.5	8.1	-0.4	1.1	7.7	6.6	-1.1	1.5
23	07:00	8.2	8.9	0.7	0.9	8.6	8.9	0.4	0.7	8.5	8.1	-0.4	1.1	7.6	6.6	-1.1	1.4
	17:00	8.2	8.9	0.7	0.9	8.5	8.9	0.4	0.7	8.5	8.1	-0.4	1.2	7.6	6.5	-1.1	1.4
24	07:00	8.2	8.9	0.7	0.9	8.5	8.9	0.4	0.7	8.5	8.1	-0.4	1.2	7.6	6.4	-1.2	1.4
	17:00	8.2	8.9	0.7	0.9	8.5	8.9	0.4	0.7	8.5	8.1	-0.4	1.1	7.5	6.3	-1.2	1.3
25	07:00	8.2	8.9	0.7	0.9	8.5	8.9	0.4	0.7	8.5	8.0	-0.4	1.2	7.5	6.2	-1.3	1.2
	17:00	8.2	8.9	0.7	1.0	8.5	8.9	0.4	0.7	8.5	8.0	-0.4	1.2	7.5	6.2	-1.3	1.2
26	07:00	8.2	9.0	0.8	1.0	8.5	8.9	0.4	0.7	8.5	8.0	-0.4	1.2	7.4	6.1	-1.3	1.1
	17:00	8.2	8.9	0.7	1.0	8.5	8.9	0.4	0.7	8.4	8.0	-0.5	1.3	7.4	6.1	-1.3	1.0
27	07:00	8.2	8.9	0.7	0.9	8.5	8.9	0.4	0.7	8.4	8.0	-0.5	1.3	7.3	6.0	-1.4	0.9
	17:00	8.2	8.8	0.6	0.9	8.4	8.8	0.3	0.7	8.4	8.0	-0.5	1.3	7.3	5.9	-1.4	0.8
28	07:00	8.2	8.8	0.6	0.8	8.4	8.8	0.3	0.7	8.4	8.0	-0.4	1.1	7.3	5.9	-1.4	0.8
	17:00	8.2	8.8	0.6	0.8	8.5	8.8	0.3	0.6	8.4	8.0	-0.4	1.1	7.3	6.0	-1.4	0.8
29	07:00	8.2	8.7	0.5	0.8	8.4	8.7	0.3	0.6	8.4	8.0	-0.4	1.2	7.4	6.1	-1.3	0.9
	17:00	8.2	8.7	0.6	0.8	8.5	8.7	0.3	0.6	8.4	8.0	-0.4	1.2	7.4	6.2	-1.2	1.0
30	07:00	8.2	8.7	0.6	0.8	8.5	8.7	0.3	0.6	8.4	7.9	-0.4	1.2	7.4	6.4	-1.0	0.9
	17:00	8.2	8.7	0.6	0.8	8.5	8.7	0.3	0.6	8.4	8.0	-0.4	1.1	7.4	6.6	-0.8	0.8
31	07:00	8.2	8.8	0.6	0.8	8.5	8.7	0.2	0.6					7.4	6.6	-0.7	0.7
	17:00	8.2	8.8	0.6	0.8	8.5	8.7	0.2	0.6					7.3	6.7	-0.6	0.6

Note : Negative head difference indicates flow direction C/S to R/S

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Table G.11: Daily Discharge Computation (1997)

DAY	MARCH				APRIL				MAY				JUNE				JULY				AUGUST				SEPTEMBER			
	C/S	R/S	Head Diff.	Discharge	C/S	R/S	Head Diff.	Discharge	C/S	R/S	Head Diff.	Discharge	C/S	R/S	Head Diff.	Discharge	C/S	R/S	Head Diff.	Discharge	C/S	R/S	Head Diff.	Discharge	C/S	R/S	Head Diff.	Discharge
	(m PWD)	(m PWD)	(m)	(m^3/s)	(m PWD)	(m PWD)	(m)	(m^3/s)	(m PWD)	(m PWD)	(m)	(m^3/s)	(m PWD)	(m PWD)	(m)	(m^3/s)	(m PWD)	(m PWD)	(m)	(m^3/s)	(m PWD)	(m PWD)	(m)	(m^3/s)	(m PWD)	(m PWD)	(m)	(m^3/s)
1	2.8	3.0			4.4	4.2			3.7	3.4			5.4	6.8	1.4	0.5	7.2	8.3	1.1	0.9	8.2	9.3	1.1	1.3	8.4	7.9	-0.5	1.0
2	2.8	3.0			4.3	4.1			3.6	3.3			5.5	7.2	1.6	0.7	7.3	8.2	1.0	0.9	8.2	9.2	1.0	1.2	8.4	7.9	-0.5	1.0
3	2.7	3.1			4.3	4.2			3.5	3.3			5.7	7.5	1.8	0.8	7.3	8.2	0.9	0.8	8.3	9.1	0.8	1.1	8.4	7.9	-0.6	1.1
4	2.7	3.0			4.3	4.2			3.4	3.4			5.9	7.6	1.7	0.8	7.3	8.1	0.8	0.8	8.2	9.0	0.8	1.0	8.4	8.1	-0.3	0.8
5	2.7	3.0			4.3	4.2			3.7	3.6			6.0	7.6	1.6	0.8	7.4	8.1	0.7	0.8	8.2	8.9	0.7	0.9	8.4	8.1	-0.3	0.8
6	2.7	3.0			4.3	4.2			3.7	3.6			6.1	7.7	1.6	0.8	7.4	8.1	0.7	0.7	8.2	8.8	0.6	0.8	8.4	8.3	-0.2	0.6
7	2.7	3.0			4.3	4.1			3.7	3.6			6.1	7.8	1.7	0.9	7.4	8.1	0.7	0.7	8.1	8.8	0.6	0.9	8.5	8.2	-0.2	0.7
8	2.7	3.1			4.3	4.2			3.8	3.7			6.1	7.9	1.8	0.9	7.4	8.0	0.6	0.7	8.1	8.7	0.6	0.9	8.5	8.3	-0.2	0.6
9	2.7	3.0			4.3	4.1			3.9	3.8			6.5	7.8	1.4	0.9	7.4	8.0	0.6	0.7	8.1	8.6	0.5	0.8	8.5	8.4	-0.1	0.5
10	2.7	3.0			4.2	4.1			4.1	3.9			6.6	7.8	1.2	0.8	7.5	8.0	0.6	0.7	8.2	8.6	0.4	0.7	8.5	8.4	-0.1	0.5
11	2.7	3.0			4.2	4.1			4.3	4.1			6.6	7.8	1.2	0.8	7.5	8.2	0.6	0.7	8.2	8.6	0.4	0.7	8.4	8.3	-0.1	0.5
12	2.7	3.0			4.3	4.2			4.6	4.8			6.7	7.7	1.0	0.7	7.9	8.9	1.1	1.1	8.3	8.6	0.4	0.7	8.5	8.3	-0.2	0.7
13	2.7	3.0			4.3	4.1			4.7	4.8			6.8	7.7	0.9	0.7	7.9	9.1	1.2	1.2	8.4	8.7	0.3	0.6	8.5	8.3	-0.3	0.8
14	2.7	3.0			4.3	4.2			4.7	4.8			6.9	7.7	0.8	0.6	8.0	9.2	1.1	1.3	8.4	8.7	0.3	0.7	8.5	8.4	-0.2	0.7
15	2.8	3.0			4.3	4.1			4.8	4.8			6.8	7.6	0.8	0.6	8.1	9.2	1.1	1.3	8.4	8.8	0.4	0.7	8.5	8.3	-0.2	0.7
16	3.1	3.1			4.3	4.1			4.8	4.9			6.8	7.6	0.8	0.6	8.1	9.2	1.1	1.3	8.4	8.8	0.4	0.7	8.5	8.3	-0.2	0.7
17	3.4	3.0			4.3	4.1			4.9	4.9			6.8	7.6	0.8	0.6	8.1	9.2	1.1	1.3	8.4	8.8	0.4	0.7	8.5	8.3	-0.3	0.8
18	3.7	3.1			4.3	4.0			4.9	4.9			6.9	7.6	0.8	0.6	8.1	9.2	1.1	1.3	8.4	8.8	0.3	0.7	8.5	8.3	-0.2	0.8
19	3.9	3.3			4.3	4.0			4.7	4.9			6.9	7.7	0.8	0.7	8.1	9.2	1.1	1.3	8.4	8.8	0.3	0.7	8.7	8.3	-0.4	1.0
20	4.0	3.7			4.3	4.0			4.7	4.9			6.9	7.7	0.8	0.6	8.1	9.2	1.1	1.2	8.4	8.8	0.3	0.7	8.9	8.4	-0.5	1.2
21	4.1	3.9			4.2	4.0			4.7	5.6	0.9	0.0	6.9	7.9	1.0	0.6	8.1	9.2	1.0	1.2	8.5	8.8	0.3	0.7	9.0	8.5	-0.5	1.2
22	4.2	4.2			4.2	4.0			5.1	6.6	1.5	0.4	7.0	8.0	1.0	0.6	8.1	9.2	1.0	1.2	8.5	8.7	0.2	0.5	9.0	8.5	-0.5	1.2
23	4.2	5.0			4.2	4.0			5.2	6.7	1.5	0.5	7.0	8.1	1.1	0.9	8.1	9.1	1.0	1.2	8.5	8.7	0.2	0.6	8.9	8.4	-0.5	1.2
24	4.3	5.5	1.3	0.0	4.2	4.0			5.2	6.8	1.6	0.5	7.0	8.3	1.3	1.0	8.2	9.1	0.9	1.1	8.5	8.5	-0.1	0.3	8.9	8.6	-0.3	1.0
25	4.3	5.7	1.4	0.1	4.2	3.8			5.3	6.9	1.6	0.5	7.0	8.3	1.3	1.0	8.2	9.1	1.0	1.1	8.5	8.5	-0.1	0.3	8.9	8.6	-0.3	0.9
26	4.3	5.5	1.2	0.0	4.1	3.7			5.3	6.9	1.6	0.5	7.0	8.3	1.3	1.0	8.2	9.2	1.0	1.2	8.5	8.3	-0.2	0.1	8.9	8.6	-0.3	0.9
27	4.3	5.2			4.0	3.7			5.3	6.8	1.5	0.5	7.0	8.4	1.3	1.0	8.2	9.2	1.1	1.2	8.5	8.3	-0.2	0.0	8.9	8.6	-0.3	0.9
28	4.4	5.0			3.9	3.6			5.3	6.8	1.5	0.5	7.1	8.3	1.3	1.0	8.2	9.3	1.2	1.3	8.5	8.1	-0.4	0.2	9.0	8.8	-0.1	0.6
29	4.4	4.8			3.8	3.5			5.3	6.8	1.5	0.5	7.1	8.3	1.2	1.0	8.2	9.3	1.1	1.3	8.5	8.1	-0.4	0.3	8.9	8.9	-0.1	0.6
30	4.4	4.6			3.7	3.6			5.4	6.8	1.5	0.5	7.1	8.3	1.2	1.0	8.2	9.3	1.1	1.3	8.5	7.9	-0.6	0.5	8.9	9.0	0.1	0.4
31	4.4	4.4							5.4	6.8	1.4	0.5					8.2	9.3	1.1	1.3	8.5	7.8	-0.6	0.5				

Negative head difference indicates flow direction C/S to R/S

Table G.12: Water Quality Data for Year 1 (1995)

November 1994

Sl.	Location	Date	Time	Habitat	Alkal (mg/l)	Ammon (mg/l)	CO_2 (mg/l)	Cl (mg/l)	O_2 (mg/l)	Hard (mg/l)	Nit (mg/l)	pH	Temp (° C)
1	MRP: Junction of Mogra and Karadair khal	22	09:00	Canal	18	0.4	7.0	2.0	6.2	15	nil	6.8	24.4
2	MRP: Patasingrabeel	22	11:45	Beel	21	nil	4.5	1.8	4.3	14	nil	7.2	25.5
3	Kushiyara Riverin front of 3-vent regulator	22	14:10	River	46	1.0	17.0	2.9	7.2	40	nil	7.2	25.5
4	Manu River at Manumukh	22	16:00	River	52	nil	23.0	3.2	6.9	65	nil	7.3	26.1
5	Riverside channel of 6-vent regulator	22	17:00	Canal	12	nil	8.0	2.2	8.1	16	nil	7.2	26.1
6	Manu River in front of Manu Barrage	23	10:25	River	89	nil	24.0	2.8	7.8	74	nil	7.4	25.0

January 1995

Sl	Location	Date	Time	Habitat	Alkl (mg/l)	Amon (mg/l)	CO_2 (mg/l)	Cl (mg/l)	O_2 (mg/l)	Hard (mg/l)	Nit (mg/l)	pH	Temp (° C)
1	MRP: Patasingra beel	24	10:45	Beel	29	0.6	6.2	4.6	4.35	54	0.03	6.7	17.7
2	MRP: Karadair khal inside 3-ventregulator	24	16:00	Canal	33	0.4	15.4	3.7	3.37	26	0.03	6.8	18.8
3	MRP: Mogra khal	25	09:30	Canal	32	1.2	20.0	5.9	4.50	38	nil	6.9	14.4
4	MRP: Akhali Gang near Patiband	25	10:45	Canal	32	0.7	16.8	3.1	3.60	32	nil	6.8	16.6
5	Kushiyara River, upstream of 3-vent regulator	25	15:50	River	63	0.2	4.0	5.6	8.77	58	nil	7.8	21.7
6	Manu River near Manumukh	26	09:55	River	108	nil	23.0	2.7	6.12	83	0.01	7.2	18.8

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Table G.12: Water Quality Data for Year 1 (1995) - continued

September 1995

Sl	Location	Date	Time	Habitat	Alkal (mg/l)	Amon (mg/l)	CO_2 (mg/l)	Cl (mg/l)	O_2 (mg/l)	Hard (mg/l)	Nit (mg/l)	pH	Temp (° C)
1	MRP: Patasingra beel	17	11:15	Beel	11	0.4	5.4	1.4	3.8	15	0.03	6.8	31.1
2	MRP: Junction of Koradair & Mogra canal	19	08:45	Canal	8	0.3	9.0	0.7	4.2	6	0.03	6.7	31.1
3	Kushiyara river in front of 3-vent regulator	18	08:50	River	23	0.4	10.0	1.3	4.0	16	0.03	6.9	30.0
4	Manu river at Manumukh	18	10:35	River	21	0.3	11.0	1.5	3.7	25	0.02	6.8	28.8
5	MRP: C/S observation chamber of fishpass	18	17:30	Fishpass	5	0.1	9.0	1.3	3.8	9	0.04	6.8	28.8

Table G.13: Water Quality Data for Year 2 (1996)

Date	Location	Habitat	Time (hrs)	Alkal (mg/l)	NH_3 (mg/l)	DO (mg/l)	CO2 (mg/l)	Cl (mg/l)	Hardness (mg/l)	NO_2 (mg/l)	pH	Temp (°C) Air	Temp (°C) Water
November 95													
Nov 23 95	Kushiyara river near 3-vent regulator	River	1227	49.0	0.3		8.2	2.3	27.0	nil	6.7		25.5
"	Monu river up from Manumukh	River	1349	54.0	0.3		11.0	2.5	48.0	nil	7.5		25.5
Nov 24 95	Patashingra beel	Beel	1000	14.0	0.2		5.4	1.5	12.0	nil	6.8		25.5
"	Junction of Karadair and Mogra canal	Canal	1120	9.0	0.1		-	1.1	5.0	nil	6.8		26.1
"	Junction of 6-vent regulator & fishpass	Canal	1230	-	0.1		-	1.2	10.0	nil	6.7		26.1
February 96													
Feb 12 96	Patasingra beel	Beel	0945	29.0	0.9	4.4	6.2	4.5	52.0	0.0	6.8		23.5
"	Mogra canal	Canal	1100	32.0	1.2	4.5	18.0	5.9	39.0	nil	6.9		23.6
"	Akali canal	Canal	1230	32.0	1.3	3.6	18.1	5.3	32.0	nil	6.9		23.6
"	Karadair canal behind 3-vent Regulator	Canal	1430	33.0	0.4	3.4	15.4	3.7	27.0	0.0	6.8		23.4
Feb 13 96	Kushiyara River in front of 3-vent regulator	River	1000	63.0	0.3	8.8	22.0	5.6	57.0	nil	7.5		24.0
Feb 14 96	Manu River near Manumukh	River	1230	78.0	0.2	6.1	23.0	4.7	81.0	0.0	7.2		23.5
May 96													
May 06 96	Patasingra beel	Beel	1300	28.0	nil	6.2	5.2	3.5	32.0	nil	6.9		33.5
"	Mogra canal	Canal	1145	29.0	nil	6.5	16.0	4.6	29.0	nil	7.2		32.0
"	Akali canal	Canal	1030	32.0	nil	5.8	16.1	4.4	22.0	nil	7.1		30.0
"	Karadair canal behind 3-vent Regulator	Canal	0830	33.0	nil	6.2	15.4	4.7	17.0	nil	7.1		29.0
May 07 96	Kushiyara River in front of 3-vent regulator	River	1030	59.0	nil	8.7	21.0	4.9	29.0	nil	6.9		31.0
"	Manu River near Manumukh	River	1300	75.0	nil	6.5	22.0	5.1	25.0	nil	7.2		32.5
September 96													
Sept 01 96	Patashingra	Beel	1030 hrs	6.0	0.0	8.7	4.0	2.1	15.0	0.03	7.1	30.5	30.0

Table G.13: Water Quality Data for Year 2 (1996)

Date	Location	Habitat	Time	Alkal	NH_3	DO	CO2	Cl	Hardness	NO_2	pH	Temp (°C)	
			(hrs)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)		Air	Water
	beel												
Sept 08 96	Confluence	Canal	0900 hrs	5.8	0.0	7.6	4.2	2.2	12.0	0.03	7.0	29.4	28.8
	of Koradair,												
	Akali &												
	Mogra canal												
Sept 26 96	Countryside	Canal	1020 hrs	8.0	0.1	4.0	9.6	1.3	3.0	0.02	6.6	34.4	30.0
	of Fishpass												
Sept 28 96	Kushiyara	River	0910 hrs	19.0	0.1	4.8	8.0	1.2	10.0	0.03	6.9	31.1	30.0
	River (in front												
	of) 3 vent												
	regulator												
	Monu River	River	1040 hrs	16.0	0.1	3.9	10.0	1.2	15.0	0.02	6.8	31.1	28.8
	at Manumukh												
October 96													
Oct23'96	Patashingra	Beel	0830 hrs	6.0	0.01	6	5	2	14	0.02	6.9	28.8	29.4
	beel												
"	Junction	Canal	1000 hrs	5.9	0.02	5.9	4.4	2.1	13	0.03	7.1	30.5	30.0
	of Koradair,												
	Akali &												
	Mogra canal												
"	Countryside	Canal	1120 hrs	5.8	0.02	5.8	4.8	1.4	4	0.02	7	33.3	36.1
	observation												
	chamber of fishpass												
Oct13'96	Kushiyara	River	0820 hrs	21	0.09	5	7	1.2	08	0.02	6.9	29.4	29.4
	River at												
	in front of 3 vent												
	regulator												
"	Monu River	River	1040 hrs	18	0.08	4.4	9	1.4	13	0.02	6.7	31.1	30.1
	At Manumukh												

Table G.14: Water Quality Data for Year 3 (1997)

Date	Location	Time	Alkalinity (mg/l)	NH_3 (mg/l)	DO (mg/l)	CO_2 (mg/l)	Cl (mg/l)	Hardness (mg/l)	NO_2 (mg/l)	pH	Temp (°C) Air	Temp (°C) Water
Month - December 96												
Dec 07 96	Patashingra beel	0915 hrs	6.0	0.0	5.8	5.1	1.9	12.0	0.0	6.8	26.7	28.0
"	Confluence of Koradair, Akali & Mogra canal	1100 hrs	5.8	0.0	5.7	5.0	2.1	13.0	0.0	6.9	29.4	28.4
"	Confluence of 3 vent regulator & Pump house chanel at haorside	1225 hrs	5.9	0.0	5.3	5.0	1.7	7.0	0.0	6.5	30.0	29.0
Dec 08 96	Confluence of 3 vent regulator & Kushiyara river	0930 hrs	20.0	0.0	5.4	7.0	1.4	11.0	0.0	7.0	26.7	28.0
"	Monu river at Monumukh	1145 hrs	16.0	0.1	4.9	6.9	1.3	17.0	0.0	6.9	28.3	28.0
Month- January 97												
Jan 16 97	Patashingra beel	900 hrs	28.0	0.6	4.3	6.1	4.6	52.0	0.0	6.7	27.8	30.0
"	Akali canal at up of the confluence of Koradair Mogra & Akali canal	1050 hrs	30.0	0.8	4.5	18.0	5.8	36.0	0.0	6.8	30.0	30.0
"	Koradair canal behind 3 vent regulator	1200 hrs	31.0	1.0	3.4	15.2	3.6	26.0	0.0	6.8	31.7	30.6
Jan 21 97	Kushiyara river (in front of 3 vent regu.)	900 hrs	60.0	0.4	8.8	4.0	5.4	57.0	nill	7.6	28.9	30.0
Jan 31 97	Monu river at Kazirbazar	1050 hrs	75.0	0.1	13.2	14.0	3.2	71.0	0.0	7.7	18.3	17.2

Table G.14: Water Quality Data for Year 3 (1997)

Date	Location	Time	Alkalinity (mg/l)	NH_3 (mg/l)	DO (mg/l)	CO_2 (mg/l)	Cl (mg/l)	Hardness (mg/l)	NO_2 (mg/l)	pH	Temp (°C) Air	Water
Month- February 97												
Feb 02 97	Patashingra beel	0900 hrs	29.0	0.5	4.5	6.1	4.3	51.0	0.0	6.7	31.1	27.8
"	Akali canal	1040 hrs	31.0	0.5	4.8	18.1	5.7	35.0	0.0	6.8	32.2	27.8
"	Koradair canal (behind 3-vent regu.)	1200 hrs	30.0	0.5	4.0	14.0	3.6	27.0	0.0	6.7	32.8	28.3
Feb 03 97	Kushiyara river (in front of 3- vent regulator)	0900 hrs	62.0	0.5	8.4	3.9	5.3	55.0	0.0	7.7	31.1	28.3
"	Monu river at Kazirbazar	1050 hrs	77.0	0.1	11.0	13.0	3.2	70.0	0.0	7.6	32.2	27.8
Month- March 97												
Mar 10 97	Irrigation canal at up of	1000 hrs	70.0	0.0	4.8	4.5	2.3	55.0	0.0	7.2	31.1	25.0
"	Patashingra beel											
Mar 11 97	Akali canal	1035 hrs	41.0	0.2	5.8	8.0	2.9	39.0	0.0	6.2	31.1	26.7
"	Koradair canal at up of 3- vent regulator	1240 hrs	50.0	0.5	5.7	9.2	2.7	41.0	0.0	6.9	33.3	27.2
Mar 22 97	Kushiyara river at the confluence of 3- vent regulator	1000 hrs	29.0	0.1	6.2	11.0	3.9	33.0	0.0	7.0	26.7	26.7
"	Monu river at up of Monumukh	1138 hrs	56.0	0.1	10.0	12.0	2.6	51.0	0.0	7.3	28.3	27.8
Mar 29 97	Monu river at up of Monu	11.3	35.0	0.1	9.5	6.7	1.3	37.0	0.0	7.3	36.7	28.9

Table G.14: Water Quality Data for Year 3 (1997)

Date	Location	Time	Alkalinity (mg/l)	NH$_3$ (mg/l)	DO (mg/l)	CO$_2$ (mg/l)	Cl (mg/l)	Hardness (mg/l)	NO$_2$ (mg/l)	pH	Temp (°C) Air	Temp (°C) Water
	barrage											
"	Reservoir at the initial point of Irrigation canal of MRP	13	39.0	0.2	6.9	7.1	1.7	41.0	0.0	7.3	36.7	29.4
Month- April 97												
Apr 26 97	Patashingra beel	0900 hrs	66.0	0.0	4.8	4.6	1.9	50.0	0.0	7.2	28.9	27.8
"	Akali canal	1030 hrs	39.0	0.3	5.8	8.1	2.6	32.0	0.0	6.4	31.1	27.8
"	Koradair canal at up of 3- vent regulator	1240 hrs	47.0	0.4	5.9	9.0	2.5	39.0	0.0	6.8	31.7	28.3
Apr 27 97	Kushiyara river at the confluence of 3- vent regulator	0900 hrs	11.0	0.0	10.4	6.6	2.1	20.0	0.0	6.9	26.7	28.3
"	Monu river at up of	1040 hrs	34.0	0.0	9.9	12.0	2.3	44.0	0.0	6.8	28.9	28.3
"	Monumukh Monu river at up of barrage	1330 hrs	33.0	0.0	9.7	6.4	1.2	36.0	0.0	7.2	36.7	28.9
"	Reservoir	1430 hrs	37.0	0.1	7.2	6.8	1.7	38.0	0.0	7.3	36.7	29.4
Month- May 97												
May 13 97	Patashingra beel	1130 hrs	10.0	0.1	8.2	5.8	2.0	6.0	0.0	7.2	36.7	30.6
"	Akali canal	1330 hrs	8.0	0.0	8.8	8.4	3.2	9.0	0.0	6.8	37.2	32.8
May 14 97	Koradair canal(behind 3- vent regulator)	1240 hrs	8.0	0.0	6.4	8.5	2.6	8.0	0.0	6.9	34.4	32.8
May 17 97	Kushiyara river (in front of	0935 hrs	15.0	0.1	6.6	8.3	2.8	11.0	0.1	6.9	32.2	31.1

Table G.14: Water Quality Data for Year 3 (1997)

Date	Location	Time	Alkalinity (mg/l)	NH_3 (mg/l)	DO (mg/l)	CO_2 (mg/l)	Cl (mg/l)	Hardness (mg/l)	NO_2 (mg/l)	pH	Temp (°C) Air	Temp (°C) Water
	3- vent regulator)											
▪	Monu river at up of Monumukh	1105 hrs	18.0	0.1	8.1	8.0	2.3	15.0	0.0	6.8	34.4	31.7
▪	Monu river at up of barrage	1400 hrs	17.0	0.0	9.5	6.0	1.3	12.0	0.0	7.0	35.6	32.8
▪	Reservoir at the initial point of irrigation canal of MRP	1430 hrs	37.0	0.1	7.2	6.8	1.7	38.0	0.0	7.3	36.7	29.4
Month- June 97												
Jun 18 97	Patashingra beel	0900 hrs	9.0	0.1	8.5	6.0	2.1	7.0	0.0	7.5	31.1	27.8
▪	Akali canal	1030 hrs	8.0	0.0	9.0	8.0	3.0	10.0	0.0	7.0	32.2	28.3
▪	Koradair canal at the junction of fishpass & 3 vent chanel	1240 hrs	8.0	0.0	8.8	8.4	2.5	9.0	0.0	7.0	32.2	28.9
Jun 22 97	Kushiyara river at up of 3 -vent regulator	0900 hrs	13.0	0.0	6.8	8.1	2.6	10.0	0.0	6.9	31.1	30.0
▪	Monu river at up of Monumukh	1120 hrs	10.0	0.1	5.6	8.0	2.4	11.0	0.0	6.8	33.3	31.1
Month- July 97												
Jul 17 97	Patashingra beel	0900 hrs	10.0	0.0	8.2	6.2	2.3	8.0	0.0	7.3	30.6	27.8
▪	Akali canal	1100 hrs	9.0	0.0	8.5	7.6	2.7	10.0	0.0	7.0	32.2	28.9
▪	Koradair canal at the confluence of fishpass and 3- vent	1250 hrs	8.0	0.0	8.6	8.2	2.6	10.0	0.0	7.2	32.2	29.4

Table G.14: Water Quality Data for Year 3 (1997)

Date	Location	Time	Alkalinity (mg/l)	NH_3 (mg/l)	DO (mg/l)	CO_2 (mg/l)	Cl (mg/l)	Hardness (mg/l)	NO_2 (mg/l)	pH	Temp (°C) Air	Temp (°C) Water
	chanel											
Jul 22 97	Kushiyara river at up of 3- vent regulator	0900 hrs	11.0	0.0	5.8	8.1	2.3	10.0	0.0	7.0	30.0	27.8
"	Monu river at up of Monumukh	1130	11.0	0.0	5.8	8.1	2.3	10.0	0.0	7.0	32.2	28.9
Month- August 97												
Aug 03 97	Kushiyara river at Rashidpur	1115 hrs	17.0	0.1	6.5	10.0	0.6	19.0	0.0	6.8	32.2	30.6

Table G.15: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1995

				Fishpass						
Year 1995	WL	WL	Head Diff.	Discharge	Inflow	Cum.	Initial		Final	
	C/S	R/S			Volume	Volume	Storage	Area	Storage	Area
	(m PWD)	(m PWD)	(meter)	(m^3/sec)	((ha-m)	(ha-m)	(ha-m)	(ha)	(ha-m)	(ha)
01-May-95	3.51	3.35				0	645	1,048	645	1,048
02-May-95	3.49	3.33				0	624	1,025	624	1,025
03-May-95	3.50	3.35				0	633	1,033	633	1,033
04-May-95	3.51	3.38				0	645	1,048	645	1,048
05-May-95	3.52	3.41				0	657	1,062	657	1,062
06-May-95	3.91	3.91				0	1,190	1,638	1,190	1,638
07-May-95	3.95	3.95				0	1,254	1,698	1,254	1,698
08-May-95	4.02	4.10				0	1,373	1,811	1,373	1,811
09-May-95	4.16	4.18				0	1,655	2,079	1,655	2,079
10-May-95	4.19	4.20				0	1,715	2,137	1,715	2,137
11-May-95	4.20	4.22				0	1,735	2,156	1,735	2,156
12-May-95	4.32	4.33				0	2,009	2,371	2,009	2,371
13-May-95	4.32	4.32				0	2,009	2,371	2,009	2,371
14-May-95	4.32	4.30				0	2,009	2,371	2,009	2,371
15-May-95	4.31	4.21				0	1,984	2,354	1,984	2,354
16-May-95	4.34	4.13				0	2,058	2,405	2,058	2,405
17-May-95	4.43	4.19				0	2,280	2,559	2,280	2,559
18-May-95	4.78	4.78				0	3,273	3,151	3,273	3,151
19-May-95	5.03	6.86	1.83	0.56	4.87	5	4,134	3,732	4,139	3,735
20-May-95	5.15	7.49	2.34	0.90	7.80	13	4,606	3,993	4,619	3,997
21-May-95	5.24	7.48	2.24	0.88	7.63	20	4,961	4,188	4,981	4,192
22-May-95	5.26	7.53	2.27	0.91	7.86	28	5,045	4,231	5,073	4,234
23-May-95	5.31	7.54	2.23	0.91	7.84	36	5,269	4,338	5,305	4,342
24-May-95	5.36	7.37	2.01	0.80	6.91	43	5,493	4,445	5,536	4,448
25-May-95	5.36	7.27	1.91	0.74	6.41	49	5,493	4,445	5,542	4,448
26-May-95	5.38	7.16	1.78	0.68	5.85	55	5,582	4,488	5,638	4,491
27-May-95	5.46	6.86	1.40	0.51	4.38	60	5,941	4,659	6,000	4,662
28-May-95	5.46	6.66	1.20	0.41	3.53	63	5,941	4,659	6,004	4,661
29-May-95	5.47	6.55	1.08	0.36	3.07	66	5,985	4,681	6,051	4,682
30-May-95	5.47	6.36	0.89	0.27	2.35	68	5,985	4,681	6,054	4,682
31-May-95	5.50	6.24	0.74	0.22	1.89	70	6,120	4,745	6,190	4,746
01-Jun-95	5.50	6.06	0.56	0.15	1.30	72	6,120	4,745	6,191	4,746
02-Jun-95	5.52	5.96	0.44	0.11	0.98	73	6,219	4,780	6,292	4,781
03-Jun-95	5.54	5.96	0.42	0.11	0.97	74	6,318	4,816	6,392	4,816
04-Jun-95	5.56	6.04	0.48	0.14	1.18	75	6,418	4,851	6,492	4,851
05-Jun-95	5.57	6.12	0.55	0.16	1.42	76	6,467	4,868	6,543	4,869
06-Jun-95	5.60	6.13	0.53	0.16	1.42	78	6,616	4,921	6,694	4,922
07-Jun-95	5.60	6.04	0.44	0.13	1.14	79	6,616	4,921	6,695	4,922
08-Jun-95	5.64	6.02	0.38	0.12	1.04	80	6,815	4,992	6,895	4,992
09-Jun-95	5.65	6.03	0.38	0.12	1.06	81	6,864	5,009	6,945	5,010
10-Jun-95	5.63	6.20	0.57	0.19	1.62	83	6,765	4,974	6,848	4,975
11-Jun-95	5.63	6.32	0.69	0.23	2.03	85	6,765	4,974	6,850	4,975
12-Jun-95	5.64	6.66	1.02	0.38	3.31	88	6,815	4,992	6,903	4,993
13-Jun-95	5.66	6.56	0.90	0.33	2.88	91	6,914	5,027	7,005	5,028
14-Jun-95	5.74	6.84	1.10	0.45	3.92	95	7,311	5,168	7,406	5,169
15-Jun-95	5.86	7.10	1.24	0.57	4.89	100	7,957	5,387	8,056	5,389
16-Jun-95	5.90	7.28	1.38	0.66	5.66	105	8,173	5,461	8,278	5,463
17-Jun-95	6.61	7.87	1.26	0.84	7.23	112	12,583	7,002	12,695	7,005
18-Jun-95	7.05	8.42	1.37	1.06	9.18	122	15,962	8,474	16,084	8,478

Table G.15: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1995

Year 1995	WL C/S (m PWD)	WL R/S (m PWD)	Head Diff. (meter)	Fishpass Discharge (m^3/sec)	Fishpass Inflow Volume ((ha-m)	Fishpass Cum. Volume (ha-m)	Initial Storage (ha-m)	Initial Area (ha)	Final Storage (ha-m)	Final Area (ha)
19-Jun-95	7.30	8.76	1.46	1.22	10.50	132	18,206	9,479	18,338	9,484
20-Jun-95	7.50	9.02	1.52	1.33	11.51	144	20,169	10,377	20,313	10,382
21-Jun-95	7.57	9.12	1.55	1.38	11.93	156	20,935	10,689	21,090	10,694
22-Jun-95	7.66	9.14	1.48	1.36	11.77	167	21,919	11,091	22,086	11,096
23-Jun-95	7.71	9.08	1.37	1.30	11.23	179	22,466	11,314	22,644	11,319
24-Jun-95	7.73	9.04	1.31	1.26	10.91	189	22,685	11,404	22,874	11,408
25-Jun-95	7.75	9.00	1.25	1.22	10.58	200	22,903	11,493	23,103	11,498
26-Jun-95	7.78	8.94	1.16	1.17	10.10	210	23,268	11,651	23,478	11,655
27-Jun-95	7.76	8.88	1.12	1.13	9.79	220	23,025	11,546	23,245	11,550
28-Jun-95	7.77	8.77	1.00	1.05	9.05	229	23,146	11,598	23,375	11,602
29-Jun-95	7.75	8.77	1.02	1.06	9.12	238	22,903	11,493	23,141	11,497
30-Jun-95	7.75	8.77	1.02	1.06	9.12	247	22,903	11,493	23,150	11,497
01-Jul-95	7.76	8.78	1.02	1.06	9.15	256	23,025	11,546	23,281	11,550
02-Jul-95	7.75	8.76	1.01	1.05	9.06	265	22,903	11,493	23,169	11,497
03-Jul-95	7.73	8.73	1.00	1.03	8.94	274	22,685	11,404	22,959	11,408
04-Jul-95	7.78	8.78	1.00	1.05	9.08	283	23,268	11,651	23,551	11,655
05-Jul-95	7.99	8.96	0.97	1.09	9.45	293	25,819	12,754	26,112	12,759
06-Jul-95	8.05	9.06	1.01	1.14	9.88	303	26,611	13,045	26,914	13,049
07-Jul-95	8.08	9.08	1.00	1.15	9.90	313	27,013	13,189	27,326	13,192
08-Jul-95	8.09	9.08	0.99	1.14	9.86	323	27,147	13,236	27,470	13,240
09-Jul-95	8.10	9.06	0.96	1.12	9.68	332	27,281	13,284	27,613	13,288
10-Jul-95	8.14	9.05	0.91	1.09	9.45	342	27,817	13,475	28,159	13,478
11-Jul-95	8.17	9.04	0.87	1.07	9.26	351	28,219	13,618	28,570	13,621
12-Jul-95	8.21	9.04	0.83	1.05	9.09	360	28,755	13,809	29,115	13,812
13-Jul-95	8.22	9.00	0.78	1.01	8.76	369	28,889	13,856	29,258	13,860
14-Jul-95	8.22	8.96	0.74	0.98	8.48	377	28,889	13,856	29,267	13,860
15-Jul-95	8.23	8.94	0.71	0.96	8.30	386	29,023	13,904	29,409	13,907
16-Jul-95	8.23	8.90	0.67	0.93	8.01	394	29,023	13,904	29,417	13,907
17-Jul-95	8.24	8.88	0.64	0.91	7.82	401	29,158	13,952	29,559	13,955
18-Jul-95	8.23	8.85	0.62	0.89	7.66	409	29,023	13,904	29,433	13,907
19-Jul-95	8.26	8.78	0.52	0.81	6.99	416	29,438	14,052	29,854	14,054
20-Jul-95	8.28	8.78	0.50	0.80	6.88	423	29,731	14,156	30,154	14,158
21-Jul-95	8.28	8.83	0.55	0.84	7.25	430	29,731	14,156	30,161	14,158
22-Jul-95	8.30	8.83	0.53	0.83	7.15	437	30,024	14,260	30,461	14,262
23-Jul-95	8.28	8.75	0.47	0.77	6.65	444	29,731	14,156	30,175	14,158
24-Jul-95	8.27	8.66	0.39	0.69	6.00	450	29,585	14,104	30,035	14,106
25-Jul-95	8.25	8.56	0.31	0.61	5.31	455	29,292	14,000	29,747	14,001
26-Jul-95	8.24	8.53	0.29	0.59	5.12	460	29,158	13,952	29,618	13,954
27-Jul-95	8.26	8.52	0.26	0.57	4.88	465	29,438	14,052	29,903	14,053
28-Jul-95	8.26	8.47	0.21	0.51	4.41	470	29,438	14,052	29,908	14,053
29-Jul-95	8.28	8.47	0.19	0.49	4.24	474	29,731	14,156	30,205	14,157
30-Jul-95	8.28	8.43	0.15	0.44	3.80	478	29,731	14,156	30,209	14,157
31-Jul-95	8.28	8.40	0.12	0.40	3.44	481	29,731	14,156	30,212	14,157
01-Aug-95	8.28	8.39	0.11	0.38	3.31	484	29,731	14,156	30,216	14,157
02-Aug-95	8.30	8.52	0.22	0.53	4.57	489	30,024	14,260	30,513	14,261
03-Aug-95	8.30	8.55	0.25	0.56	4.85	494	30,024	14,260	30,518	14,262
04-Aug-95	8.30	8.53	0.23	0.54	4.66	499	30,024	14,260	30,523	14,261
05-Aug-95	8.31	8.47	0.16	0.46	3.95	503	30,171	14,312	30,673	14,313
06-Aug-95	8.40	8.48	0.08	0.35	3.01	506	31,489	14,780	31,995	14,781

Table G.15: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1995

Year 1995	WL C/S (m PWD)	WL R/S (m PWD)	Head Diff. (meter)	Fishpass Discharge (m^3/sec)	Fishpass Inflow Volume ((ha-m)	Fishpass Cum. Volume (ha-m)	Initial Storage (ha-m)	Initial Area (ha)	Final Storage (ha-m)	Final Area (ha)
07-Aug-95	8.44	8.45	0.01	0.15	1.30	507	32,075	14,988	32,582	14,989
08-Aug-95	8.55	8.39	-0.16	0.81		507	33,756	15,593	34,262	15,593
09-Aug-95	8.56	8.36	-0.20	0.87		507	33,916	15,651	34,423	15,651
10-Aug-95	8.57	8.34	-0.23	0.92		507	34,076	15,710	34,583	15,710
11-Aug-95	8.57	8.32	-0.25	0.95		507	34,076	15,710	34,583	15,710
12-Aug-95	8.56	8.27	-0.29	1.01		507	33,916	15,651	34,423	15,651
13-Aug-95	8.63	8.42	-0.21	0.92		507	35,038	16,060	35,545	16,060
14-Aug-95	8.75	8.82	0.07	0.37	3.17	510	36,962	16,761	37,472	16,762
15-Aug-95	8.85	9.00	0.15	0.52	4.53	515	38,713	17,363	39,228	17,365
16-Aug-95	8.85	9.11	0.26	0.67	5.82	520	38,713	17,363	39,234	17,365
17-Aug-95	8.86	9.14	0.28	0.70	6.05	526	38,888	17,424	39,415	17,426
18-Aug-95	8.88	9.18	0.30	0.73	6.28	533	39,239	17,544	39,771	17,546
19-Aug-95	8.90	9.29	0.39	0.83	7.19	540	39,589	17,664	40,129	17,667
20-Aug-95	8.96	9.32	0.36	0.81	7.01	547	40,640	18,026	41,187	18,028
21-Aug-95	9.00	9.36	0.36	0.82	7.09	554	41,340	18,266	41,894	18,268
22-Aug-95	9.00	9.33	0.33	0.79	6.79	561	41,340	18,266	41,901	18,268
23-Aug-95	8.99	9.30	0.31	0.76	6.57	567	41,165	18,206	41,732	18,208
24-Aug-95	9.03	9.30	0.27	0.72	6.22	574	41,903	18,387	42,477	18,389
25-Aug-95	9.08	9.26	0.18	0.61	5.23	579	42,842	18,589	43,421	18,590
26-Aug-95	9.08	9.28	0.20	0.64	5.49	584	42,842	18,589	43,426	18,590
27-Aug-95	9.06	9.26	0.20	0.63	5.46	590	42,467	18,508	43,056	18,509
28-Aug-95	9.05	9.20	0.15	0.55	4.79	595	42,279	18,468	42,873	18,469
29-Aug-95	9.04	9.18	0.14	0.54	4.63	599	42,091	18,428	42,690	18,429
30-Aug-95	9.03	9.16	0.13	0.52	4.47	604	41,903	18,387	42,507	18,388
31-Aug-95	9.02	9.12	0.10	0.46	3.98	608	41,716	18,347	42,323	18,348
01-Sep-95	9.02	9.12	0.10	0.46	3.98	612	41,716	18,347	42,327	18,348
02-Sep-95	9.03	9.10	0.07	0.40	3.44	615	41,903	18,387	42,518	18,388
03-Sep-95	9.05	9.14	0.09	0.44	3.84	619	42,279	18,468	42,898	18,469
04-Sep-95	9.05	9.13	0.08	0.42	3.65	623	42,279	18,468	42,901	18,469
05-Sep-95	9.04	9.04	0.00			623	42,091	18,428	42,714	18,428

Table G.16: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1996

Year 1996	WL C/S (m PWD)	WL R/S (m PWD)	Head Diff. (meter)	Discharge (m^3/sec)	Fishpass Inflow Volume ((ha-m)	Cum. Volume ((ha-m)	Initial Storage (ha-m)	Area (ha)	Final Storage (ha-m)	Area (ha)
01-Mar-96	3.97	3.53				0	1,285	1,728	1,285	1,728
02-Mar-96	4.08	3.58				0	1,494	1,926	1,494	1,926
03-Mar-96	4.09	3.58				0	1,514	1,945	1,514	1,945
04-Mar-96	4.05	3.56				0	1,434	1,869	1,434	1,869
05-Mar-96	4.05	3.55				0	1,434	1,869	1,434	1,869
06-Mar-96	4.00	3.53				0	1,333	1,773	1,333	1,773
07-Mar-96	3.97	3.5				0	1,285	1,728	1,285	1,728
08-Mar-96	3.94	3.46				0	1,238	1,683	1,238	1,683
09-Mar-96	3.86	3.4				0	1,111	1,562	1,111	1,562
10-Mar-96	3.81	3.37				0	1,032	1,487	1,032	1,487
11-Mar-96	3.77	3.34				0	968	1,427	968	1,427
12-Mar-96	3.67	3.3				0	840	1,280	840	1,280
13-Mar-96	3.91	3.36				0	1,190	1,638	1,190	1,638
14-Mar-96	4.20	3.46				0	1,735	2,156	1,735	2,156
15-Mar-96	4.86	5.16				0	3,543	3,339	3,543	3,339
16-Mar-96	4.44	5.86	1.42	0.15	1.26	1	2,304	2,576	2,306	2,577
17-Mar-96	4.59	6.08	1.49	0.23	1.99	3	2,711	2,823	2,715	2,825
18-Mar-96	4.47	6.15	1.68	0.27	2.32	6	2,378	2,627	2,384	2,631
19-Mar-96	4.26	5.98	1.72	0.20	1.77	7	1,861	2,269	1,868	2,274
20-Mar-96	4.36	5.87	1.51	0.15	1.32	9	2,107	2,439	2,116	2,445
21-Mar-96	4.16	5.67	1.51	0.08	0.68	9	1,655	2,079	1,664	2,088
22-Mar-96	4.21	5.44				9	1,756	2,175	1,765	2,184
23-Mar-96	4.21	5.06				9	1,756	2,175	1,765	2,184
24-Mar-96	4.16	4.81				9	1,655	2,079	1,664	2,088
25-Mar-96	4.56	4.56				9	2,625	2,775	2,634	2,780
26-Mar-96	4.68	4.46				9	2,971	2,968	2,980	2,973
27-Mar-96	4.61	4.36				9	2,769	2,856	2,778	2,861
28-Mar-96	4.58	4.61				9	2,683	2,807	2,692	2,813
29-Mar-96	4.46	6.01	1.55	0.21	1.79	11	2,354	2,610	2,365	2,618
30-Mar-96	4.86	6.53	1.67	0.42	3.59	15	3,543	3,339	3,558	3,349
31-Mar-96	4.81	6.98	2.17	0.66	5.67	20	3,375	3,221	3,395	3,236
01-Apr-96	4.76	7.31	2.55	0.85	7.36	28	3,206	3,104	3,234	3,123
02-Apr-96	4.73	7.56	2.83	1.01	8.71	36	3,115	3,048	3,151	3,069
03-Apr-96	4.56	7.68	3.12	1.11	9.57	46	2,625	2,775	2,671	2,801
04-Apr-96	4.76	7.7	2.94	1.09	9.43	55	3,206	3,104	3,261	3,143
05-Apr-96	4.58	7.71	3.13	1.12	9.71	65	2,683	2,807	2,748	2,844
06-Apr-96	4.66	7.67	3.01	1.09	9.39	75	2,913	2,936	2,988	2,978
07-Apr-96	5.01	7.57	2.56	0.97	8.40	83	4,055	3,689	4,138	3,735
08-Apr-96	4.96	7.46	2.50	0.91	7.89	91	3,881	3,573	3,972	3,637
09-Apr-96	4.96	7.3	2.34	0.82	7.07	98	3,881	3,573	3,979	3,642
10-Apr-96	4.36	7.15	2.79	0.81	6.97	105	2,107	2,439	2,212	2,512
11-Apr-96	4.71	7.06	2.35	0.71	6.16	111	3,057	3,016	3,168	3,078
12-Apr-96	4.88	6.76	1.88	0.53	4.58	116	3,611	3,386	3,726	3,466
13-Apr-96	4.46	6.56	2.10	0.47	4.05	120	2,354	2,610	2,473	2,690
14-Apr-96	4.38	6.36	1.98	0.37	3.23	123	2,157	2,474	2,279	2,559
15-Apr-96	4.34	6.16	1.82	0.28	2.43	125	2,058	2,405	2,183	2,492
16-Apr-96	4.26	5.9	1.64	0.17	1.47	127	1,861	2,269	1,987	2,356
17-Apr-96	4.31	5.56	1.25	0.03	0.30	127	1,984	2,354	2,111	2,442
18-Apr-96	4.29	5.48	1.19	0.01	0.06	127	1,935	2,320	2,062	2,408

Table G.16: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1996

Year 1996	WL C/S (m PWD)	WL R/S (m PWD)	Head Diff. (meter)	Discharge (m^3/sec)	Fishpass Inflow Volume ((ha-m)	Cum. Volume ((ha-m)	Initial Storage (ha-m)	Area (ha)	Final Storage (ha-m)	Area (ha)
19-Apr-96	4.24	5.3				127	1,816	2,232	1,943	2,326
20-Apr-96	4.18	5.14				127	1,695	2,117	1,822	2,238
21-Apr-96	4.30	4.98				127	1,959	2,337	2,086	2,425
22-Apr-96	4.26	5.08				127	1,861	2,269	1,988	2,357
23-Apr-96	4.30	5.29				127	1,959	2,337	2,086	2,425
24-Apr-96	4.81	5.34				127	3,375	3,221	3,502	3,310
25-Apr-96	4.81	5.45				127	3,375	3,221	3,502	3,310
26-Apr-96	4.92	5.48	0.56	0.01	0.04	127	3,746	3,480	3,873	3,568
27-Apr-96	4.61	5.61	1.00	0.05	0.41	128	2,769	2,856	2,897	2,927
28-Apr-96	4.69	5.69	1.00	0.07	0.63	128	2,999	2,984	3,128	3,056
29-Apr-96	4.71	5.71	1.00	0.08	0.68	129	3,057	3,016	3,186	3,090
30-Apr-96	4.71	5.69	0.98	0.07	0.62	130	3,057	3,016	3,187	3,091
01-May-96	4.56	5.51	0.95	0.02	0.13	130	2,625	2,775	2,755	2,848
02-May-96	4.71	5.5	0.79	0.01	0.10	130	3,057	3,016	3,187	3,091
03-May-96	4.71	5.52	0.81	0.02	0.15	130	3,057	3,016	3,187	3,091
04-May-96	4.81	5.5	0.69	0.01	0.09	130	3,375	3,221	3,505	3,312
05-May-96	4.76	5.5	0.74	0.01	0.10	130	3,206	3,104	3,336	3,195
06-May-96	4.71	5.52	0.81	0.02	0.15	130	3,057	3,016	3,187	3,091
07-May-96	4.71	5.5	0.79	0.01	0.10	130	3,057	3,016	3,187	3,091
08-May-96	4.66	5.5	0.84	0.01	0.10	130	2,913	2,936	3,044	3,009
09-May-96	4.61	5.48	0.87	0.01	0.05	131	2,769	2,856	2,900	2,928
10-May-96	4.61	5.92	1.31	0.16	1.40	132	2,769	2,856	2,901	2,929
11-May-96	4.62	6.43	1.81	0.39	3.36	135	2,798	2,872	2,933	2,947
12-May-96	4.61	6.6	1.99	0.48	4.10	139	2,769	2,856	2,908	2,933
13-May-96	4.61	6.85	2.24	0.61	5.25	145	2,769	2,856	2,914	2,936
14-May-96	4.71	7.23	2.52	0.81	7.00	152	3,057	3,016	3,209	3,106
15-May-96	5.06	8.03	2.97	1.26	10.86	162	4,252	3,797	4,415	3,887
16-May-96	4.98	8.15	3.17	1.35	11.67	174	3,948	3,620	4,122	3,726
17-May-96	5.16	8.26	3.10	1.39	12.04	186	4,646	4,014	4,832	4,117
18-May-96	5.12	8.24	3.12	1.39	11.98	198	4,488	3,928	4,687	4,037
19-May-96	5.56	8.22	2.66	1.29	11.16	209	6,418	4,851	6,627	4,925
20-May-96	5.34	8.2	2.86	1.32	11.41	221	5,403	4,402	5,624	4,508
21-May-96	5.37	8.1	2.73	1.25	10.79	232	5,538	4,467	5,769	4,577
22-May-96	5.48	8.09	2.61	1.22	10.56	242	6,030	4,702	6,272	4,799
23-May-96	5.54	7.92	2.38	1.10	9.52	252	6,318	4,816	6,570	4,905
24-May-96	5.46	7.74	2.28	1.00	8.67	260	5,941	4,659	6,201	4,774
25-May-96	5.48	7.53	2.05	0.87	7.54	268	6,030	4,702	6,298	4,808
26-May-96	5.46	7.56	2.10	0.89	7.73	276	5,941	4,659	6,216	4,779
27-May-96	5.44	7.38	1.94	0.79	6.84	282	5,851	4,617	6,133	4,750
28-May-96	5.48	7.46	1.98	0.83	7.19	290	6,030	4,702	6,320	4,816
29-May-96	5.53	7.57	2.04	0.89	7.67	297	6,269	4,798	6,566	4,903
30-May-96	5.72	7.7	1.98	0.93	8.05	305	7,212	5,132	7,517	5,238
31-May-96	5.82	8.04	2.22	1.12	9.71	315	7,740	5,314	8,055	5,421
01-Jun-96	6.00	8.12	2.12	1.14	9.82	325	8,715	5,644	9,040	5,765
02-Jun-96	6.17	8.44	2.27	1.31	11.31	336	9,721	6,017	10,057	6,142
03-Jun-96	6.40	8.58	2.18	1.35	11.65	348	11,163	6,507	11,510	6,620
04-Jun-96	6.52	8.63	2.11	1.35	11.68	359	11,949	6,768	12,308	6,901
05-Jun-96	6.60	8.6	2.00	1.31	11.33	371	12,512	6,976	12,883	7,113
06-Jun-96	6.70	8.67	1.97	1.33	11.51	382	13,216	7,236	13,599	7,381

Table G.16: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1996

Year 1996	WL C/S (m PWD)	WL R/S (m PWD)	Head Diff. (meter)	Discharge (m^3/sec)	Fishpass Inflow Volume ((ha-m)	Cum. Volume ((ha-m)	Initial Storage (ha-m)	Area (ha)	Final Storage (ha-m)	Area (ha)
07-Jun-96	6.83	8.67	1.84	1.30	11.20	394	14,194	7,658	14,588	7,842
08-Jun-96	6.87	8.61	1.74	1.24	10.75	404	14,507	7,804	14,911	7,993
09-Jun-96	6.88	8.52	1.64	1.18	10.20	414	14,585	7,841	15,000	8,034
10-Jun-96	6.85	8.44	1.59	1.14	9.81	424	14,351	7,731	14,775	7,929
11-Jun-96	6.80	8.34	1.54	1.08	9.36	434	13,959	7,549	14,393	7,751
12-Jun-96	6.76	8.24	1.48	1.03	8.89	443	13,647	7,403	14,089	7,609
13-Jun-96	6.78	8.08	1.30	0.92	7.96	450	13,803	7,476	14,253	7,686
14-Jun-96	6.77	7.98	1.21	0.86	7.44	458	13,725	7,440	14,183	7,653
15-Jun-96	6.74	7.88	1.14	0.81	6.97	465	13,498	7,341	13,963	7,551
16-Jun-96	6.68	7.8	1.12	0.77	6.70	472	13,075	7,184	13,547	7,359
17-Jun-96	6.65	7.7	1.05	0.72	6.25	478	12,864	7,106	13,342	7,283
18-Jun-96	6.66	7.61	0.95	0.67	5.76	484	12,935	7,132	13,418	7,311
19-Jun-96	6.69	7.52	0.83	0.61	5.23	489	13,146	7,210	13,635	7,397
20-Jun-96	6.68	7.61	0.93	0.66	5.71	495	13,075	7,184	13,570	7,367
21-Jun-96	6.70	7.54	0.84	0.61	5.30	500	13,216	7,236	13,716	7,435
22-Jun-96	6.70	7.48	0.78	0.58	5.00	505	13,216	7,236	13,721	7,438
23-Jun-96	6.74	7.5	0.76	0.58	5.00	510	13,498	7,341	14,008	7,571
24-Jun-96	6.79	7.55	0.76	0.59	5.12	515	13,881	7,512	14,396	7,753
25-Jun-96	6.82	7.56	0.74	0.59	5.09	520	14,116	7,622	14,636	7,864
26-Jun-96	6.84	7.53	0.69	0.56	4.88	525	14,272	7,695	14,797	7,940
27-Jun-96	6.85	7.51	0.66	0.55	4.75	530	14,351	7,731	14,880	7,978
28-Jun-96	6.85	7.44	0.59	0.51	4.38	534	14,351	7,731	14,885	7,980
29-Jun-96	6.86	7.41	0.55	0.49	4.20	538	14,429	7,768	14,967	8,019
30-Jun-96	6.89	7.39	0.50	0.46	4.00	542	14,663	7,877	15,206	8,130
01-Jul-96	7.06	7.43	0.37	0.42	3.62	546	16,050	8,513	16,596	8,756
02-Jul-96	7.35	8.03	0.68	0.70	6.02	552	18,697	9,703	19,249	9,956
03-Jul-96	7.61	8.51	0.90	0.93	8.00	560	21,372	10,868	21,932	11,097
04-Jul-96	7.81	8.85	1.04	1.09	9.42	569	23,632	11,808	24,202	12,055
05-Jul-96	7.99	8.98	0.99	1.11	9.59	579	25,819	12,754	26,398	12,970
06-Jul-96	8.10	9.02	0.92	1.09	9.41	588	27,281	13,284	27,869	13,493
07-Jul-96	8.13	9.03	0.90	1.08	9.36	598	27,683	13,427	28,281	13,640
08-Jul-96	8.15	9.02	0.87	1.07	9.21	607	27,951	13,523	28,558	13,739
09-Jul-96	8.15	9.01	0.86	1.06	9.14	616	27,951	13,523	28,567	13,742
10-Jul-96	8.15	9	0.85	1.05	9.07	625	27,951	13,523	28,576	13,745
11-Jul-96	8.15	9.02	0.87	1.07	9.21	634	27,951	13,523	28,586	13,748
12-Jul-96	8.15	9.02	0.87	1.07	9.21	643	27,951	13,523	28,595	13,752
13-Jul-96	8.14	9	0.86	1.05	9.11	653	27,817	13,475	28,470	13,707
14-Jul-96	8.12	8.96	0.84	1.03	8.93	662	27,549	13,379	28,211	13,615
15-Jul-96	8.16	8.96	0.80	1.01	8.75	670	28,085	13,570	28,756	13,809
16-Jul-96	8.18	8.98	0.80	1.02	8.80	679	28,353	13,666	29,032	13,907
17-Jul-96	8.22	8.95	0.73	0.97	8.41	688	28,889	13,856	29,577	14,101
18-Jul-96	8.20	8.94	0.74	0.98	8.44	696	28,621	13,761	29,317	14,009
19-Jul-96	8.20	8.93	0.73	0.97	8.37	704	28,621	13,761	29,326	14,012
20-Jul-96	8.22	8.95	0.73	0.97	8.41	713	28,889	13,856	29,602	14,110
21-Jul-96	8.23	8.95	0.72	0.97	8.37	721	29,023	13,904	29,745	14,161
22-Jul-96	8.22	8.93	0.71	0.96	8.27	729	28,889	13,856	29,619	14,116
23-Jul-96	8.22	8.92	0.70	0.95	8.20	738	28,889	13,856	29,627	14,119
24-Jul-96	8.22	8.91	0.69	0.94	8.13	746	28,889	13,856	29,635	14,122
25-Jul-96	8.22	8.91	0.69	0.94	8.13	754	28,889	13,856	29,643	14,125

Table G.16: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1996

Year 1996	WL C/S (m PWD)	WL R/S (m PWD)	Head Diff. (meter)	Discharge (m^3/sec)	Fishpass Inflow Volume ((ha-m)	Cum. Volume ((ha-m)	Initial Storage (ha-m)	Area (ha)	Final Storage (ha-m)	Area (ha)
26-Jul-96	8.23	8.98	0.75	0.99	8.58	762	29,023	13,904	29,786	14,175
27-Jul-96	8.22	8.88	0.66	0.92	7.92	770	28,889	13,856	29,660	14,130
28-Jul-96	8.21	8.79	0.58	0.85	7.32	778	28,755	13,809	29,533	14,085
29-Jul-96	8.21	8.73	0.52	0.80	6.88	785	28,755	13,809	29,540	14,088
30-Jul-96	8.21	8.69	0.48	0.76	6.58	791	28,755	13,809	29,547	14,090
31-Jul-96	8.23	8.78	0.55	0.83	7.15	798	29,023	13,904	29,822	14,188
01-Aug-96	8.23	8.78	0.55	0.83	7.15	805	29,023	13,904	29,829	14,191
02-Aug-96	8.25	8.74	0.49	0.78	6.74	812	29,292	14,000	30,104	14,288
03-Aug-96	8.27	8.72	0.45	0.75	6.48	819	29,585	14,104	30,403	14,395
04-Aug-96	8.29	8.62	0.33	0.64	5.55	824	29,878	14,208	30,702	14,501
05-Aug-96	8.38	8.62	0.24	0.57	4.88	829	31,196	14,676	32,025	14,971
06-Aug-96	8.39	8.63	0.24	0.57	4.90	834	31,343	14,728	32,177	15,024
07-Aug-96	8.38	8.6	0.22	0.54	4.69	839	31,196	14,676	32,035	14,974
08-Aug-96	8.36	8.49	0.13	0.42	3.66	842	30,903	14,572	31,745	14,871
09-Aug-96	8.35	8.42	0.07	0.32	2.79	845	30,757	14,520	31,602	14,820
10-Aug-96	8.34	8.38	0.04	0.26	2.20	847	30,610	14,468	31,457	14,769
11-Aug-96	8.31	8.3	-0.01	0.55		847	30,171	14,312	31,018	14,613
12-Aug-96	8.31	8.35	0.04	0.25	2.18	849	30,171	14,312	31,020	14,614
13-Aug-96	8.31	8.4	0.09	0.36	3.07	853	30,171	14,312	31,023	14,615
14-Aug-96	8.31	8.46	0.15	0.44	3.84	856	30,171	14,312	31,027	14,616
15-Aug-96	8.31	8.49	0.18	0.48	4.17	861	30,171	14,312	31,031	14,618
16-Aug-96	8.32	8.52	0.20	0.51	4.40	865	30,317	14,364	31,182	14,671
17-Aug-96	8.34	8.6	0.26	0.58	5.01	870	30,610	14,468	31,480	14,777
18-Aug-96	8.44	8.7	0.26	0.60	5.17	875	32,075	14,988	32,950	15,299
19-Aug-96	8.47	8.75	0.28	0.63	5.41	881	32,515	15,145	33,395	15,461
20-Aug-96	8.48	8.79	0.31	0.66	5.70	886	32,661	15,197	33,547	15,517
21-Aug-96	8.51	8.82	0.31	0.67	5.75	892	33,114	15,359	34,006	15,684
22-Aug-96	8.52	8.87	0.35	0.71	6.13	898	33,275	15,418	34,173	15,745
23-Aug-96	8.51	8.87	0.36	0.72	6.20	904	33,114	15,359	34,019	15,689
24-Aug-96	8.49	8.87	0.38	0.73	6.33	911	32,808	15,249	33,718	15,579
25-Aug-96	8.48	8.87	0.39	0.74	6.40	917	32,661	15,197	33,578	15,528
26-Aug-96	8.46	8.85	0.39	0.74	6.36	923	32,368	15,093	33,291	15,424
27-Aug-96	8.45	8.81	0.36	0.70	6.09	929	32,222	15,040	33,151	15,373
28-Aug-96	8.43	8.77	0.34	0.68	5.88	935	31,929	14,936	32,864	15,269
29-Aug-96	8.43	8.73	0.30	0.64	5.52	941	31,929	14,936	32,869	15,271
30-Aug-96	8.48	8.73	0.25	0.59	5.14	946	32,661	15,197	33,607	15,539
31-Aug-96	8.49	8.69	0.20	0.54	4.64	951	32,808	15,249	33,758	15,594
01-Sep-96	8.48	8.66	0.18	0.51	4.41	955	32,661	15,197	33,616	15,542
02-Sep-96	8.46	8.65	0.19	0.52	4.49	960	32,368	15,093	33,328	15,437
03-Sep-96	8.44	8.63	0.19	0.52	4.46	964	32,075	14,988	33,039	15,332
04-Sep-96	8.43	8.62	0.19	0.51	4.45	968	31,929	14,936	32,897	15,280
05-Sep-96	8.43	8.57	0.14	0.45	3.87	972	31,929	14,936	32,901	15,282
06-Sep-96	8.42	8.56	0.14	0.45	3.86	976	31,782	14,884	32,758	15,231
07-Sep-96	8.45	8.57	0.12	0.42	3.64	980	32,222	15,040	33,201	15,391
08-Sep-96	8.45	8.57	0.12	0.42	3.64	983	32,222	15,040	33,205	15,392
09-Sep-96	8.44	8.5	0.06	0.31	2.70	986	32,075	14,988	33,061	15,340

Table G.17: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1997

Year 1997	WL C/S (m PWD)	WL R/S (m PWD)	Fishpass Head Diff. (meter)	Fishpass Discharge (m^3/sec)	Fishpass Inflow Volume (ha-m)	Fishpass Cum. Volume (ha-m)	Initial Storage (ha-m)	Initial Area (ha)	Final Storage (ha-m)	Final Area (ha)
01-Mar-97	2.77	3.04				-	118	325	118	325
02-Mar-97	2.75	3.04				-	109	300	109	300
03-Mar-97	2.72	3.05				-	103	281	103	281
04-Mar-97	2.72	3.04				-	103	281	103	281
05-Mar-97	2.71	3.04				-	100	274	100	274
06-Mar-97	2.71	3.04				-	100	274	100	274
07-Mar-97	2.70	3.04				-	98	268	98	268
08-Mar-97	2.70	3.05				-	98	268	98	268
09-Mar-97	2.67	3.04				-	92	249	92	249
10-Mar-97	2.68	3.04				-	94	255	94	255
11-Mar-97	2.71	3.04				-	100	274	100	274
12-Mar-97	2.70	3.04				-	98	268	98	268
13-Mar-97	2.70	3.04				-	98	268	98	268
14-Mar-97	2.70	3.04				-	98	268	98	268
15-Mar-97	2.84	3.04				-	150	412	150	412
16-Mar-97	3.12	3.05				-	309	710	309	710
17-Mar-97	3.43	3.04				-	568	973	568	973
18-Mar-97	3.69	3.06				-	864	1,310	864	1,310
19-Mar-97	3.86	3.29				-	1,111	1,562	1,111	1,562
20-Mar-97	3.98	3.68				-	1,301	1,743	1,301	1,743
21-Mar-97	4.08	3.91				-	1,494	1,926	1,494	1,926
22-Mar-97	4.17	4.22				-	1,675	2,098	1,675	2,098
23-Mar-97	4.23	5.01				-	1,796	2,213	1,796	2,213
24-Mar-97	4.28	5.54	1.26	0.03	0.24	0	1,910	2,303	1,910	2,303
25-Mar-97	4.30	5.65	1.35	0.07	0.59	1	1,959	2,337	1,960	2,337
26-Mar-97	4.33	5.51	1.18	0.02	0.15	1	2,033	2,388	2,034	2,389
27-Mar-97	4.34	5.24				1	2,058	2,405	2,059	2,406
28-Mar-97	4.35	5.04				1	2,083	2,422	2,084	2,423
29-Mar-97	4.36	4.81				1	2,107	2,439	2,108	2,440
30-Mar-97	4.37	4.58				1	2,132	2,457	2,133	2,457
31-Mar-97	4.38	4.40				1	2,157	2,474	2,157	2,474
01-Apr-97	4.36	4.21				1	2,107	2,439	2,108	2,440
02-Apr-97	4.34	4.05				1	2,058	2,405	2,059	2,406
03-Apr-97	4.33	4.20				1	2,033	2,388	2,034	2,389
04-Apr-97	4.33	4.17				1	2,033	2,388	2,034	2,389
05-Apr-97	4.34	4.21				1	2,058	2,405	2,059	2,406
06-Apr-97	4.33	4.23				1	2,033	2,388	2,034	2,389
07-Apr-97	4.31	4.13				1	1,984	2,354	1,985	2,355
08-Apr-97	4.28	4.16				1	1,910	2,303	1,911	2,303
09-Apr-97	4.27	4.12				1	1,885	2,286	1,886	2,286
10-Apr-97	4.24	4.09				1	1,816	2,232	1,817	2,233
11-Apr-97	4.23	4.08				1	1,796	2,213	1,797	2,214
12-Apr-97	4.27	4.23				1	1,885	2,286	1,886	2,286
13-Apr-97	4.26	4.07				1	1,861	2,269	1,862	2,269
14-Apr-97	4.26	4.15				1	1,861	2,269	1,862	2,269
15-Apr-97	4.26	4.08				1	1,861	2,269	1,862	2,269
16-Apr-97	4.25	4.07				1	1,836	2,251	1,837	2,252

Table G.17: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1997

				Fishpass						
Year 1997	WL	WL	Head Diff.	Discharge	Inflow	Cum.	Initial		Final	
	C/S	R/S			Volume	Volume	Storage	Area	Storage	Area
	(m PWD)	(m PWD)	(meter)	(m^3/sec)	(ha-m)	(ha-m_)	(ha-m)	(ha)	(ha-m)	(ha)
17-Apr-97	4.26	4.05				1	1,861	2,269	1,862	2,269
18-Apr-97	4.25	4.03				1	1,836	2,251	1,837	2,252
19-Apr-97	4.25	4.01				1	1,836	2,251	1,837	2,252
20-Apr-97	4.24	4.00				1	1,816	2,232	1,817	2,233
21-Apr-97	4.23	3.99				1	1,796	2,213	1,797	2,214
22-Apr-97	4.24	3.97				1	1,816	2,232	1,817	2,233
23-Apr-97	4.24	3.96				1	1,816	2,232	1,817	2,233
24-Apr-97	4.24	3.95				1	1,816	2,232	1,817	2,233
25-Apr-97	4.16	3.84				1	1,655	2,079	1,656	2,080
26-Apr-97	4.09	3.74				1	1,514	1,945	1,515	1,946
27-Apr-97	4.01	3.67				1	1,353	1,792	1,354	1,793
28-Apr-97	3.93	3.60				1	1,222	1,668	1,223	1,669
29-Apr-97	3.82	3.54				1	1,048	1,502	1,049	1,503
30-Apr-97	3.74	3.47				1	925	1,382	926	1,383
01-May-97	3.65	3.40				1	815	1,251	816	1,253
02-May-97	3.58	3.34				1	730	1,150	731	1,151
03-May-97	3.51	3.31				1	645	1,048	646	1,049
04-May-97	3.43	3.36				1	568	973	569	973
05-May-97	3.65	3.63				1	815	1,251	816	1,253
06-May-97	3.68	3.61				1	852	1,295	853	1,296
07-May-97	3.69	3.61				1	864	1,310	865	1,311
08-May-97	3.75	3.68				1	937	1,397	938	1,398
09-May-97	3.88	3.80				1	1,143	1,592	1,144	1,593
10-May-97	4.08	3.94				1	1,494	1,926	1,495	1,927
11-May-97	4.30	4.12				1	1,959	2,337	1,960	2,338
12-May-97	4.56	4.76				1	2,625	2,775	2,626	2,776
13-May-97	4.68	4.81				1	2,971	2,968	2,972	2,969
14-May-97	4.72	4.83				1	3,086	3,032	3,087	3,033
15-May-97	4.76	4.84				1	3,206	3,104	3,207	3,105
16-May-97	4.82	4.85				1	3,408	3,245	3,409	3,246
17-May-97	4.85	4.87				1	3,510	3,315	3,511	3,316
18-May-97	4.87	4.88				1	3,577	3,362	3,578	3,363
19-May-97	4.65	4.88				1	2,884	2,920	2,885	2,920
20-May-97	4.66	4.88				1	2,913	2,936	2,914	2,936
21-May-97	4.70	5.56	0.86	0.03	0.26	1	3,028	3,000	3,029	3,001
22-May-97	5.06	6.57	1.51	0.41	3.58	5	4,252	3,797	4,257	3,800
23-May-97	5.19	6.70	1.51	0.46	4.00	9	4,764	4,079	4,773	4,084
24-May-97	5.23	6.80	1.57	0.51	4.39	13	4,922	4,166	4,935	4,173
25-May-97	5.29	6.86	1.57	0.53	4.59	18	5,179	4,295	5,197	4,304
26-May-97	5.28	6.87	1.59	0.54	4.64	22	5,135	4,274	5,157	4,284
27-May-97	5.33	6.84	1.51	0.52	4.45	27	5,359	4,381	5,385	4,394
28-May-97	5.32	6.80	1.48	0.50	4.29	31	5,314	4,359	5,345	4,374
29-May-97	5.33	6.80	1.47	0.49	4.27	35	5,359	4,381	5,394	4,398
30-May-97	5.35	6.81	1.46	0.50	4.29	40	5,448	4,424	5,488	4,443
31-May-97	5.36	6.79	1.43	0.49	4.20	44	5,493	4,445	5,537	4,466
01-Jun-97	5.36	6.79	1.43	0.49	4.20	48	5,493	4,445	5,541	4,468
02-Jun-97	5.46	7.23	1.77	0.70	6.08	54	5,941	4,659	5,995	4,685

Table G.17: Impacted Area Analysis for MRIP under Existing Conditions (with pump), 1997

Year 1997	WL C/S (m PWD)	WL R/S (m PWD)	Head Diff. (meter)	Fishpass Discharge (m^3/sec)	Fishpass Inflow Volume (ha-m)	Fishpass Cum. Volume (ha-m)	Initial Storage (ha-m)	Initial Area (ha)	Final Storage (ha-m)	Final Area (ha)
03-Jun-97	5.70	7.53	1.83	0.83	7.21	61	7,113	5,097	7,174	5,119
04-Jun-97	5.92	7.60	1.68	0.83	7.20	69	8,281	5,498	8,350	5,521
05-Jun-97	5.98	7.61	1.63	0.83	7.15	76	8,606	5,608	8,682	5,633
06-Jun-97	6.10	7.66	1.56	0.83	7.19	83	9,307	5,864	9,389	5,895
07-Jun-97	6.11	7.79	1.68	0.91	7.84	91	9,366	5,886	9,457	5,919
08-Jun-97	6.10	7.86	1.76	0.95	8.23	99	9,307	5,864	9,406	5,901
09-Jun-97	6.45	7.84	1.39	0.86	7.42	106	11,485	6,611	11,592	6,646
10-Jun-97	6.58	7.76	1.18	0.78	6.72	113	12,371	6,924	12,484	6,966
11-Jun-97	6.59	7.75	1.16	0.77	6.64	120	12,442	6,950	12,561	6,994
12-Jun-97	6.72	7.69	0.97	0.70	6.02	126	13,357	7,288	13,483	7,335
13-Jun-97	6.82	7.68	0.86	0.66	5.71	132	14,116	7,622	14,247	7,683
14-Jun-97	6.86	7.66	0.80	0.64	5.50	137	14,429	7,768	14,566	7,832
15-Jun-97	6.84	7.61	0.77	0.61	5.30	142	14,272	7,695	14,415	7,761
16-Jun-97	6.83	7.61	0.78	0.62	5.32	148	14,194	7,658	14,342	7,727
17-Jun-97	6.84	7.61	0.77	0.61	5.30	153	14,272	7,695	14,425	7,766
18-Jun-97	6.85	7.62	0.77	0.62	5.32	158	14,351	7,731	14,509	7,805
19-Jun-97	6.87	7.68	0.81	0.65	5.58	164	14,507	7,804	14,671	7,881
20-Jun-97	6.88	7.66	0.78	0.63	5.45	169	14,585	7,841	14,755	7,920
21-Jun-97	6.91	7.86	0.95	0.74	6.43	176	14,820	7,950	14,996	8,032
22-Jun-97	6.98	7.97	0.99	0.79	6.84	183	15,367	8,206	15,550	8,290
23-Jun-97	6.99	8.08	1.09	0.86	7.42	190	15,446	8,242	15,636	8,328
24-Jun-97	7.01	8.34	1.33	1.02	8.83	199	15,612	8,318	15,810	8,406
25-Jun-97	7.01	8.34	1.33	1.02	8.83	208	15,612	8,318	15,819	8,410
26-Jun-97	7.01	8.34	1.33	1.02	8.83	216	15,612	8,318	15,828	8,414
27-Jun-97	7.04	8.38	1.34	1.04	8.98	225	15,875	8,435	16,100	8,535
28-Jun-97	7.06	8.34	1.28	1.01	8.69	234	16,050	8,513	16,284	8,617
29-Jun-97	7.07	8.28	1.21	0.96	8.32	242	16,138	8,552	16,380	8,660
30-Jun-97	7.10	8.29	1.19	0.96	8.30	251	16,401	8,669	16,651	8,781
01-Jul-97	7.20	8.29	1.09	0.93	8.01	259	17,277	9,059	17,536	9,174
02-Jul-97	7.26	8.24	0.98	0.87	7.54	266	17,814	9,299	18,080	9,421
03-Jul-97	7.29	8.18	0.89	0.82	7.10	273	18,108	9,434	18,382	9,559
04-Jul-97	7.31	8.12	0.81	0.77	6.69	280	18,305	9,524	18,585	9,652
05-Jul-97	7.35	8.09	0.74	0.74	6.38	286	18,697	9,703	18,984	9,834
06-Jul-97	7.36	8.08	0.72	0.73	6.28	293	18,795	9,748	19,088	9,882
07-Jul-97	7.36	8.05	0.69	0.71	6.11	299	18,795	9,748	19,094	9,885
08-Jul-97	7.40	8.04	0.64	0.68	5.90	305	19,188	9,928	19,493	10,067
09-Jul-97	7.43	8.04	0.61	0.67	5.79	311	19,482	10,063	19,793	10,205
10-Jul-97	7.45	8.04	0.59	0.66	5.71	316	19,679	10,152	19,995	10,297
11-Jul-97	7.52	8.16	0.64	0.71	6.18	322	20,388	10,466	20,711	10,598
12-Jul-97	7.86	8.92	1.06	1.12	9.68	332	24,240	12,071	24,572	12,215
13-Jul-97	7.94	9.09	1.15	1.21	10.50	343	25,212	12,492	25,554	12,640
14-Jul-97	8.01	9.15	1.14	1.23	10.63	353	26,075	12,855	26,428	12,980
15-Jul-97	8.08	9.21	1.13	1.25	10.77	364	27,013	13,189	27,377	13,318
16-Jul-97	8.09	9.22	1.13	1.25	10.80	375	27,147	13,236	27,522	13,370
17-Jul-97	8.09	9.22	1.13	1.25	10.80	386	27,147	13,236	27,533	13,374
18-Jul-97	8.09	9.22	1.13	1.25	10.80	396	27,147	13,236	27,543	13,377
19-Jul-97	8.08	9.20	1.12	1.24	10.70	407	27,013	13,189	27,420	13,333

Table G.18: Flood Routing Analysis for MRIP under Normal Conditions (without pump), 1996

Year	2							Project WL		Area Submerged	
				Project		Fishpass		Without	With	Without	With
Date	Rainfall	Evaporation	Infiltration	Inflow	Outflow	Inflow	River WL	Fishpass	Fishpass	Fishpass	Fishpass
	(mm)	(mm)	(mm)	(m^3/sec)	(m^3/sec)	(m^3/sec)	(m PWD)	(m PWD)		(ha)	(ha)
01-Mar-96	0	4.06	2.00	-1.79	0.00		3.53	4.10	4.1	1,964	1,964
02-Mar-96	0	4.06	2.00	-1.79	0.00		3.58	4.09	4.09	1,945	1,945
03-Mar-96	0	4.06	2.00	-1.79	0.00		3.58	4.08	4.08	1,926	1,926
04-Mar-96	0	4.57	2.00	-1.90	0.00		3.56	4.08	4.08	1,926	1,926
05-Mar-96	0	5.08	2.00	-2.02	0.00		3.55	4.07	4.07	1,907	1,907
06-Mar-96	0	4.57	2.00	-1.90	0.00		3.53	4.06	4.06	1,888	1,888
07-Mar-96	0	4.57	2.00	-1.90	0.00		3.50	4.05	4.05	1,869	1,869
08-Mar-96	0	4.06	2.00	-1.79	0.00		3.46	4.04	4.04	1,850	1,850
09-Mar-96	0	4.57	2.00	-1.90	0.00		3.40	4.04	4.04	1,850	1,850
10-Mar-96	3	3.56	2.00	-1.05	0.00		3.37	4.03	4.03	1,830	1,830
11-Mar-96	1	3.56	2.00	-1.54	0.00		3.34	4.02	4.02	1,811	1,811
12-Mar-96	87	3.56	2.00	16.35	0.23		3.30	4.17	4.17	2,098	2,098
13-Mar-96	2	5.03	2.00	-1.63	0.19		3.36	4.16	4.16	2,079	2,079
14-Mar-96	0	5.97	2.00	-2.35	0.14		3.46	4.15	4.15	2,060	2,060
15-Mar-96	0	5.59	2.00	-2.24	0.00		5.16	4.14	4.14	2,041	2,041
16-Mar-96	0	5.08	2.00	-2.10	0.00	0.16	5.86	4.13	4.13	2,022	2,023
17-Mar-96	0	6.10	2.00	-2.32	0.00	0.26	6.08	4.12	4.12	2,003	2,006
18-Mar-96	0	5.08	2.00	-2.06	0.00	0.29	6.15	4.11	4.11	1,984	1,989
19-Mar-96	0	5.08	2.00	-2.04	0.00	0.21	5.98	4.10	4.1	1,964	1,972
20-Mar-96	0	5.59	2.00	-2.14	0.00	0.16	5.87	4.10	4.1	1,964	1,973
21-Mar-96	0	5.08	2.00	-2.01	0.00	0.08	5.67	4.09	4.09	1,945	1,955
22-Mar-96	2	5.08	2.00	-1.65	0.00		5.44	4.08	4.08	1,926	1,936
23-Mar-96	1	4.94	2.00	-1.75	0.00		5.06	4.07	4.07	1,907	1,917
24-Mar-96	3	5.41	2.00	-1.37	0.00		4.81	4.07	4.07	1,907	1,917
25-Mar-96	0	5.08	2.00	-1.95	0.00		4.56	4.06	4.06	1,888	1,897
26-Mar-96	14	5.59	2.00	0.79	0.00		4.46	4.06	4.06	1,888	1,897
27-Mar-96	6	3.02	2.00	-0.37	0.00		4.36	4.06	4.06	1,888	1,897
28-Mar-96	9	4.06	2.00	0.07	0.00		4.61	4.06	4.06	1,888	1,897
29-Mar-96	51	4.12	2.00	8.38	0.00	0.23	6.01	4.10	4.11	1,964	1,976
30-Mar-96	47	2.76	2.00	8.24	0.00	0.48	6.53	4.13	4.14	2,022	2,037
31-Mar-96	16	5.34	2.00	12.35	0.00	0.73	6.98	4.18	4.19	2,117	2,139
01-Apr-96	0	3.56	2.00	-1.81	0.00	0.92	7.31	4.18	4.2	2,117	2,146
02-Apr-96	0	4.57	2.00	-2.04	0.00	1.08	7.56	4.17	4.19	2,098	2,136
03-Apr-96	0	4.57	2.00	-2.03	0.00	1.16	7.68	4.16	4.18	2,079	2,127
04-Apr-96	0	5.08	2.00	-2.14	0.00	1.18	7.70	4.15	4.18	2,060	2,117
05-Apr-96	1	4.05	2.00	-1.73	0.00	1.18	7.71	4.14	4.17	2,041	2,108
06-Apr-96	0	3.56	2.00	-1.74	0.00	1.16	7.67	4.13	4.17	2,022	2,098
07-Apr-96	1	5.51	2.00	-1.98	0.00	1.09	7.57	4.13	4.17	2,022	2,107
08-Apr-96	3	5.08	2.00	-1.44	0.00	1.03	7.46	4.12	4.17	2,003	2,096
09-Apr-96	0	5.08	2.00	-2.06	0.00	0.93	7.30	4.11	4.16	1,984	2,085
10-Apr-96	0	5.59	2.00	-2.16	0.00	0.84	7.15	4.10	4.16	1,964	2,073
11-Apr-96	0	5.59	2.00	-2.14	0.00	0.78	7.06	4.09	4.15	1,945	2,060
12-Apr-96	0	5.59	2.00	-2.12	0.00	0.61	6.76	4.08	4.14	1,926	2,046
13-Apr-96	0	5.08	2.00	-1.99	0.00	0.50	6.56	4.08	4.14	1,926	2,050
14-Apr-96	0	4.57	2.00	-1.86	0.00	0.40	6.36	4.07	4.14	1,907	2,034
15-Apr-96	0	4.06	2.00	-1.73	0.00	0.30	6.16	4.06	4.13	1,888	2,017
16-Apr-96	0	4.06	2.00	-1.72	0.00	0.18	5.90	4.05	4.12	1,869	2,000

Table G.18: Flood Routing Analysis for MRIP under Normal Conditions (without pump), 1996

Year	2							Project WL		Area Submerged	
				Project		Fishpass		Without	With	Without	With
Date	Rainfall	Evaporation	Infiltration	Inflow	Outflow	Inflow	River WL	Fishpass	Fishpass	Fishpass	Fishpass
	(mm)	(mm)	(mm)	(m^3/sec)	(m^3/sec)	(m^3/sec)	(m PWD)	(m PWD)		(ha)	(ha)
03-Jun-96	22	3.00	2.00	37.05	0.00	1.49	8.58	5.77	5.84	5,222	5,352
04-Jun-96	15	3.66	2.00	17.32	0.00	1.52	8.63	5.79	5.86	5,259	5,393
05-Jun-96	29	1.97	2.00	58.66	0.00	1.48	8.60	5.89	5.97	5,442	5,582
06-Jun-96	13	2.38	2.00	16.65	0.00	1.52	8.67	5.91	5.99	5,479	5,623
07-Jun-96	18	3.05	2.00	25.85	0.00	1.51	8.67	5.96	6.04	5,571	5,726
08-Jun-96	7	3.46	2.00	-0.78	0.00	1.47	8.61	5.95	6.03	5,553	5,711
09-Jun-96	0	4.57	2.00	-5.19	0.00	1.41	8.52	5.95	6.03	5,553	5,715
10-Jun-96	0	4.54	2.00	-5.35	0.00	1.36	8.44	5.94	6.03	5,534	5,699
11-Jun-96	1	5.59	2.00	-5.62	0.00	1.30	8.34	5.93	6.02	5,516	5,683
12-Jun-96	1	1.94	2.00	-3.27	0.00	1.23	8.24	5.92	6.01	5,498	5,667
13-Jun-96	0	4.00	2.00	-4.97	0.00	1.13	8.08	5.92	6.01	5,498	5,671
14-Jun-96	0	6.10	2.00	-6.29	0.00	1.07	7.98	5.91	6	5,479	5,654
15-Jun-96	0	5.59	2.00	-5.95	0.00	1.01	7.88	5.90	6	5,461	5,638
16-Jun-96	10	5.59	2.00	-0.01	0.00	0.96	7.80	5.90	6	5,461	5,641
17-Jun-96	2	5.59	2.00	-4.78	0.00	0.90	7.70	5.89	5.99	5,442	5,625
18-Jun-96	7	4.57	2.00	-1.46	0.00	0.85	7.61	5.89	5.99	5,442	5,628
19-Jun-96	14	4.92	2.00	2.32	0.00	0.79	7.52	5.89	5.99	5,442	5,630
20-Jun-96	19	7.56	2.00	3.90	0.00	0.84	7.61	5.90	6	5,461	5,651
21-Jun-96	28	5.00	2.00	10.49	0.00	0.80	7.54	5.91	6.01	5,479	5,674
22-Jun-96	15	1.87	2.00	4.85	0.00	0.76	7.48	5.92	6.02	5,498	5,696
23-Jun-96	20	1.40	2.00	15.04	0.00	0.77	7.50	5.94	6.04	5,534	5,739
24-Jun-96	26	3.40	2.00	46.98	0.00	0.78	7.55	6.02	6.12	5,688	5,906
25-Jun-96	30	3.00	2.00	58.32	0.00	0.77	7.56	6.10	6.2	5,864	6,084
26-Jun-96	4	2.94	2.00	-2.32	0.00	0.76	7.53	6.10	6.2	5,864	6,086
27-Jun-96	1	5.08	2.00	-5.41	0.00	0.75	7.51	6.09	6.19	5,842	6,067
28-Jun-96	4	4.06	2.00	-3.06	0.00	0.71	7.44	6.09	6.19	5,842	6,069
29-Jun-96	16	4.03	2.00	4.32	0.00	0.69	7.41	6.09	6.19	5,842	6,071
30-Jun-96	27	3.24	2.00	43.58	0.00	0.66	7.39	6.16	6.26	5,996	6,223
01-Jul-96	92	3.00	0.00	227.31	0.00	0.61	7.43	6.47	6.56	6,653	6,877
02-Jul-96	116	3.00	0.00	287.75	0.00	0.88	8.03	6.82	6.9	7,622	7,919
03-Jul-96	68	3.00	0.00	166.03	0.00	1.14	8.51	7.00	7.07	8,279	8,567
04-Jul-96	47	3.07	0.00	111.37	0.00	1.34	8.85	7.11	7.19	8,708	9,001
05-Jul-96	32	3.03	0.00	74.03	0.00	1.41	8.98	7.18	7.26	8,981	9,281
06-Jul-96	15	3.97	0.00	27.13	0.00	1.43	9.02	7.21	7.28	9,098	9,406
07-Jul-96	26	4.56	0.00	53.56	0.00	1.42	9.03	7.26	7.33	9,299	9,617
08-Jul-96	15	4.02	0.00	26.15	0.00	1.41	9.02	7.28	7.35	9,389	9,713
09-Jul-96	4	3.05	0.00	1.63	0.00	1.40	9.01	7.29	7.36	9,434	9,763
10-Jul-96	5	3.02	0.00	5.12	0.00	1.39	9.00	7.29	7.36	9,434	9,769
11-Jul-96	1	2.94	0.00	-2.55	0.00	1.40	9.02	7.29	7.37	9,434	9,774
12-Jul-96	9	2.00	0.00	13.42	0.00	1.40	9.02	7.30	7.38	9,479	9,825
13-Jul-96	0	2.03	0.00	-1.90	0.00	1.39	9.00	7.30	7.38	9,479	9,830
14-Jul-96	25	2.00	0.00	54.46	0.00	1.34	8.96	7.35	7.43	9,703	10,060
15-Jul-96	27	2.39	0.00	62.22	0.00	1.32	8.96	7.40	7.48	9,928	10,290
16-Jul-96	12	3.27	0.00	20.60	0.00	1.33	8.98	7.42	7.5	10,018	10,384
17-Jul-96	7	3.00	0.00	8.59	0.00	1.31	8.95	7.43	7.51	10,063	10,429
18-Jul-96	3	3.00	0.00	-0.32	0.00	1.30	8.94	7.43	7.51	10,063	10,433
19-Jul-96	21	4.57	0.00	40.33	0.00	1.28	8.93	7.46	7.54	10,197	10,558

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Table G.18: Flood Routing Analysis for MRIP under Normal Conditions (without pump), 1996

Year	2							Project WL		Area Submerged	
				Project		Fishpass		Without	With	Without	With
Date	Rainfall	Evaporation	Infiltration	Inflow	Outflow	Inflow	River WL	Fishpass	Fishpass	Fishpass	Fishpass
	(mm)	(mm)	(mm)	(m^3/sec)	(m^3/sec)	(m^3/sec)	(m PWD)	(m PWD)		(ha)	(ha)
20-Jul-96	1	2.33	0.00	-1.68	0.00	1.30	8.95	7.46	7.54	10,197	10,562
21-Jul-96	11	2.38	0.00	19.97	0.00	1.29	8.95	7.48	7.56	10,287	10,647
22-Jul-96	8	5.49	0.00	4.99	0.00	1.27	8.93	7.48	7.56	10,287	10,652
23-Jul-96	7	2.38	0.00	11.18	0.00	1.26	8.92	7.49	7.57	10,332	10,696
24-Jul-96	0	3.44	0.00	-4.12	0.00	1.26	8.91	7.49	7.57	10,332	10,701
25-Jul-96	4	3.58	0.00	-0.30	0.00	1.26	8.91	7.49	7.57	10,332	10,705
26-Jul-96	2	5.22	0.00	-4.43	0.00	1.31	8.98	7.48	7.57	10,287	10,670
27-Jul-96	4	3.95	0.00	-0.02	0.00	1.24	8.88	7.48	7.57	10,287	10,674
28-Jul-96	7	2.40	0.00	4.72	0.00	1.17	8.79	7.49	7.58	10,332	10,718
29-Jul-96	7	3.05	0.00	5.05	0.00	1.13	8.73	7.49	7.58	10,332	10,722
30-Jul-96	36	2.09	0.00	86.88	0.00	1.07	8.69	7.56	7.65	10,645	11,034
31-Jul-96	9	2.40	0.00	15.39	0.00	1.13	8.78	7.57	7.66	10,689	11,083
01-Aug-96	13	2.49	0.00	27.03	0.00	1.12	8.78	7.60	7.69	10,823	11,220
02-Aug-96	26	2.49	0.00	59.38	0.00	1.08	8.74	7.64	7.73	11,002	11,403
03-Aug-96	8	3.00	0.00	12.83	0.00	1.06	8.72	7.65	7.74	11,047	11,451
04-Aug-96	57	4.06	0.00	134.96	0.00	0.94	8.62	7.76	7.84	11,546	11,978
05-Aug-96	46	6.03	0.00	100.49	0.00	0.91	8.62	7.83	7.91	11,914	12,349
06-Aug-96	1	6.08	0.00	-6.72	0.00	0.92	8.63	7.83	7.91	11,914	12,352
07-Aug-96	0	4.57	0.00	-6.29	0.00	0.90	8.60	7.82	7.9	11,861	12,303
08-Aug-96	1	2.49	0.00	-2.17	0.00	0.82	8.49	7.82	7.9	11,861	12,306
09-Aug-96	2	6.05	0.00	-5.81	0.00	0.76	8.42	7.82	7.91	11,861	12,309
10-Aug-96	8	6.54	0.00	1.40	0.00	0.73	8.38	7.82	7.91	11,861	12,312
11-Aug-96	1	2.20	0.00	-2.18	0.00	0.68	8.30	7.81	7.9	11,808	12,262
12-Aug-96	1	2.54	0.00	-2.65	0.00	0.71	8.35	7.81	7.9	11,808	12,265
13-Aug-96	28	2.41	0.00	44.23	0.00	0.74	8.40	7.84	7.93	11,966	12,425
14-Aug-96	7	2.02	0.00	11.35	0.00	0.78	8.46	7.85	7.94	12,019	12,480
15-Aug-96	12	3.05	0.00	21.22	0.00	0.79	8.49	7.87	7.96	12,124	12,589
16-Aug-96	17	3.36	0.00	33.11	0.00	0.81	8.52	7.89	7.98	12,229	12,697
17-Aug-96	45	2.38	0.00	107.36	0.00	0.83	8.60	7.97	8.05	12,649	13,065
18-Aug-96	46	3.56	0.00	108.28	0.00	0.87	8.70	8.04	8.12	12,998	13,388
19-Aug-96	11	2.95	0.00	19.79	0.00	0.90	8.75	8.05	8.13	13,045	13,438
20-Aug-96	14	3.84	0.00	25.79	0.00	0.92	8.79	8.07	8.15	13,141	13,537
21-Aug-96	22	4.06	0.00	43.91	0.00	0.93	8.82	8.10	8.18	13,284	13,683
22-Aug-96	13	2.92	0.00	24.14	0.00	0.97	8.87	8.11	8.19	13,332	13,733
23-Aug-96	0	3.92	0.00	-6.06	0.00	0.97	8.87	8.11	8.19	13,332	13,736
24-Aug-96	0	3.05	0.00	-4.71	0.00	0.97	8.87	8.11	8.2	13,332	13,739
25-Aug-96	0	2.54	0.00	-3.91	0.00	0.97	8.87	8.10	8.19	13,284	13,695
26-Aug-96	0	4.06	0.00	-6.25	0.00	0.96	8.85	8.10	8.19	13,284	13,698
27-Aug-96	2	4.57	0.00	-4.23	0.00	0.92	8.81	8.10	8.19	13,284	13,700
28-Aug-96	3	6.57	0.00	-6.37	0.00	0.90	8.77	8.09	8.18	13,236	13,655
29-Aug-96	15	3.05	0.00	15.75	0.00	0.86	8.73	8.10	8.19	13,284	13,706
30-Aug-96	33	2.48	0.00	68.10	0.00	0.83	8.73	8.15	8.24	13,523	13,947
31-Aug-96	8	2.00	0.00	15.64	0.00	0.79	8.69	8.16	8.25	13,570	13,997
01-Sep-96	6	3.00	0.00	6.88	0.00	0.77	8.66	8.16	8.25	13,570	13,999
02-Sep-96	3	4.06	0.00	-1.63	0.00	0.76	8.65	8.16	8.25	13,570	14,002
03-Sep-96	0	3.76	0.00	-5.44	0.00	0.74	8.63	8.16	8.25	13,570	14,004
04-Sep-96	2	5.05	0.00	-5.07	0.00	0.74	8.62	8.15	8.24	13,523	13,959

Table G.18: Flood Routing Analysis for MRIP under Normal Conditions (without pump), 1996

Year	2							Project WL		Area Submerged	
				Project		Fishpass		Without	With	Without	With
Date	Rainfall	Evaporation	Infiltration	Inflow	Outflow	Inflow	River WL	Fishpass	Fishpass	Fishpass	Fishpass
	(mm)	(mm)	(mm)	(m^3/sec)	(m^3/sec)	(m^3/sec)	(m PWD)	(m PWD)		(ha)	(ha)
05-Sep-96	2	6.92	0.00	-8.00	0.00	0.70	8.57	8.15	8.24	13,523	13,961
06-Sep-96	19	2.78	0.00	25.22	0.00	0.68	8.56	8.16	8.25	13,570	14,010
07-Sep-96	26	4.54	0.00	52.78	0.00	0.66	8.57	8.20	8.29	13,761	14,203
08-Sep-96	1	2.94	0.00	-2.76	0.00	0.66	8.57	8.20	8.29	13,761	14,205
09-Sep-96	0	3.05	0.00	-4.85	0.00	0.60	8.50	8.19	8.28	13,713	14,159
10-Sep-96	0	4.57	0.00	-7.26	0.00	0.50	8.40	8.19	8.28	13,713	14,161
11-Sep-96	0	4.57	0.00	-7.25	0.00	0.44	8.34	8.18	8.27	13,666	14,114
12-Sep-96	1	4.00	0.00	-4.42	0.00	0.34	8.27	8.18	8.27	13,666	14,116
13-Sep-96	0	3.05	0.00	-4.83	5.49	0.51	8.17	8.18	8.27	13,666	14,114
14-Sep-96	0	4.57	0.00	-7.22	17.29	0.57	8.08	8.16	8.25	13,570	14,017
15-Sep-96	0	5.59	0.00	-8.78	22.81	0.62	8.00	8.14	8.23	13,475	13,920
16-Sep-96	0	5.08	0.00	-7.92	28.61	0.71	7.89	8.12	8.21	13,379	13,822
17-Sep-96	9	4.06	0.00	5.89	30.70	0.74	7.84	8.10	8.19	13,284	13,724
18-Sep-96	20	4.00	0.00	21.30	32.30	0.77	7.80	8.09	8.18	13,236	13,674
19-Sep-96	30	4.10	0.00	51.88	35.04	0.84	7.76	8.10	8.19	13,284	13,719
20-Sep-96	24	4.10	0.00	50.59	34.54	0.83	7.78	8.11	8.2	13,332	13,765
21-Sep-96	65	4.10	0.00	154.44	38.26	0.99	7.78	8.19	8.28	13,713	14,143
22-Sep-96	36	4.10	0.00	79.55	30.15	0.78	7.97	8.22	8.3	13,856	14,283
23-Sep-96	8	4.10	0.00	8.90	22.21	0.64	8.08	8.21	8.29	13,809	14,234
24-Sep-96	11	4.10	0.00	17.40	21.97	0.64	8.08	8.21	8.29	13,809	14,232
25-Sep-96	0	4.25	0.00	-6.79	22.86	0.64	8.05	8.19	8.28	13,713	14,135
26-Sep-96	5	3.05	0.00	1.89	24.45	0.67	8.01	8.18	8.27	13,666	14,085
27-Sep-96	1	2.70	0.00	-2.36	26.69	0.70	7.96	8.16	8.25	13,570	13,988
28-Sep-96	5	2.52	0.00	2.70	21.58	0.60	8.02	8.14	8.23	13,475	13,890
29-Sep-96	2	3.98	0.00	-2.91	23.09	0.63	7.98	8.13	8.22	13,427	13,841
30-Sep-96	0	2.54	0.00	-3.94	25.44	0.65	7.93	8.11	8.2	13,332	13,743
01-Oct-96	0	2.00	0.00	-3.08	23.03	0.60	7.95	8.09	8.18	13,236	13,646
02-Oct-96	0	3.00	0.00	-4.60	25.01	0.63	7.90	8.07	8.16	13,141	13,549
03-Oct-96	2	4.06	0.00	-3.42	29.60	0.69	7.81	8.05	8.14	13,045	13,451
04-Oct-96	6	3.76	0.00	2.55	31.75	0.73	7.75	8.03	8.11	12,950	13,353
05-Oct-96	46	5.05	0.00	89.64	32.15	0.76	7.78	8.07	8.15	13,141	13,542
06-Oct-96	49	6.92	0.00	105.65	22.34	0.61	7.99	8.12	8.2	13,379	13,779
07-Oct-96	6	2.78	0.00	7.50	15.99	0.55	8.05	8.12	8.2	13,379	13,777
08-Oct-96	0	4.54	0.00	-7.02	13.64	0.52	8.06	8.10	8.18	13,284	13,680
09-Oct-96	0	2.94	0.00	-4.53	20.19	0.58	7.98	8.09	8.17	13,236	13,630
10-Oct-96	0	3.05	0.00	-4.67	23.33	0.61	7.92	8.07	8.15	13,141	13,533
11-Oct-96	0	4.57	0.00	-6.95	26.85	0.65	7.85	8.05	8.13	13,045	13,436
12-Oct-96	0	4.57	0.00	-6.90	29.83	0.68	7.78	8.02	8.1	12,902	13,290
13-Oct-96	0	4.00	0.00	-5.98	34.81	0.78	7.66	8.00	8.08	12,807	13,193
14-Oct-96	0	3.05	0.00	-4.52	35.76	0.79	7.61	7.97	8.05	12,649	13,060
15-Oct-96	0	4.57	0.00	-6.69	41.63	0.94	7.45	7.94	8.03	12,492	12,928
16-Oct-96	0	5.59	0.00	-8.07	47.51	1.13	7.26	7.90	7.99	12,281	12,739
17-Oct-96	0	5.08	0.00	-7.21	50.58	1.21	7.13	7.85	7.94	12,019	12,472
18-Oct-96	0	4.06	0.00	-5.66	50.93	1.18	7.08	7.81	7.9	11,808	12,258
19-Oct-96	0	4.00	0.00	-5.48	51.94	1.18	7.01	7.77	7.85	11,598	12,043
20-Oct-96	0	4.10	0.00	-5.51	51.92	1.13	6.97	7.73	7.82	11,404	11,839
21-Oct-96	0	4.10	0.00	-5.41	51.30	1.08	6.94	7.69	7.78	11,225	11,646

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Table G.18: Flood Routing Analysis for MRIP under Normal Conditions (without pump), 1996

Year	2							Project WL		Area Submerged	
				Project		Fishpass		Without	With	Without	With
Date	Rainfall	Evaporation	Infiltration	Inflow	Outflow	Inflow	River WL	Fishpass	Fishpass	Fishpass	Fishpass
	(mm)	(mm)	(mm)	(m^3/sec)	(m^3/sec)	(m^3/sec)	(m PWD)	(m PWD)		(ha)	(ha)
22-Oct-96	0	4.10	0.00	-5.32	59.82	1.33	6.62	7.63	7.72	10,957	11,365
23-Oct-96	0	4.10	0.00	-5.21	60.65	1.28	6.54	7.58	7.67	10,734	11,137
24-Oct-96	0	4.10	0.00	-5.10	64.10	1.30	6.36	7.53	7.62	10,511	10,909
25-Oct-96	0	4.10	0.00	-4.98	66.53	1.21	6.21	7.47	7.56	10,242	10,651
26-Oct-96	0	4.25	0.00	-5.03	67.56	1.04	6.11	7.40	7.5	9,928	10,365
27-Oct-96	6	3.05	0.00	2.76	69.81	0.88	5.96	7.35	7.45	9,703	10,137
28-Oct-96	36	2.70	0.00	33.60	119.43	0.71	5.92	7.27	7.37	9,344	9,775
29-Oct-96	54	2.52	0.00	97.24	65.77	0.83	6.07	7.30	7.4	9,479	9,907
30-Oct-96	20	3.98	0.00	39.87	56.53	0.74	6.38	7.28	7.37	9,389	9,814

Appendix H

WATER BALANCE MODEL FOR MANU RIVER IRRIGATION PROJECT

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H.1 WATER BALANCE MODEL

H.1.1 Introduction

A mathematical model of the project water balance was developed to investigate the hydraulic operation of MRIP in quantitative detail. Although this model is set up specifically for MRIP, it could be applied to any non-submersible embankment type project with little or no modification.

The model incorporates inflow into the project area and outflow from the project area. The water balance model accounts for effects from rainfall, evaporation, the Manu barrage, the 3- and 6-vent regulators, upstream *chorras*, the Kashimpur pumphouse, infiltration, evaporation, and the fishpass (Table H.1). The model provides a comparative statement of various inflows and outflows.

The model represents a quantitative estimation. The database used for the water balance model includes:

- Water Level (R/S and C/S).
- Rainfall.
- Evaporation.
- Drainage through pump house.
- Manu barrage irrigation inflow.
- Fishpass inflow / outflow.
- Drainage regulator operating period.
- Project elevation-area-storage data.

Since rainfall and evaporation are available as daily data, the time step used for the model was 24 hours.

H.1.2 Manu River Irrigation Project Area

MRIP is located at the base of the Bhatera Hills. The project area is 243 km². Since the project receives runoff from the upper catchment (Bhatera Hills), the upper catchment area has a hydrological effect on MRIP and must be included in the total runoff area.

$$AREA = AP + AB$$

- AREA = Total runoff area.
- AP = Project area (243 km²).
- AB = Upper catchment area.

The elevation of MRIP area varies from 1 m PWD to 14 m PWD. The upper catchment area lies within the Bhatera Hills, and elevation varies up to 433 m PWD.

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H.2 NATURE AND ESTIMATION OF FLOWS

H.2.1 Types of Inflows

Inflows into the project area are as follows:

Manu Barrage Irrigation Canal: The two main irrigation intake canals from Manu barrage are Manumukh main canal and Rajnagar main canal. The normal pool level of the barrage is 12.03 m PWD. At this pool level, inflow through these two irrigation canals is 5.7 m^3/sec. Fifty percent of the irrigation water is stored in *beel*s. The water flows overland and through drainage channels.

Fishpass Structure: During the pre-monsoon and monsoon seasons, the direction of flow at the structure is from R/S to C/S. Measured flows from R/S to C/S vary up to 1.20 m^3/sec. Discharges have been measured at different head differences, and coefficients of discharge have been calculated for flows in both directions.

Rainfall: At present, there are three rain gauges operating near the MRIP area. These are at Moulvibazar (R-122), Chandbagh (R-104), and Langla (R-117). Daily rainfall was considered as the average of these three rainfall stations.

Leakage Through 3-vent Regulator: Successive discharges have been measured in front of the 3-vent regulator. They were measured for different head differences across the structure, and only when the gate was closed. The invert level of the structure is 1.41 m PWD and the soffit level is 3.23 m PWD. Since water level rarely falls below soffit level of the regulator, full flow discharges within the structure are either from R/S to C/S or C/S to R/S. From the discharge analysis, it is estimated that an equivalent area of 0.94 m^2 remains open when the gate is closed. During the pre-monsoon and monsoon period, significant leakage occurs through the 3-vent regulator.

Inflow from Upstream *Chhoras*: Runoff from the upper catchment area comes into the project through many *chhora*s, culverts, and pipes. To reduce waterlogging and keep lands near the upper catchment free from floods, many culverts and pipes are provided along Moulvibazar - Fenchuganj road. Inflow from *chhora*s may be caused by local rainfall or by rainfall in upper areas. The major upstream *chhora*s are: Akali Chhora, Binnojuri Chhora, Udna Chhora, Kuchimura Chhora, Khoiyajani Chhora, Haar Chhora, Dhamai Chhora, and Kalanou Chhora.

Other inflow systems are: 1) through inlet structures set in the project embankment, 2) over any submerged portion of the project embankment, and 3) through any public cuts or breaches in the project embankment.

H.2.2 Types of Outflows

Outflows from the project area are as follows:

Pump House: There are eight electrically driven pumps at the Kashimpur pumping station. Each pump has a discharge capacity of 4.25 m^3/sec. During the pre-monsoon season, pumps are operated to maintain *haor* water level at 4.12 m PWD. This protects *boro* crops from inundation. During the monsoon season, pumps remain in operation to protect b. *aman* from submergence. When water level in the *haor* reaches homestead level, all the pumps remain in operation.

Drainage Regulators: There are two main drainage sluices in the Kushiyara section of the project embankment. The 6-vent (1.83 m x 1.52 m) sluice has an invert level at 4.10 m PWD, and the 3-vent (1.83 m x 1.52 m) sluice has invert level at 1.40 m PWD. These drainage sluices allow gravity drainage of water from the project area when water levels in the Kushiyara River permit. Analytical discharge computation for drainage regulators are provided below.

Fishpass Structure: During the post-monsoon and dry seasons, the flow direction is from C/S to R/S. Flow from C/S to R/S varies up to 1.5 m^3/sec. Discharges have been measured at different head differences, and coefficients of discharge have been calculated for flows in both directions.

Evaporation: Since evaporation from an area varies less than rainfall, MRIP evaporation is reasonably represented by the Bangladesh pan data for Srimangal. For the most part, the record of this pan is acceptable. Any anomalous recordings, such as 33 mm/day, are ignored. In all such cases the daily evaporation is reduced to 8 mm/day, which is recognised by the BWDB as the maximum possible daily pan evaporation. There are also one or two days of missing data. The missing values are estimated by linear interpolation between the preceding and following day evaporation values.

Infiltration: The infiltration is assumed equal to be 2 mm/day. This value is typical of measurements taken in paddy lands that are similar to those of MRIP.

It is assumed that infiltration occurs only in conjunction with rainfall:

If rainfall $\geq$ 2 mm, then infiltration = 2 mm

◇ If rainfall $\leq$ 2 mm, then infiltration = rainfall

Infiltration occurs only during the pre-monsoon and dry seasons. Afterwards, the soil becomes saturated.

H.2.3 Topographic Data

The project area has been computed from the BWDB 1 : 15,840 scale map. Spot elevations are digitised. In locations where data are not given (*beels*), spot elevations are provided through field verification. A contour map with a grid of 0.25 km x 0.25 km was prepared using computer software (Figure B1). Storage has been computed from elevation-area data.

H.3 DISCHARGE COMPUTATION THROUGH DRAINAGE SLUICES

H.3.1 Types of Flow Through Sluices

Flow through a sluice may be classified into two general types, depending upon the existing headwater and tailwater levels. If the inlet and outlet are submerged, the sluice vent will flow full (like a pipe). If the inlet and outlet are not submerged, the vent will flow partially full and act as an open channel.

For practical purposes, the two general types can be broken down into six specific types of flow.

Type 1: Inlet and outlet submerged

The outlet is submerged by high tailwater. The vent will flow full with the control at the outlet. Discharge is a function of head differential between inlet and outlet water levels.

$$q = C_d D (2gh)^{1/2}$$

where C_d = Coefficient of discharge.
D = Height of vent.
g = Acceleration due to gravity (9.81 m/sec^2).
h = Head difference across the structure.

C_d is a function of inlet coefficient, exit coefficient, length of barrel, roughness coefficient, acceleration due to gravity, and hydraulic radius.

Type 2: Inlet submerged, outlet not submerged, vent hydraulically long

Although the tailwater level is below the vent soffit, the vent will flow full. The vent is sufficiently long for friction forces to cause the depth of flow to expand, filling the vent. This type is common in long culverts, but will not usually occur in sluices.

Type 3: Inlet submerged, outlet not submerged, vent hydraulically short

This is the same as type 2, except the vent will not flow full. This is the usual sluice condition: the headwater depth is greater than 1.5 times the vent height. The control is at the entrance and similar to orifice discharge.

$$q = C_q D (2gH)^{1/2}$$

where C_q = Coefficient of discharge.
D = Height of gate.
g = Acceleration due to gravity.
H = Inlet depth of water.

C_q is a function of height of the gate and depth of water.

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Type 4: Inlet not submerged, high tailwater

When the head water depth is less than 1.5 times the vent height, the entrance is not sealed by water. The sluice acts as a broadcrest weir. The tail water level is higher than the critical flow depth through the vent. This type is also associated with a drowned out hydraulic jump. The control is at the outlet.

$$q = C_1 d_1 (2gh)^{1/2}$$

where C_1 = Coefficient of discharge.
d_1 = depth of vent.
g = Acceleration due to gravity.
h = Head difference.

C_1 is a function of entrance co-efficient.

Type 5: Inlet not submerged, low tailwater

Type 5 is similar to type 4, except the tailwater depth is less than critical flow depth through the vent. This type will usually occur when a stilling pool or downstream drop is part of the structure, and the flow is made to pass through critical depth. A hydraulic jump usually occurs downstream. The control is at the outlet.

$$q = C_2 H^{3/2}$$

where C_2 = Discharge coefficient.
H = Inlet height of water.

C_2 is a function of entrance co-efficient.

Type 6: Inlet not submerged, low tailwater

This is the same as type 5, except the vent invert slope is greater than critical. Since sluices are usually designed with a flat invert, this type will not occur.

H.3.2 Table Computation

The water balance computation presented in Tables H.1 to H.7 for 1996 includes the following data and computations:

Column 1: Date.

Column 2 and 3: R/S water level and C/S water level.

Column 4: Area submerged at C/S water level. Area has been computed from elevation-area- storage data.

Column 5: Storage inside the project, computed from elevation-area- storage data.

Column 6: Daily change of storage.

Column 7, 8, and 9: Daily rainfall data at Moulvibazar, Langla, and Chandbagh.

Column 10: Average rainfall of Moulvibazar, Langla, and Chandbagh.

Column 11: Daily infiltration data (2.00 mm/day).

Column 12: Daily evaporation data.

Column 13: Inflow from rainfall.

runoff = Project area (ha) * average rainfall (m/day)

Column 14: Inflow through fishpass: The following formula has been used to compute discharge in m^3/sec.

$$Q = 8.64C_dA(2gh)^{1/2} \text{ (ha-m/day)}$$

C_d is the co-efficient of discharge calibrated from measured velocity and discharge data.

Column 15: Inflow through barrage. At full supply level, inflow through canal is 5.71 m^3/s.

$$Q = 5.71*8.64 \text{ (ha-m/day)}$$

50% of the inflow is considered as storage

Column 16: Leakage through 3-vent regulator. During gate closed condition leakage area is 0.94 m^2:

$$Q = C_d0.94(2gh)^{1/2} * 8.64 \text{ (ha-m/day)}$$

Column 17: Inflow from upstream chhoras.

upstream inflow = Change of storage - Inflow + outflow (ha-m/day)

Column 18: Outflow through pumphouse.

$$Q = 4.25*(\text{operating hour})*0.36 \text{ (ha-m/day)}$$

Columns 19 and 20: 3-vent and 6-vent regulator discharges are computed using formulae from the BWDB hydrological design manual.

Column 21: Outflow through fishpass. The following formulae have been used to compute discharge:

$$Q = C_1d_1(2gh)^{1/2} * 8.64 \text{ (ha-m/day) (Flow type 4)}$$

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$$Q = C_2H^{3/2} * 8.64 \text{ (ha-m/day)(Flow type 5)}$$

Coefficient of discharges have been computed from measured velocities and discharge data.

Column 22: Infiltration is considered up to July. For project submerged area, outflow through infiltration = area submerged * infiltration * 24.30 (ha-m/day).

For project dry area :

If rain ≥ 2.00 mm : Infiltration = 2.00 mm Outflow = Area dry * 24.30 * infiltration (ha-m/day)

If rain < 1.00 mm : Infiltration = rain (mm) Outflow = Area dry * rain * 24.30 (ha-m/day)

Total outflow through infiltration = outflow from submerged area + outflow from dry area.

Column 23: Outflow through evaporation

For submerged area: Outflow through evaporation (E_1),

$$E_1 = \text{Evaporation} * \text{Area submerged} / 1000 \text{(ha-m/day)}$$

For dry area: If Rain - Infiltration - Evaporation,

$$\text{Outflow, } E_2 = \text{Evaporation} * \text{Area dry} /1000 \text{(ha-m/day)}$$

If Rain - Infiltration < Evaporation,

$$\text{Outflow, } E_2 = (\text{Rain - Infiltration}) * \text{Area dry} / 1000 \text{(ha-m/day)}$$

$$\text{Total Evaporation} = E_1 + E_2$$

The MRIP total inflow and outflow for 1996 (March-September) is shown in Tables H.1 to H.7.

H.4 CONCLUSION AND RECOMMENDATION

H.4.1 Improvement of Model

There were several sources of uncertainty in the water balance model:

- The water balance model is based on a single reservoir system. However during the pre-monsoon and dry seasons, multiple reservoir systems exist. Any rainfall into the project area or inflow from the upper catchment into lower areas is stored in *beels*. There is therefore variation of water levels in the project from upper areas to lower area. During the monsoon season, two reservoirs are formed: Boro Kawadighi Haor and Chotto Kawadighi Haor. The same situation exists, but since there are only two waterbodies the deviation from the model is less severe.

- Recorded water levels at *haor* side are taken during both pump operating and non-operating periods. Water level fluctuated up to eight centimetres due to pump operation. Due to inter-flow system among reservoirs and pump operation, project still water level could not be measured.

- Topographic maps used for storage computation were prepared by BWDB in 1960. Present topography, especially at *beel* areas, has changed due to inflow from upstream *chhoras*. Developed elevation - storage data differ from actual storage data.

- No rainfall station is available inside the project area. Only data from three adjacent rainfall stations are used for computation. The average of the three rainfall data sets is used for rainfall inflow. The isohyetal map indicates wide variation of rainfall over the project area. Rainfall also varies with time at different locations. Evaporation is considered Srimangal pan evaporation data, which is 30 km from MRIP. Groundwater effect is not considered in the model.

To achieve more accurate results from the model, it is recommended to set water level gauges at different locations inside the project area. Data should be gathered from more rainfall stations so that the average can represent a more reliable value. Inflow from upstream areas should be monitored throughout the year to verify the model data. Data on topography of the *beel* area needs to be updated.

H.4.2 Impact of Fishpass Inflow

Rainfall impact: During the 1996 pre-monsoon season, the maximum measured inflow through the fishpass was 11 ha-m/day. This is much less than evaporation and infiltration losses. There is a decrease in water level if no rainfall occurs and no inflow comes from upstream. Water level will remain constant if the rainfall is 5 mm to 8 mm. Because of the inefficient drainage system, any rainfall above 30 mm during the pre-monsoon season causes an increase in water level in successive days. MRIP was designed to keep the water level in fishery areas under 4.11 m PWD. Area under 4.11 m PWD is 1983 ha, and storage is 1554 ha-m (Figure H.1). If the drainage system is improved and fishery areas remain under 4.11 m PWD, then occasional high rainfall runoff will be stored in the fisheries. This will cause little or no damage to low-lying irrigable area.

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Pumphouse effect: There are eight pumps, each having an outflow capacity of 36.72 ha-m/day. During the low water of the pre-monsoon season, two pumps are sufficient. The number of pumps can be increased with the increase in water level. Without considering evaporation and infiltration, if one pump remains in operation for four to six hours it can bail out the inflow from the fishpass. Inundation impacts are shown graphically in Figures H.2 to H.4.

Irrigation and groundwater impact: Manu River irrigation inflow starts in January and continues until the end of March. Irrigation inflow from the Manu River varies with the supply level, from 5 to 6 m^3/sec. Some seepage is observed into deeper *beels* and main drainage channels. Kushiyara River water level remains below *haor* water level during this period if flooding does not occur, allowing gravity drainage. Outflow through the 3-vent regulator is 2-3 m^3/sec.

There is a perception among farmers that crops can be damaged when the fishpass gate opens. To keep the gate open during the upcoming pre-monsoon season, it is suggested that some public meetings be held. These can give the farmers physical understanding of the field situation when the fishpass is in operation. Some water level gauges should be set in *beel* areas to verify fluctuation of water levels. To reduce the apprehension of farmers and mitigate the impact of rainfall, BWDB pumps should remain operating at full capacity. A rubber dam can be considered at the confluence of Mogra Channel and Akali Channel.

Table H.1: Water Balance Model for MRIP

Period : March 1996

Date	R/S WL	C/S WL	Area Submerged	Project Storage	Change of Storage	Rainfall: Maulvibazar	Rainfall: Langla	Rainfall: Chandbagh	Average Rainfall	Infiltration	Evaporation	Inflow into the Project through: Rainfall	Inflow: Fishpass	Inflow: Barrage	Inflow: 3 - Vent Regulator	Inflow: Upstream Chhoras	Outflow from the Project through: Pumphouse	Outflow: 3-vent Regulator	Outflow: 6-vent Regulator	Outflow: Fishpass	Outflow: Infiltration	Outflow: Evaporation
	(m PWD)	(m PWD)	(ha)	(ha-m)	(ha-m)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01-Mar-96	3.53	3.97	1727.91	1286.44	0.00	0	0	0	0	2	4.06	0.00		26.92	0.00	209.76		16.66			3.46	7.02
02-Mar-96	3.56	4.06	1926.14	1493.97	206.53	0	0	0	0	2	4.06	0.00		26.92	0.00	23.66		17.80			3.85	7.53
03-Mar-96	3.56	4.09	1946.26	1514.09	20.12	0	0	0	0	2	4.06	0.00		26.92	0.00	-76.64		17.97			3.89	7.91
04-Mar-96	3.56	4.06	1888.74	1433.60	-80.49	0	0	0	0	2	4.57	0.00		26.92	0.00	3.99		17.63			3.74	8.54
05-Mar-96	3.55	4.06	1888.74	1433.60	0.00	0	0	0	0	2	5.06	0.00		26.92	0.00	-96.50		17.80			3.74	9.49
06-Mar-96	3.53	4.00	1773.07	1332.99	-100.61	0	0	0	0	2	4.57	0.00		26.92	0.00	-44.62		17.19			3.56	8.11
07-Mar-96	3.50	3.97	1727.91	1286.44	-47.55	0	0	0	0	2	4.57	0.00		26.92	0.00	-44.92		17.19			3.46	7.90
08-Mar-96	3.46	3.94	1682.76	1237.89	-47.55	0	0	0	0	2	4.06	0.00		26.92	0.00	-128.06		17.46			3.37	6.64
09-Mar-96	3.40	3.86	1662.34	1111.10	-126.79	0	0	0	0	2	4.57	0.00		26.92	0.00	-77.87		17.02			3.12	7.14
10-Mar-96	3.37	3.81	1467.06	1031.86	-79.24	1	0	8	3	2	3.56	72.90		26.92	0.00	-91.86		16.66			48.60	5.29
11-Mar-96	3.34	3.77	1426.87	965.46	-63.40	0	2	0	1	2	3.56	16.20		26.92	0.00	-131.34		16.80			18.10	6.07
12-Mar-96	3.30	3.67	1260.44	839.56	-125.90	0	70	192	67	2	3.56	2122.20		26.92	0.00	-1647.03		16.29			48.60	94.41
13-Mar-96	3.36	3.91	1637.60	1190.35	350.79	7	0	0	2	2	5.03	56.70		26.92	0.00	537.97		16.66			48.60	8.24
14-Mar-96	3.46	4.20	2165.75	1736.44	546.09	0	0	0	0	2	5.97	0.00		26.92	0.00	263.39	16.66	21.60			4.31	12.57
15-Mar-96	5.16	4.30	2334.86	1959.30	223.86	0	0	0	0	2	5.59	0.00		26.92	13.74	376.21	82.02	0.00			4.67	13.06
16-Mar-96	5.56	4.44	2576.15	2304.42	345.12	0	0	0	0	2	5.06	0.00		26.92	29.96	507.11	137.70	0.00			5.15	13.09
17-Mar-96	6.06	4.59	2623.39	2711.49	407.07	0	0	0	0	2	6.10	0.00		26.92	30.67	-210.16	186.67	0.00			5.66	17.21
18-Mar-96	6.15	4.47	2627.46	2378.37	-333.12	0	0	0	0	2	5.06	0.00		26.92	32.57	-401.80	186.06	0.00			5.26	13.36
19-Mar-96	5.96	4.26	2286.51	1860.70	-517.67	0	0	0	0	2	5.06	0.00		26.92	32.92	-6.93	161.11	0.00			4.84	11.52
20-Mar-96	5.87	4.20	2165.75	1736.44	-125.26	0	0	0	0	2	5.59	0.00		26.92	30.84	5.69	129.59	0.00			4.31	12.06
21-Mar-96	5.67	4.16	2079.21	1654.95	-80.49	0	0	0	0	2	5.06	0.00		26.92	30.84	180.97	122.40	0.00			4.16	10.56
22-Mar-96	5.44	4.21	2174.88	1755.56	100.61	0	3	2	2	2	5.06	40.50		26.92	27.91	42.10	54.15	0.00			41.22	11.06
23-Mar-96	5.06	4.21	2174.88	1755.56	0.00	0	0	3	1	2	4.94	24.30		26.92	23.16	-23.86	112.91	0.00			26.47	10.74
24-Mar-96	4.61	4.16	2079.21	1654.95	-100.61	10	0	0	3	2	5.41	81.00		26.92	20.30	992.26	89.51	0.00			48.60	11.26
25-Mar-96	4.56	4.86	2775.17	2625.10	970.15	0	0	0	0	2	5.06	0.00		26.92	0.00	370.65	31.37	0.00			5.56	14.10
26-Mar-96	4.46	4.66	2966.04	2970.66	345.56	0	16	27	14	2	5.59	346.30		26.92	0.00	-335.35	41.31	11.76			48.60	135.79
27-Mar-96	4.36	4.61	2855.54	2769.08	-201.58	11	6	0	6	2	3.02	137.70		26.92	0.00	-26.69	56.90	12.53			48.60	73.29
28-Mar-96	4.61	4.58	2807.32	2682.69	-86.39	0	27	0	9	2	4.06	216.70		26.92	4.32	-340.44	90.12	0.00			48.60	96.76
29-Mar-96	6.01	4.46	2610.37	2353.72	-328.97	15	52	66	51	2	4.12	1239.30		26.92	31.26	130.92	69.06	0.00			48.60	100.12
30-Mar-96	6.53	4.96	3336.73	3543.37	1189.65	61	20	41	47	2	2.76	1150.20		26.92	32.49	-1126.79	134.96	0.00			48.60	66.97
31-Mar-96	6.96	4.81	3221.37	3374.67	-168.70	36	12	0	16	2	5.34	380.70		26.92	36.96	-106.94	186.20	0.00			48.60	129.86

Table H.2: Water Balance Model for MRIP

Period : April 1996

Date	R/S WL	C/S WL	Area Submerged	Project Storage	Change of Storage	Rainfall			Average Rainfall	Infiltration	Evaporation	Inflow into the Project through					Outflow from the Project through					
						Moulvibazar	Langla	Chandbagh				Rainfall	Fishpass	Barrage	3 - Vent Regulator	Upstream Chharas	Pumphouse	3-vent Regulator	6-vent Regulator	Fishpass	Infiltration	Evaporation
	(m PWD)	(m PWD)	(ha)	(ha-m)	(ha-m)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01-Apr-96	7.31	4.77	3127.49	3239.71	-134.96	0	0	0	0	2	3.56	0.00			40.09	-1.85	175.03				6.26	11.12
02-Apr-96	7.84	4.72	3032.33	3058.84	-180.87	0	0	0	0	2	4.57	0.00			42.26	0.77	167.06				6.06	13.86
03-Apr-96	7.68	4.67	2951.97	2941.86	-143.96	0	0	0	0	2	4.57	0.00			44.41	83.74	137.58				5.90	13.50
04-Apr-96	7.70	4.66	2935.90	2913.06	-28.80	0	0	0	0	2	5.08	0.00			43.11	55.30	164.02				5.87	14.91
05-Apr-96	7.71	4.63	2887.68	2826.67	-86.39	0	2	0	1	2	4.06	16.20			44.80	35.36	180.71				20.06	11.69
06-Apr-96	7.67	4.60	2839.46	2740.28	-86.39	0	0	0	0	2	3.56	0.00			43.63	227.33	140.00				5.68	10.10
07-Apr-96	7.57	4.64	2903.75	2855.47	115.19	0	3	0	1	2	5.51	24.30			40.15	209.12	118.21				27.20	15.99
08-Apr-96	7.46	4.68	2968.04	2970.66	115.19	9	0	0	3	2	5.06	72.90			39.74	135.94	189.12				48.60	15.06
09-Apr-96	7.30	4.69	2984.12	2999.45	28.79	0	0	0	0	2	5.08	0.00			36.45	49.75	124.70				5.97	15.16
10-Apr-96	7.15	4.67	2951.97	2941.86	-57.59	0	0	0	0	2	5.59	0.00			41.99	0.81	105.79				5.90	16.50
11-Apr-96	7.06	4.64	2903.75	2855.47	-86.39	0	0	0	0	2	5.59	0.00			36.53	-30.71	100.96				5.81	16.23
12-Apr-96	6.76	4.60	2839.46	2740.28	-115.19	0	0	0	0	2	5.59	0.00			34.47	-41.20	86.90				5.68	15.87
13-Apr-96	6.56	4.56	2775.17	2626.10	-118.18	0	0	0	0	2	5.08	0.00			36.46	-67.96	121.64				5.55	14.10
14-Apr-96	6.36	4.50	2678.74	2452.32	-172.78	0	0	0	0	2	4.57	0.00			35.34	-15.35	100.96				5.36	12.26
15-Apr-96	6.16	4.46	2610.37	2353.72	-98.60	0	0	0	0	2	4.06	0.00			33.67	21.83	113.63				5.22	10.61
16-Apr-96	5.90	4.43	2559.09	2279.76	-73.96	0	0	0	0	2	4.06	0.00			32.14	-0.15	90.42				5.12	10.40
17-Apr-96	5.56	4.40	2507.81	2205.81	-73.96	0	0	0	0	2	4.57	0.00			26.06	-4.31	81.24				5.02	11.47
18-Apr-96	5.46	4.37	2456.53	2131.86	-73.96	0	20	0	7	2	6.10	162.00			27.39	133.61	83.54				48.60	116.91
19-Apr-96	5.30	4.40	2507.81	2205.81	73.96	6	0	0	2	2	6.10	48.60			25.83	132.86	94.10				48.60	15.29
20-Apr-96	5.14	4.42	2542.00	2255.11	49.30	0	27	36	21	2	4.57	510.30			24.62	-68.40	82.02				48.60	111.10
21-Apr-96	4.96	4.52	2710.88	2509.91	254.80	20	2	0	7	2	3.56	178.20			20.74	105.79	81.70				48.60	89.04
22-Apr-96	5.06	4.55	2759.10	2596.30	86.39	0	0	0	0	2	5.08	0.00			22.72	86.74	60.13				5.52	14.02
23-Apr-96	5.29	4.56	2775.17	2625.10	28.80	0	72	30	34	2	5.56	826.20			24.97	-66.35	62.66				48.60	135.01
24-Apr-96	5.34	4.74	3084.48	3143.43	518.33	29	22	44	32	2	5.90	769.50			15.32	-19.66	41.31				48.60	140.37
25-Apr-96	5.45	4.90	3432.61	3678.32	534.89	26	26	0	17	2	5.75	421.20			20.13	-56.65	61.20				48.60	139.73
26-Apr-96	5.48	4.94	3526.50	3813.26	134.96	20	0	0	7	2	5.00	162.00			15.64	113.16	63.34				48.60	114.58
27-Apr-96	5.61	4.96	3573.44	3880.76	67.48	0	0	0	0	2	3.56	0.00			25.14	3.66	110.16				7.15	12.71
28-Apr-96	5.69	4.93	3503.02	3779.54	-101.22	0	0	0	0	2	5.59	0.00			25.14	34.63	100.67				7.01	19.57
29-Apr-96	5.71	4.91	3456.06	3712.06	-67.48	0	0	0	0	2	5.59	0.00			25.14	47.13	113.83				6.91	19.31
30-Apr-96	5.69	4.89	3409.14	3644.58	-67.48	0	0	54	18	2	4.06	437.40			24.88	2.26	114.75				48.60	96.76
01-May-96	5.51	4.96	3549.97	3847.02	202.44																	

Table H.3: Water Balance Model for MRIP

Period : May 1996

Date	R/S WL	C/S WL	Area Submerged	Project Storage	Change of Storage	Rainfall: Moulvibazar	Rainfall: Langla	Rainfall: Chandbagh	Average Rainfall	Infiltration	Evaporation	Inflow into the Project through: Rainfall	Inflow: Fishpass	Inflow: Barrage	Inflow: 3 - Vent Regulator	Inflow: Upstream Chhoras	Outflow from the Project through: Pumphouse	Outflow: 3-vent Regulator	Outflow: 6-vent Regulator	Outflow: Fishpass	Outflow: Infiltration	Outflow: Evaporation
	(m PWD)	(m PWD)	(ha)	(ha-m)	(ha-m)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01-May-96	5.51	4.96	3732.38	4133.87	459.29	0	32	16	16	2	4.06	380.70			24.54	-273.82	63.04				46.60	96.76
02-May-96	5.50	5.01	3599.01	4058.10	-75.77	0	0	0	0	2	3.00	0.00			22.38	-26.42	66.37				7.36	11.07
03-May-96	5.52	4.96	3620.38	3948.24	-109.86	4	12	16	11	2	5.02	289.20			22.64	87.83	82.63				46.60	121.89
04-May-96	5.50	5.02	3710.69	4094.49	146.25	7	0	0	2	2	5.06	84.70			20.91	-67.36	89.06				46.60	18.55
05-May-96	5.50	5.00	3620.38	3948.24	-146.25	0	0	0	0	2	4.87	0.00			21.60	-12.81	119.96				7.24	16.55
06-May-96	5.52	4.96	3626.50	3813.28	-134.96	0	0	0	0	2	6.10	0.00			22.64	-19.50	109.55				7.06	21.50
07-May-96	5.50	4.96	3432.61	3678.32	-134.96	0	0	0	0	2	5.89	0.00			22.38	22.41	119.96				6.87	19.15
08-May-96	5.50	4.92	3362.20	3577.11	-101.21	0	0	0	0	2	4.96	0.00			23.07	-15.93	118.73				6.72	16.65
09-May-96	5.46	4.90	3286.32	3442.15	-134.96	0	0	0	0	2	4.87	0.00			23.41	-14.42	88.74				6.54	14.94
10-May-96	5.92	4.87	3197.90	3340.93	-101.22	0	34	34	23	2	6.10	869.40			28.77	11.83	108.86				46.60	146.13
11-May-96	6.43	4.97	3432.61	3678.32	337.39	52	10	6	23	2	6.16	880.80	3.31		33.78	27.17	113.22				46.60	149.59
12-May-96	6.60	5.06	3643.55	3981.98	303.66	10	18	21	16	2	5.49	395.90	3.99		35.42	13.91	116.26				46.60	133.46
13-May-96	6.85	5.10	3732.38	4133.87	151.89	26	20	21	22	2	2.96	834.60	5.00		37.56	-66.55	113.83				46.60	72.81
14-May-96	7.23	5.18	3864.17	4409.56	275.69	55	45	42	47	2	4.02	1150.20	6.50		39.92	-443.17	55.69				46.60	97.75
15-May-96	8.03	5.40	4187.76	4960.93	551.37	0	9	0	3	2	2.54	72.90	9.55		43.29	-45.86	136.77				46.60	10.64
16-May-96	8.15	5.38	4122.71	4842.78	-118.15	8	23	0	10	2	4.06	281.10	9.99		44.76	127.96	165.30				46.60	96.76
17-May-96	8.26	5.40	4187.76	4960.93	118.15	15	3	23	14	2	4.00	332.10	10.41		44.24	44.06	186.06				46.60	97.20
18-May-96	8.24	5.44	4252.31	5089.86	128.93	0	25	62	29	2	3.06	704.70	10.33		44.41	-361.86	140.61				46.60	74.07
19-May-96	8.22	5.60	4316.60	5224.18	134.32	36	0	0	12	2	4.94	263.50	10.20		40.96	293.46	86.61				46.60	119.94
20-May-96	8.20	5.67	4509.47	5627.14	402.96	0	0	0	0	2	4.06	0.00	10.19		42.51	-26.10	133.87				9.02	18.33
21-May-96	8.10	5.62	4445.18	5492.82	-134.32	16	9	0	8	2	6.70	194.40	9.99		41.86	84.04	132.80				46.60	146.89
22-May-96	8.09	5.63	4445.18	5492.82	0.00	0	0	0	0	2	4.87	0.00	9.65		40.61	37.06	147.66				8.89	20.32
23-May-96	7.92	5.61	4402.32	5403.27	-89.55	0	0	0	0	2	6.10	0.00	8.95		36.79	34.53	136.17				8.60	25.64
24-May-96	7.74	5.61	4359.46	5313.73	-89.54	0	4	27	10	2	6.10	281.10	8.71		37.93	182.48	149.16				46.60	146.13
25-May-96	7.83	5.66	4423.75	5448.05	134.32	0	0	0	0	2	4.06	0.00	8.02		36.94	3.84	185.30				8.86	17.96
26-May-96	7.86	5.63	4359.46	5313.73	-134.32	0	17	16	11	2	4.06	289.20	7.48		36.46	171.74	148.41				46.60	96.76
27-May-96	7.36	5.66	4445.18	5492.82	179.09	1	67	72	47	2	5.52	1134.00	6.67		34.99	-232.13	133.86				46.60	134.23
28-May-96	7.46	5.80	4745.20	6119.65	626.83	115	15	0	43	2	2.62	1053.00	7.00		35.34	182.16	142.29				46.60	63.57
29-May-96	7.87	5.96	5087.26	7112.69	993.04	9	57	49	38	2	1.76	831.60	7.44		35.66	-266.11	97.92				46.60	43.16
30-May-96	7.70	6.06	5277.12	7631.70	519.01	27	20	0	16	2	2.00	380.70	7.84		35.34	-36.01	126.23				46.60	46.60
31-May-96	8.04	6.07	5332.23	7794.14	162.44	1	130	52	61	2	2.20	1462.30	9.27		37.41	-1281.47	146.38				46.60	53.56

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Table H.4: Water Balance Model for MRIP

Period : June 1996

Date	R/S WL	C/S WL	Area Submerged	Project Storage	Change of Storage	Rainfall Moulvibazar	Rainfall Langla	Rainfall Chandbagh	Average Rainfall	Infiltration	Evaporation	Inflow into the Project through: Rainfall	Inflow: Fishpass	Inflow: Barrage	Inflow: 3-Vent Regulator	Inflow: Upstream Chhoras	Outflow from the Project through: Pumphouse	Outflow: 3-vent Regulator	Outflow: 6-vent Regulator	Outflow: Fishpass	Outflow: Infiltration	Outflow: Evaporation
	(m PWD)	(m PWD)	(ha)	(ha-m)	(ha-m)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01-Jun-96	8.12	6.18	6039.4	9760.06	661.06	130	12	30	67	2	3.00	1393.20	9.46		36.63	-436.41	146.36				46.80	72.90
02-Jun-96	8.44	6.30	6297.59	10617.06	737.03	22	27	46	32	2	3.16	786.70	10.87		37.84	44.34	107.71				46.80	76.69
03-Jun-96	8.56	6.40	6506.78	11162.53	645.45	23	20	23	22	2	3.00	634.80	11.16		37.07	473.36	146.4				46.80	72.90
04-Jun-96	8.63	6.52	6768.02	11946.81	786.26	30	15	0	15	2	3.86	364.50	11.26		36.55	461.67	173.04				46.80	89.04
05-Jun-96	8.60	6.60	6976.20	12612.11	563.30	0	3	86	29	2	1.97	712.80	11.02		36.51	124.00	82.77				46.80	47.82
06-Jun-96	8.67	6.70	7236.43	13216.24	704.13	12	26	0	13	2	2.36	324.00	11.22		35.26	903.70	189.87				46.80	67.83
07-Jun-96	8.67	6.83	7656.39	14194.10	977.86	7	16	30	18	2	3.06	429.30	11.02		34.13	181.77	190.64				46.80	74.07
08-Jun-96	8.61	6.87	7804.32	14507.01	312.91	20	0	0	7	2	3.46	162.00	10.64		33.18	209.70	204.71				46.80	83.96
09-Jun-96	8.52	6.86	7840.80	14585.23	78.22	0	1	0	0	2	4.57	8.10	10.16		32.14	36.66	186.81				21.17	35.85
10-Jun-96	8.44	6.86	7767.84	14428.78	-156.45	0	0	0	0	2	4.54	0.00	9.80		31.71	-15.01	210.38				18.54	36.27
11-Jun-96	8.34	6.83	7656.39	14194.10	-234.68	0	2	0	1	2	5.59	16.20	9.37		31.19	-17.97	204.26				26.4	42.80
12-Jun-96	8.24	6.80	7546.96	13959.43	-234.67	2	0	0	1	2	1.94	16.20	8.93		30.89	16.91	186.19				26.27	14.61
13-Jun-96	8.06	6.78	7475.96	13802.96	-156.45	0	0	0	0	2	4.00	0.00	8.06		28.66	107.07	177.17				14.96	29.90
14-Jun-96	7.96	6.77	7439.80	13724.75	-78.23	0	0	0	0	2	6.10	0.00	7.84		27.66	-19.14	182.68				14.66	45.36
15-Jun-96	7.88	6.74	7340.52	13497.89	-226.86	0	0	0	0	2	5.59	0.00	7.09		26.87	-74.93	184.96				14.66	41.02
16-Jun-96	7.80	6.70	7236.43	13216.24	-281.65	0	22	9	10	2	5.59	261.10	6.81		26.61	-26.83	215.42				46.80	136.79
17-Jun-96	7.70	6.66	7184.36	13075.4	-140.83	1	0	5	2	2	5.59	46.80	6.36		25.75	101.81	234.40				46.80	40.15
18-Jun-96	7.61	6.66	7132.34	12934.58	-140.83	0	16	2	7	2	4.57	162.00	5.87		24.84	367.80	189.26				46.80	111.10
19-Jun-96	7.52	6.69	7210.4	13146.82	211.24	22	19	0	14	2	4.92	332.10	5.32		22.90	-109.11	153.46				46.80	119.56
20-Jun-96	7.61	6.66	7184.36	13075.4	-70.41	32	26	0	19	2	7.56	469.80	5.62		24.26	50.01	176.87				46.80	183.61
21-Jun-96	7.54	6.70	7236.43	13216.24	140.83	30	9	45	26	2	5.00	660.40	5.40		23.07	-106.66	151.47				46.80	121.80
22-Jun-96	7.46	6.74	7340.89	13497.89	281.66	5	14	26	15	2	1.87	356.40	5.09		22.20	5.21	149.15				46.80	45.49
23-Jun-96	7.50	6.76	7403.02	13646.53	148.64	20	5	33	20	2	1.40	494.10	5.06		21.95	-141.86	140.30				46.80	33.92
24-Jun-96	7.58	6.78	7475.96	13802.96	156.45	4	29	45	26	2	3.40	639.90	5.21		21.95	-236.43	143.06				46.80	82.52
25-Jun-96	7.56	6.80	7546.96	13959.43	156.45	54	19	18	30	2	3.00	737.10	5.18		21.80	-23.09	149.94				46.80	72.90
26-Jun-96	7.53	6.86	7767.84	14426.78	469.35	5	3	0	4	2	2.94	89.10	4.96		20.91	44.23	166.01				46.80	22.81
27-Jun-96	7.51	6.86	7731.36	14350.56	-78.22	3	0	0	1	2	5.06	24.30	4.81		20.39	188.11	166.31				32.03	39.26
28-Jun-96	7.44	6.86	7731.36	14350.56	0.00	0	0	11	4	2	4.06	89.10	4.43		19.27	213.13	167.69				46.80	31.42
29-Jun-96	7.4	6.86	7767.84	14426.78	78.22	5	2	37	16	2	4.03	380.70	4.24		18.66	51.4	73.75				46.80	97.96
30-Jun-96	7.39	6.89	7877.26	14663.46	234.68	7	19	56	27	2	3.24	664.20	4.02		17.80	627.66	0.00				46.80	78.63
01-Jul-96		7.06	8612.78	16049.93	1386.47																	

Table H.5: Water Balance Model for MRIP

Period : July 1996

Date	R/S WL	C/S WL	Area Submerged	Project Storage	Change of Storage	Rainfall: Moulvibazar	Rainfall: Langla	Rainfall: Chandbagh	Average Rainfall	Infiltration	Evaporation	Inflow into the Project through: Rainfall	Inflow: Fishpass	Inflow: Barrage	Inflow: 3 - Vent Regulator	Inflow: Upstream Chhoras	Outflow from the Project through: Pumphouse	Outflow: 3-vent Regulator	Outflow: 6-vent Regulator	Outflow: Fishpass	Outflow: Infiltration	Outflow: Evaporation
	(m PWD)	(m PWD)	(ha)	(ha-m)	(ha-m)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01-Jul-96	7.43	7.06	8612.78	16049.93	1366.47	22	104	181	92	2	3.00	2243.70	3.60		15.29	506.11	0.00				46.60	72.90
02-Jul-96	8.03	7.36	9703.42	18697.13	2647.20	116	84	146	116	2	3.00	2616.50	6.11		20.74	-48.96	0.00				46.60	72.90
03-Jul-96	8.51	7.61	10668.03	21372.33	2675.20	45	69	91	68	2	3.00	1660.50	8.15		23.55	686.91	0.00				46.60	72.90
04-Jul-96	8.58	7.81	11606.40	23632.23	2259.90	66	73	0	47	2	3.07	1142.10	9.58		25.66	1341.44	205.54				46.60	74.65
05-Jul-96	8.96	7.99	12754.36	25819.23	2187.00	15	9	70	32	2	3.03	765.70	9.76		24.97	990.42	226.75				46.60	73.65
06-Jul-96	9.02	8.10	13264.00	27281.06	1461.83	8	5	32	15	2	3.97	364.50	9.59		24.11	374.75	225.63				46.60	96.42
07-Jul-96	9.03	8.13	13427.12	27683.16	402.10	10	14	64	26	2	4.86	631.80	9.53		23.66	-6.47	231.34				46.60	110.71
08-Jul-96	9.02	8.16	13522.64	27951.22	268.06	7	16	21	18	2	4.02	356.40	9.36		23.41	-0.66	242.36				46.60	97.89
09-Jul-96	9.01	8.15	13522.64	27951.22	0.00	0	12	0	4	2	3.06	97.20	9.31		23.33	226.34	244.80				46.60	62.77
10-Jul-96	9.00	8.15	13522.64	27951.22	0.00	1	4	11	5	2	3.02	129.60	9.24		23.16	132.46	172.56				46.60	73.29
11-Jul-96	9.02	8.16	13522.64	27951.22	0.00	2	0	0	1	2	2.94	16.20	9.36		23.41	237.30	212.36				34.23	38.70
12-Jul-96	9.02	8.15	13522.64	27951.22	0.00	3	0	24	9	2	2.00	218.70	9.42		23.41	-73.86	214.81				46.60	46.60
13-Jul-96	9.00	8.14	13474.63	27817.19	-134.03	0	0	1	0	2	2.03	8.10	9.37		23.33	-48.56	201.36				30.56	27.36
14-Jul-96	8.96	8.12	13379.42	27549.12	-268.07	0	44	30	26	2	2.00	599.40	9.09		23.07	216.12	214.36				46.60	46.60
15-Jul-96	8.96	8.16	13570.26	28085.25	536.13	34	11	36	27	2	2.39	656.10	8.91		22.46	-89.91	222.77				46.60	56.13
16-Jul-96	8.96	8.16	13665.86	28353.32	268.07	18	10	7	12	2	3.27	283.50	8.96		22.46	571.99	222.77				46.60	79.41
17-Jul-96	8.96	8.22	13856.49	28889.45	536.13	3	7	10	7	2	3.00	162.00	8.56		21.81	-115.86	222.77				46.60	72.90
18-Jul-96	8.94	8.20	13761.07	28621.39	-268.06	7	2	0	3	2	3.00	72.90	8.58		21.60	213.71	228.90				46.60	41.26
19-Jul-96	8.93	8.20	13761.07	28621.39	0.00	0	20	43	21	2	4.87	810.30	8.50		21.81	116.33	220.09				46.60	111.10
20-Jul-96	8.96	8.22	13856.49	28889.45	268.06	1	0	2	1	2	2.33	24.30	8.58		21.81	366.17	216.04				36.16	32.31
21-Jul-96	8.96	8.23	13904.20	29023.48	134.03	2	12	20	11	2	2.38	275.40	8.50		21.34	-107.78	226.06				46.60	57.83
22-Jul-96	8.93	8.22	13856.49	28889.45	-134.03	3	13	8	8	2	5.49	194.40	8.41		21.17	199.96	241.89				46.60	133.46
23-Jul-96	8.92	8.22	13856.49	28889.45	0.00	8	3	10	7	2	2.38	170.10	8.33		21.00	134.06	227.05				46.60	57.83
24-Jul-96	8.91	8.22	13856.49	28889.45	0.00	0	0	0	0	2	3.44	0.00	8.26		20.91	267.36	221.09				27.71	47.72
25-Jul-96	8.91	8.22	13856.49	28889.45	0.00	0	11	0	4	2	3.56	89.10	8.26		20.91	276.65	164.63				46.60	49.66
26-Jul-96	8.96	8.23	13904.20	29023.48	134.03	5	0	0	2	2	5.22	40.50	8.72		21.77	128.11	215.42				45.13	72.56
27-Jul-96	8.86	8.22	13856.49	28889.45	-134.03	7	6	0	4	2	3.96	105.30	8.03		20.39	63.01	203.03				46.60	79.13
28-Jul-96	8.79	8.21	13808.78	28755.42	-134.03	0	4	17	7	2	2.40	170.10	7.40		19.18	113.63	203.49				46.60	56.22
29-Jul-96	8.73	8.21	13808.78	28755.42	0.00	0	10	11	7	2	3.06	170.10	6.93		18.14	131.78	204.26				46.60	74.07
30-Jul-96	8.69	8.21	13808.78	28755.42	0.00	84	26	0	36	2	2.09	882.90	6.61		17.48	-344.24	195.23				46.60	50.54
31-Jul-96	8.75	8.23	13904.20	29023.48	268.06	5	9	12	9	2	2.40	210.60	7.21		18.66	-13.96	115.67				46.60	56.22

Table H.6: Water Balance Model for MRIP

Period : August 1996

Date	R/S WL	C/S WL	Area Submerged	Project Storage	Change of Storage	Rainfall			Average Rainfall	Infiltration	Evaporation	Inflow into the Project through					Outflow from the Project through					
						Maulvibazar	Langla	Chandbagh				Rainfall	Fishpass	Barrage	3 - Vent Regulator	Upstream Chhoras	Pumphouse	3-vent Regulator	6-vent Regulator	Fishpass	Infiltration	Evaporation
	(m PWD)	(m PWD)	(ha)	(ha-m)	(ha-m)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01-Aug-96	5.78	5.27	14103.70	29584.55	293.00	12	24	4	13		2.49	324.00	7.21		16.66	96.35	169.57				48.60	60.56
02-Aug-96	5.74	5.28	14155.74	29731.05	146.50	5	3	70	26		2.49	631.80	6.77		17.63	-224.90	175.64				48.60	60.56
03-Aug-96	5.72	5.29	14207.79	29877.55	146.50	2	0	23	8		3.00	202.50	6.49		16.55	414.35	225.66				48.60	72.90
04-Aug-96	5.62	5.31	14311.87	30170.56	293.01	0	172	0	57		4.06	1393.20	5.46		14.43	-436.63	241.13				48.60	96.76
05-Aug-96	5.62	5.35	14520.05	30756.56	586.00	53	3	82	46		5.03	1117.80	4.76		12.27	-122.30	231.34				48.60	146.56
06-Aug-96	5.63	5.39	14728.23	31342.57	586.01	0	1	3	1		5.06	32.40	4.77		12.27	178.17	242.36				42.22	89.55
07-Aug-96	5.60	5.36	14676.18	31196.07	-146.50	0	0	0	0		4.57	0.00	4.86		11.76	34.39	247.26				29.36	67.10
08-Aug-96	5.49	5.36	14572.09	30903.06	-293.01	0	3	0	1		2.49	24.30	3.49		9.07	53.39	161.57				36.87	36.31
09-Aug-96	5.42	5.35	14520.05	30756.56	-146.50	1	5	0	2		5.06	48.60	2.65		6.65	170.64	236.53				48.60	87.52
10-Aug-96	5.36	5.34	14468.01	30610.06	-146.50	8	10	7	8		5.54	202.50	2.13		5.01	-197.02	246.64				48.60	165.69
11-Aug-96	5.30	5.31	14311.87	30170.56	-439.50	0	2	0	1		2.20	16.20	3.06		0.00	294.96	247.40				35.26	31.54
12-Aug-96	5.35	5.31	14311.87	30170.56	0.00	0	2	0	1		2.54	16.20	2.11		5.01	262.97	214.66				35.26	36.35
13-Aug-96	5.40	5.31	14311.87	30170.56	0.00	50	5	0	26		2.41	688.50	2.91		7.52	-60.19	236.53				48.60	56.61
14-Aug-96	5.46	5.33	14415.96	30463.56	293.00	2	15	0	7		2.02	162.00	3.86		9.76	13.26	237.61				48.60	48.99
15-Aug-96	5.49	5.32	14363.92	30317.06	-146.50	8	27	0	12		3.06	283.50	4.02		10.63	65.65	241.13				48.60	74.07
16-Aug-96	5.52	5.32	14363.92	30317.06	0.00	38	12	0	17		3.36	405.00	4.26		11.23	241.44	236.66				48.60	81.65
17-Aug-96	5.60	5.34	14468.01	30610.06	293.00	32	26	74	48		2.36	1086.40	4.90		12.79	703.36	236.01				48.60	57.53
18-Aug-96	5.70	5.44	14988.45	32075.07	1465.01	18	62	59	46		3.56	1125.90	5.06		12.79	-199.96	222.77				48.60	86.41
19-Aug-96	5.75	5.45	15196.62	32661.08	586.01	3	9	21	11		2.96	267.30	5.31		13.31	55.97	221.84				48.60	71.73
20-Aug-96	5.79	5.45	15196.62	32661.08	0.00	4	23	16	14		3.54	348.30	5.62		14.00	482.52	225.22				48.60	93.31
21-Aug-96	5.82	5.51	15359.13	33114.39	453.31	36	5	21	22		4.06	526.50	5.67		14.00	16.09	264.59				48.60	96.76
22-Aug-96	5.87	5.52	15417.55	33274.70	160.31	4	0	34	13		2.92	307.80	6.07		14.86	-163.86	205.63				48.60	70.96
23-Aug-96	5.87	5.51	15359.13	33114.39	-160.31	0	0	0	0		3.92	0.00	6.15		15.12	-11.94	225.22				30.72	60.21
24-Aug-96	5.87	5.49	15248.67	32807.58	-306.81	0	0	0	0		3.06	0.00	6.30		15.47	131.46	222.77				30.50	46.48
25-Aug-96	5.87	5.45	15196.62	32661.08	-146.50	0	0	0	0		2.54	0.00	6.37		15.72	-36.02	206.06				30.39	36.60
26-Aug-96	5.85	5.45	15092.53	32368.08	-293.00	0	0	0	0		4.06	0.00	6.33		15.72	136.54	213.59				30.19	61.34
27-Aug-96	5.81	5.45	15040.49	32221.57	-146.51	0	6	0	2		4.57	48.60	6.04		15.12	-47.87	197.52				48.60	66.77
28-Aug-96	5.77	5.43	14936.40	31928.57	-293.00	2	0	6	3		5.57	64.80	5.82		14.69	260.66	199.21				48.60	96.16
29-Aug-96	5.73	5.43	14936.40	31928.57	0.00	1	17	26	15		3.06	388.40	5.44		13.74	677.89	196.29				48.60	74.07
30-Aug-96	5.73	5.45	15196.62	32661.08	732.51	7	5	64	33		2.45	801.90	5.02		12.53	-324.27	239.90				48.60	60.17
31-Aug-96	5.69	5.49	15248.67	32807.58	146.50	20	0	5	5		2.00	202.50	4.49		11.23	102.97	220.99				48.60	48.60

Table H.7: Water Balance Model for MRIP

Period : September 1996

Date	R/S WL	C/S WL	Area Submerged	Project Storage	Change of Storage	Rainfall			Average Rainfall	Infiltration	Evaporation	Inflow into the Project through					Outflow from the Project through					
						Muhvbazar	Langa	Chandbagh				Rainfall	Fishpass	Barrage	3 - Vent Regulator	Upstream Chhoras	Pumphouse	3-vent Regulator	6-vent Regulator	Fishpass	Infiltration	Evaporation
	(m PWD)	(m PWD)	(ha)	(ha-m)	(ha-m)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(mm/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)	(ha-m/day)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01-Sep-96	8.66	8.46	15196.62	32561.06	-146.50	0	15	3	6		3.00	146.50	4.26		10.63	-91.06	241.13				46.60	72.90
02-Sep-96	8.66	8.46	15092.53	32366.06	-293.00	10	0	0	3		4.06	81.00	4.33		10.97	-89.06	220.32				46.60	61.34
03-Sep-96	8.63	8.44	14966.46	32075.07	-293.01	0	1	0	0		3.76	8.10	4.42		10.97	159.36	239.90				33.06	84.36
04-Sep-96	8.62	8.43	14936.40	31928.57	-146.50	0	4	2	2		5.06	48.60	4.29		10.97	214.36	184.22				46.60	75.40
05-Sep-96	8.57	8.43	14936.40	31928.57	0.00	0	0	6	2		6.92	48.60	3.96		9.42	163.82	220.32				46.60	103.36
06-Sep-96	8.56	8.42	14884.36	31782.07	-146.50	0	86	0	19		2.76	453.60	3.69		9.42	327.53	236.66				46.60	67.46
07-Sep-96	8.57	8.45	15040.49	32221.57	439.50	60	2	15	26		4.54	623.70	3.47		8.73	-279.09	197.96				46.60	110.22
08-Sep-96	8.57	8.45	15040.49	32221.57	0.00	2	0	2	1		2.94	32.40	3.47		8.73	65.76	170.29				42.43	44.16
09-Sep-96	8.50	8.44	14966.46	32075.07	-146.50	0	0	0	0		3.06	0.00	2.73		6.13	116.46	46.66				29.96	46.66
10-Sep-96	8.40	8.44	14966.46	32075.07	0.00	0	0	0	0		4.57	0.00				49.41		5.01	56.66	3.78	29.96	66.53
11-Sep-96	8.34	8.43	14936.40	31928.57	-146.50	0	0	0	0		4.57	0.00				243.16		7.52	133.10	4.37	29.57	66.29
12-Sep-96	8.27	8.43	14936.40	31928.57	0.00	4	0	0	1		4.00	32.40				-30.64		10.02	177.42	5.21	42.36	89.75
13-Sep-96	8.17	8.41	14832.31	31636.57	-293.00	0	0	0	0		3.06	0.00				-129.26		12.27	217.21	5.86	29.66	46.21
14-Sep-96	8.06	8.38	14676.16	31196.07	-439.50	0	0	0	0		4.57	0.00				-79.56		13.74	242.57	6.60	29.36	67.10
15-Sep-96	8.00	8.36	14520.06	30756.56	-439.51	0	0	0	0		5.59	0.00				101.81		14.86	262.44	7.03	29.04	81.14
16-Sep-96	7.89	8.33	14418.96	30463.56	-293.00	0	0	0	0		5.06	0.00				274.03		16.66	294.19	7.60	26.53	73.23
17-Sep-96	7.84	8.32	14363.92	30317.06	-146.50	0	26	0	9		4.06	210.60				709.21		17.46	307.26	8.22	46.60	96.76
18-Sep-96	7.80	8.36	14520.06	30756.56	439.50	4	16	39	20		4.00	477.90				170.64		18.66	328.92	8.66	46.60	97.20
19-Sep-96	7.76	8.36	14672.09	30903.06	146.50	6	46	37	30		4.10	720.90				-200.99		19.44	343.57	8.77	46.60	99.63
20-Sep-96	7.76	8.36	14672.09	30903.06	0.00	3	70	0	24		4.10	591.30				-77.23		19.15	337.74	8.92	46.60	99.63
21-Sep-96	7.76	8.36	14672.09	30903.06	0.00	51	107	37	65		4.10	1579.50				-39.69		19.15	337.74	9.15	46.60	99.63
22-Sep-96	7.97	8.43	14936.40	31928.57	1025.51	65	3	39	36		4.10	865.70				340.29		17.02	300.80	8.43	46.60	99.63
23-Sep-96	8.06	8.46	15196.62	32561.06	732.51	2	10	12	8		4.10	194.40				267.96		15.90	280.46	7.76	46.60	99.63
24-Sep-96	8.06	8.46	15196.62	32561.06	0.00	2	16	14	11		4.10	275.40				30.91		15.90	280.46	8.22	46.60	99.63
25-Sep-96	8.06	8.47	15144.56	32514.56	-146.50	0	0	0	0		4.26	0.00				260.36		16.33	287.46	8.36	30.29	64.39
26-Sep-96	8.01	8.46	15092.53	32366.06	-146.50	0	14	0	5		3.06	113.40				-110.91		16.56	297.56	8.44	46.60	70.56
27-Sep-96	7.96	8.43	14936.40	31928.57	-439.51	4	0	0	1		2.70	32.40				233.54		17.19	304.04	8.52	42.36	40.33
28-Sep-96	8.02	8.42	14884.36	31782.07	-146.50	2	12	0	5		2.52	113.40				184.23		15.90	280.46	7.56	46.60	61.33
29-Sep-96	7.96	8.41	14832.31	31636.57	-146.50	3	0	4	2		3.96	84.70				-219.63		15.60	290.52	8.06	46.60	99.09
30-Sep-96	7.93	8.37	14624.14	31049.56	-586.01	0	0	0	0		2.54	0.00				92.31		16.66	294.19	8.06	29.26	37.15
01-Oct-96			14520.06	30756.56	-293.00																	

Figure H.1: Contour Map of MRIP

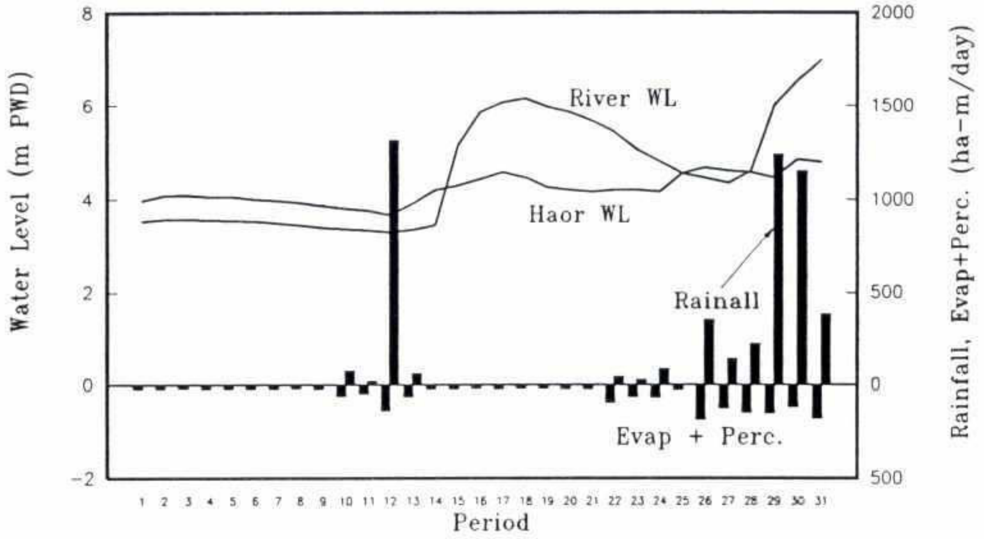
Demarcated Fishery during Dry Season

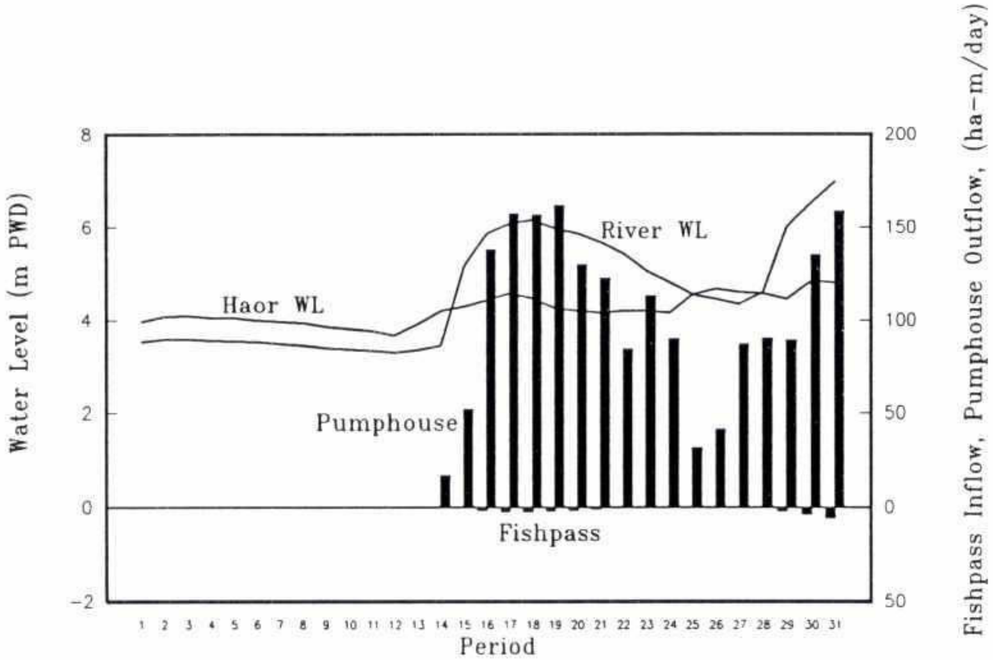
Contour Map of
Manu River Irrigation Project

FILE:FPP-230.DWG

Inundation Impact

March 1996





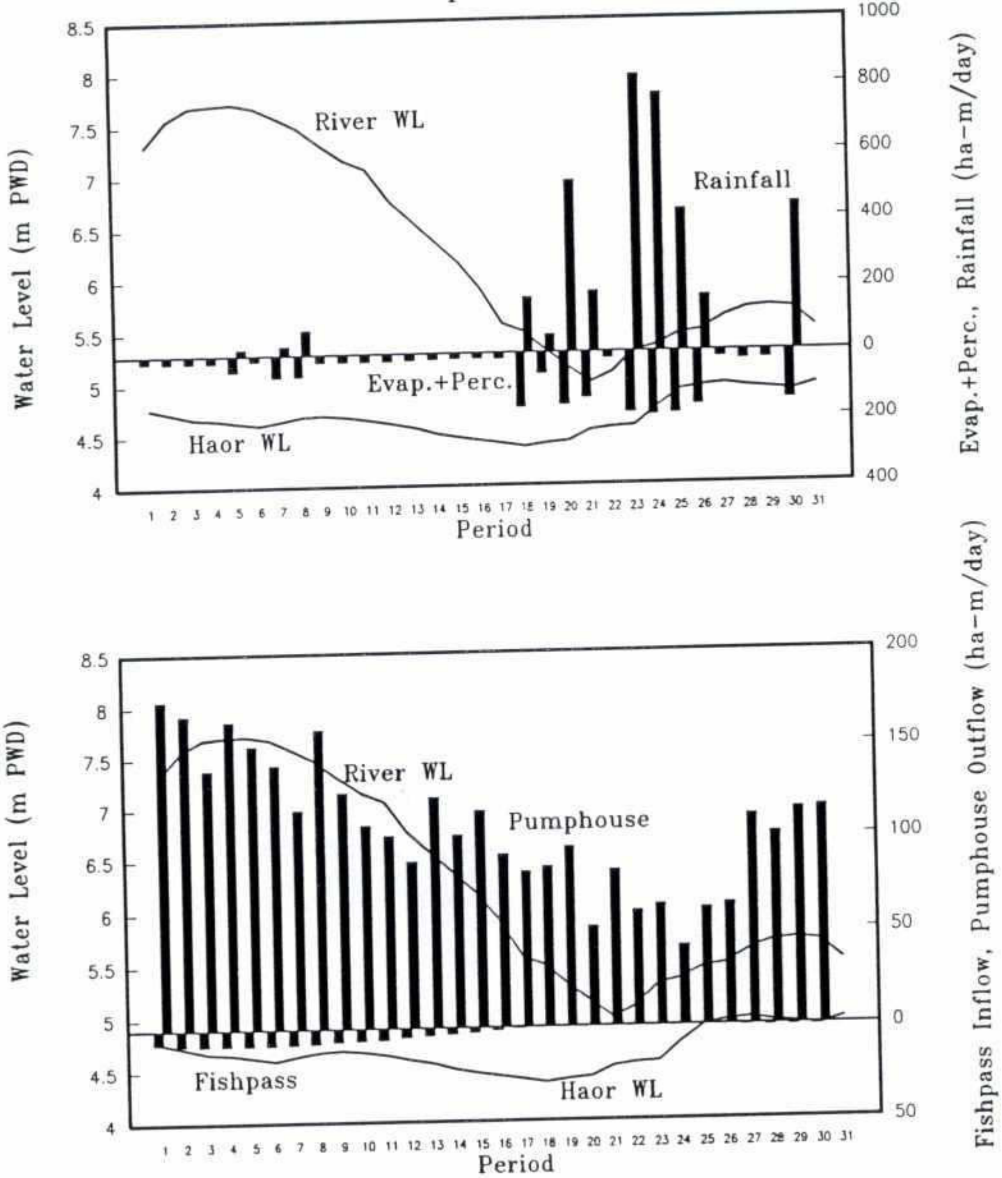
FILE: FPP-231DWG

Northeast Regional Project	
Inflow / Outflow Impact for March 1996	
Prepared by: Salahuddin	November, 96
Computer Drafting by: Jalal	AutoCAD Drawing

Figure H.3

Inundation Impact

April 1996

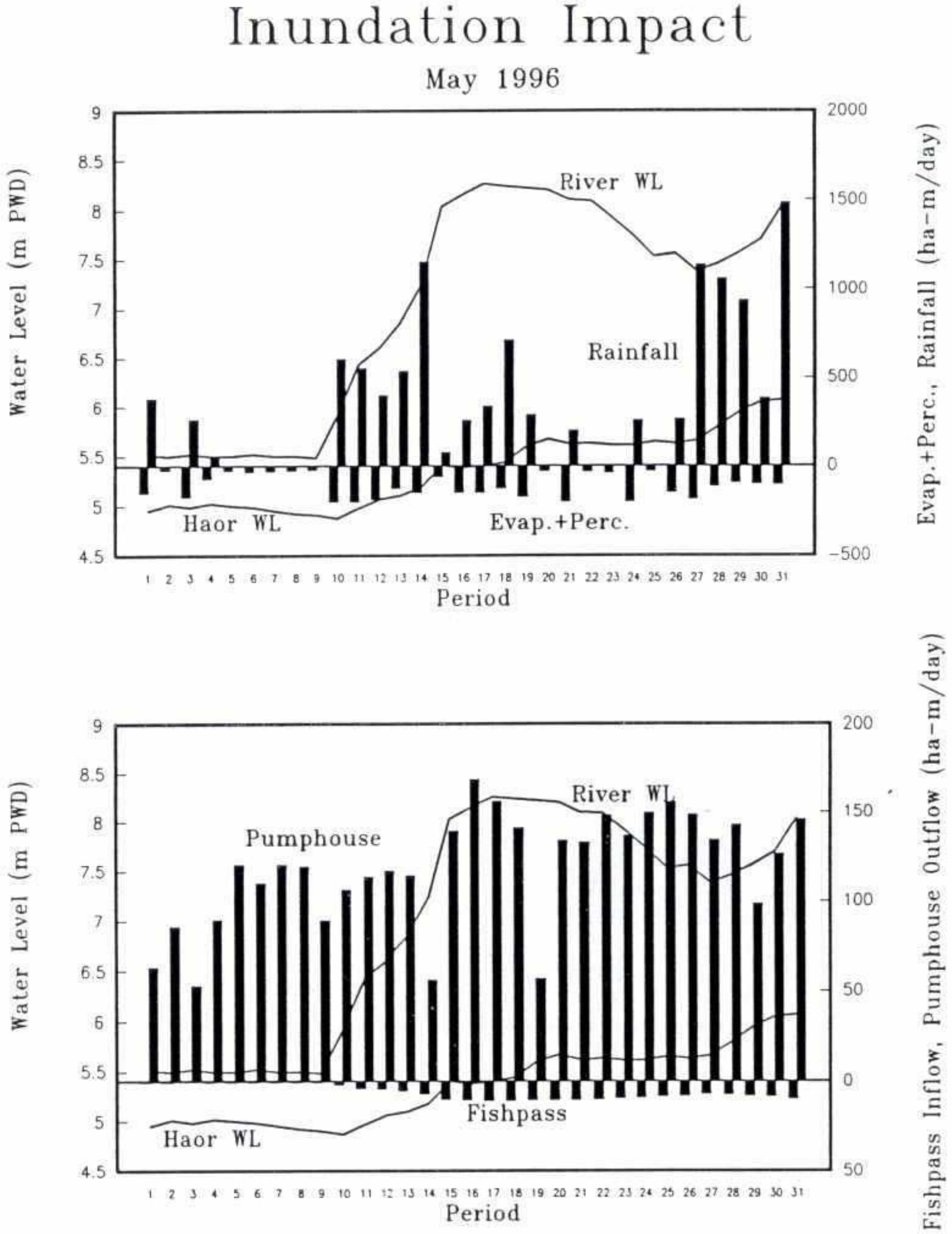


Northeast Regional Project

Inflow / Outflow Impact for April 1996

Prepared by: Salahuddin	November 96
Computer Drafting by: Jalal	AutoCAD Drawing

FILE: fpp-232.DWG



Northeast Regional Project	
Inflow / Outflow Impact for May 1996	
Prepared by: Salahuddin	November 96
Computer Drafting by: Jalal	AutoCAD Drawing

FILE: fpp-233.DWG

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Appendix I

MEMORANDUM OF UNDERSTANDING

AND

FISHPASS
OPERATION, MAINTENANCE
AND MANAGEMENT
MANUAL

DOCUMENT I

MEMORANDUM OF UNDERSTANDING

MEMORANDUM OF UNDERSTANDING

BETWEEN

THE MINISTRY OF WATER RESOURCES

AND

THE MINISTRIES OF FISHERIES AND LIVESTOCK

CONCERNING

OPERATION AND MAINTENANCE OF FISHPASS STRUCTURE UNDER MANU IRRIGATION PROJECT OF BANGLADESH WATER DEVELOPMENT BOARD

JANUARY 1998

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MEMORANDUM OF UNDERSTANDING

BETWEEN

THE MINISTRY OF WATER RESOURCES

AND

THE MINISTRY OF FISHERIES AND LIVESTOCK

The Ministry of Water Resources (hereinafter called MOWR and the Ministry of Fisheries and Livestock (hereinafter called MOFL), desiring to record an understanding concerning operation and maintenance of the Kashimpur Fishpass Structure under the Manu Irrigation project in the district of Moulvibazar have agreed as follows:

ARTICLE I
NATURE OF THE MEMORANDUM OF UNDERSTANDING

SECTION 1.01

This Memorandum of understanding is a cooperation agreement between the two Ministries of the People's Republic of Bangladesh in relation to the project.

ARTICLE II
RESPONSIBLE AUTHORITIES

SECTION 2.01

MOWR designates the Bangladesh Water Development Board (hereinafter called BWDB) as the agency responsible for the implementation of its obligations under this Memorandum of Understanding.

SECTION 2.02

MOFL designates the Department of Fisheries (hereinafter called DOF) as the agency responsible for the implementation of its obligations under this Memorandum of Understanding.

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ARTICLE III
THE PROJECT

SECTION 3.01

MOWR and MOFL shall participate in the Fishpass Structure Operation and Maintenance project (hereinafter called the PROJECT). The objective of PROJECT is to establish a permanent operation and maintenance system to contribute to the improvement of haor fisheries in a sustainable way within the Manu Irrigation Project of the BWDB under MOWR.

The PROJECT background and description are as follows:

The Fishpass Pilot Project is a component of the Northeast Regional Water Management Project under the Flood Action Plan 6 of the Government of the People's Republic of Bangladesh. It was constructed across the embankment of the Manu River Irrigation Project of BWDB at Kashimpur under the district of Moulvibazar under Canada Government grant.

The Fishpass is a single-jet vertical slot structure. The objective of the project is to reestablish an open fish migration route between the Kushiyara River and the Kawadighi Haor in order to mitigate adverse impacts of flood control projects on floodplain fisheries.

The Kushiyara is the largest river in the Northeast Region and acts as an important fish migration pathway. Prior to the construction of the 60 km long full flood protection embankment, Kawadighi Haor was a highly productive mother fishery of regional importance. It was cut off by the Manu River Irrigation Project. The ultimate state vision of the present Kashimpur fishpass pilot project is to rehabilitate the Kawadighi mother fishery.

The fishpass was constructed on land owned by the BWDB. Construction was carried out during the winter dry season period of January-May 1995. The structure consists of a 61.85 m long concrete chute subdivided by baffles into 17 pools and two observation chambers. The access channels at either end connect to the Karadair khal. The access channels, along with portions of the khal and the adjoining Kushiyara River have been designated a fish sanctuary in order to protect vulnerable migrating fish from fishing mortality. Operation of the fishpass began on May 24, 1995. Impact monitoring, operation, maintenance and management of the fishpass has been carried out by NERP over a period of 29 months. The pilot phase of the project terminated on December 31, 19 97 and the structure was handed over to the GOB, represented by the BWDB.

SECTION 3.02

The cooperative effort between the two Parties to this arrangement shall extend over a period till the time when both the Parties mutually decide to dissociate with this Memorandum of Understanding.

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ARTICLE IV
OPERATION, MAINTENANCE AND MANAGEMENT MANUAL

SECTION 4.01

For implementation of the PROJECT, MOWR and MOFL will utilize an Operation, Maintenance and Management Manual which will constitute an operational document between BWDB and DOF. The Operational, Maintenance and Management Manual designated as Annex 'A' will be completed, approved and signed between BWDB and DOF and will form part of this Memorandum of Understanding.

ARTICLE V
RESPONSIBILITIES OF BANGLADESH WATER DEVELOPMENT BOARD

SECTION 5.01

The Bangladesh Water Development Board will be one of the implementing agencies for Operation, Maintenance and Management of the Kashimpur Fishpass. Specific responsibilities of BWDB will include the following:

(i) Accept authority and responsibility for the fishpass structure.

(ii) Instruct its staff (specifically the Sub-Divisional Engineer [Kashimpur Pumphouse], the Sub-Assistant Engineer [Kashimpur Pumphouse], the Executive Engineer [Circle-1, O&M Division, Moulvibazar] and the Superintending Engineer [O&M Division, Moulvibazar]) to take responsibility for operation, maintenance and safety of the structure.

(iii) Provide logistic support for operation and maintenance through the Sub-Divisional Engineer 's office (Kashimpur Pumphouse).

(iv) Carry out any civil, mechanical and electrical repair or maintenance required during the operation phase through the staff of the Sub-Divisional Engineer's office (Kashimpur Pumphouse).

(v) Allocate a regular budget in the Annual Development Programme (ADP) of the government for operation, maintenance, and management of the PROJECT.

(vi) Participate in a two-tier committee structure, consisting of an Operation Committee and a Management Committee, in collaboration with the Directorate of Fisheries (DOF), other government departments (Agriculture and Environment), local administration, local elected representatives and beneficiary groups of farmers, fishers and women.

(vii) Make available the Sub-divisional Engineer (Kashimpur Pumphouse) to act as convenor of the Operation Committee for day-to-day operations.

(viii) Make available the BWDB Executive Engineer (Moulvibazar) to act as head of a new Management Committee that will be formed at Moulvibazar for overall management, including planning, budgeting and supervision.

(ix) Prepare a regular annual maintenance plan and budget in cooperation with the Operation Committee and the Management Committee.

(x) Record water levels on a daily basis in the river and the haor.

(xi) Ensure that fishpass gate opening and gate closing are carried out in accordance with the rules set out in the manual (Annex 'A').

(xii) Ensure that general rules for safety as specified in the manual (Annex 'A') are carried out at all times.

(xiii) Carry out periodic and annual maintenance of the fishpass, in accordance with the rules and regulations of BWDB for execution of the maintenance works, and as specified in the manual (Annex 'A').

(xiv) Carry out regular inspections for operational and maintenance works as specified in the manual (Annex 'A').

(xv) Prepare an inspection report indicating every damage, possibility of damage, breach of rules and other particulars on fishpass operation, maintenance and management, as specified in the manual (Annex 'A').

(xvi) Carry out periodic visits to the fishpass and record and forward findings to the Chief Engineer, Planning.

(xvii) Immediately prepare an interim report if any emergency occurs, and send it to the Superintending Engineer, Moulvibazar for authorization to take necessary action.

(xviii) Make available the necessary tools and materials through the Sub-Divisional Engineer's office (Kashimpur Pumphouse) to carry out operation and maintenance works.

(xix) Make available accommodation at the BWDB compound at Kashimpur for the Thana Fisheries Officer of DOF during the period May to July each year.

(xx) Take responsibility for liaison with the Directorate of Agriculture Extension, as represented by the Thana Agriculture Officer (Rajnagar) concerning fishpass gate opening and closing.

(xxi) Take responsibility for liaison with the representative of the Directorate of Environment concerning any environmental issues affecting Kawadighi Haor.

(xxii) Take responsibility for liaison with the Thana Nirbahi Officer (Rajnagar) and the Officer-in-Charge (Rajnagar Police Station) concerning the provision of administrative and judicial support for sanctuary management and *haor* management.

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(xxiii) Employ two Guards on a regular basis for the fishpass, who will record water levels, open and close the gates, clean water hyacinth and debris at the channels and inside the fishpass structure, ensure the safety of the structure, and guard the fish sanctuary area.

(xxiv) Engage two Operators as required, on a monthly basis, during fish sampling at the fishpass, with the cost to be paid by the agency undertaking the fish sample survey.

(xxv) Ensure on behalf of the Operation Committee that the guards are performing their duties regularly.

(xxvi) Ensure that the opening and closing of the gates shall be according to the rules specified in the manual (Annex 'A') and that indiscriminate closing of the fishpass shall not be made, outside the BWDB regulations for water levels on the *haor*.

(xxvii) Ensure that signboards are posted and maintained in the area to be the fish sanctuary.

(xxviii) Ensure that the BWDB fishpass guards patrol the fish sanctuary on a day and night basis.

(xxix) Ensure that the fish sanctuary guards and Ansars shall report in writing on a weekly basis to the Operation Committee, headed by the Sub-Divisional Engineer (Kashimpur Pumphouse).

(xxx) Take responsibility for clearing the fish sanctuary area of water hyacinth each year at the end of the post-monsoon period, through the Operation Committee.

(xxxi) Give consideration to closing the 3-vent regulator during the dry season to maintain the designed and desired minimum water level in the *beels* at 4.10 m PWD.

(xxxii) Prepare an annual report of operation, maintenance and management for presentation to the Ministry of Water Resources.

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ARTICLE VI
RESPONSIBILITIES OF DEPARTMENT OF FISHERIES

SECTION 6.01

The Department of Fisheries will be one of the implementing agencies for operation, maintenance and management of the Kashimpur Fishpass. Specific responsibilities will include the following:

(i) Monitor periodically the fish passing through the fishpass structure, according to the guidelines set out in the attached manual.

(ii) Instruct the Thana Fisheries Officer (Rajnagar) to participate as a member of the Operation Committee. The Thana Fisheries Officer (Rajnagar) or any other officer assigned by DOF will stay at Kashimpur from May to July period each year.

(iii) Instruct the District Fisheries Officer (Moulvibazar) to participate as a member of the Management Committee.

(iv) Instruct the Thana Fisheries Officer to take necessary steps to manage the fish sanctuary, including monitoring the sanctuary on a routine basis.

(v) Execute whatever task are judged necessary to control illegal fishing practices, as well as conduct periodic patrols and arrange for a mobile court to penalize offenders.

(vi) Conduct a public information campaign to discourage the practice of *beel* de-watering.

(vii) Operate and maintain the Fisheries Biology Laboratory of the PROJECT installed at the District Fisheries office, Moulvibazar.

(viii) Arrange public viewing and exhibition of the Fisheries Biology Laboratory of the PROJECT.

(ix) Allocate regular budget in the ADP for operation and maintenance of the Fisheries Biology Laboratory of the PROJECT.

(x) Prepare an annual report of operation, maintenance and management for presentation to the Ministry of Fisheries and Livestock.

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ARTICLE VII
RESPONSIBILITIES OF MINISTRY OF WATER RESOURCES AND MINISTRY OF FISHERIES AND LIVESTOCK

SECTION 7.01

Both ministries will have a general policy role. They will hold a joint annual meeting to review the annual fish operation, maintenance and management reports prepared by their respective agency or department. Executive orders will be issued to take action on any matters arising from the reports and the review process.

ARTICLE VIII
INFORMATION

SECTION 8.01

MOWR and MOFL shall ensure that this Memorandum of Understanding is carried out with due diligence and efficiency and each shall furnish to the other all such information relating to the PROJECT as shall reasonably be requested.

ARTICLE IX
COMMUNICATION

SECTION 9.01

Any communications or documents given, made or sent by either MOWR or MOFL pursuant to this Memorandum of Understanding, shall be in writing and shall be deemed to have been duly given, made or sent to the Party to which it is addressed at the time of its delivery by hand, mail, telegram, cable or radiogram at its respective address, namely:

For MOWR Secretary,
Ministry of Water Resources
Bhaban No 6
Bangladesh Secretariat
Dhaka

Telephone: 868688

Fax: 862400

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For MOFL	Secretary Ministry of Fisheries and Livestock Bhaban No 6 Bangladesh Secretariat
Telephone:	861258
Fax:	861117

SECTION 9.02

Any one of the Parties hereto may, by written notice to the other Party hereto, change the address to which any notice or request intended for the Party so giving such notice shall be addressed.

SECTION 9.03

All communications and documents submitted to either MOWR or MOFL shall be in either Bangla or the English language.

ARTICLE X
INTERPRETATION

SECTION 10.01

Difference which may arise in the application of the provisions of this Memorandum of Understanding shall be settled by means of negotiations between MOWR and MOFL or any other manner mutually agreed upon by the two Ministries.

ARTICLE XI
ENTIRE UNDERSTANDING

SECTION 11.01

This Memorandum of Understanding together with Annex 'A' which form an integral part hereof constitutes the entire understanding between the Parties with respect to the PROJECT.

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ARTICLE XII
CONSULTATIONS

SECTION 12.01

MOWR and MOFL will endeavour to consult each other in respect of any matter that may from time to time arise in connection with this Memorandum of Understanding.

ARTICLE XIII
GENERAL PROVISIONS

SECTION 13.01

This Memorandum of Understanding shall come into effect on the date of signature. This Memorandum of Understanding may be amended from time to time, as deemed necessary, by mutual agreement by an exchange of letters between the Parties hereto.

IN WITNESS WHEREOF, the undersigned have signed this Memorandum of Understanding in duplicate in Dhaka on the________________ day of __________________, 1998.

ON BEHALF OF THE MINISTRY OF WATER RESOURCES	ON BEHALF OF THE MINISTRY OF FISHERIES AND LIVESTOCK
__________________________	__________________________

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The purpose of this Memorandum of Understanding is to record the bipartite agreement between the Bangladesh Water Development Board (a specialised agency of the Ministry of Water Resources) and the Department of Fisheries (a department of the Ministry of Fisheries and Livestock) on the operation of the Kashimpur Fishpass located in Moulvibazar District. The roles and responsibilities of each agency are defined herein, and further elaborated in detail in Attachment 1 (Operation, Maintenance and Management Manual - Fishpass at Kashimpur). The responsibility for operation, maintenance and management of the fishpass is shared by the two parties on behalf of their respective ministries, and each undertakes to provide the staff and material resources as allocated and scheduled herein.

Signed on ____________________

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for Bangladesh Water Development Board for Department of Fisheries

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for Ministry of Water Resources for Ministry of Fisheries and Livestock

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1. FISHPASS OPERATION AND MAINTENANCE CONTEXT

1.1 Introduction

The Fishpass Pilot Project (FPP) is a component of the Northeast Regional Water Management Project (NERP) of the Flood Action Plan (FAP). It was funded by CIDA and executed by NERP with the collaboration of the Department of Fisheries (DOF) and the Bangladesh Water Development Board (BWDB). FPP consisted of the construction of a vertical slot fishpass across the embankment of the Manu River Irrigation Project (MRIP) near the Kashimpur pumphouse.

The fishpass was be handed over to the GOB in December 1997/January 1998. The lead agency responsible for the fishpass will be the Ministry of Water Resources through the BWDB, with collaboration from the Ministry of Fisheries and Livestock through the Directorate of Fisheries.

This Memorandum of Understanding describes the agreement between the two parties concerning the operation, maintenance and management of the Kashimpur Fishpass.

1.2 Description

A fishpass of the single-jet vertical slot design was constructed across the flood embankment of the Manu River Irrigation Project (MRIP) at Kashimpur in Moulvibazar District in order to assess the efficacy of this type of structure for mitigating the adverse impacts of flood control projects on floodplain fisheries. The objective of the project was to reestablish an open fish migration route between the Kushiyara River and Kawadighi Haor. The Kushiyara is the largest river in the Northeast Region and acts as an important fish migration pathway. Prior to the construction of the 60 km long full flood protection embankment, Kawadighi Haor was a highly productive fishery (ie a mother fishery) of regional importance. The end state vision of the Kashimpur fishpass pilot project is to rehabilitate the Kawadighi mother fishery.

The fishpass was constructed on land owned by the BWDB. Construction was carried out during the winter dry season period January-May 1995. The structure consists of a 61.85 m long concrete chute subdivided by baffles into 17 pools and two observation chambers. The access channels at either end connect to the Karadair khal. The access channels, along with portions of the khal and the adjoining Kushiyara River have been designated a fish sanctuary in order to protect vulnerable migrating fish from fishing mortality. Operation of the fishpass began on 24 May 1995. Impact monitoring, operation, maintenance and management of the fishpass has been carried out by NERP over a period of 29 months. The pilot phase of the project terminated on 31 Dec 97, and the structure was handed over to the GOB, represented by the BWDB.

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2. ROLES AND RESPONSIBILITIES

2.1 Role of Bangladesh Water Development Board

The Bangladesh Water Development Board will be one of the implementing agencies for operation, maintenance and management of the Kashimpur Fishpass. Specific responsibilities will include the following:

1. Accept authority and responsibility for the fishpass structure.

2. Instruct its staff (specifically the Sub-Divisional Engineer [Kashimpur Pumphouse], the Sub-Assistant Engineer [Kashimpur Pumphouse], the Executive Engineer [Circle-1, O&M Division, Moulvibazar] and the Superintending Engineer [&M Division, Moulvibazar]) to take responsibility for operation, maintenance and safety of the structure.

3. Provide logistic support for operation and maintenance through the SDE's office (Kashimpur Pumphouse).

4. Carry out any minor civil, mechanical and electrical repair or maintenance required during the operation phase through the staff of the SDE office (Kashimpur Pumphouse).

5. Provide a regular budget for future operation, maintenance, and management of the fishpass.

6. Participate in a two-tier committee structure, consisting of an Operation Committee and a Management Committee, in collaboration with the Directorate of Fisheries (DOF), other government departments (Agriculture and Environment), local administration, local elected representatives and beneficiary groups of farmers, fishers and women.

7. Make available the Sub-divisional Engineer (Kashimpur Pumphouse) to act as convenor of the Operation Committee for day-to-day operations.

8. Make available the BWDB Executive Engineer (Moulvibazar) to act as head of a new Management Committee that will be formed at Moulvibazar for overall management, including planning, budgeting and supervision.

9. Prepare a regular annual maintenance plan and budget in cooperation with the Operation Committee and the Management Committee.

10. Record water levels on a daily basis in the river and the haor.

11. Ensure that fishpass gate opening and gate closing are carried out in accordance with the rules of the attached manual.

12. Ensure that general rules for safety as specified in the attached manual are carried out at all times.

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13. Carry out periodic and annual maintenance of the fishpass, in accordance with the rules and regulations of BWDB for execution of the maintenance works, and as specified in the attached manual.

14. Carry out regular inspections for operational and maintenance works as specified in the attached manual.

15. Prepare an inspection report indicating every damage, possibility of damage, breach of rules and other particulars on fishpass operation, maintenance and management, as specified in the attached manual.

16. Carry out periodic visits to the fishpass and record and forward findings to the Chief Engineer.

17. Immediately prepare an interim report if any emergency occurs, and send it to the Superintending Engineer for authorization to take necessary action.

18. Make available the necessary tools and tackles and materials through the SDE's office (Kashimpur Pumphouse) to carry out operation and maintenance works.

19. Make available accommodation at the BWDB compound at Kashimpur for the Tana Fisheries Officer during the period May to July each year.

20. Take responsibility for liaison with the Directorate of Agriculture Extension, as represented by the Thana Agriculture Officer (Rajnagar) concerning fishpass gate opening and closing.

21. Take responsibility for liaison with the representative of the Directorate of Environment concerning any environmental issues affecting Kawadighi Haor.

22. Take responsibility for liaison with the Thana Nirbahi Officer (Rajnagar) and the Officer-in-Charge (Rajnagar P.S.) concerning the provision of administrative and judicial support for sanctuary management and *haor* management.

23. Employ two Guards on a regular basis for the fishpass, who will record water levels, open and close the gates, clean water hyacinth and debris at the channels and inside the fishpass structure, ensure the safety of the structure, and guard the fish sanctuary area.

24. Engage two Operators as required, on a monthly basis, during fish sampling at the fishpass, with the cost to be paid by the agency undertaking the fish sample survey.

25. Ensure on behalf of the Operation Committee that the guards are performing their duties regularly.

26. Ensure that the opening and closing of the gates shall be according to the rules specified in the attached manual, and that indiscriminate closing of the fishpass shall not be made, outside the BWDB regulations for water levels on the *haor*.

27. Ensure that signboards are posted and maintained in the area to be the fish sanctuary.

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28. Ensure that the BWDB fishpass guards patrol the fish sanctuary on a day and night basis.

29. Ensure that the fish sanctuary guards and ansars shall report in writing on a weekly basis to the Operation Committee, headed by the SDE (Kashimpur Pumphouse).

30. Take responsibility for clearing the fish sanctuary area of water hyacinth each year at the end of the post-monsoon period.

31. Give consideration to closing the 3-vent regulator during the dry season to maintain the designed and desired minimum water level in the *beels* at 4.10 m PWD.

32. Prepare an annual report of operation, maintenance and management for presentation to the Ministry of Water Resources.

2.2 **Role of Department of Fisheries**

The Department of Fisheries will be one of the implementing agencies for operation, maintenance and management of the Kashimpur Fishpass. Specific responsibilities will include the following:

33. To monitor periodically the fish passing through the fishpass structure, according to the guidelines set out in the attached manual.

34. Instruct the Thana Fisheries Officer (Rajnagar) to participate as a member of the Operation Committee. The Thana Fisheries Officer (Rajnagar) will stay at Kashimpur from May to July each year.

35. Instruct the District Fisheries Officer (Moulvibazar) to participate as a member of the Management Committee.

36. Instruct the Thana Fisheries Officer to take necessary steps to manage the fish sanctuary, including monitoring the sanctuary on a routine basis.

37. Execute whatever task are judged necessary to control illegal fishing practices, as well as conduct periodic patrols and arrange for a mobile court to penalize offenders.

38. Conduct a public information campaign to discourage the practice of *beel* de-watering.

39. Prepare an annual report of operation, maintenance and management for presentation to the Ministry of Fisheries and Livestock.

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2.3 Roles of Ministry of Water Resources and Ministry of Fisheries and Livestock

Both ministries will have a general policy role. They will hold a joint annual meeting to review the annual fish operation, maintenance and management reports prepared by their respective agency or department. Executive orders will be issued to take action on any matters arising from the reports and the review process.

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DOCUMENT 2

FISHPASS
OPERATION, MAINTENANCE AND MANAGEMENT MANUAL

TABLE OF CONTENTS

1. Background

The Fishpass Pilot Project (FPP) was funded by CIDA and executed by NERP with the collaboration of the Department of Fisheries (DOF) and the Bangladesh Water Development Board (BWDB). The FPP consisted of the construction of a vertical slot fishpass across the embankment of the Manu River Irrigation Project (MRIP), near the Kashimpur pumphouse. The fishpass was constructed on land owned by the BWDB. The fishpass structure was opened in May 1995. Since that time, impact monitoring, operation, maintenance and management of the fishpass has been carried out by NERP.

With completion of the pilot project on December 31 1997, the fishpass has been handed over to the GOB. The lead agency responsible for the fishpass will be the Ministry of Water Resources (MOWR) through the BWDB, with collaboration from the Ministry of Fisheries and Livestock (MOFL) through the Department of Fisheries (DOF). This will be agreed upon through a Memorandum of Understanding (MOU).

BWDB (O&M Division) will provide a regular budget for future operation, maintenance, and management of the fishpass.

The Department of Fisheries under MOFL will allocate regular budget in the ADP for operation and maintenance of the Fisheries Biology Laboratory of the project under District Fisheries office at Moulvibazar.

Based on NERP's experience with the pilot project and consultation with the project beneficiaries, this manual, including a budget will serve as a guideline for future fishpass operation, maintenance and management.

2. Organizational Structure

BWDB's operation, maintenance and management will include collaboration with the DOF, other government departments (Agriculture and Environment), local administration, local elected representatives and beneficiary groups of farmers, fishers and women. A two-tier committee structure, consisting of an Operation Committee and a Management Committee has been agreed upon, to meet the Organizational needs for operation, maintenance and management.

At the fishpass site at Kashimpur, the existing Operation Committee has been reformed and is being utilised for day to day operations. Headed by the Sub-divisional Engineer (Kashimpur Pumphouse), the 14-member Operation Committee includes departmental officials (Fisheries, Agriculture), elected representatives, fishers and farmers.

A new Management Committee has been formed at Moulvibazar for overall management, including planning, budgeting and supervision. This 20 member committee is headed by the BWDB Executive Engineer (Moulvibazar)/ Upazilla Chairman and includes departmental officials (BWDB, DOF, Agriculture Extension, Environment), the local administration (magistrate, police), elected male and female representatives and various interest groups (lease-holders, farmers, fishers and NGOs).

The responsibilities of both the Committees includes monitoring fishpass operation, fish sampling, sanctuary management, *beel* management and assisting BWDB (O&M Division) to prepare a maintenance plan.

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3. Budget and Planning

A regular and annual maintenance budget will be prepared by the BWDB (O&M Division), Moulvibazar, in co-operation with the Operation Committee and the Management Committee. The budget estimated for this manual is based on the assumption that the structure will remain in operation from March to September. Fish sampling will be carried out regularly or periodically, with the authorization of the Management Committee. Sanctuary management and *beel* management will be monitored throughout the year. The budget includes costs for fishpass operation, maintenance, equipment, management contingency items, pumping of water and fish sampling.

4. Fishpass Operational Plan and Activities

The main responsibility of the Operating Committee is to determine the annual period of operation for the fishpass and the correct time to open the fishpass gate. Successful completion of this task will involve discussion with farmer and fisher groups.

The Operating Committee will observe the crop status in the field and the area of cultivation. The Committee will discourage any crop cultivation in areas are below elevation 4.10 m (PWD), since this area is designated for fishery use. The MRIP is designed to keep the water body at 4.10 m (PWD), which will keep 1,965 hectares of the area submerged. The Operation Committee will observe the presence and magnitude of flood surges in the river and the water level status in Kawadighi Haor.

The Operation Committee will evaluate the importance of opening the fishpass during flood surges, through discussions with both the farmers and the fishermen. The Committee will verify the change in the *haor* water level in relation to fishpass opening. This verification will reduce the farmer's apprehension of crop damage by inundation.

As a general rule, the Operation Committee shall convene monthly. The monthly meeting of March shall be held in the first week to decide the opening of the fishpass. Additional meetings can also be called to deal with any emergency that may arise. Decisions about opening and closing the fishpass gates in relation to flood surges on the river usually must be taken in a matter of hours.

The Operation Committee shall be responsible for the following tasks:

- Water level record - the daily river water level and *haor* water level shall be recorded in a register. Water level shall be recorded throughout the year. Two permanent gauges are set at the riverside (R/S) and countryside (C/S) gates of the fishpass structure. Two temporary gauges require to be set at channels when water level lowers. Water level difference will indicate inflow into the *haor* or outflow from the *haor*. Gauge reader shall record the water level. Temporary gauges shall be available at the BWDB Kashimpur office;

- Gate opening - the gates of the fishpass shall open by the Operator, with the approval of the Operation Committee. The C/S gate will be opened before opening the R/S gate because the C/S gate cannot withstand the pressure caused by the water head on the R/S. Opening of the R/S gate before opening the C/S gate may cause damage to the C/S gate;

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- Gate closing - on a routine basis, the fishpass gates will be closed in the post-monsoon period at the end of September. ***However, the gate shall also be closed when the head difference across the structure is one meter or above during flow from C/S to R/S or when the riverside water level drops to 7.00 m (PWD) or below.*** An increase in head difference and lowering of river water level result in high velocity and possible erosion of the riverside channel. All gates will be locked after each operation and only the Operator shall be in possession of the keys or opening tools. The Operator shall not be allowed to surrender the keys or opening tools to any unauthorized person, and

- Control of aquatic debris and water hyacinth - no debris or aquatic plants should pass through the fishpass. Before operation begins, bamboo fencing shall be placed at R/S channel and at C/S channel, at a minimum distance of 50 meters from the structure itself.

5. Fish Sampling

To monitor the fish passing through the fishpass structure, sampling cages shall be used. To observe fish movement from R/S to C/S, the C/S sampling cage shall be operated. To observe fish movement from C/S to R/S, the R/S sampling cage shall be operated. A specific form shall be used to keep a record of sampled fish (sample form included with this manual). Fish sampling will only be allowed when it is approved from the Management Committee. The following activities and preventive measures shall be taken during fish sampling:

- Sampling cages shall be hung with two chain pulley blocks, each having a capacity of two tons;

- Sampling cages shall be lowered and raised by two trained Operators. The Operators shall not be frequently changed and unskilled Operators will not be allowed to operate the sampling cages. The sampling cages will be locked so that, unauthorized users cannot use them for illegal fishing;

- There will be no tilting of the sampling cage when it is lowered and raised;

- Each sampling period will not be more than two hours. If the sampling cage is submerged for excessive periods, the net of the cage can become blocked with small aquatic plants. This blockade will create water pressure on the sampling cage, creating the potential for damage to the cage or the trusses, on which the sampling cage is fixed;

- Sampling cage will be cleaned with a wire brush after each fish sampling;

- When the sampling cage is raised for monitoring fish movement, only one Operator is allowed to enter inside the sampling cage to extract the fish samples;

- At any time when the sampling cage is in the raised position, the Operator will assure that it is supported by iron angle bars (50 mm x 50 mm x 6 mm) at its four corners;

- During fish sampling, the screen at the upper gate shall be in position in order that fish can pass through the lower gate;

- Fish sampling equipment, including scale, balance, thermometer and bucket shall be carried to the site. After measurement of the fish sample, all live fish shall be released to the *haor* or river, depending on the direction of their migration, and

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- Some fish sampling can be done in the presence of farmers, fishermen and the Operation Committee members. Fish sampling in presence of local people will provide transparency for this activity.

6. General Rules for Safety

- The fishpass gates must be locked at all times. No unauthorized persons are allowed to change the position of the vertical gates. The keys will be kept with the Gate-Keeper.

- People are not allowed to enter the fishpass without approval from the relevant authority.

- Any trees planted near the structure, should be of the species where their roots do no extend outwards to damage the concrete of the structure.

- Bathing or washing at the channels will be prohibited.

- No one will pour any debris, bricks, earth or mud inside the structure.

- When fish sampling is not carried out, the opening of the observation chamber shall be covered with M.S. grill. The M.S. grill shall be locked and the key will remain with the SDE (Kashimpur Pumphouse). Removing of M.S. grill for sampling purposes will be decided upon by the Management Committee, who will provide written authorization to the SDE (Kashimpur Pumphouse).

- During fish sampling periods, people will be kept at safe distance during raising or lowering of the cage, so that, accidental event do not cause injury to any person.

- The electrical supply to the fishpass structure should be kept in good condition to avoid electrical accidents.

7. Maintenance

BWDB (O&M Division) will carry out periodic and annual maintenance of the fishpass. Rules and regulations of BWDB will be followed in execution of the maintenance works. BWDB (O&M Division), with the assistance of the Operation Committee and the Management Committee will prepare a list of the maintenance works for submission to the Executive Engineer. The Executive Engineer will review the list of maintenance works and submit the list to the Superintending Engineer for recommendation. Annual maintenance works will be completed by the end of February. The following maintenance work shall be carried out:

Channel Maintenance (annual maintenance/ dry season)

- Remove floating aquatic debris and water hyacinth;

- Cut grasses and weeds prior to monsoon;

- Maintain channel slope by repair of channel erosion;

- Fill animal holes in the side slopes, and

- Repair scour holes, remove deposition of silt and sand in the channels.

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Cement Concrete (C. C.) Block Maintenance (annual maintenance/ dry season)

- Re-position C.C. blocks are displaced;
- Remove damaged C.C. blocks and set new C.C. blocks, and
- Cutting grasses and weeds at the edges of blocks.

Main Structure Maintenance (annual and periodic maintenance)

- Clean and re-paint gauges fixed at the side of vertical gates;
- Clean deposited silts and algae inside the structure;
- Clean and re-paint exposed metal works;
- Clear, keep tidy and prevent encroachment of surrounding vegetation, and
- Keep the earthwork around the structure in good condition at all times, to prevent seepage.

Vertical Lift Gates (annual and periodic maintenance)

- Repair gates as necessary;
- Regularly ensure that gate movement is unimpeded;
- Clean and grease moving parts;
- Tighten and/ or replace nuts;
- Clean, rub down and re-paint metal work, and
- Periodically check and repair electricity lines.

Trusses and Sampling Cages (annual and periodic maintenance)

- Clean and re-paint exposed metal work;
- Clean and lubricate chain pulley blocks;
- Repair chain pulley blocks when necessary;
- Replace nets of sampling cages and paint sampling cages, and
- Tighten and/ or replace nuts.

8. Inspection for Operation and Maintenance Works

The Operation Committee, the Sub-Assistant Engineer (Kashimpur Pumphouse) and the Guard will each make a check of the components of fishpass maintenance, for which they are responsible. Any occurrence or damage with which they cannot deal with themselves is to be reported to the Sub-Divisional Engineer (Kashimpur Pumphouse), who will then make an inspection. The Sub-Divisional Engineer will prepare an inspection report indicating every damage, possibility of damage, breach of rules and other particulars on fishpass operation,

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maintenance and management. The report will also contain recommendations for action by the Operation Committee and the Management Committee. The report will be forwarded to the Executive Engineer, who will make inspection trips, as and when he deems necessary. The Executive Engineer will add his remarks on the report of the SAE and SDE and will forward to the Superintending Engineer for authorization.

The Superintending Engineer will make periodic visits to the fishpass. The findings of the Superintending Engineer will be recorded and forwarded to the Chief Engineer. This report will contain a description of operation, maintenance and management activities and recommendation to the Operation Committee and the Management Committee for their necessary action to rectify any problems.

If any emergency occurs, an interim report will be made immediately and sent to the Superintending Engineer for authorization to take the necessary action.

9. Tools and Materials for Maintenance

In order to execute the maintenance work, it is important that the necessary tools and tackles and materials are available from the SDE's office (Kashimpur Pumphouse) and made available, as required. Tools such as hoe, sickle, spade, saw, axe, crowbar, spanner, hand drill shall be required. The gate handles shall be stored with the SDE (Kashimpur Pumphouse) and made available for opening and closing the vertical gates. For the maintenance of the vertical lift gates, the chain blocks and the cages, the operators must be provided with grease, lubricating oil, paint, turpentine or petroleum.

10. GOB Staffing

BWDB (O&M Division)
The fishpass structure shall be under the authority of the Bangladesh Water Development Board. The Sub-Divisional Engineer (Kashimpur Pumphouse), the Sub-Assistant Engineer (Kashimpur Pumphouse), the Executive Engineer (Circle-1, O&M Division, Moulvibazar) and the Superintending Engineer (O&M Division, Moulvibazar) will be responsible for operation, maintenance and safety of the structure. The SDE's office (Kashimpur Pumphouse) will provide logistic support for operation and maintenance. Any minor civil, mechanical and electrical repair and / or maintenance required during the operation phase will be done by the staff of the SDE office (Kashimpur Pumphouse).

Department of Fisheries
As a member of both the Operation and Management Committees, the Thana Fisheries Officer (Rajnagar) and the District Fisheries Officer (Moulvibazar) shall be particularly concerned with the fishpass gate opening and closing and the management of the sanctuary and the Kawadighi Haor, including all its *beels*. The Thana Fisheries Officer (Rajnagar) will stay at Kashimpur from May to July each year. Accommodation will be arranged at the BWDB compound at Kashimpur. A furnished room has been handed over for this purpose.

Department of Agricultural Extension
As a member of both the Operation and Management Committees, the Thana Agriculture Officer (Rajnagar) shall be particularly concerned for the fishpass gate opening and closing.

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Department of Environment
As part of the Management Committee, the representative of the Department of Environment shall be particularly concerned to address any issue concerned with environment effects in the Kawadighi Haor.

Administration and Police
The Thana Nirbahi Officer (Rajnagar) and the Officer-in-Charge (Rajnagar P.S.) will provide administrative and judicial support for sanctuary management and *haor* management.

11. Additional Personnel Requirement

Guards
BWDB will employ two Guards on a regular basis for the fishpass. Their duties will include recording water level, opening and closing the gates and cleaning water hyacinth and debris at the channels and inside the fishpass structure. They shall be also responsible for the safety of the structure and for guarding the sanctuary area. The Guards will report to the SDE (Kashimpur Pumphouse), with information to the Operation Committee.

Operators
Two Operators are required during fish sampling at the fishpass. They shall be engaged as required, on a monthly basis, by the agency undertaking the fish sample survey. The Operators will report to the agency undertaking the sampling. The operators shall be well trained in raising and lowering the sampling cages. Their duties will include operating the sampling cages at any time of the day or evening and cleaning the cages after each sampling operation. The total cost of the fish sampling survey will be borne by the agency, undertaking the sampling operation.

12. Committee Arrangements

There will be a two-tier committee system for maintenance, operation and management of the fishpass. A newly formed Management Committee at Moulvibazar will be responsible for overall management, planning and budgeting. The Operation Committee at Kashimpur will be responsible for fishpass operation and maintenance, with some monitoring functions of the fishpass sanctuary and the Kawadhigi Haor, as assigned by the Management Committee.

The Existing Operation Committee
The Operation Committee is situated at Kashimpur. At the time of the hand over, the Operation Committee has been successfully managing the tasks related to fishpass operation and settlement of disputes for the past 2 years. The present Operation Committee has been strengthened and will continue for a term of 2 years. Upon the expiry of its present term, the Management Committee will reform the Operation Committee based on the guidelines given in the subsequent section. The SDE (Kashimpur Pumphouse) will serve as Convenor and the Fatehpur Union Council Chairman will serve as Member-Secretary. The Committee will be strengthened by the Fisheries Officer and the Agriculture Officer of Rajnagar thana.
The proposed new 14-member Operation Committee is as follows:

1. SDE (Kashimpur Pumphouse), BWDB - Convenor
2. Md. Jami Ahmed (Chairman, Fatehpur Union Council & Fisher Lessee) - Member-Secretary
3. Thana Fisheries Officer (Rajnagar) - Member
4. Thana Agricultural Officer (Rajnagar) - Member
5. Sayeed Mia (Member, Fatehpur Union Council, Islampur) - Member

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6. Suresh Chandra Namasudra (Member, Fatehpur Union Council and Fisherman, Jahidpur) Member
7. Akal Mia (Contractor, Islampur) - Member
8. Kadir Mia (Farmer, Kashimpur) - Member
9. Sufian Mia (Farmer, Islampur) - Member
10. Munir Mia (Farmer, Islampur) - Member
11 Shamsul Islam Mollah (Farmer, Islampur) - Member
12. Mosabbir Mia (Farmer, Kashimpur) - Member
13. Hanif Ullah (Chairman, Shapla Fisheries Cooperative Society and Chairman, Open Water Management Samity, Manumukh) - Member
14. Abdul Hamid (Farmer) - Member

The Operation Committee will meet once per month. Such routine meetings will be called by the Member Secretary. Urgent meetings will be called, as necessary, by the SDE (Kashimpur Pumphouse). The Convenor of the Operation Committee can hold a general meeting based on the decision of the Operation Committee.

The Operation Committee will continue to hold their meetings in the BWDB building, for which purposes, a furnished room has been provided.

The Operation Committee will be mainly responsible for operation of the fishpass. Fishpass opening and closing shall be in collaboration with the interests of farmers, who have crops in the Kawadighi Haor. It is essential that decisions related to operation of the fishpass be made within a matter of hours, when water suddenly rises on the river.

The Operation Committee shall also assist in monitoring illegal fishing activities in the sanctuary and the Kawadighi Hoar, on instruction from the Management Committee.

In the future, the Operation Committee will be re-formed to consist of 12 members, as follows:

The Re-formed Operation Committee

Serial No.	Representative	Number
1.	SDE (Kashimpur pump house), BWDB - Convenor	1
2.	Fatehpur Union Council Chairman - Member Secretary	1
3.	Thana Fisheries Officer- Member	1
4.	Thana Agricultural Officer - Member	1
5.	Fatehpur Union Council Member (male, representing wards near the Fishpass) - Member	1
6.	Fatehpur Union Council member (female, representing wards near the Fishpass) - Member	1
7.	Farmer (close to the Fishpass) - Member	1
8.	Farmer (close to the Fishpass) - Member	1
9.	Farmer (in distant haor) - Member	1
10.	Fisherman (river fisherman) - Member	1
11.	Fisherman (haor fisherman) - Member	1
12.	Fisherman (haor fisherman) - Member	1
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The Management Committee

A second committee has been formed as a Management Committee, situated in Moulvibazar. They will be responsible for overall management of the fishpass including repair, maintenance, annual plans and budgets, as well as monitoring of the fish sanctuary and management of the Kawadighi Haor. The Management Committee will also represent the fishpass for visitors and officials wishing to visit the fishpass.

At present, the Management Committee consists of 20 members, headed by the BWDB Executive Engineer (Moulavibazar). The Thana Fishery Officer (Rajnagar) will serve as Member-Secretary of the committee. The Management Committee members include leasees, fishers, farmers, elected male and female representatives, government officers (BWDB, DOF, DAE, and DOE) and a local NGO. Local administration is represented by the Thana Magistrate and the Officer-in-Charge, Rajnagar P.S.

The Management Committee will meet at a minimum of twice a year - once in the pre-monsoon period and once in the dry season period. At other times, the Management Committee may be required to call urgent meetings to provide support to the Operation Committee or to oversee problems associated with fishpass management. The Convenor of the Management Committee can hold a general meeting based on the decision of the Management Committee.

Pre-monsoon meeting issues will include fishpass opening and control of illegal fishing in the sanctuary. Dry season meeting issues will include maintenance and budget preparations, and *hoar* management issues including de-watering of *beels* and assuring minimum dry season water levels.

The Management Committee will be composed, as follows:

Serial No.	Representative	Number
1.	Executive Engineer, BWDB (Moulvibazar) or Thana Parishad Chairman (after the Upazilla elections) - Convenor *	1
2.	Thana Fisheries Officer (Rajnagar) - Member Secretary	1
3.	Thana Magistrate - Member	1
4.	BWDB SDE (Concerned with Fishpass) - Member	1
5.	Officer-in-Charge, Rajnagar P.S. - Member	1
6.	SDE (Kashimpur Pumphouse) - Member	1
7.	Thana Agricultural Officer (Rajnagar) - Member	1
8.	Representative from Directorate of Environment - Member	1
9.	Chairman, Fatehpur Union - Member	1
10.	Woman Fatehpur Union Council Member (representing wards near the Fishpass) - Member	1
11.	Representatives from Operation Committee (Kashimpur) -Members	2
12.	Farmers (one from near Fishpass and one from Haor, excluding Operation Committee Representation) - Members	2
13.	Fishermen (excluding Operation Committee representatives)	1
14.	Woman from fishers family - Member	1
	Leasees (2 from Kawadighi Hoar Fisherman's Association and 1 from a River Fisheries Committee) - Members	3
16.	NGO Representative - Member	1
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* Note: After the election of Upazilla Parishad Chairman, the Executive Engineer will be withdrawn and BWDB representatives on the Management Committee will remain as SDE (concerned with Fishpass) and SDE (Kashimpur Pumphouse).

13. Fishpass Structure Management

The Management Committee shall be overall responsible for operation and management of the fishpass. They shall delegate the task of fishpass operation to the Operation Committee who will take the necessary decisions for fishpass operation.

- Guard duty - The Operation Committee, through the SDE (Kashimpur Pumphouse) shall observe that the Guards are performing their duties regularly. No unauthorized persons or activities will be allowed at the fishpass.
- Opening and closing the gates - care shall be taken to keep the fishpass open over the whole period of operation. No indiscriminate closing of the fishpass shall be made, outside the BWDB regulations for water levels on the *haor*.
- Prohibited fishing - at the structure and the fishpass channels shall be checked regularly.
- Safety measures - at the fishpass structure shall be verified regularly.
- Electricity - there shall be regular electricity supply at the fishpass site.

Any minor conflicts due to fishpass operation shall be settled by the Operation Committee, through the Union Council Chairman. In case of failure to settle disputes, the Convenor of the Operation Committee will report to the Management Committee, who will in turn apply for judicial back-up from the Thana Magistrate and the O.C.

14. BWDB Reporting

The Superintendent Engineer, BWDB, Moulvibazar will prepare an annual report of operation, maintenance and management for presentation to the Ministry of Water Resources through Chairman, BWDB.

15. Fishpass Sanctuary Management

<u>Sanctuary Establishment</u>
In 1995, the Ministry of Land declared a fishpass sanctuary on both sides of the fishpass. The Ministry of Land also instructed DOF (Moulvibazar) and the concerned Administration to execute the effective management of the fish sanctuary. The fish sanctuary was established to ensure the undisturbed migration of fish from river to the Kawadighi Haor. During the dry season, the sanctuary area becomes a relatively secure refuge for fish stocks inside the *haor*. The management of the fish sanctuary is also important for the natural propagation of fish.

<u>Sanctuary Area</u>
The following areas have been declared a fish sanctuary for five years, effective from May 30 1995. The sanctuary consists of four areas, which were formerly *jalmohals* along the adjacent parts of the Kushiyara River and the Koradair Khal. A location map is included in the manual.

The sanctuary area is described as follows:

Area Name	Location	Area/ distance
Koradair Khal 3	C/S	13.65 ha
Koradair Khal 1	C/S	4.21 ha
Koradair Khal 2	C/S	8.40 ha
Junction of Kushiyara River reaches 16 and 17 (including pumphouse outlet channel)	R/S	500 meter long

Sanctuary Management Tasks

The Management Committee shall be overall responsible for management of the sanctuary. They may request assistance from the Operation Committee for some tasks related to management of the sanctuary.

The following activities may be utilized in managing the Sanctuary:

- Signboards - there will be posting and maintenance of the signboards which declare the area to be a sanctuary;

- Patrol of the Sanctuary - sanctuary patrol will be carried out on a day and night basis by two BWDB Fishpass Guards. They shall be supported by the Ansars assigned for Kashimpur pumphouse protection. This may be arranged by the TNO (Rajnagar). The Operations Committee shall make routine visits to the sanctuary.

- Sanctuary Reporting - the guards and ansars shall report in writing on a weekly basis to the Operation Committee, headed by the SDE (Kashimpur Pumphouse). The SDE will then report on a monthly basis to the Management Committee, with its Member Secretary as the Thana Fisheries Officer (Rajnagar). The Management Committee will take what judiciary or other action, they deem to be necessary.

- Routine Visits by the Thana Fisheries Officer (Rajnagar) - In addition to monitoring during the May to July period, the Thana Fisheries Officer shall monitor the sanctuary on a routine basis. He shall submit written inspection reports to the District Fishery Officer (Moulvibazar), with copies to the Management Committee.

- Cleaning the Sanctuary - through a budget arranged by BWDB (O&M Division), the Operation Committee will clear the water hyacinth from the sanctuary area, each year at the end of the post-monsoon period.

- Renewal of Sanctuary Agreement - At the end of sanctuary period (May 2000), the Management Committee will apply for extension of the sanctuary agreement, through the District Fisheries Officer (Moulvibazar).

Fisheries Management of Kawadighi Haor and Beels

The Management Committee shall be overall responsible for the promotion of fish conservation in Kawadighi Hoar and its *beels*. They may request assistance from the DOF and the local judiciary and police for some tasks related to controlling illegal fishing practices. The following activities may be initiated by the Management Committee to promote good fish conservation of the *haor* and *beels*:

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MRIP Water Level During the Dry Season
The water level on the *beels* is related to good conservation of fish during the dry season. During this period, farmers and fishers prefer a lower water level in order to maximize fish catch and cultivate *boro* rice at the side of *beels*. Low water levels reduce the fish stock remaining in the *beels* and leads to an increase in fish disease.

The MRIP is designed to maintain minimum water level at 4.10 m PWD. To maintain the designed and desired water level in the *beels*, BWDB and the Management Committee should consider closing the 3-vent regulator during the dry season.

De-watering of *Beels*
The common practice of both leasee and fisherman is to de-water beels during the latter part of the dry season, in order to obtain the maximum catch. The practice of de-watering beels has been prohibited by a gazetted notification from the Ministry of Fisheries and Livestock, entitled "The Protection and Conservation of Fish Rules, 1985" vide Rule 3, Sub-rules 1 and 2.

In order to discourage the practice of *beel* de-watering, a public information campaign should be conducted by the DOF. In addition, the DOF should conduct periodic patrols and arrange for a mobile court to penalize offenders.

Illegal Fishing Practices
The use of illegal fishing gear is prohibited by a gazetted notification from the Ministry of Fisheries and Livestock, entitled "The Protection and Conservation of Fish Rules, 1985" vide Rule 12. Catching of under-sized fish is prohibited by the "The Protection and Conservation of Fish Rules, 1985" vide Rule 9.

These activities should be discouraged through a public information campaign. Monitoring of illegal fishing practices should be conducted through DOF patrols of the *hoar* and the arrangement of a mobile court to penalize offenders.

It is suggested that mobile courts should be conducted twice in the dry season and twice in the monsoon season. This protection measure can be initiated by the Management Committee, the DOF, the judicial authorities and the police.

Management of Fish Laboratory
The Fisheries Biology Laboratory has been shifted and installed at the District Fisheries office at Moulvibazar. The District Fisheries office will operate and maintain the laboratory and arrange public viewing and exhibition of the Fisheries Biology Laboratory.

16. DOF Reporting

The Department of Fisheries, District Office, Moulvibazar will prepare an annual report of fisheries operation, maintenance and management for presentation to the MOFL.

17. Pump Cost for Additional Storage

Inflow through fishpass from March to September causes additional storage at the project area. This additional storage submerges certain agriculture area. Any significant change in water level and inundation of low elevation land during the pre-monsoon season caused by fishpass could result in the submergence of deepwater *aman* at an early vegetative growth stage and the *boro* rice at the ripening stage. Moreover *aus* crop could also be inundated with the inflow from fishpass. Additional storage may delay the transplantation of *aman* seedling. Late transplantation would reduce the yield, as plants would not get sufficient time for vegetative growth. Hence to save the crops from submergence, pumping is essential. Pumping hours require to bail out this additional storage due to fishpass is estimated based on the rated capacity of the pumps. Total cost of pumping was estimated based on the pumping cost per hour.

18. Budget

The annual budget required for operation and maintenance of fishpass is based on the activities related to operation, maintenance, equipment and contingency for management. A budget estimate for sampling has been provided, with the understanding that this cost will be borne by the agency who wishes to conduct the fish sampling. The budget costs for fishpass guards has been included under Operation. Since operation and maintenance of the fishpass will be maintained by O&M staff of the MRIP, any office expenditure or overhead cost is not considered in this budget.

This annual budget, including future maintenance works has been prepared on the basis of the expenditures incurred during monitoring of the FPP. Any major expenditure or any new work at the fishpass is not considered in the budget. Estimates are based on the *Standard Schedule of Rates Manual*, Moulvibazar O&M Circle. Items which are not included at the schedule of rates, have been budgeted at the rates of actual cost at field level.

SUMMARY OF ANNUAL FISHPASS BUDGET

Budget Heads	Amount (Tk)
1. Operating Cost	55,560.00
2. Periodic and Annual Maintenance Cost	46,500.00
3. Equipment Cost	7,000.00
4. Management Contingency	18,000.00
5. Pumping Cost	500,000.00
6. Physical Contingency	22,940.00
Sub-Total	**650,000.00**
7. Fish Sampling Cost*	53,920.00
Grand-Total	**703,920.00**

NOTE: * Fish sampling cost is to be borne by the agency undertaking sampling.

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1. Operating Cost

Operating Budget Head	Amount (Tk)
1.1 Salary for two Guards/ Gate Keepers for 12 months at the rate of Tk.2,000 per month	48,000.00
1.2 Use of grease at four vertical gates - 2 months, 12 kg. grease @ Tk. 130 per kg	1,560.00
1.3 Repair of electricity lines - purchase of bulb, tube light, ballast, starter, wire, and other accessories, 12 months @ Tk. 500 per month	6,000.00
Sub-Total	**55,560.00**

2. Periodic and Annual Maintenance Cost

Maintenance Budget Head	Amount (Tk)
Channel Maintenance	
2.1 Cutting grass and weeds at dry season	1,000.00
2.2 Earth work repair for slope erosion and animal holes	2,000.00
2.3 Labour for repair of scour and siltation of channels	2,000.00
Preventive Works	
2.4 Bamboo fencing at R/S channel and C/S channel to protect aquatic plants from entering the fishpass	4,000.00
Main Structure and Gates	
2.5 Earthwork at slope of the embankment adjacent to fishpass	1,500.00
2.6 Cleaning and re-painting gauges located adjacent to gates	1,000.00
2.7 Cleaning silt and algae inside the structure	3,000.00
2.8 Cleaning and re-painting M. S. grills at the top of the fishpass	3,000.00
2.9 Cleaning and re-painting vertical lift gates	2,000.00
Trusses and Sampling Cages:	
2.10 Cleaning and re-painting trusses	2,000.00
2.11 Repairing sheds of trusses	1,000.00
2.12 Replacing nets of sampling cages	15,000.00
2.13 Re-painting sampling cages	3,000.00
Water hyacinth	
2.14 Clearing water hyacinth in the sanctuary area	6,000.00
Sub-Total	**46,500.00**

3. Equipment Cost

Equipment Budget Head	Amount (Tk)
3.1 Tools for maintenance and regular works such as hammer, hand gloves, hoe, sickle, spade, spanner, axe, hand drill, etc.	3,000.00
3.2 Safety tools such as first aid box, torch, umbrella, and gum boot	2,000.00
3.3 Bamboo ladder for repairing works	500.00
3.4 Uniform for Guard	1,500.00
Sub-Total	**7,000.00**

4. Management Contingency

Management Contingency Head	Amount (Tk)
4.1 Monthly operation meeting - 12 (meetings) x 13 (members) x Tk 50 (travel) and tea	8,000.00
4.2 Management Committee meeting - 2 (meetings) x 20 (members) x Tk 200 (travel) and tea	10,000.00
Sub-Total	**18,000.00**

5. Pumping Cost

Pumping Budget Head	Amount (Tk)
5.1 Cost of pumping for additional storage at the project area	500,000.00
Sub-Total	**500,000.00**

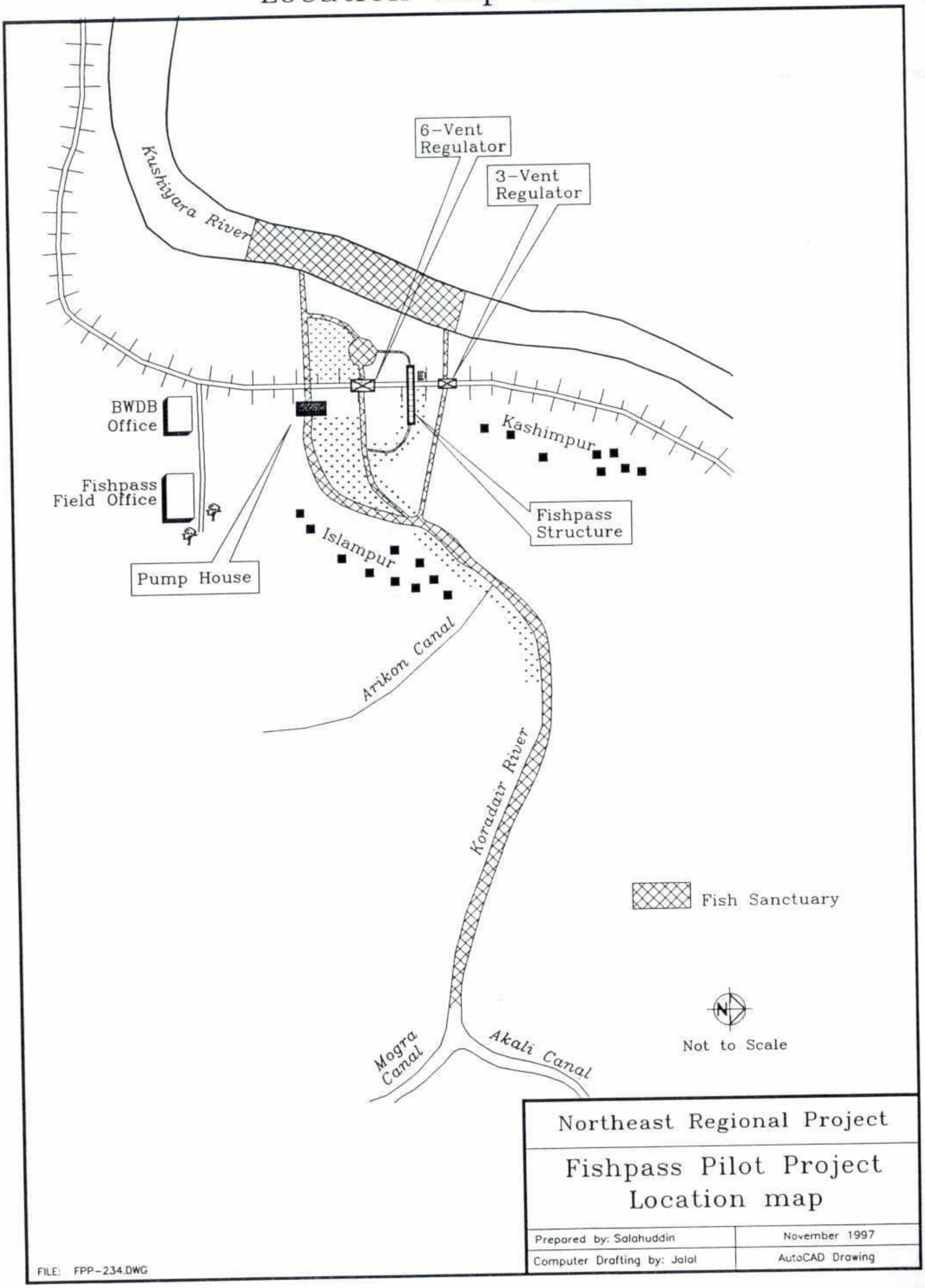
6. Physical Contingency

Contingency Budget Head	Amount (Tk)
6.1 Physical contingency 3.5% of the total cost	22,940.00
Sub-Total	22,940.00

7. Fish Sampling Cost

Fish Sampling Budget Head	Amount (Tk)
7.1 Two Sampling Operators - 7 months (march to September) salary @ Tk 2000 per month	28,000.00
7.2 Re-placement of chain pulley blocks (2 ton capacity) - 4 numbers @ Tk. 3500 per block	14,000.00
7.3 Repair of chain pulley blocks	4,000.00
7.4 Use of lubricant (mobile oil) for chain pulley blocks - 10 litres @ Tk. 52 per litre	520.00
7.5 G.I. Wire brush for cleaning sampling cages - 4 brushes, 7 months @ Tk.50 per brush	1,400.00
7.6 Equipments for fish measurements - scale, balance (500 gm), balance (20 kg), thermometer, buckets	6,000.00
Sub-Total	**53,920.00**

Location Map of FPP



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FISHPASS SAMPLING FORM

Date start: ______________ Date end: ______________

Time start: __________ Time end: __________ Duration: ______________

Water level start R/S _______ m PWD Water level end R/S _______ m PWD

Water level start C/S _______ m PWD Water level end C/S _______ m PWD

Water temperature: Air__________°C, Water__________°C

Weather: ____

Chamber Sampled : River Side / Country Side

Species	Number	Total Length (cm)	Weight (g)	Remarks

Appendix J

CONCEPTUAL DESIGN DEVELOPMENT OF VERTICAL SLOT FISHPASS

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J.1 INTRODUCTION

J.1.1 Fishpass Structures at FCDI Projects

The objective of construction of fishpass structures at FCDI projects is to create fish migration routes between haors and rivers. The migratory routes are for spawning, grazing, and overwintering. Construction of fishpasses was conceived to mitigate the adverse impact of FCDI projects by providing passage to migrating fish stocks across the embankment with the expectation of increasing fish production and fish biodiversity.

Conventional fishpasses are constructed along rivers where there are obstructions across the rivers. These fishpasses are built with the assumption that fish migrate only in the upstream direction. In contrast, construction of fishpass at FCDI projects must allow for fish to migrate bidirectionally (from river to haor and haor to river). One solution to this problem is to construct two fishpasses to allow segregated migration in each direction. Cost and space considerations however might not allow such a solution. Alternatively, it may be possible to design a single fishpass for bidirectional migration.

At existing flow control structures as well as at locations where new regulators are planned between rivers and haors, migrating fish encounter adverse hydraulic conditions in both upstream and downstream direction. Existing control structures would likely require major modifications for conversion into fishpasses. Such a converted structure may still be less efficient compared to constructing a separate new fishpass.

Hydraulic design of a conventional fishpass is based on target species that will utilise the fishpass. However, during design of fishpasses at FCDI projects consideration must be given to direction of movement by the various species that will use the structure. Before construction of fishpass structure, it is appropriate to do large scale model studies to ensure that the design functions satisfactorily.

J.1.2 Fishpass Application Projects

BWDB has constructed many FCDI projects and there are plans for construction of new projects at different locations of Bangladesh. There are opportunities to install fishpasses to reduce the negative impact of full flood control embankments. In an existing project or newly planned project, detailed hydrological, fisheries, and socio-economic baseline studies are essential. At partial flood control projects, fishpass can be installed for spawning migration during the pre-monsoon if feasible. The following points should be considered for the installation of fishpass at FCDI projects :

- Disruption of fish migration.
- Availability of migratory fishes in the river.
- Size of the FCDI project.
- Floodplain area, depth and inundation duration.
- Beel system in the project area and availability of perennial beels.
- Perennial channel system.
- Hydrology of the river.
- Cropping pattern of the project.
- Community interest in fisheries.

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J.1.3 Hydrology and Hydraulics

Hydrology

Each of the existing flood control structures and new structures planned are all unique as to site hydrology. Information needed for the design of fishpass includes site specific data such as river side water levels and haor side water levels, local topography, magnitude of flow and velocities and water surface profiles along each bank upstream and downstream of the proposed fishpass location. Combined with biological requirements and hydraulics, these physical parameters will determine the type of fishpass facility which will suit a specific FCDI project.

Hydraulics

Through knowledge of the hydraulics at existing and new flood control structures is imperative for the planning and design of fishpass facilities. Theoretical principles combined with actual site observations and possible modelling are tools used to appropriately locate fishpass entrances and exits, and to determine the scale of the facility and passage flow in combination with biological requirements. Model studies can be a valuable tool in helping the designer understand the fishpass and fish entrance setting.

The main concern in the hydraulic design of a fishpass is to determine the best way to control the water flowing through the structure so as to dissipate its energy most efficiently without hindering the swimming ability of the fish. There is however no rational approach to the problem of energy dissipation in a fishpass and most existing structures built have been copied from original designs made with the help of hydraulic model studies. The ultimate design would be a large scale model where flow pattern, energy dissipation and surface profiles can be observed and improvements made if necessary.

J.2 DESIGN GUIDELINES FOR FISHPASSES AT FCDI PROJECTS

J.2.1 Hydrology

Water Levels
For hydrological analysis, river water level and haor water level should be available for a minimum of 15 years. Daily data should be available for computational purpose. Water levels are the primary data for selection of type of structure, size of structure, and hydraulic analysis. For a fishpass at a newly planned FCDI project, haor water level should be computed from daily basis routing analysis.

Water level hydrographs show the number of flood surges in the river and the magnitude of the flood surge. It is observed from monitoring of the fishpass at Kashimpur that higher fish migration takes place during high head difference across the structure at pre-monsoon and monsoon. Project water level does not fluctuate in unison with river water level. Hence, a higher number of fluctuations in river water level is a positive indication for higher migration. Low water level to high water level in a river can be attained within a shorter period or longer period. The preferred high head difference is one which is caused by an increase in river water level within a short period. Hence fluctuation of river water levels is an important factor for in migration (river to haor).

The increase in river water level may be because of local rainfall or rainfall in the catchment. Simultaneous rainfall and high water level difference is a favourable situation for fish migration.

The hydrology of each FCDI project is unique. It is necessary to evaluate project water level for a series of years. River water level hydrographs for available years should be used for the design of a fishpass. To determine the project water level, routing analysis should be done using data of rainfall, percolation, evapotranspiration for a series of years. Routing analysis should be on a daily basis for the total year.

Velocity
Velocities at a fishpass depend on the type and dimensions of the structure. For a vertical slot fishway the maximum velocity at a slot can be calculated as $V_{max} = (2gh)^{1/2}$ m/sec. For design purpose, maximum velocity should be used instead of average velocity. Inlet and exit velocity should be such that fish can locate the entrances to the fishpass.. At the inlet and exit of the structure there should be no eddies or turbulence which will obstruct fish movement. Depending on in-migration or out-migration maximum velocity at slots should be compatible with the behaviour and swimming ability of fishes. Velocities at the slot should be such that energy dissipation or turbulence at pools does not create any injury to fish. In pools there should be some low velocity areas where fish can rest between moving from one pool to another.

Design Head and Head Drop
Head differences during flood surges can be estimated for each year by analysing available annual hydrographs and computing project water levels. For the computation of design, frequency of occurrences of head differences should be prepared. A maximum frequency of occurrence of the design head difference is desirable for fish migration. Dimensions of the structure should be based on the design head, and should be such that maximum head difference is dissipated within the structure. In order to avoid eddies at the inlet and exit, the total head drop should be within

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the structure. Allowable head drop at each pool should be considered from design velocity. Since head loss at pools varies with the change of total head, approximate head loss can be estimated from water surface profile.

J.2.2 Hydraulics

Baffles and Pool Dimension
The total number of baffles in a fishpass can be computed from the design and the maximum head difference across the structure, and allowable head drop at each pool. Pool dimensions should take into account the maximum turbulence limit. Also, flow profile will govern the pool dimensions so that a resting area can be formed in the pool. Flow profile at the fishpass should be such that a series of streamlines are formed through which fishes can identify the direction of movement (Figure J.1). Experimented pool dimensions and flow profiles are shown in Figure J.2.

Baffle Adjustment
A fishpass should be designed to achieve equal head drop at each slot and single event of head difference across the structure. Flood surges are not of equal magnitudes, and generally pre-monsoon surges are of higher magnitude than monsoon surges. Due to lower head difference during the monsoon, flow velocities at slots and at inlet and exit decreases. To increase the flow velocities at the structure and in C/S channels, some baffles can be designed to be movable which can be removed during the monsoon.

Invert Level
The invert level of a fishpass depends on river bed level and perennial beel level, and should allow inflow with minimum depth of flow of 1.5 meter during the first pre-monsoon flash flood. Also, it should allow pre-monsoon drainage when river water level falls.

Slope of Fishpass
The slope of the structure should be such that an equal depth of water is present in the pools at the design head difference. During higher fish migration periods, there should be equal head drop at pools. During the post-monsoon when drainage occurs, excessive turbulence may occur at downstream slots due to reverse flow. To avoid excessive turbulence during the post-monsoon, a milder slope is preferred. Considering these criterion, a slope should be provided to achieve optimum operational conditions throughout the monsoon.

Slot Width
Slot width should be determined from the size of fishes that will use the fishpass, and the volume of water that will be allowed to enter the FCDI project area.

Stilling Basin
Though a fishway is designed to facilitate no head losses at inlets and exits, high head difference across the structure may cause some head loss at inlet or at outlet. Therefore, the stilling basin should be designed with a consideration of 0.3 m to 0.5 m head loss. This will prevent erosion of inlet and outlet channels.

Inflow through Fishpass
Inflow in an FCDI project will depend on the beel area and the channel system of the project. In an FCDI project area where boro crop dominates, the volume of inflow should cause little or no damage to crops. Discharge can be controlled by increasing the number of baffles or by

reducing the opening area. For FCDI projects where agriculture damage is a factor, adjusting the opening area and adjusting movable baffles can reduce inflow during the pre-monsoon and increase inflow during the monsoon. To asses the impact of inflow on agriculture land, the total inflow and outflow system in the project area should be computed. This can provide an approximate impact estimate on agriculture. Considering only the inflow through the fishpass will not reliably predict the actual impact on agriculture. It is preferred that the impact of inflow should be verified in the field rather than relying on theoretical computation. The equation for computation of discharge through fishpass from river to haor is as follows:

$$Q = C_d A(2gh)^{1/2}$$

Where Q : Discharge in m^3/sec
C_d : Coefficient of discharge
A : Area in m^2
g : Acceleration due to gravity in m/sec^2
h : Head loss at slot in meter

Coefficient of discharge C_d, should be taken as 0.62.

Flood Intensity
From FPP monitoring, it is evident that increased flood intensity results in higher fish production. Hence an appropriate application of fishpasses is in FCDI projects where flood intensity is higher.

J.2.3 Physiography of Project Area

Topography and Project Area
The topography of an FCDI project should be such that a certain number of floodplains are inundated during the monsoon and post-monsoon. The depth of water at floodplains should be greater than five meters for a longer period over a larger area. The preferred beel area is twenty percent of the project area, and ten percent of the project area should be perennial beels where water depths are above two meter. FCDI projects where less volume of water is stored, and the stored volume of water is segregated among several beels may be less suitable for setting of fishpasses. Projects ranging from medium to large in size may be feasible for fishpass installation. Small scale projects can be taken into consideration if special conditions exist, depending on an assessment by a fisheries expert.

Drainage System
The total FCDI project area drainage system should be a quick draining system so that rainfall runoff can be stored in the beel areas at earliest possible time, or can be drained through sluices if river water level permits. An improved drainage system where crops are not damaged would allow full time operation of a fishpass.

Fishpass Channel
The bed level of a fishpass channel should be at the level of country side invert level. The inlet and outlet channels of a fishpass should be a minimum 200 m straight. The channel should be connected with major beels. The banks of the channel should be embanked so that during the pre-monsoon crops are not damaged by water inflow through the fishpass. The preferred fishpass channel at an FCDI project is one which was a previous migratory route for fishes.

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J.3 ADDITIONAL ENGINEERING ACTIVITIES

From monitoring of FPP, it is concluded that the maximum fish migration takes place during March to August. During the pre-monsoon (March-May) water area in the FCDI project remains small and water depth is shallow. For conservation of fishes, an increase of wetland area and higher depth of water is required. Also, the inflow of water creates conflicts between fisherman and farmer. To mitigate these problems the following activities should be carried out:

- Drainage channel and beel re-excavation: Main drainage channels can be re-excavated to increase the storage volume. Perennial beels can be excavated and some of the seasonal beels can be re-excavated to make them perennial. This will result in an increase in storage volume and increase in conservation of fishes.

- Construction of submersible embankment: Submersible embankments along the main drainage channels and at the periphery of the perennial beels can protect crops from damages (Figure J.3).

- Installation of pumps: To mitigate the potential conflict between fishermen and farmers, provision can be made for operation of a diesel or electric driven pump of capacity 0.5 cumec during the premonsoon and early monsoon if necessary.

- Use of Rubber Dam: During pre-monsoon inflow through a fishpass, provision for using rubber dams at drainage channels and at beels can be considered to protect crops from damage if necessary.

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J.4 STRUCTURAL LAYOUTS OF VERTICAL SLOT FISHPASS

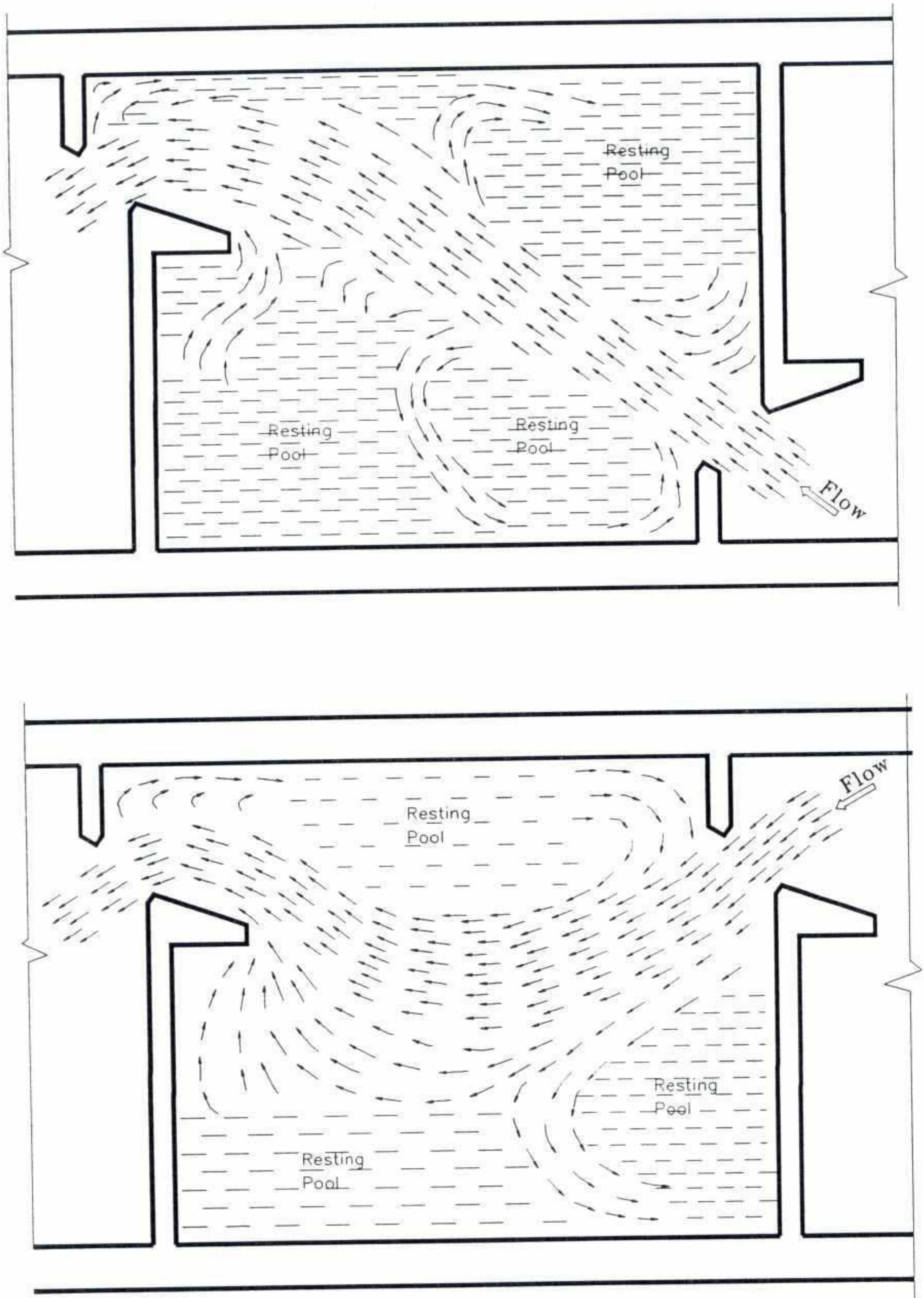
In the design of a fishpass, it is imperative to select the hydraulic operation period and the direction of fish movement. A structural layout for unidirectional water flow will differ from bidirectional water flow. Also, layout will change with the direction of fish movement. The following classification can be made considering flow directions :

- Case 1: Flow of water is from river to haor. A conceptual layout of Case 1 is presented in Figure J.4. The direction of fish movement is from river to haor. High head difference which results in high velocity at vertical slot is acceptable since fish migration is concurrent. The preferred slope of the structure is 0.03 to 0.05. Larger pool dimension is required to minimise the turbulence limit. A stilling basin of minimum required length should be provided at both ends of the structure.

- Case 2: Flow of water is from river to haor. A conceptual layout of Case 2 is presented in Figure J.5. The direction of fish movement is from river to haor and haor to river. Head drop at each slot should be calculated from the design velocity of migrating fishes concurrent and countercurrent. In this situation a larger number of baffles is required to minimise the head difference. A mild slope should be used for this case (less than 0.03). Pool dimensions should be relatively smaller. A stilling basin of minimum required length should be provided at both ends of the structure.

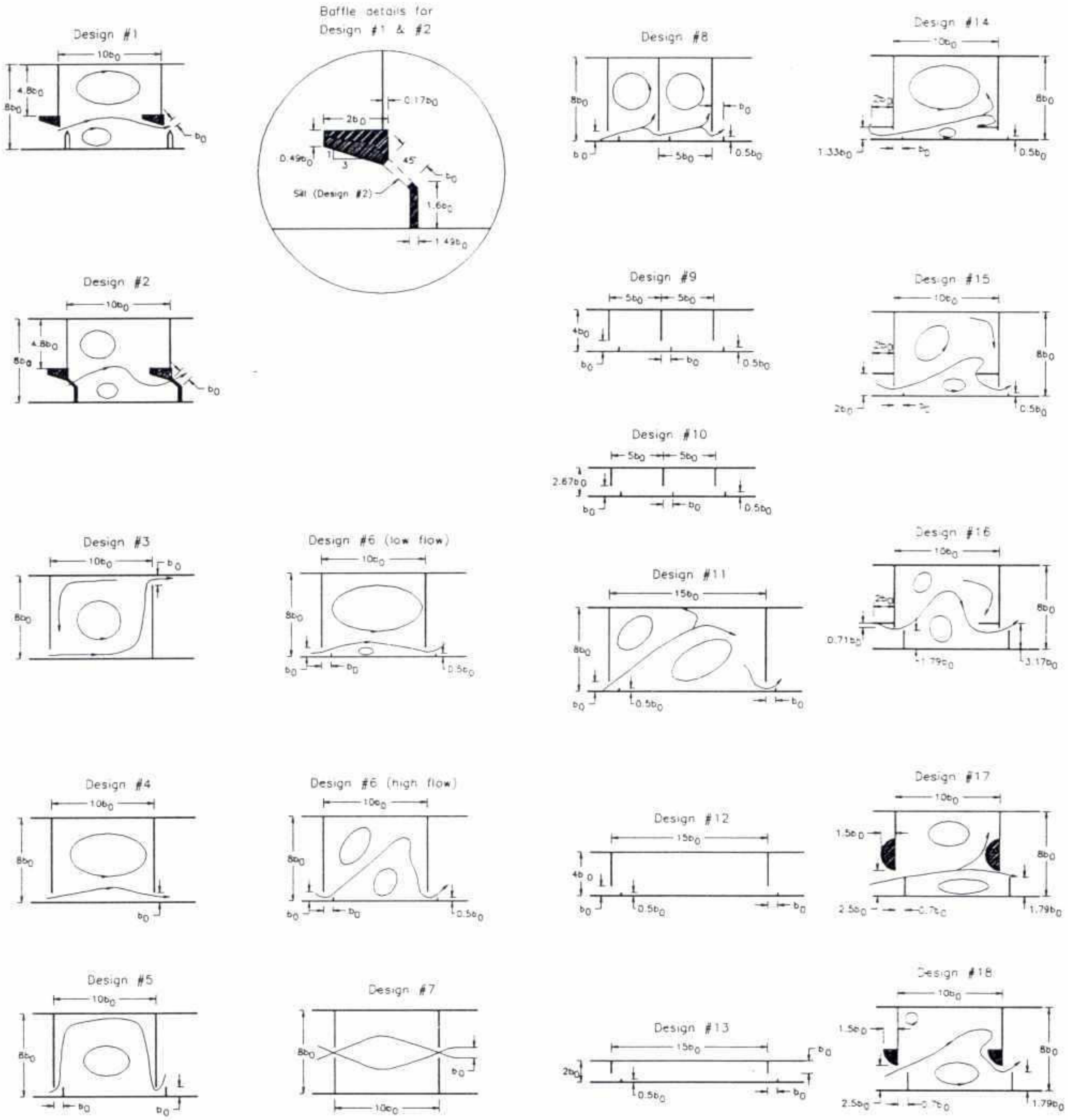
- Case 3: Flow of water is from river to haor and haor to river. A conceptual layout of Case 3 is presented in Figure J.6. The direction of fish movement is from river to haor and haor to river. Head drop at each slot is calculated from the design velocity of migrating fishes concurrent and countercurrent. A larger number baffles is required to minimise the head loss at each baffle. A mild slope should be adopted at the structure (less than 0.03). Also, slope can be in both direction or a portion of the bed can be horizontal. The stilling basin at the river side should be of low froude number. Adequate protective works at the river side channel should be considered for this case.

Figure J.1



Streamline Flow Profile

FILE:FPP-249.DWG



Ref. Introduction to Fishway Design, Working Document
by
Chris Katopdis

Department Freswater Institute
Central and Arctic Region
Department of Fisheries and Oceans
Winnipeg, Manitoba
Canada
January 1992

Experimented Vertical Slot Fishpass Pools
Including Circulation Patterns

FILE: FPP-248.DWG

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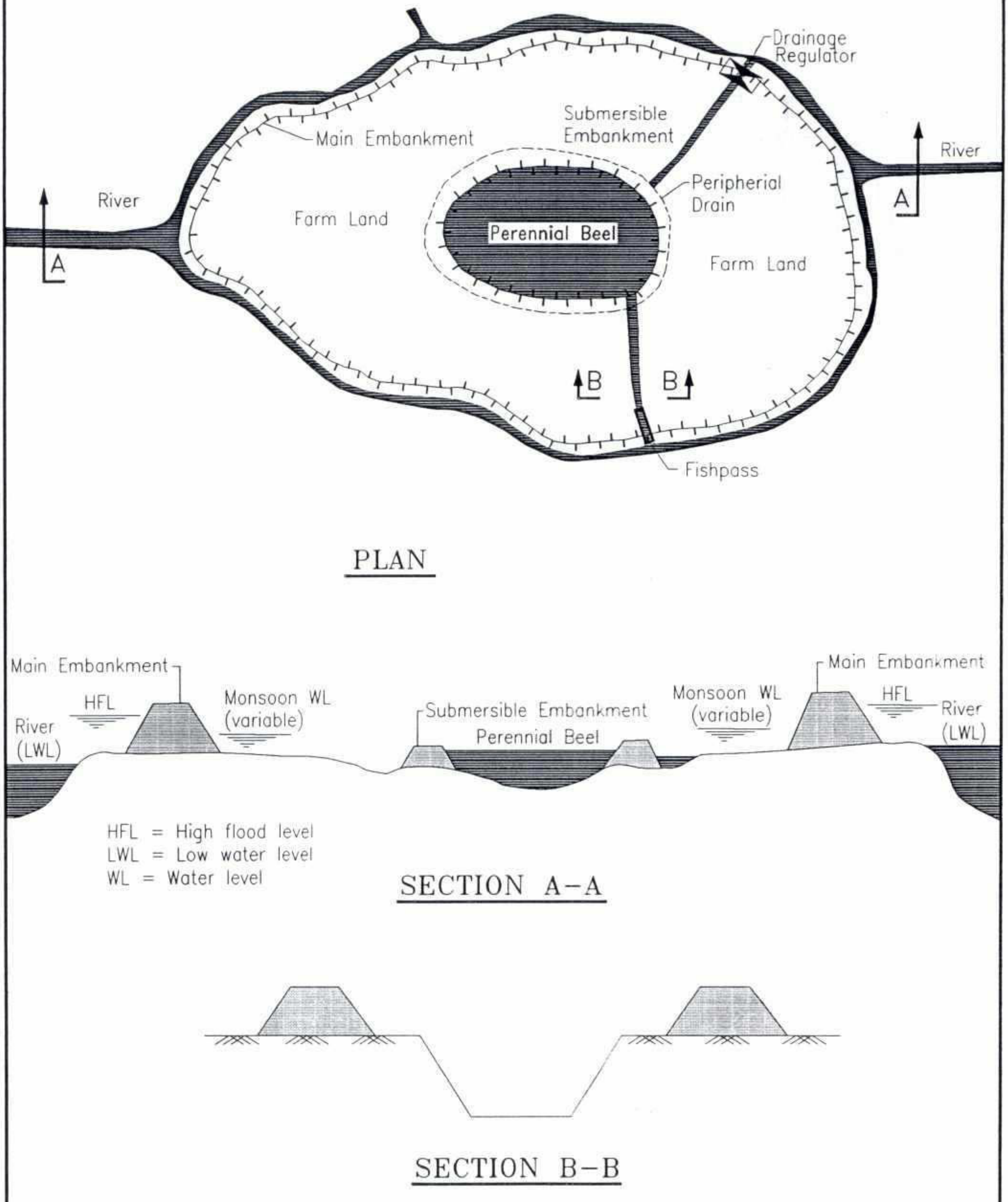
Figure J.3



Submersible Embankment at Beel and Channel

FILE: FPP-251.DWG

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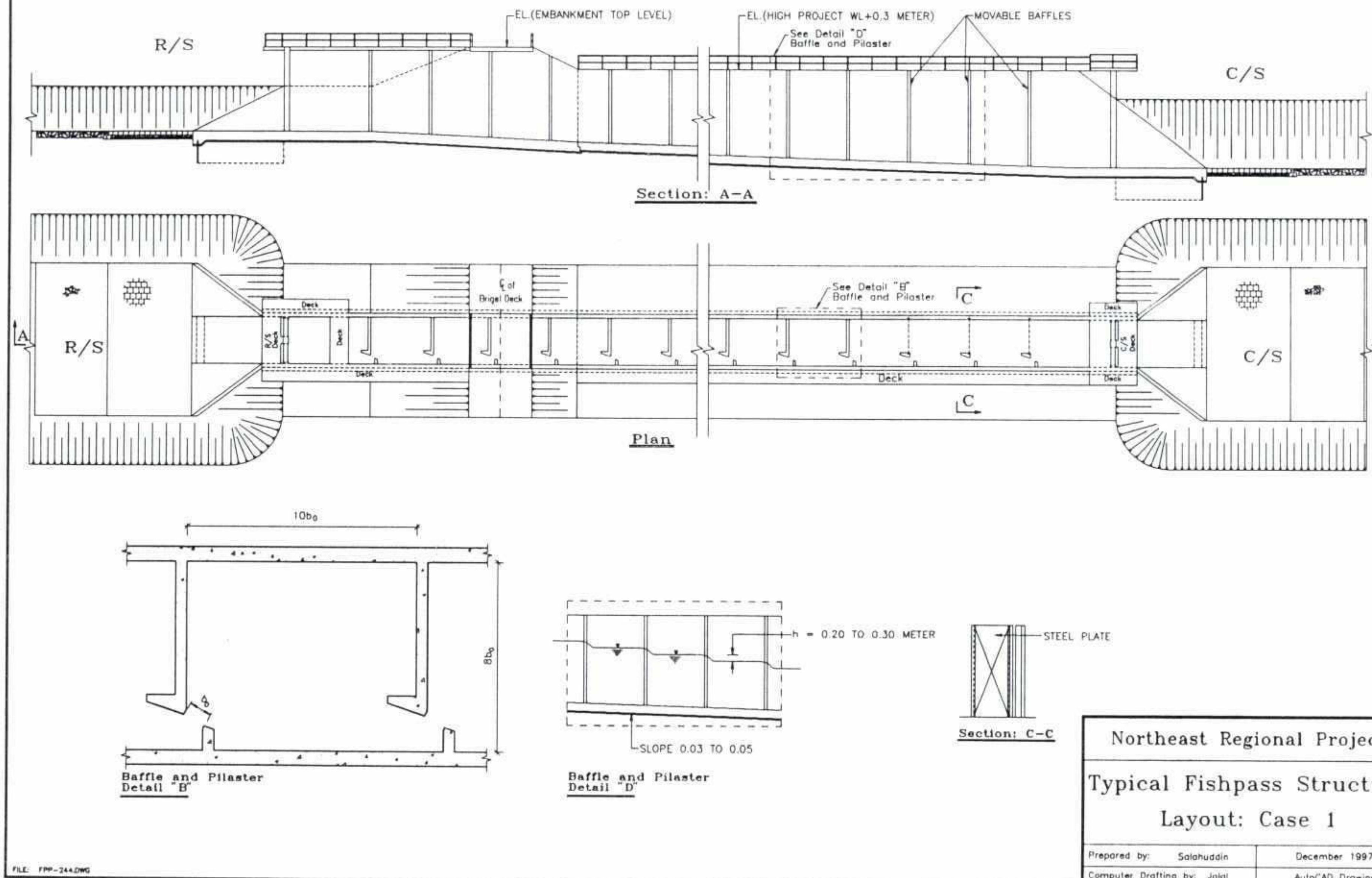
Figure J.4



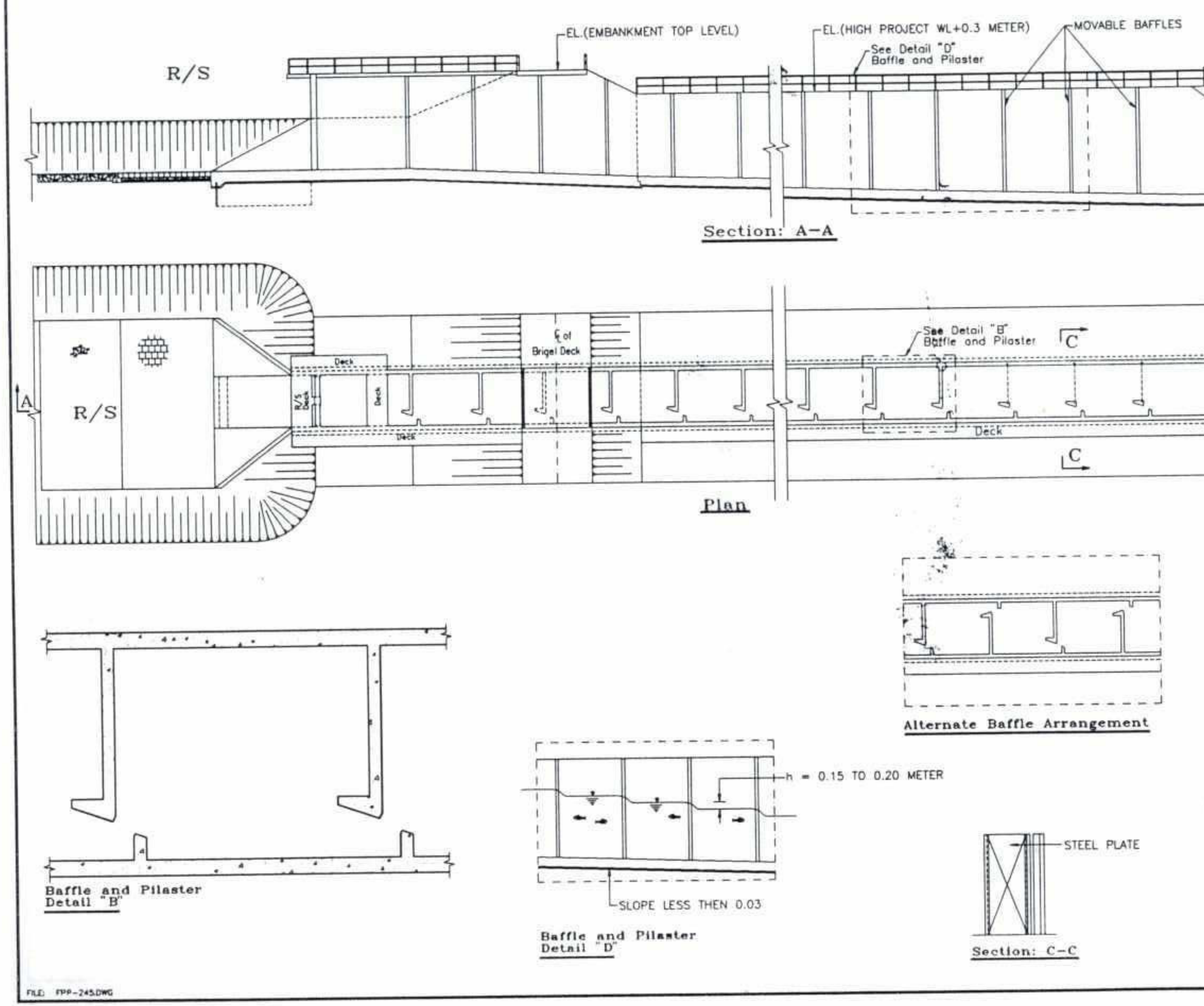
Northeast Regional Project

Typical Fishpass Structure

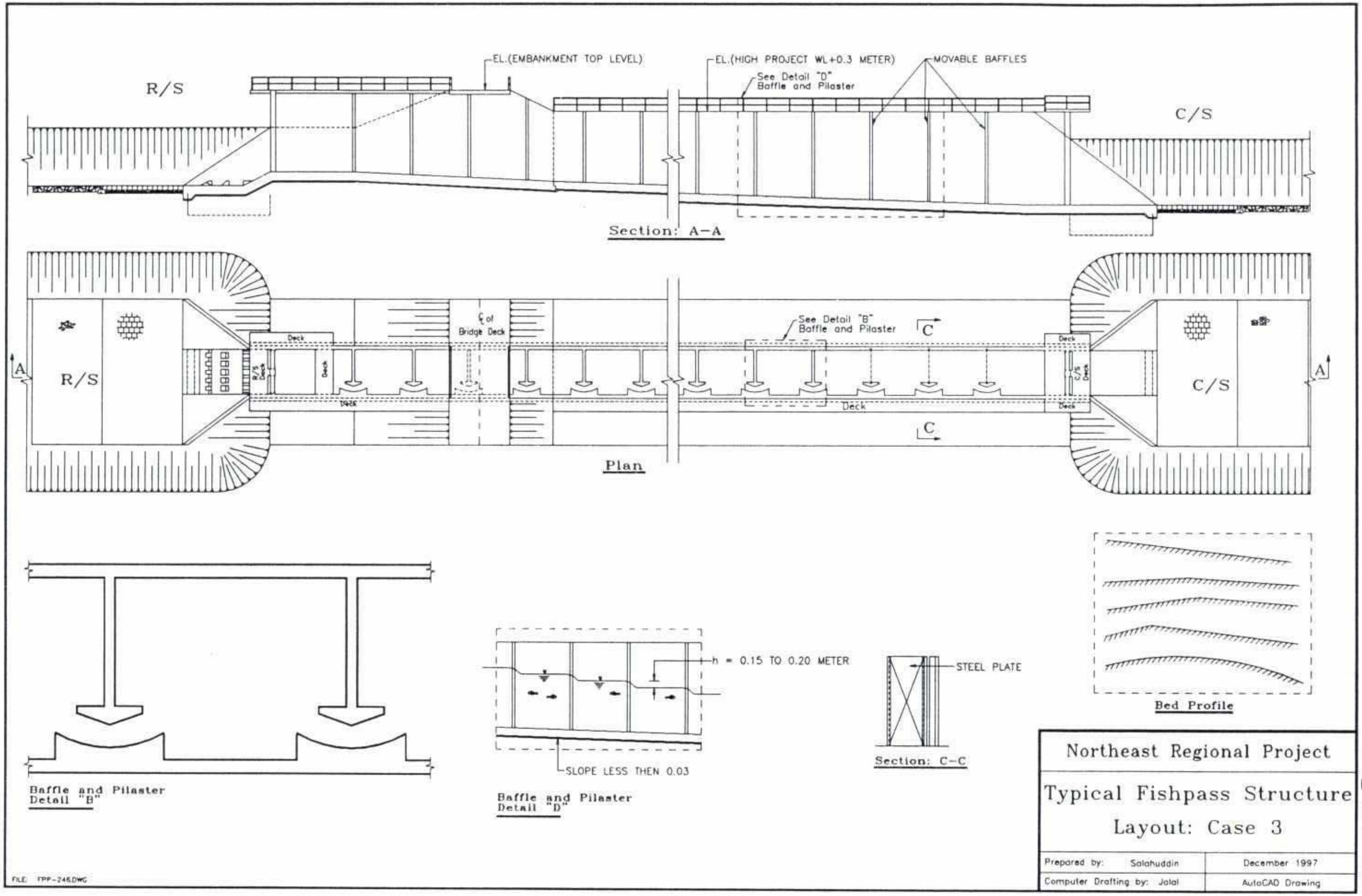
Layout: Case 1

Prepared by: Salahuddin	December 1997
Computer Drafting by: Jalal	AutoCAD Drawing

Figure J.5



Northeast Regional Project	
Typical Fishpass Structure Layout: Case 2	
Prepared by: Salahuddin	December 1997
Computer Drafting by: Jalal	AutoCAD Drawing



R/S
C/S
EL.(EMBANKMENT TOP LEVEL)
EL.(HIGH PROJECT WL+0.3 METER)
See Detail "D" Baffle and Pilaster
MOVABLE BAFFLES
Section: A-A
Deck
℄ of Bridge Deck
See Detail "B" Baffle and Pilaster
C
A
Plan
h = 0.15 TO 0.20 METER
SLOPE LESS THEN 0.03
STEEL PLATE
Section: C-C
Bed Profile
Baffle and Pilaster Detail "B"
Baffle and Pilaster Detail "D"
Northeast Regional Project
Typical Fishpass Structure
Layout: Case 3
Prepared by: Solahuddin
December 1997
Computer Drafting by: Jalal
AutoCAD Drawing
FILE: FPP-246.DWG

Figure J.6

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Appendix K

SUMMARY OF MEETINGS OF KAWADIGHI HAOR FISHERIES ASSOCIATION AND OTHER GROUPS

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K.1 KAWADIGHI HAOR FISHERIES ASSOCIATION

K.1.1 Meeting Held 11 July 1995

Location: FPP office at Kashimpur
Participants: 45 villagers of different professions (fishermen, lessee, fish traders, farmers) from 13 villages, NERP staff, District Fisheries Officer, Moulvibazar.
Meeting objectives:

- To discuss FPP objectives and present status;
- To form a haor fisheries association;
- To discuss management of the fish sanctuary;
- To inform fishermen of the tagging programme, its objectives, and reward for tag recovery;
- To discuss the need for a training program for fishermen and women fish processors;
- To discuss the need to stop illegal fishing and not to catch undersize fish;
- To seek cooperation for the operation of the fishpass;
- To discuss measures for fisheries resource management.

After discussion, a haor fisheries association was formed. It consists of a committee with 37 fishermen and 6 fisherwomen members, who act as representatives from fishing villages. It was agreed that the members of the committee would take initiatives on the above matters. It was also decided in the meeting that the members of the Kawadighi Haor Fisheries Committee and FPP staff would meet once in a month, and this would include a training program. Another decision taken in the meeting was to step up vigilance against illegal fishing. The lessee offered to take the initiative to inform the fishermen using a megaphone. This was implemented on Jul 17 95. The people were told not to catch carp varieties below a minimum size and to refrain from using *current jal*. It was also announced that legal action would be taken against those who defy the order.

K.1.2 Meeting Held 27 July 1995

Location: Antehory fishing village
Participants: 35 of fishermen and other people from Antehory and Kadipur fishing villages and the local member of the haor fisheries association.
Issues discussed:

- Fishpass operation and monitoring;
- Absence of danger to crops from water passing through the fishpass;
- Biological management of fisheries resources in the haor;
- Conflict between the lessee and local fishermen, and possible solutions;
- Participation of women in fish production (as fisherwomen) and their prospects;
- Significance of the fish sanctuary and the responsibility of the people to look after the sanctuary.

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K.1.3 Meeting Held 3 August 1995

Location: Manumukh fishing village
Participants: Fishermen from Manumukh and Chandpur and members of the New Fisheries Management Policy (NFMP) association
Issues discussed:

- Impact and role of NFMP in improving their socioeconomic conditions;
- Fish sanctuary management and their responsibility;
- Improved fish transportation and fish drying;
- Fish disease and control measures;
- Impact of fishpass and its prospects.

K.1.4 Meeting Held 8 September 1995

Location: FPP office at Kashimpur
Participants: Local fishermen and the member of the fishermen committee from Jahidpur, Abdullapur, Rashidpur and Kashimpur fishing villages
Issues discussed:

- Fish sanctuary management and public participation;
- Post-harvest technology;
- Implementation of the Fish Act;
- Problems involving fishpass operation and monitoring;
- Abundance of new species in the haor area.

K.1.5 Meeting Held 4 October 1995

Location: FPP office at Kashimpur
Participants: Villagers from Islampur and Kashimpur and FPP staff
Issues discussed:

- Cessation of fishing in the fish sanctuary area;
- Cooperation in operation of fishpass;
- Importance of not catching juvenile fish and to refrain from using current jal;
- Beel management and harvesting technology;
- Abundance of new species in the haor area.

K.1.6 Meeting Held 4 January 1996

Venue: FPP office at Kashimpur
Participants: 35 members of the KHFA from 16 villages and NERP staff.
Issues discussed:

- Cooperation regarding participation in the Macher Mela (Fish Fair) at Sherpur;
- Discussion on *beel* fishing to assess production trends of the *haor* and the appearance of new species;
- Outbreak of fish disease and remedial measures;
- Organising meetings to be held at different *khola*s (fish landing centers).

K.1.7 Meeting Held 7 February 1996

Venue: Patasingra Beel *khola*
Participants: 25 fishermen from Antehori, Ghargaon, Rakta, Amirpur, and Shahpur villages and NERP staff.
Issues discussed:

- Post harvest fish handling, transportation and marketing;
- Fish processing through sun drying;
- Biological management of the fisheries of the *haor*.

K.1.8 Meeting Held 14 February 1996

Venue: Shalkatua and Majerbandh Beel *khola*
Participants: 32 fishermen from Rakta, Ghargaon, Amirpur, Banarai, and Noagaon villages and NERP staff.
Issues discussed:

- Post harvest fish handling, transportation, and marketing;
- Fish processing through sun drying;
- Biological management of the fisheries of the *haor;*
- Controlling aquatic weeds;
- *Beel* management and harvesting technology.

K.1.9 Meeting Held 24 February 1996

Venue: Rukka Beel *khola*
Participants: 28 fishermen from Rukka, Ghargaon, Rakta, Shahpur, Amirpur, Rashidpur, and Jahidpur villages and NERP staff.
Issues discussed:

- Post harvest fish handling, transportation and marketing;
- Fish processing through sun drying;
- Biological management of the fisheries of the *haor;*
- Use of illegal fishing gear.

K.1.10 Meeting Held 27 March 1996

Venue: FPP office at Kashimpur
Participants: 36 fishermen from Antehory, Kadirpur, Rakta, Ghargaon, Manumukh, Shahpur, Rashidpur, Jahidpur, and Islampur villages and NERP staff.
Issues discussed:

- Cooperation in operation of the fishpass;
- Sanctuary management and public participation;
- Selection of participants for the training program to be held the following month;
- Conflict between the lessee and local fishermen.

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K.1.11 Meeting Held 21 May 1996

Venue: Kashimpur market
Participants: 200 villagers of different professions (farmers, fishermen, fish-traders, day labourers, shopkeepers, boatmen) and NERP staff. The meeting was chaired by Mr. Abdul Hamid, a widely respected person in the locality.
Issues discussed:

- Explain the objectives of the fishpass;
- Explain the purpose of declaring Karadair Khal a fish sanctuary;
- Seek cooperation for smooth operation of the fishpass and proper management of sanctuary.

K.1.12 Meeting Held 22 June 1996

Venue: FPP field office
Participants: 35 members of KHFA from 18 villages, District Fisheries Officer of Moulvibazar, Garry Bernacsek, Nazmul Islam, and other biologists and COs.
Issues discussed:

- Biological management of Kawadighi Haor;
- Abundance of new species;
- Implementation of the Fish Act;
- Conversion of one *beel* into a reserve fishery;
- Strengthening of the association.

After the meeting, operation of the fishpass was explained, and sampling procedures were demonstrated to the meeting participants. They witnessed various species migrating through the fishpass.

K.1.13 Meeting Held 18 July 1996

Venue: FPP field office
Participants: Members of KHFA and LCC
Issues discussed:

- Fishpass operation;
- Sanctuary management;
- Implementation of the Fish Act.

K.1.14 Meeting Held 29 August 1996

Venue: Ghargaon village
Participants: 27 fishermen from Ghargaon, Amirpur, and Banarai villages, KHFA members, and NERP staff.
Issues discussed:

- *Beel* flushing during the dry season to control the outbreak of fish disease;
- On-site training of fish transportation and fish drying;

•	Abundance of new species in the *haor* area;
•	Impact of the fishpass.

K.1.15 Meeting Held 3 September 1996

Venue: Rashidpur village
Participants: Members of KHFA and fishermen from Rashidpur, Zahidpur, and Kashimpur (19 participants).
Issues discussed:

- Conservation of the fish resources of the *haor;*
- Effect of catching juvenile fish;
- Creating awareness regarding the Fish Act;
- Fish transportation and fish drying.

K.1.16 Meeting Held 21 January 1997

Venue: Patashingra beel khola
Participants: 24 fishermen from Antehory, Gorgaon, Rokta and Shahpur villages
Issues discussed:

- Post harvesting technology
- Biological management of beels
- Demerits of aquatic weeds

K.1.17 Meeting Held 12 March 1997

Venue: Rashidpur fishermen's village
Participants: 22 fishermen, their wives and NERP staff.
Issues discussed:

- Objective of cage culture;
- Future problems and their solutions

K.1.18 Meeting Held 28 May 1997

Venue: FPP field office
Participants: Members of KHFA, Operation Committee, and NERP field staff
Issues discussed:

- Status of fishpass operation
- Sanctuary management and public participation
- Importance of not catching juvenile fish and to refrain from using current jal

K.1.19 Meeting Held 31 July 1997

Venue: FPP field office
Participants: Members of KHFA, Operation Committee and NERP staff
Issues discussed:

- Sanctuary management
- Smooth operation of fishpass
- Conversion of Patashingra beel into reserve fishery
- Cage culture by women
- Disturbance of animal grazing at plantation site
- Another fishpass at Machuakhali
- Extension of NERP programme

K.1.20 Meeting Held 15 October 1997

Venue: BRAC office, Rajnagar
Participants: KHFA and Operation Committee members, Carol Eggen, Mosharraf Hossain (NERP Dhaka), Exec. Eng. (BWDB, Moulvibazar), S.D.E-1 and S.D.E-2 (BWDB, Moulvibazar and Rajnagar), BRAC Manager and COs.
Issues discussed:

- Overall discussion about Fishpass;
- Fishpass operation;
- Probable structures and roles of Operation and Management Committees
- Sanctuary management;
- Field workshop about last three years result of FPP.

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K.2 WOMEN GROUPS

K.2.1 Meeting Held 17 October 1996

Venue: FPP field office
Participants: 49 women from 18 fishing villages, Rafiqul Islam from DOF (trainer), Zakia Begum from COMMUNICA, S.M. Nazmul Islam, Mohiuddin Ahmed, Carol Eggen and other field staff of NERP
Issues discussed:

- Nutritional value of fish;
- Modern methods of drying fish, making sidol and smoking fish.

K.2.2 Meeting Held 23 December 1996

Venue: FPP field office
Participants: 20 women from the villages of Gorgaon & Monumukh, NERP staff and Mr. Rafiqul Islam (trainer) from DOF.
Issues discussed:

- Value of fish product & by product;
- Training of women in fish processing, drying, smoking and sidol making;
- Quality of fish product.

K.2.3 Meeting Held 15 March 1997

Venue: Monumukh village
Participants: fishermen and women of this village.
Issues discussed:

- The condition of fish processing;
- Interest to use modern technique in fish processing;
- Materials to be supplied for using modern techniques.

K.2.4 Meeting Held 18 March 1997

Venue: Rashidpur village
Participants: Members of women cage culture group, their husbands, S.M. Nazmul Islam, Garry Bernacsek and other field staff of NERP
Issues discussed:

- Open discussion on cage culture;
- Their thinking about cage culture.

K.2.5 Meeting Held 19 March 1997

Venue: Kashimpur village
Participants: Members of women plantation group and NERP staff

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Issues discussed:

- Pit making for plantation;
- Their interest for making pits.

The women expressed interest in making pits and it was decided that they would be paid Tk 5 for each pit dug.

K.2.6 Meeting Held 7 April 1997

Venue: FPP field office
Participants: 30 landless local women as members of plantation group, Md. Fazlul Kader (Ranger of Moulvibazar) of Forestry Department as the Trainer, S.M. Nazmul Islam, Mohiuddin Ahmed and field staff of NERP
Issues discussed:

- Importance of plantation;
- Involvement of women in plantation;
- Plantation technique and care taking of plants.

K.2.7 Meeting Held 27 April 1997

Venue: FPP field office
Participants: Members of cage culture group and NERP staff
Issues discussed:

- Cage making and setting technique.

K.2.8 Meeting Held 15 May 1997

Venue: Chandpur village
Participants: Members of fish processing group and NERP staff
Issues discussed:

- The situation of their fish processing;
- The use of modern techniques for fish processing.

K.2.9 Meeting Held 18 May 1997

Venue: Rashidpur village
Participants: Members of cage culture group, village people and NERP staff
Issues discussed:

- Cage setting in the river;
- Care taking of cages.

K.2.10 Meeting Held 7 June 1997

Venue: Rashidpur village

Participants: Members of cage culture group and NERP staff
Issues discussed:

- Cage culture training.

K.2.11 Meeting Held 9 June 1997

Venue: FPP field office
Participants: Members of cage culture group, District Fisheries Officer (Moulvibazar) as trainer, S.M. Nazmul Islam, Mohiuddin Ahmed and field staff of NERP
Issues discussed:

- Importance of cage culture;
- Cage materials, making and setting technique;
- Food and feeding of fishes;
- Feeding time and technique;
- Taking care of fish and cages.

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K.3 OPERATION COMMITTEE

K.3.1 Meeting Held 24 April 1996

Venue: FPP field office
Participants: 33 participants (Local council representatives, Officials from DOF, Officials from BWDB, fishermen's and farmers' representatives, and NERP staff)
Issues discussed:

- FPP objectives and present status;
- Impact of the fishpass on fish production of Kawadighi Haor;
- Impact of water on crops from discharges through the fishpass during the pre-monsoon season;
- Smooth operation of the fishpass and proper management of the fish sanctuary.

After discussion on the above issues it was decided to form a local consultative committee (LCC), with the Chairman of the local Union Council as the chairman. Local population, farmers, and fishermen would be represented on the committee. The terms of reference of the committee were also decided.

K.3.2 Meeting Held 8 May 1996

Venue: FPP field office
Participants: 14 participants (LCC members, officials of BWDB, and NERP staff).
Issues discussed:

- Condition of the rice fields and crop harvesting;
- Fixing the time for beginning the operation of the fishpass;
- Management of the sanctuary;
- Importance of the declaration of one *beel* of the *haor* as a reserve fishery.

As rice harvesting in the low-lying areas was completed, farmers had no disagreement with opening the fishpass as soon as the water levels rose to operating level. It was also decided that the fishpass would remain in operation unless any natural adverse situation occurred.

K.3.3 Meeting Held 18 May 1996

Venue: FPP field office
Participants: LCC members and NERP staff
Issues discussed:

- Organise a public meeting to create mass awareness regarding management of the fish sanctuary;
- Status of the fishpass operation.

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K.3.4 Meeting Held 6 June 1996

Venue: FPP field office
Participants: Members of LCC and NERP staff
Issues discussed:

- Cooperation in operation of the fishpass;
- Sanctuary management.

K.3.5 Meeting Held 10 August 1996

Venue: FPP field office
Participants: Members of LCC and NERP staff
Issues discussed:

- Sanctuary management;
- Fishpass operation.

K.3.6 Meeting Held 17 September 1996

Venue: FPP field office
Participants: LCC members and NERP staff
Issues discussed:

- Management of the sanctuary;
- Declaration of Patasingra Beel as a reserve fishery;
- Construction of a new fishpass at Machuakhali;
- Removal of water hyacinth from the sanctuary area.

K.3.7 Meeting Held 7 April 1997

Venue: FPP field office
Participants: Operation Committee members, Superintending Engineer, Executive Engineer and Subdivisional Engineer of BWDB, District Fisheries Officer (Moulvibazar) of DOF, Nazmul Islam, Mohiuddin Ahmed and other field staff of NERP
Issues discussed:

- Condition of rice crops in the field and harvesting time
- Fixing the time for beginning of operation of the fishpass
- Management of sanctuary
- Importance of the declaration of Patashingra beel in the haor as a reserve fishery
- Women's tree plantation programme and its land dispute
- Women's cage culture

After harvesting of low-lying areas local *boro* rice crop, farmers had no disagreement with opening of the fishpass as soon as the water level rose to operating level.

K.3.8 Meeting Held 9 June 1997

Venue: FPP field office
Participants: Members of Operation and Management Committee, S.M. Nazmul Islam, Mohiuddin and field staff of NERP
Issues discussed:

- Status of fishpass operation
- Sanctuary management

K.3.9 Meeting Held 26 June 1997

Venue: FPP field office
Participants: Operation committee members and NERP field staff
Issues discussed:

- Cooperation for fishpass operation
- Sanctuary management and cooperation

K.3.10 Meeting Held 22 August 1997

Venue: FPP field office, Kashimpur
Participants: Operation Committee members, Mosharraf Hossain (NERP, Dhaka), Liaquat Ali (BWDB, Dhaka) and NERP field staff.
Issues discussed:

- Fishpass operation;
- Sanctuary management;
- Present LCC as Operation Committee;
- Phase out and handover of FPP;
- Needs of Field Workshop for result dissemination of FPP in last three years;
- Guidelines for fishpass operation based on previous experience;
- Formation of Management Committee.

K.3.11 Meeting Held 7 October 1997

Venue: FPP field office, Kashimpur
Participants: Operation Committee members, Director, DPS-I and Liaquat Ali (BWDB, Dhaka), Supt. Eng. (BWDB, Moulvibazar), Sub-divisional Eng. (BWDB, Kashimpur Pump House) and NERP field staff.
Issues discussed:

- Handover of FPP;
- Probable structure of proposed Management Committee;
- Fishpass operation;
- Sanctuary management;
- Another fishpass at Machuakhali;
- Extension of NERP work;
- Women's tree plantation program;
- Women's cage culture program.

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K.3.12 Meeting Held 13 October 1997

Venue: FPP field office, Kashimpur
Participants: Operation Committee members, Carol Eggen, Mosharraf Hossain (NERP, Dhaka) and COs.
Issues discussed:

- Handover of FPP;
- Present LCC as Operation Committee;
- Probable structure of Management Committee;

- Inputs to prepare guideline of fishpass operation, maintenance and management manual from previous experience of Operation Committee members;
- Field workshop for result dissemination of FPP in last three years;
- Present position of cage culture women groups;
- Present position of tree plantation women groups (handover to BRAC);
- Patasingra *beel* in the *haor* as a reserve fishery;
- Another fishpass at Machuakhali;
- Water hyacinth problem.

Decision was taken for preparation of rough guideline with consultation of Operation Committee members.

K.3.13 Meeting Held 17 October 1997

Venue: FPP field office, Kashimpur
Participants: Operation Committee members, Salahuddin Khan (NERP, Dhaka) and field staff.
Issues discussed:

- Preparation of rough guideline for fishpass operation, maintenance and management manual;
- Discussion of result of October 15 meeting at BRAC office, Rajnagar.

K.3.14 Meeting Held 20 October 1997

Venue: FPP field office, Kashimpur
Participants: Operation Committee members, Salahuddin Khan (NERP, Dhaka) and COs.
Issues discussed:

- Closing of fishpass operation;
- Water hyacinth problem.

K.3.15 Meeting Held 24 October 1997

Venue: FPP field office, Kashimpur
Participants: Operation Committee members and COs.
Issues discussed:
- Finalised rough guideline of fishpass operation, maintenance and management manual;
- Planning for field workshops.

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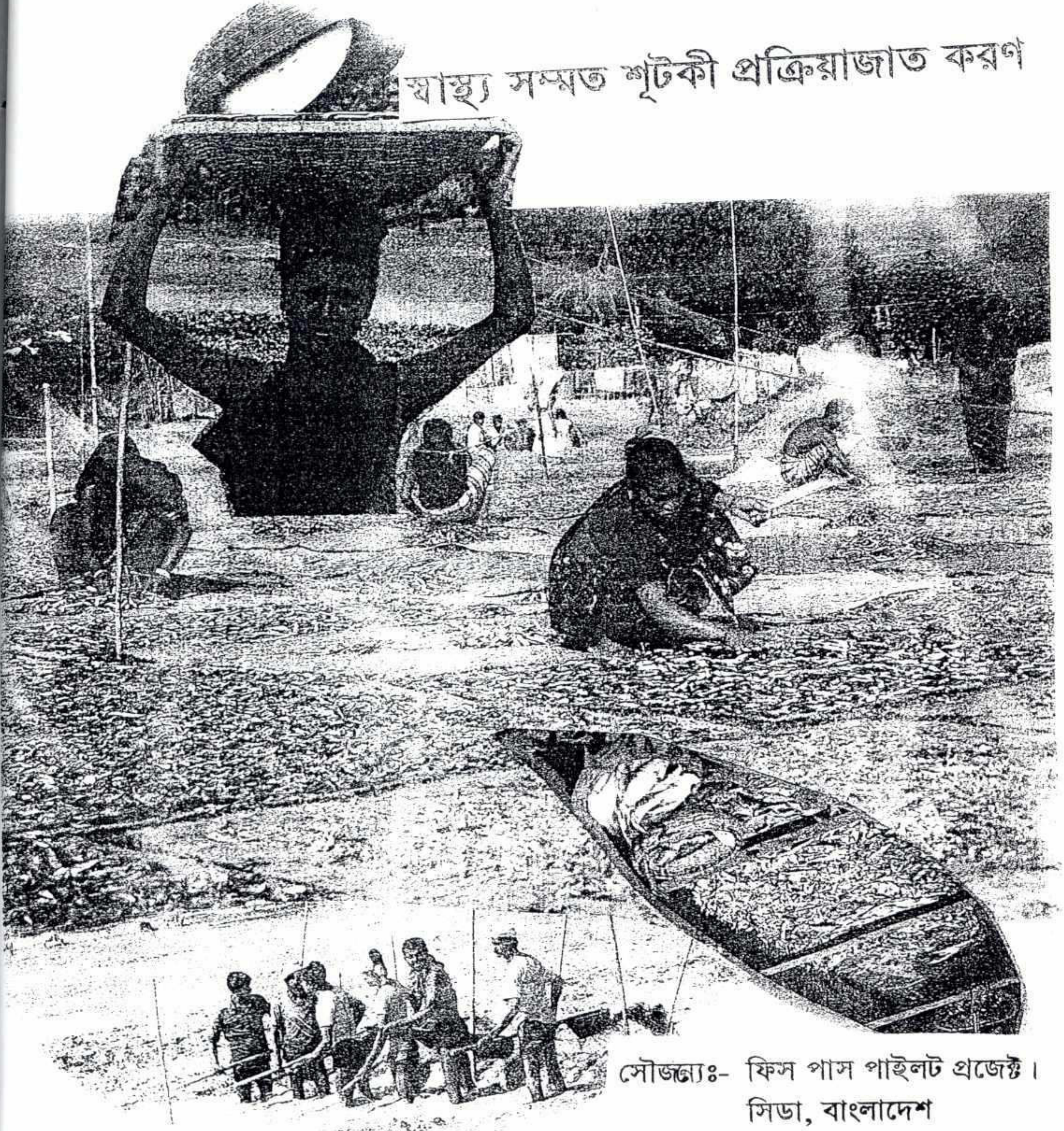
Appendix L

FISH PROCESSING MANUAL

স্বাস্থ্য সম্মত শুটকী প্রক্রিয়াজাত করণ



সৌজন্যেঃ- ফিস পাস পাইলট প্রজেক্ট।
সিডা, বাংলাদেশ

স্বাস্থ্য সম্মত শূটকী প্রক্রিয়াজাত করণ

১ম প্রকাশনা- মার্চ/৯৭ ইং

লেখক/সম্পাদকঃ-
মোঃ রফিকুল ইসলাম
পরিদর্শন কর্মকর্তা
মৎস্য পরিদর্শন মাননিয়ন্ত্রন
মৎস্য অধিদপ্তর।

প্রকাশকঃ- ফিস পাস পাইলট প্রজেক্ট
নর্থ ইষ্ট ফিসারীজ ডেভেলপমেন্ট প্রকল্প
সিডা, বাংলাদেশ।

প্রচ্ছদঃ- লেখক।

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উৎসর্গঃ-

মৎস্য প্রক্রিয়াজাত করণ কাজে
নিয়োজিত এদেশের খেটে
খাওয়া মানুষদেরকে ।

সুচীপত্র


আমি একজন
মৎস্য সম্প্রসারন
কর্মকর্তা
আমি একজান ভালো
মৎস্য জীবি। আমি
কর্মকর্তার উপদেশ মেনে
চলি
আমার মাছের মান
ভালো বলে আমি
ভালো মূল্য পাই।
আমার এখনও
প্রশিক্ষণের প্রয়োজন-
কেননা নিম্নমানের মাছের
কারনে
কেহ আমার মাছ
ক্রয় করছে না।
X

মাছ প্রক্রিয়াজাত করণের উদ্দেশ্যঃ

সৃষ্টির প্রথম দিন থেকে মানুষ বেঁচে থাকার জন্য খাদ্য দ্রব্য গ্রহণ করছে। মাছ আমাদের দৈনন্দিন খাদ্যের অপরিহার্য অংশ এবং প্রাণীজ আমিষের প্রধান উৎস। প্রাণিজ আমিষের শতকরা ৮০ ভাগই আসে মাছ হতে। মাছ অতিদ্রুত পঁচনশীল আমিষ জাতীয় খাদ্য । পঁচনশীল এই আমিষের মান রক্ষা করে ভোক্তাদের চাহিদা অনুসারে সরবরাহ করার লক্ষ্যেই প্রক্রিয়াজাত করা আবশ্যক।

বিভিন্ন প্রক্রিয়ায় মাছ প্রক্রিয়াজাত করা যায়। আর এর প্রধান উদ্দেশ্য হলো প্রাণীজ প্রোটিনের খাদ্যমান বজায় রেখে ভোক্তাদের চাহিদা অনুসারে সুস্বাদু মাছের যোগান দেয়া। যে সকল প্রক্রিয়ায় সাধারণতঃ প্রক্রিয়াজাত করা যায় তা হলোঃ

(১) বরফায়িত করে (২) হিমায়িত করে (৩) কৌটাজাত করে (৪) শুকিয়ে শুটকী তৈরী করে।

এগুলোর মধ্যে শুকিয়ে শুটকী তৈরী করে সংরক্ষণই খুবই সহজ লব্য এবং কম মূলধনে করা যায়। এ সকল দিকে বিবেচনা করেই আমরা কিভাবে কম খরচে মানসম্পন্ন শুটকী তৈরী করা যায় তা নিয়ে আলোচনা করছি। সাধারণতঃ নিম্নলিখিত প্রক্রিয়ায় আমরা শুটকী তৈরী করতে পারি-

(ক) মাছ শুধু রোদে শুকিয়ে। (খ) মাছ লবন দিয়ে রোদে শুকিয়ে। (গ) মাছ শুধু লবন ও অল্প রোদ দিয়ে। (ঘ) ধূমায়িত করে। (ঙ) সোলার ড্রায়ারের সাহায্যে। (চ) সিদল বা কারমেন্টেট করে এবং (ছ) যান্ত্রিক ড্রায়ারের সাহায্যে।

যান্ত্রিক ড্রায়ারের সাহায্যে শুটকী তৈরী করা ব্যয় বহুল বলে সারা বিশ্বেই এই প্রক্রিয়া শুটকী বানানো খুব একটা গ্রহণ যোগ্য হয় নাই। আমাদের দেশে প্রধানতঃ রোদে শুকিয়ে লবন দিয়ে রোদে শুকিয়ে এবং সিদল করে শুটকী তৈরী করা হয়। সনাতন পদ্ধতিতে শুটকী বানানোর এখনও আমাদের দেশে চালু থাকলেও যথাযত মাননিয়ন্ত্রন না করে শুটকী বানানোর ফলে এর খাদ্যমান বেশীদিন বজায় থাকছে না। যার ফলে একাজে জড়িত জেলে, মৎস্যজীবি প্রতিবছর প্রচুর অর্থ উপার্জন হতে বঞ্চিত হচ্ছে।

জেলে, মৎস্যজীবিদের আর্থিক ও সামাজিক অবস্থা বিবেচনা করেই সনাতন পদ্ধতির পাশাপাশি উন্নত সনাতন পদ্ধতি ব্যবহার করে কিভাবে স্বাস্থ্য সম্মত ও মান সম্পন্ন শুটকী তৈরী করতে পারা যায় তা নিয়েই আলোচনা করা হয়েছে এবং অধিকাংশ বিষয় লেখ চিত্রের সাহায্যে বুঝানো চেষ্টা করা হয়েছে।

যে কোন প্রক্রিয়া প্রক্রিয়াজাত করার পূর্বে কাঁচা মালের সুষ্ঠু ব্যবহারের দিকে আমাদের নজর দিতে হবে। এজন্য মাছ ধরার পর প্রক্রিয়াজাত করার পূর্ব পর্যন্ত প্রতিটি স্তরে সুষ্ঠু সুন্দর, স্বাস্থ্য সম্মতভাবে মাছকে নাড়াচাড়া করতে হবে। করনীয় বিষয়াদি গুলো নিয়েও সামান্য আলোকপাত করা হয়েছে। যা বর্তমান প্রেক্ষাপটে খুবই প্রয়োজনীয়।

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জেলে বা মৎস্য চাষির জন্য করণীয় বিষয়াদিঃ

১। ধরার সময় মাছ যাতে আঘাত প্রাপ্ত না হয় সেদিকে নজর রাখুন।

২। মাছ ধরার পরই পরিস্কার ঠান্ডা পানি দ্বারা ধুয়ে ঠান্ডা অবস্থায় পরিস্কার পাত্রে রাখুন।

৩। মাটিতে হোগলাপাতার চাটাইয়ে রোদে মাছ রাখা যাবে না।

৪। ধৃত মাছ পশু পাখির বা মানুষের বিষ্টার সংস্পর্শে আসতে না পারে সেদিকে নজর রাখুন।

৫। মাছ চাষের সময় কোন ঔষধ ব্যবহার করা হলে, ব্যবহারের কমপক্ষে ২১ দিন পর মাছ ধরুন।

৬। মাছ ধরার সকল পর্যায়ে পরিস্কার পরিচ্ছন্নতা বজায় রাখুন।

৭। সংক্রামক রোগাক্রান্ত ব্যাক্তিকে মাছ ধরা ও নাড়াচাড়ার কাজ হতে বিরত রাখুন।

৮। ছিদ্রযুক্ত পরিস্কার ধাতব বা প্লাষ্টিককের পাত্রে প্রয়োজন মত বরফ মিশেয়ে মাছ সংরক্ষণ করুণ।

৯। স্থানীয় বাজার বা দূরের শহরের বাজারে ব্যবহার হবে কিনা তা চিহ্নিত করুণ।

১০। তাপ নিরোধক পাত্রে যানে মাছ একজায়গা থেকে অন্য জায়গায় বরফ সহ পরিবহণ করুণ।

১১। পরিহণের সময় মাছের ভিতরের তাপমাত্রা রেকর্ড করুণ। তাপমাত্রা ০°– ৫°সেঃ এর মধ্যে হওয়া বাঞ্ছনীয়।

মাছের রাসায়নিক সংযুক্তি

মাছের দেহ অনেক গুলো রাসায়নিক দ্রব্যের সমন্বয়ে গঠিত । মাছের প্রকার, ধরণ, আকার, পরিবেশ এবং বয়স ইত্যাদির উপর মাছের রাসায়নিক সংযুক্তি বিভিন্ন রকম ।

মাছের রাসায়নিক সংযুক্তি

গঠন	মাছ			শক্তি	গরুর মাংস
	সবচেয়ে কম	সাধারন অবস্থা	অতিরিক্ত		
প্রোটিন/আমিষ------	৬	১৬-২১	২৮	৩১৪-	২০
ফ্যাট/চর্বি ----------	০.১	০.২-২৫	৬৭	৫৮১.	৩
সরকরা/কার্বোহাইড্রেড		<০.৫	-	কিঃ	১
ছাই --------------	০.৪	১.২-১.৫	১.৫	জুল/১০০	১
পানি--------------	২৮	৬৬-৮১	৯৬	গ্রাঃ	৭৫

সরকরা/প্রোটিনের মধ্যে প্রয়োজনীয় অ্যামিনো এসিড

অ্যামিনো এসিড	মাছ	দুধ	মাংশ	ডিম
লাইসিন	৮.৮	৮.১	৯.৩	৬.৮
ট্রিপটোফেন	১.০	১.৬	১.১	১.৯
হিস্টিডিন	২.০	২.৬	৩.৮	২.২
ফিনাইল এলাইনিন	৩.৯	৫.৩	৪.৫	৫.৪
লিউসিন	৮.৪	১০.২	৮.২	৮.৪
আইসো লিউসিন	৬.০	৭.২	৫.২	৭.১
থ্রিয়োনিন	৪.৬	৪.৪	৪.২	৫.৫
মিথাইয়োনিন-সিরাটিন	৪.০	৪.৩	২.৯	৩.৩
ভেলিন	৬.০	৭.৬	৫.০	৮.১

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টাটকা/তাজা মাছ বা পঁচা মাছ চেনার উপায়

টাটকা মাছ	পঁচা মাছ
১। ত্বকের রং উজ্জ্বল	১। ত্বকের রং ঘোলাটে-ছাপছাপ দাগ যুক্ত রং ফ্যাকাশে বা সাদা।
২। শরীরের সাথে আইশ/খোলস দৃঢ়	২। আইশ আলগা, খোলস ঢিলা।
৩। চক্ষু উজ্জ্বল ও সামান্য উচু	৩। চক্ষু ঘোলাটে, কুক্ষি কোটার গত/বসা
৪। ফুলকার রং সাধারণত উজ্জ্বল লাল সচ্ছ ক্রেদ দ্বারা আবৃত।	৪। ফুলকার রং হলুদ, ধূসর বা বাদামী ঘোলাটে ক্রেদ দ্বারা আবৃত।
৫। মাংস পেশী কঠিন, স্থিতিস্থাপক আংগুল দিয়ে টিপ দিলে কোন দাগ থাকে না।	৫। মাংস নরম, আংগুল দিয়ে চাপ দিলে রস বের হয়।
৬। ফুলকার গন্ধ টাটকা, কোন পাচা গন্ধ নাই।	৬। ফুলকার গন্ধ পচাঁ, ঝাঝালো, টক বা ডিম পচাঁ গন্ধের মত ।
৭। চামড়ার উপর সামান্য ক্রেদ/স্লাইম দেখা যায়।	৭। চামড়ার উপর যথেষ্ট ক্রেদ/স্লাইম থাকে, বেশী পঁচা হলে জমাট স্লাইম দেখা যায়।
৮। শরীর শক্ত আঁট-সাঁট থাকে।	৮। শরীর ঢিলে হয়ে যায়।
৯। মাছ পানির মধ্যে ডুবে যায়।	৯। মাছ পানির উপর ভাসতে থাকে।
১০। পেট শক্ত/দৃঢ় ও অক্ষত থাকে	১০। পেট ফেটে যায়, নাড়িভূড়ি বের হয়ে যায়।
১১। পায়ু/নাভীর রং গোলাপী বা লালচে।	১১। পায়ুর/নাভীর রং বাদামী ও বাহিরের দিকে বাড়ানো থাকে।

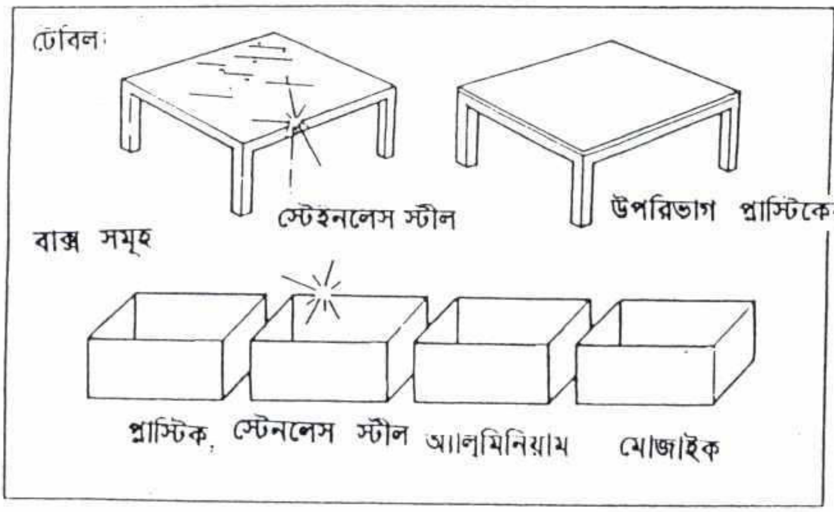

ফুলকা লাল এবং
কোন শ্লেষ্মা নাই
তাজা গন্ধ।
১মে মাছের ফুলকার
চেহারা দেখুন।
এই মাছটি ধূসর
এবং শ্লেষ্মা যুক্ত,
গন্ধ ঝাঁঝালো।
মাছের চোখ দেখুন-
চোখ উজ্জ্বল, চকচকে
এবং বাহিরের দিকে ফুলা,
কোন জমাট রক্ত নাই, চোখের
পুতি হালকা ধূসর।
চোখ সম্পূর্ণ রক্তযুক্ত,
বসানো এবং
পুতি সম্পূর্ণ ধূসর।
দেহ শক্ত, রং উজ্জ্বল,
কোন শ্লেষ্মা নাই. খোসা
মজবুত এবং শক্তভাবে
লাগানো।
আকৃতি এবং গঠন-
দেহ লালচে এবং হলুদাভ,
স্লাইম যুক্ত, খোসা নরম
এবং আংগুলের চাপে গর্তের
সৃষ্টি হয়।
এই মাছটি তাজা,
যথাশীঘ্র, বাজারজাত করুণ,
ভালো দর পাওয়া যাবে।
এই মাছ খাবার
অনোপোযোগী,
পঁচা দুর্গন্ধযুক্ত।

* মাছ ধরার পর সুষ্ঠু স্বাস্থ্য সম্মতভাবে পরিবহন ও বাজারজাত করনের দিকে সকলের নজর রাখতে হবে। মাছ অবতরন কেন্দ্রের স্বাস্থ্য সম্মত অবস্থার উন্নয়ন করা না হলে, পঁচনশীল এই আমিষের মান রক্ষা করা সম্ভব নহে। মাছ বাজারজাত করার সময় সবসময় খেয়াল রাখতে হবে, যেন কোন ময়লা, ধূলা বালির সংস্পর্শে এসে মাছ দুষিত বা রোগাক্রান্ত না হয়। এ জন্য অবতরন কেন্দ্র বা মাছ বাজারের স্বাস্থ্য সম্মত দিক গুলোর দিকে নজর রাখতে হবে।
স্বাস্থ্য সম্মত ও মান সম্পন্ন মৎস্য ও মৎস্যজাত পন্য উৎপাদন করতে চাইলে নিম্নলিখিত বিষয়গুলো গোচরে আনতে হবে।

ক. মাছ প্রক্রিয়াজাত ও বাজারজাত করার স্থানের স্বাস্থ্য সম্মত অবস্থা।
খ. ব্যবহৃত যন্ত্রপাতি, (দা, বটি, বাক্স, ঠান্ডা করার পাত্র ইত্যাদির) স্বাস্থ্য সম্মত অবস্থা।
গ. জেলে বা শ্রমিকদের স্বাস্থ্য সম্মত অবস্থা এবং
ঘ. মাছের নাড়ি-ভূড়ি স্বাস্থ্য সম্মত অবস্থার ধ্বংশ করা।
ঙ. মাছ পরিস্কার করার জন্য ৫-১০ পিপি এম ক্লোরিন দ্রবন ব্যবহার করা।
চ. মাছ প্রক্রিয়াজাত এলাকা থেকে, শৌচাগার দূরে রাখতে হবে।

মাছ পরিস্কার করার কাজে ব্যবহৃত যন্ত্রপাতিঃ

সকল দ্রব্য বা যন্ত্রপাতি খুবই মসৃন ও জলনিরোধক হতে হবে।
টেবিল স্টেইনলেস স্টীল বা উপরিভাগ প্লাস্টিকের, বাক্স সমূহ প্লাস্টিক, স্টেনলেস স্টীল, অ্যালুমিনিয়াম, মোজাইক বা ছিদ্র হীন বা পাকা হতে হবে।



মাছের পঁচন রোধের অন্যান্য প্রক্রিয়াঃ-

* যেখানে বরফ পাওয়া যাবে না সেখানে যে প্রক্রিয়ার সাময়িকভাবে মাছের পঁচন রোধ করা যায়। তাহলোঃ

১। ছায়াযুক্ত স্থানে মাছ রাখুন এবং ভেজা পরিস্কার বস্তা দ্বারা আবৃত করুন। আবৃত ভেজা বস্তায় জলীয় অংশ উড়ে যাওয়ার দরুন মাছ কিছুটা ঠান্ডা হবে।

২। যদি মাছকে লবনাক্ত বা শুটকী করা হয় তাহলে ১০ ঃ ১ হারে মাছ ও লবন মিশান। ১০ - ১৫ ঘন্টা এভাবে মাছ সংরক্ষণ করা যায়।

৩। টাটকা তাজামাছ ক্রেতাদের নিকট সরবরাহের উদ্দেশ্যে মাছ ধরার সাথে সাথে নাড়িভূড়ি, ফুলকা পরিস্কার করুন।

লবন মিশান এবং ছায়াযুক্ত স্থানে রাখুন।

মাছ বাছাই ও গ্রেডিং করার সময় যাতে মাছের মান নষ্ট না হয় সেজন্য নিম্নলিখিত পদ্ধতি গুলো গ্রহণ করতে হবে।

৩৪০

মাছের আহরনোত্তর পরিচর্যা

মাছ আমাদের দৈনন্দিন খাদ্য তালিকায় অপরিহার্য অংশ এবং প্রাণীজ প্রোটিনের প্রধান উৎস। বাংলাদেশে প্রতিবছর যে পরিমান মাছ ধরা পড়ে তার ৫ ভাগের অধিক আহরনোত্তর পরিচর্যা এবং সঠিক সময়ে সঠিক ভাবে পরিবহণ ও বাজার জাত করার পূর্বেই নষ্ট হয়ে যাচ্ছে। যার দাম প্রায় ৪০০ কোটি টাকা। মাছ ধরার সময় স্বাস্থ্য বিধি মেনে চললে এবং ধরার পর স্বাস্থ্য সম্মত পন্থায় পরিবহণ ও বাজারজাত করা হলে এ ক্ষতির হাত হতে রক্ষা পাওয়া যায়। এ ছাড়া নিম্নমানের মাছ রপ্তানী হওয়ায় আমাদের দেশ পার্শ্ববর্তী দেশ হতে প্রতি কেজিতে ৪০ - ৮০ টাকা কম পাচ্ছে বর্তমান বাজার দর অনুসারে। যার পরিমান প্রায় ১৫০ কোটি টাকা। যথাযত মান রক্ষা করা হলে এবং ধরায় পর সুষ্ঠুভাবে সংরক্ষণ, পরিবহণ ও বাজারজাত করা হলে আমরা এ ক্ষতির হাত হতে রক্ষা পেতে পারি। সাথে সাথে দেশ প্রায় ৫৫০ কোটি টাকার বৈদেশিক মুদ্রা অর্জন করতে সক্ষম হবে।

ধরার সময় এবং ধরার পর যে সকল কারণে মাছ নষ্ট হয়ে যাচ্ছে যার ফলে আমরা কমমূল্য পাচ্ছি তা হলো-

১। অসাবধানতাবতঃ এবং অস্বাস্থ্যকর পরিবেশে মাছ ধরা;

২। অস্বাস্থ্যকর পরিবেশে ধৃতমাছ/চিংড়ি সংরক্ষণ করা;

৩। নিম্নতাপমাত্রায় সংরক্ষণের লক্ষ্যে বরফের ব্যবহার না করা;

৪। প্যাকিং এর কাজে নোংরা হোগলা পাতার চাটাই, ভেজা নোংরা ছালার ব্যাগ ব্যবহার করা;

৫। মাছ ও চিংড়ি প্রাথমিকভাবে যে সকল স্থানে অবতরণ করা হয় তার নিম্নমান এবং অস্বাস্থ্যকর অবস্থা;

৬। ধৌত করার কাজে অপরিস্কার/কর্দমাক্ত দুষিত পানির ব্যবহার;

৭। উম্মুক্ত মাঠে মাটিতে বা হোগলা পাতার চাটাইয়ে রেখে চিংড়ির মাথা ছাড়ানো, খোসা ছাড়ানো বা মাছের নাড়িভূড়ি, ফুলকা ইত্যাদি পরিস্কার করা;

৮। পরিবহণকালে অপরিস্কার নোংরা যানবাহন ব্যবহার করা, বরফ ব্যবহার না করা এবং বরফ ব্যবহারের প্রক্রিয়া সম্পর্কে অজ্ঞতা;

৯। সংক্রমশ রোধ করার জন্য করনীয় বিষয়াদি সম্বন্ধে এ কাজে নিয়োজিত ব্যাক্তিদের অজ্ঞতা;

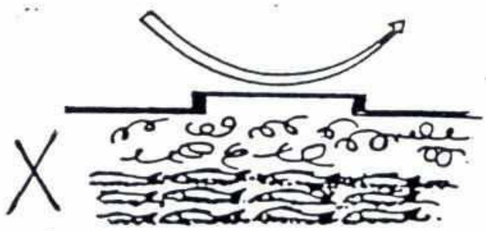
১০। সর্বোপরি মৎস্য প্রক্রিয়াকরণ কাজে নিয়োজিত প্রক্রিয়াকারক/শ্রমিকদের স্বাস্থ্যসম্পর্কীয় জ্ঞানের অভাব ও মনের অভাব।

উল্লেখিত ক্রটি সমূহ দুর করার পর স্বাস্থ্য সম্মতভাবে তাপনিরুদক অবস্থায়, বরফ সহ পরিবহণ করা হলেই ক্রেতাদের চাহিদা অনুসারে মাম সম্পন্ন মৎস্য ও মৎস্যজাত পণ্য উৎপাদন ও রপ্তানী করা সম্ভব।

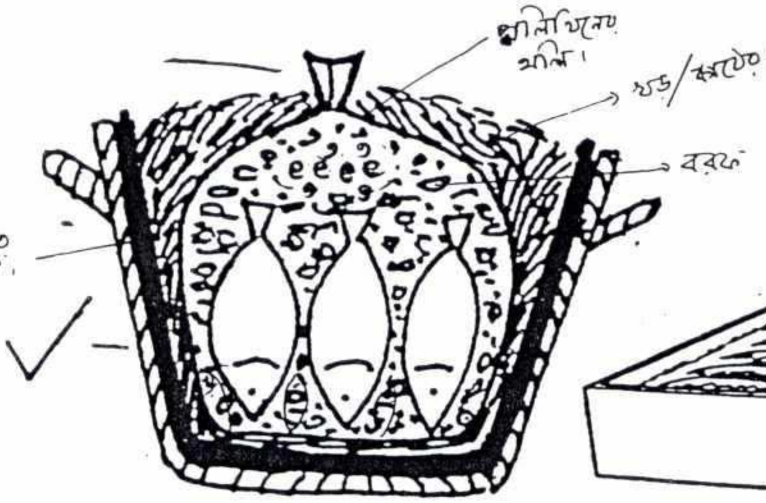
চিত্রের সাহয্যে নিম্নে একটি তুলনামুলক বিবরণী তৈরী করা হলো।

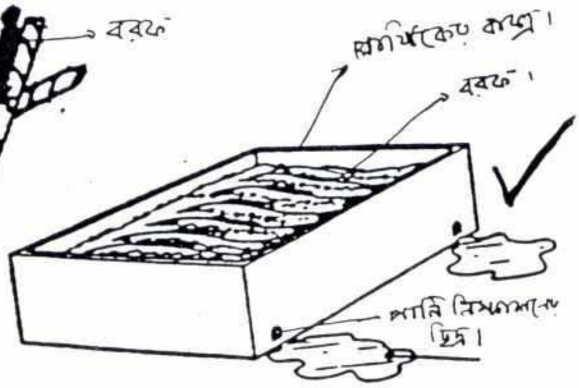
** মাছ স্বাস্থ্যসম্মতভাবে পরিবহনের সময় যে সকল দিক খেয়াল রাখতে হবে তা হলো।

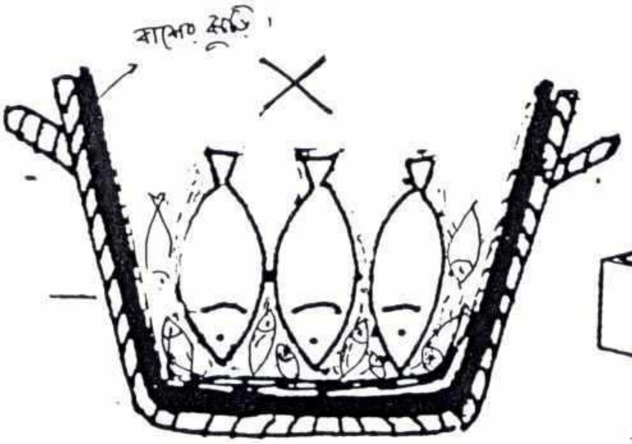
১। মাছ উন্মুক্ত রাখা যাবে না



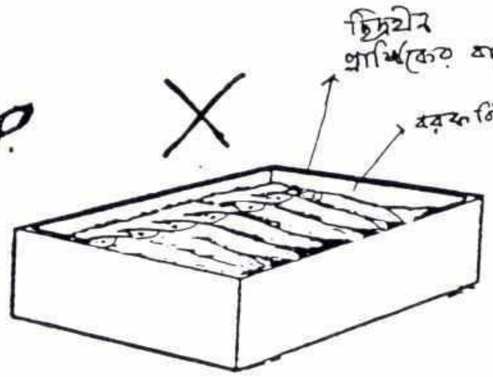
২। ছিদ্রযুক্ত প্লাস্টিকের বাক্স বা বাঁশের ঝুড়িতে মাছ বরফ সহ পরিবহন করতে হবে।





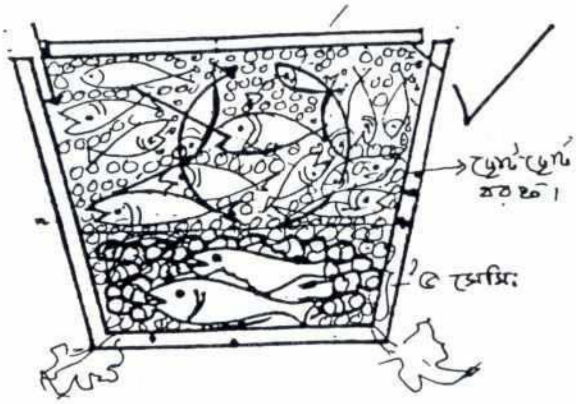


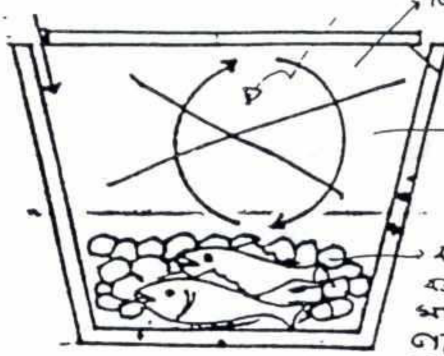
বরফ বিহীন বাঁশের ঝুড়িতে মাছ।



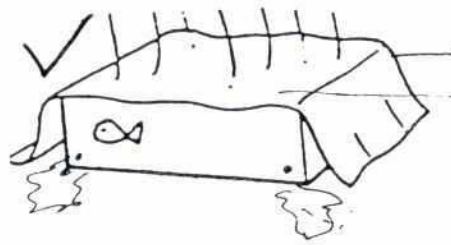
বরফ বিহীন, ছিদ্রহীন, বরফগলা পানি নিষ্কাশনের কোন ব্যবস্থা নেই।

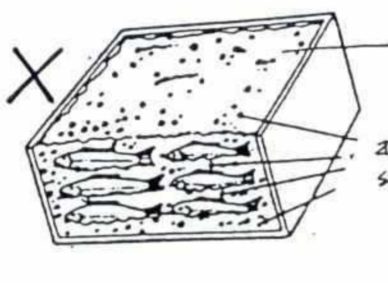
৩। বড় ঝুড়ি/ বাক্সে অল্প মাছ, বরফের বড় বড় টুকরো ব্যবহার স্বাস্থ্যসম্মত নয়।





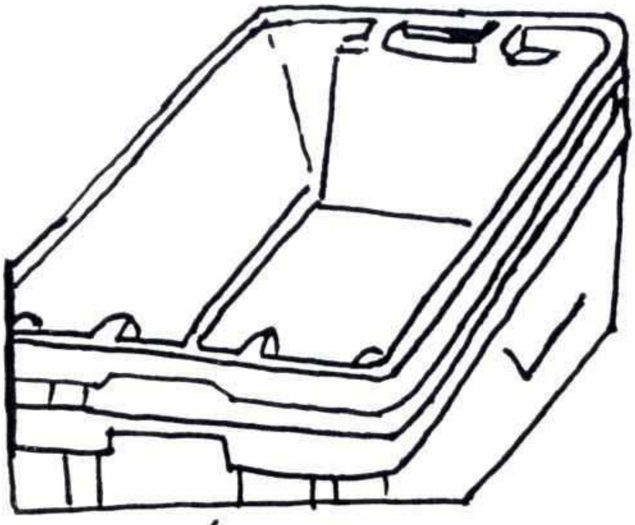
৪। রোদ, ধুলা বালি থেকে রক্ষার জন্য ঢাকনা ব্যবহার করতে হবে।





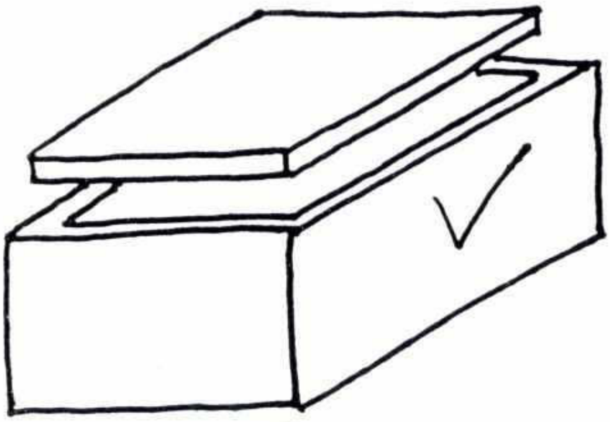
৩৪৪

মাছ/ চিংড়ি রাখার পাত্র।



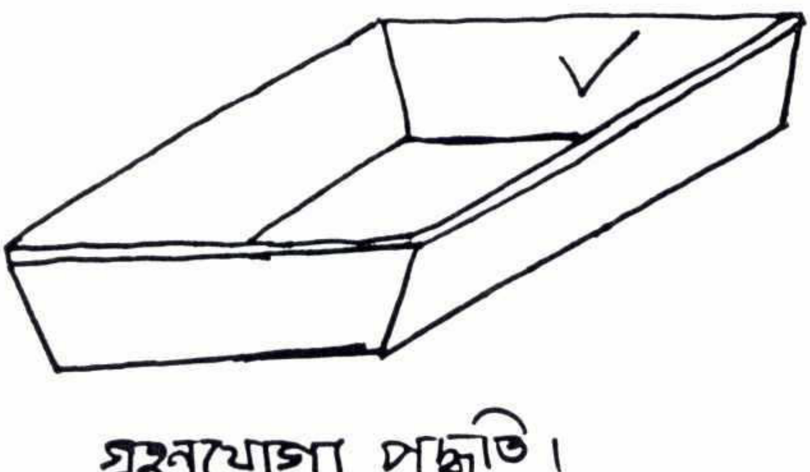
প্লাস্টিকের ট্রে
- গাদা করে রাখা যায়
- স্তুপীকৃত অবস্থায় রাখা যায়

আদর্শ পদ্ধতি।



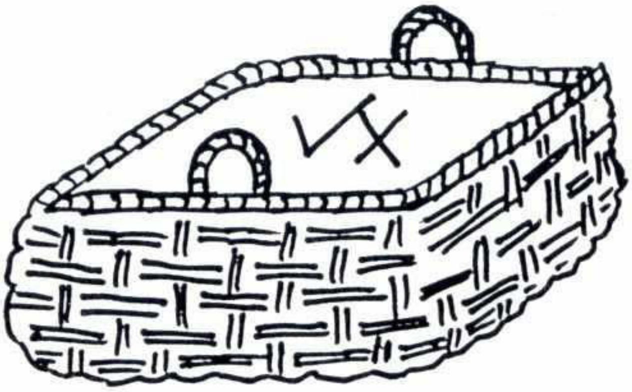
অন্তরিত প্লাস্টিকের বাক্স।
কাঠ এবং ধাতু।

ভাল পদ্ধতি



টিন বা স্টেনলেস স্টীল ট্রে।

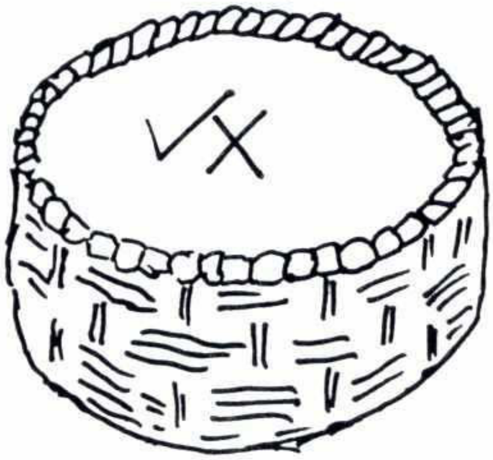
গ্রহনযোগ্য পদ্ধতি।



ব্যবহার পদ্ধতি

ত্রুটিপূর্ণ

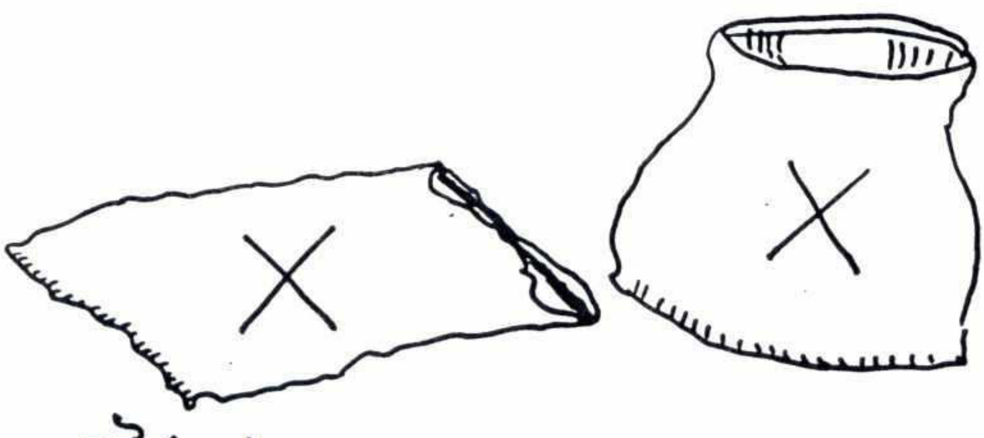
বাঁশের খাঁচা/একবার ব্যবহার যোগ্য



ব্যবহার পদ্ধতি

ত্রুটিপূর্ণ

বাঁশের খাঁচা/একবার ব্যবহার যোগ্য



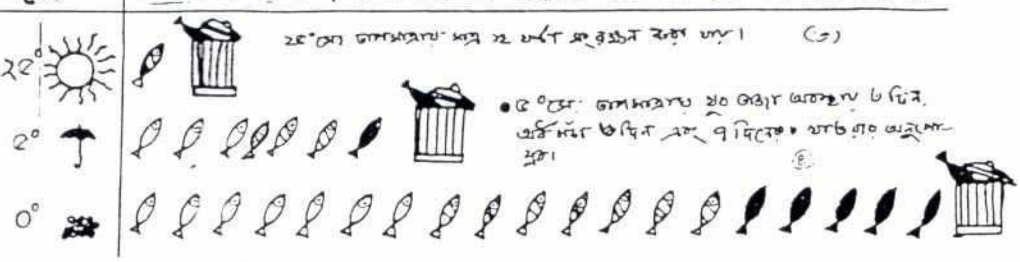
ব্যবহার পদ্ধতি

খুব খারাপ

চট/পাটের বস্তা

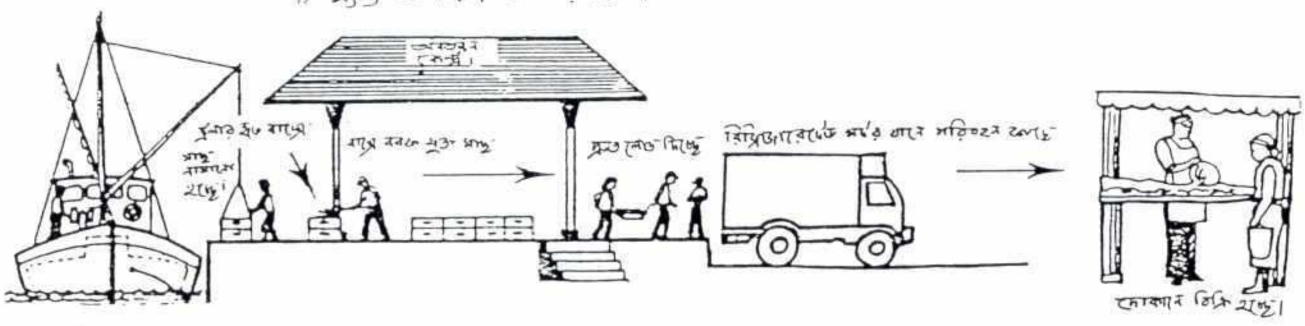
৩৪৮

১। বিভিন্ন শীতল অবস্থায় মাছ কতদিন সংরক্ষণ করা যায়



২। খুবই ভালো অবস্থায় 0° সেঃ তাপমাত্রায় খুব ভালো অবস্থায় ৭ দিন, অর্ধভালো অবস্থায় ১৬ দিন এবং ২০ দিন পর খাওয়ার অনুপযোগী।

৩। মাছ অবতরণ ও পরিবহন।

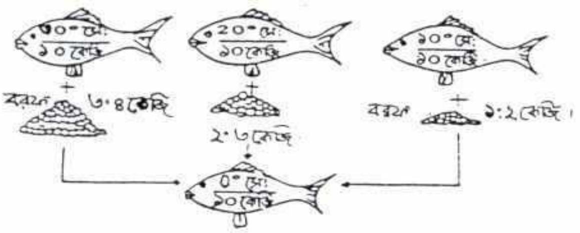


৪। তাপমাত্রা ও বরফের তুলনামূলক চিত্র।

৫।

তাপমাত্রা °সেঃ	মাছের ভিতরের তাপমাত্রা 0° সেঃ রাখার জন্য ১২ ঘণ্টা জন্য যে পরিমাণ বরফের প্রয়োজন।	
	মাছের পরিমাণ ১০ কেজি	মাছের পরিমাণ ৪০ কেজি।
৩০	৪.০ কেজি।	৯.২ কেজি
২৫	৩.৫ ”	৭.৮ ”
২০	৩.০ ”	৬.৪ ”
১৫	২.৫ ”	৫.০ ”
১০	২.০ ”	৩.৫ ”

৬। বিভিন্ন তাপমাত্রার ১০ কেজি মাছকে তাপমাত্রা 0° সেঃ নামানোর জন্য যে পরিমাণ বরফের প্রয়োজন তার একটি তুলনামূলক চিত্র।



মাছ বাছাই ও গ্রেডিং করার সময় যাতে মাছের মান নষ্ট না হয় সেজন্য নিম্নলিখিত পদ্ধতি গুলো গ্রহণ করতে হবে।

* ঠান্ডা রাখার জন্য মাছে বরফ মিশান এবং ছায়াতে রাখুন।
* যত তাড়াতাড়ি সম্ভব বাছাই ও গ্রেডিং এর কাজ শেষ করুণ।
* পরিস্কার ঝুড়িতে বা বাক্সে মাছ বরফ সহ মজুদ করুণ।
* মাছ একটি আদর্শ খাদ্য। যত্নের সাথে হাতড়া এবং কখনো নিক্ষেপ করবেন না বা উপরে পা রাখবেন না।

গ্রেডিং।

মাছের সতেজতা বিবেচনা করে শ্রেণীবিন্যাস করা হয়েছে।

প্রক্রিয়া জাত করা

মাছ প্রক্রিয়াজাত করার সময় নিম্নলিখিত বিষয়গুলো খেয়াল রাখতে হবে।

* ক্রেতা কি ধরনের মাছ চায়।
* কোন ধরনের মাছ প্রক্রিয়াজাত করতে হবে?
* ঐ সময়ের আবহাওয়ার অবস্থা কি ?
* ব্যবহৃত যন্ত্রপাতির প্রাপ্যতা ।

প্রক্রিয়াজাত করার প্রাথমিক পর্যায়ঃ

স্বাস্থ্যসম্মত মান সম্পন্ন মৎস্য ও মৎস্যজাত তৈরী করার ক্ষেত্রে মাছের নাড়িভুড়ি ফুলকা, পরিস্কার করা এবং টুকরা করা আবশ্যক। নিম্নলিখিত কারনগুলোর জন্যই মাছ ধরার পর নাড়িভুড় পরিস্কার করা প্রয়োজন।

* উৎপাদিত পণ্যের দাম বেড়ে যায়। * উৎপাদিত পন্য ভোক্তাদের চাহিদা বৃদ্ধি করে।
* পঁচন রোধ করে মাছের মান রক্ষা করা যায়। * মৎস্য পণ্য উৎপাদনে সহজ হয়ে যায়
* উৎপাদন ব্যয় কমিয়ে দেয় * মাছের মজুদকাল বৃদ্ধি পায় এবং * যানবাহননে ব্যয় কমে যায়।

শুটকী তৈরীঃ

শুকিয়ে শুটকী তৈরী করে মাছের খাদ্য মান রক্ষা করা সাড়া বিশ্বে প্রচলিত প্রথা। ইহা খুবই সাধারণ ব্যবস্থা। স্বাস্থ্যসম্মত দিক গুলো নজরে রেখে শুটকী তৈরী করা হলে ৬ থেকে ১২ মাস পর্যন্ত এর খাদ্য মান বজায় থাকে।

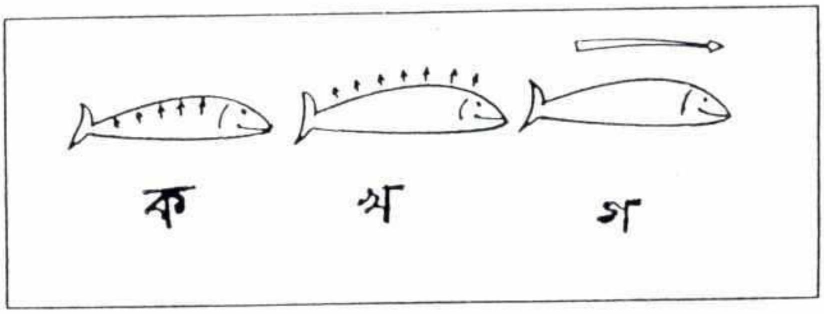
* শুকিয়ে শুটকী করার ফলে মাছের পঁচন রোধ করা যায়।
* প্রাকৃতিক উৎস থেকে আলো বাতাস এ কাজে ব্যবহার করা হয়। ইহা ব্যয় বহুল নহে।
* কোন ভারী ব্যয়বহুল যন্ত্রপাতির প্রয়োজন হয় না।
* এর জন্য সামান্য জ্ঞান থাকলেই চলে।

কিভাবে পানি অপসারন করা হয়-

ক. পানি মাছের উপরি ভাগের দিকে চলে যায়।

খ. মাছের গায়ের পানি বাস্প হয়ে বাতাসে মিশে যায়।

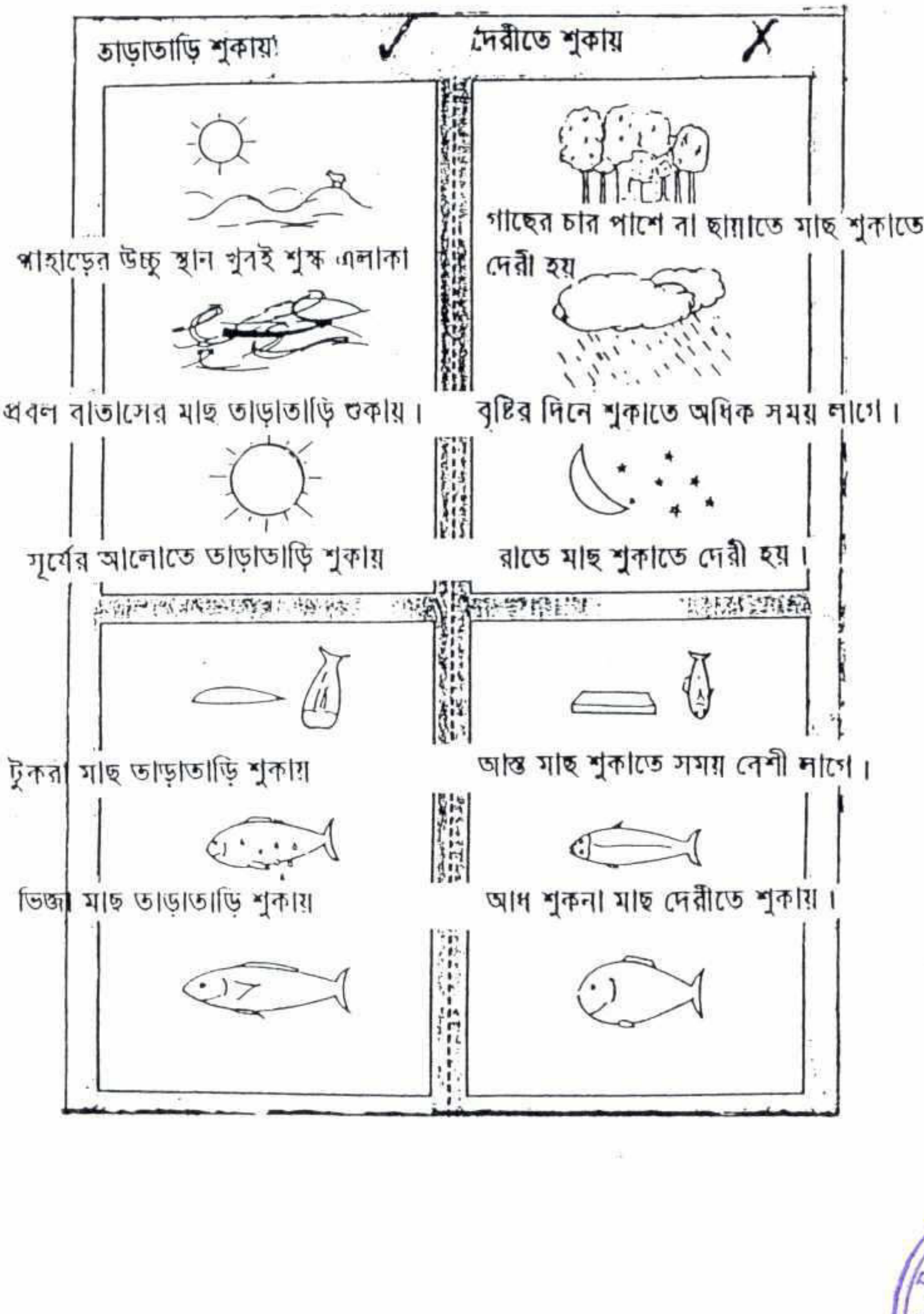
গ. জলীয় বাস্প উড়ে যায়।



শুটকী তৈরীর সময় নিম্নলিখিত বিষয়গুলোর দিকে খেয়াল রাখতে হবে।

* সমুদ্র/নদী/বিল/হাওড় এর পারে শুটকী তৈরী করা ঠিক নহে। কেননা এ সকল এলাকায় বাতাসে আদ্রতা বেশী থাকে।
* শুষ্ক এবং যেখানে প্রচুর বাতাস বহে, খোলা মাঠ শুটকী তৈরীর অনুকুলে।
* বাড়ির আংগিনা, ঘরের দেয়ালের সাথে, গাছের নীচে, নীচু জায়গায় শুটকী তৈরীর জন্য অনুকুলো নহে।
* বর্জা/ময়লা/কারখানায় পার্শ্বে/ডাষ্টবিনের পার্শ্বে বা অন্য কোন নোংরা জায়গায় শুটকী তৈরী করা উচিৎ নহে। এতে তৈরী শুটকী খুব সহজেই সংক্রমিত হয়।

মাছ শুকানোর ক্ষেত্রে বেশ কিছু বাধা আছে যা মাছকে তাড়াতাড়ি শুকাতে প্রতিবন্ধকতা তৈরী করে। নিম্নের চিত্র থেকে বুঝা যাবে।



৩৭০

মাটির উপরে এবং মাচানে মাছ শুকানোর সুবিধা অসুবিধা-

মাচানে ✓

* বাতাস খুব সহজে যাতায়াত করতে পারে

* তার, জাল, যুক্ত বা বাঁশের চালুনীতে সকল দিকেই বাতাস চলাচল করতে পারে।

* মাছ সহজে ধুলা বালি, অন্য কোন ময়লা পোকা মাকড়, পশু পাখি বিড়াল ইঁদুর এর সংস্পর্শে আসতে পারে না। যার ফলে শুটকী সংক্রমিত হয় না।

* সহজে বৃষ্টি এবং মাটিতে প্রবাহিত পানি থেকে রক্ষা পায়।

* মাছের গায়ের পানি ঝরে পড়ে।

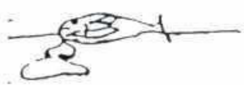
মাটিতে X

মাটিতে বাতাস খুব সহজে যাতায়াত করতে পারেনা।

মাত্র একদিকে বাতাস চলাচল করতে পারে।

সহজে ধুলি বালি, পোকা মাকড় ইঁদুর বিড়ালের এবং মশা মাছি সংস্পর্শে এসে, মাছ সংক্রমিত করে।

বৃষ্টি থেকে রক্ষা পেলেও মাটিতে প্রবাহিত পানি থেকে রক্ষা করা যায় না।



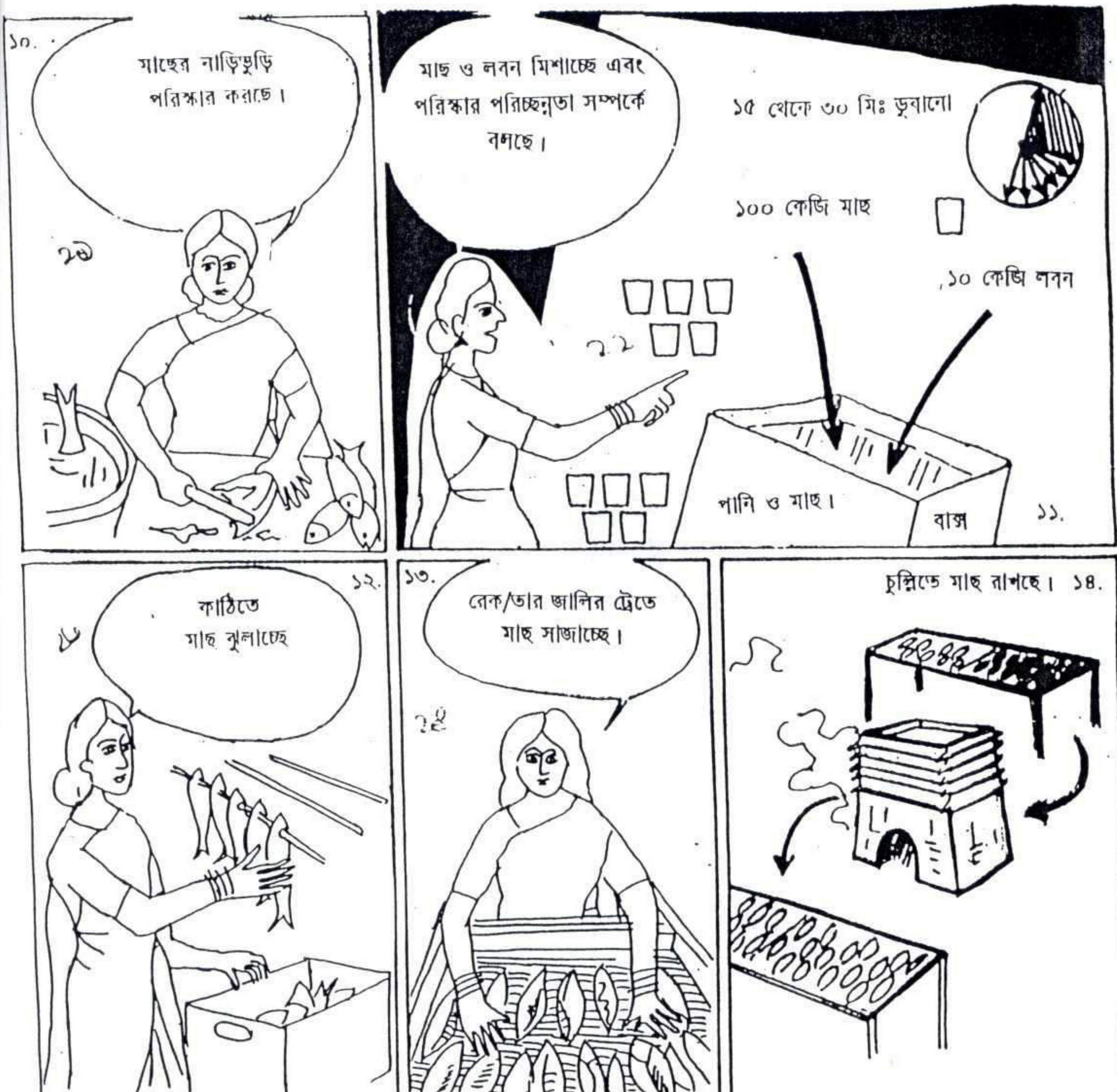
মাছের গায়ের পানি ঝড়ে কাঁদার সৃষ্টি করে

মাচানে বিছিয়ে রোদে শুকিয়ে শুটকী তৈরী করলে মান সম্পন্ন শুটকী তৈরী করা যায়। কেননা এতে সময় কম লাগে। মাছ রোগজীবানু ধুলা বালি, পোকা মাকড় এর সংস্পর্শে সহজে আসতে পারে না। যার ফলে ক্রেতাদের চাহিদা বৃদ্ধি পায় এবং ভালো দাম পাওয়া যায়।

ধূমায়িত করে শুটকী করার পদ্ধতিঃ

বর্ষাকালে যখন অধিক পরিমানে মাছ ধরা পড়ে তখন আকাশ মেঘে ঢাকা থাকে ফলে সনাতন পদ্ধতিতে রোদে শুকিয়ে শুটকী করা খুবই কষ্ট সাধ্য হয়ে যায় এধরনের অবস্থায় সাধারণতঃ ধূমায়িত করে শুটকী তৈরী করা হয়। এ পদ্ধতিতে শুটকী তৈরী বাংলাদেশে খুব একটা প্রচলিত নয়। বাংলাদেশের উত্তর পশ্চিম অঞ্চলে বর্ষা মৌসুমে যখন অধিক পরিমান চিংড়ি ধরা পড়ে তখন সাধারণতঃ অল্প পরিমান মাছ পঁচন থেকে রক্ষা করার জন্য ধূমায়িত করে শুটকী তৈরী করা হয়। পৃথিবীর বিভিন্নদেশে এই প্রক্রিয়ায় শুটকী তৈরী করা হয়। বিশেষ করে সাউথ আফ্রিকার দেশ সমূহে। নিম্নে ছবিগুলো থেকে আমরা বিষয়টি ভালোভাবে বুঝতে সক্ষম হবো এবং প্রয়োজনীয়তা ও ব্যবহার সম্পর্কে জ্ঞানলাভ করতে পারবো।


৪ বৃষ্টি পড়ছে
দৌড়ে পালাচ্ছে
দৌড়ে পালাচ্ছে
সকল শুটকী
ভিজে গেছে.
৫. মাছ নষ্ট হয়ে গেছে।
৬.
কিভাবে বৃষ্টি থেকে রক্ষা পাওয়া যায় তা ভাবছে।
মন খারাপ মাছ নষ্ট হয়ে গেছে
৭.
বুদ্ধি পেয়ে গেছে
তবু খুবই চিন্তিত
৮.
খুশীতে জড়িয়ে ধরছে এবং পরিকল্পনা করছে।
বিভিন্ন ধরনের চুলা বানাচ্ছে।
৯.


১০.
মাছের নাড়িভুড়ি
পরিস্কার করছে।
মাছ ও লবন মিশাচ্ছে এবং
পরিস্কার পরিচ্ছন্নতা সম্পর্কে
বলছে।
১৫ থেকে ৩০ মিঃ ডুবানো
১০০ কেজি মাছ
১০ কেজি লবন
পানি ও মাছ।
বাক্স
১১.
১২.
কাঠিতে
মাছ ঝুলাচ্ছে
১৩.
রেক/তার জালির ট্রেতে
মাছ সাজাচ্ছে।
চুল্লিতে মাছ রাখছে। ১৪.

২৫৪

কাঠ সংগ্রহ করছে।
১৫.
কাঠে আগুন ধরাচ্ছে,
৮ থেকে ২৪ ঘন্টা.
৩ দিনে থেকে ৭ দিন।
ধূমায়িত ও সনাতন পদ্ধতির পার্থক্য।
১৬.
আগুনের তাপ পরীক্ষা করছে।
১৭.
মাছের রং
পরীক্ষা করছে।
১৮.
কাঠ জ্বালিয়ে ধূয়ার
সৃষ্টি করছে।
১৯.


কিভাবে ধূমায়িত মাছের রং সুন্দর হয় তা ভাবছে।
২০.
ধুঁয়া তৈরীর জন্য কাঠের গুড়া মিশাচ্ছে।
২১.
মাছের রং পরীক্ষা করছে
সঠিকভাবে ধূমায়িত হচ্ছে কিনা তা পরীক্ষা করছে।
২২.
ধূমায়িত মাছ পরীক্ষা করছে।
২৩.
সুন্দর করে ট্রেতে /রেকে সাজিয়ে কার্টনে ভরছে।
২৪
খুবই খুশি তাই ?
২৫.


ধূমায়িত
করে প্রক্রিয়াজাত মাছ দেখাচ্ছে।
২৬.
গন্ধ নিচ্ছে এবং
মান যাচাই করছে।
২৭.
২৮:
সুন্দর করে
সাজিয়ে প্যাকিং করছে।
বাসায়/বাড়িতে
রান্না করছে।
২৯.
বৃষ্টিহলেও এখন কোন
অসুবিধা নাই তাই
দুজনেই খুশি।

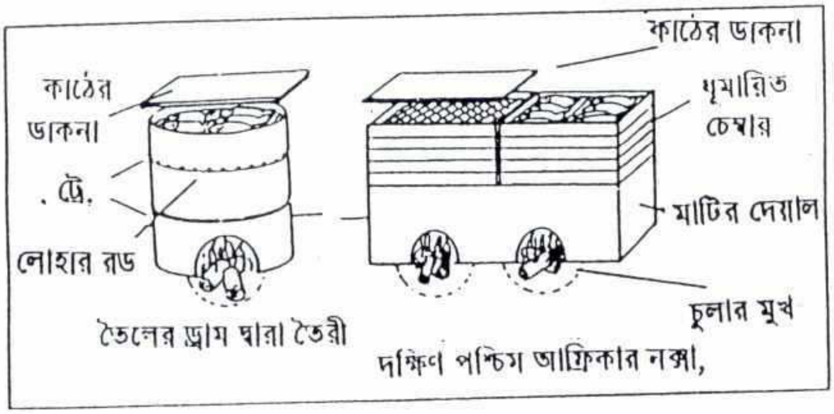
* সাধারণতঃ দুইভাবে মাছ ধূমায়িত করা যায়।

ক. ৮০° সেঃ অধিক তাপমাত্রায় ধূমায়িত করা বা Hot Smoking.

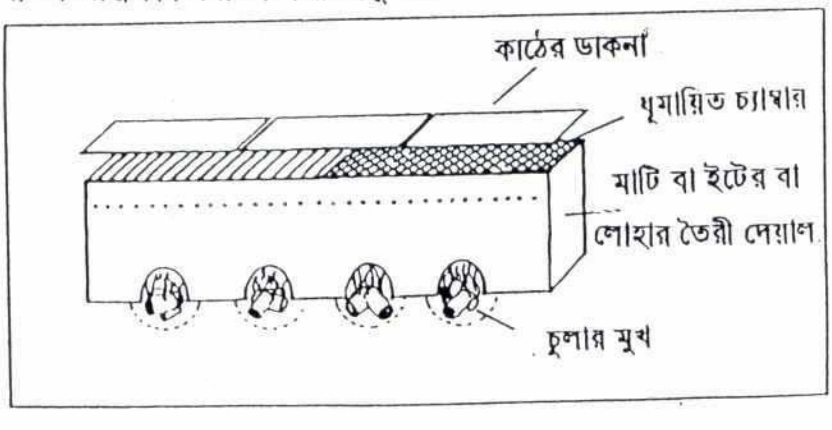
খ. ৩০-৪০° সেঃ তাপমাত্রায় ধূমায়িত করা বা Cold Smoking.

* ধূমায়িত করার লক্ষ্যে চুলা বানানো পদ্ধতি ?

সাধারণতঃ স্থানীয় বাজারে সহজ লভ্য দ্রব্য দ্বারাই ধূমায়িত করার চুল্লি বানানো হয়। নীচে চুল্লি বানানোর কয়টি নমুনা দেখানো হলো।



দক্ষিণ আফ্রিকার সনাতন পদ্ধতির চুলা।



৩০৫

সিদল শুটকী

সিদল বা ফারমেন্টেড শুটকী তৈরী করণ প্রক্রিয়াঃ

বাংলাদেশের বিশেষ করে সিলেট এলাকায় সিদল শুটকী তৈরী করা হয়। সাধারণতঃ পুটিমাছের সিদল বানানো হয়। সিদল শুটকীকে ফারমেন্টেড শুটকী বলা হয়। বাংলাদেশ ছাড়াও দক্ষিণ পূর্ব এশিয়ার বিভিন্ন দেশ সিদল শুটকী তৈরী করনে। বর্তমানে ইহা দেশীয় বাজার ছাড়াও বিশ্বের বিভিন্ন দেশে রপ্তানী করা হচ্ছে। স্বাস্থ্য সম্মতভাবে মানসম্পন্ন সিদল শুটকী তৈরী করতে পারলে দেশীয় বাজারের পাশাপাশি বিদেশে রপ্তানী করে আরো অধিক বৈদেশিক মুদ্রা আয় করা সম্ভব। এই প্রক্রিয়ায় তৈরী শুটকী থেকে ৬ মাস পর্যন্ত সংরক্ষণ করা যায়।

নিম্নে সনাতন পদ্ধতি ও উন্নত পদ্ধতিতে শুটকী তৈরীর তুলনামূলক চিত্র তুলে ধরা হলো।

সনাতন পদ্ধতি		উন্নত পদ্ধতি	
১।	ছোটমাছ বা পুটি মাছ বরফ বিহীন অবস্থায় সংগ্রহ করা হয়।	১।	ছোটমাছ বা পুটি মাছ বরফ দিয়ে সংগ্রহ করা হয়।
২।	নাড়িভুড়ি ফুলকা, আঁশ পরিস্কার করা হয় এবং পানি দ্বারা ধৌত করা হয়।	২।	নাড়িভুড়ি ফুলকা, আঁশ ফেলে চলমান ঠান্ডা পানিতে পরিস্কার করি।
৩।	সূর্যের আলোতে চাটাইয়ে বিছিয়ে বা দূর্বাঘাসে বিছিয়ে শুকানো হয়। শুকাতে সময় লাগে ৪ থেকে ৭ দিন।	৩।	সূর্যের আলোতে বাঁশের/কাঠের মাচানে শুকানো হয়। শুকাতে সময় লাগে ২-৩ দিন।
৪।	শুকানোর পর পানিতে ভিজিয়ে রাখা হয় প্রায় ৪ থেকে ৬ ঘন্টা।	৪।	শুকানোর পর বরফ মিশ্রিত পরিস্কার খাবার উপযোগী পানিতে ভিজিয়ে রাখা ২-৪ ঘন্টা পানির সহিত ১-২ পিপিএম পটাশিয়াম সরবেট লবন মিশানো হয়।
৫।	ঢাকনা বিহীন মাটির কলস বা পাতিল ব্যবহার করা হয়।	৫।	ঢাকনা যুক্ত মাটির কলস/পাতিল ব্যবহার করা হয়।
৬।	পাতিলে মাছের তৈল মেখে রোদে শুকানো হয়।	৬।	পাতিলের গায়ে মাছের তৈল মেখে রোদে এবং আগুনে ২-৩ দিন শুকানো হয়।
৭।	পাতিল মাছ ঢেলে দিয়ে ভরে দেয়া হয়।	৭।	পাতিলের ভিতর মাছ স্বরে স্বরে সাজানো হয়। প্রতি স্বরের মাঝে কলার পাতা বা পলিথিন বিছিয়ে দেয়া হয়।
৮।	পাতিলের মুখ মাটি দিয়ে ভরে দেয়া হয়।	৮।	পাতিলের ঢাকনা লাগিয়ে মুখ শক্ত করে মাটি দিয়ে এটে দিতে হবে।
৯।	ঘরের মধ্যে ছায়াযুক্ত স্থানে ২-৩ মাস রেখে দেয়া হয়।	৯।	ঘরের মধ্যে গর্ত করে প্রায় দেড়মাস পুতে রাখা হয়। হালকা হলুদ রং ধারনা করলে বুঝা যায় তৈরী হয়ে গেছে।
১০।	হালকা রোদ দিয়ে পাতিলেই সংগ্রহ করা হয়।	১০।	হালকা রোদ দিয়ে ছিদ্রহীন পলিথিন থলিতে সংরক্ষণ করা হয়।

নিম্নে সিদল শুটকী বানানোর প্রক্রিয়া ছবির সাহায্যে দেখানো হলো।

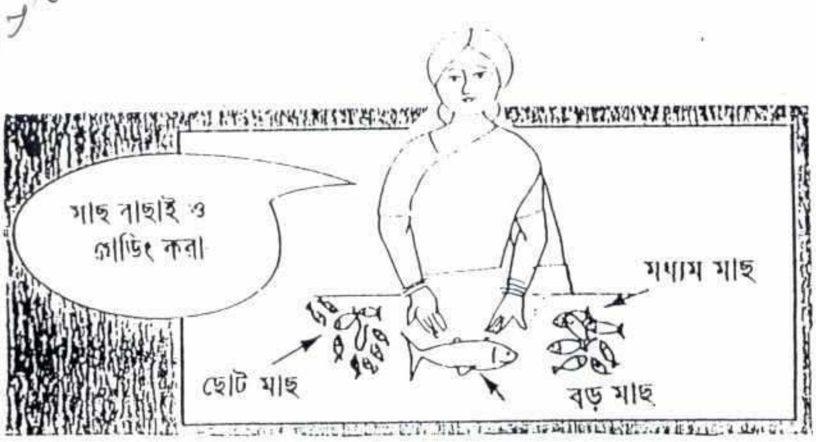
সনাতন পদ্ধতি

উন্নত পদ্ধতি

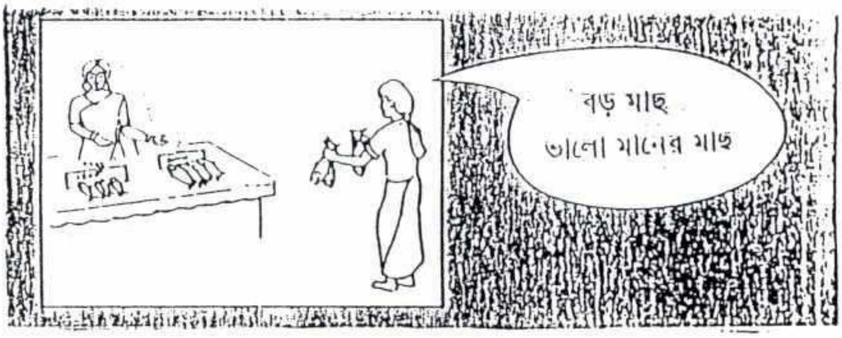
উন্মুক্ত আবহাওয়ায় রোদে রাখার জন্য মাছের মান নষ্ট হয়ে গেছে।

বরফ মিশানোর ফলে মাছের মান বজায় থাকে, প্রায় ১০ দিন

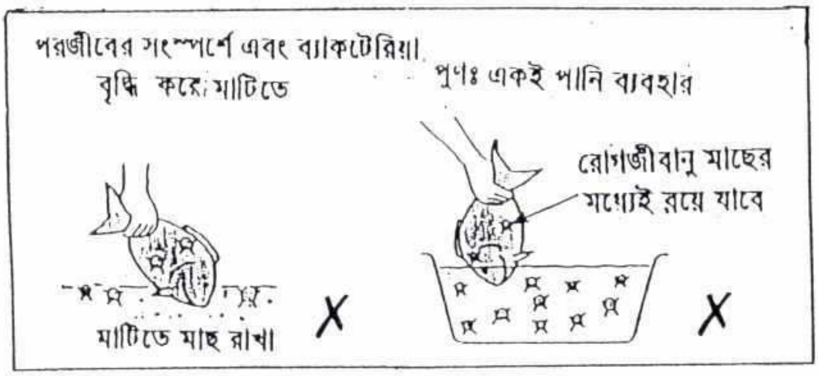
৩১০



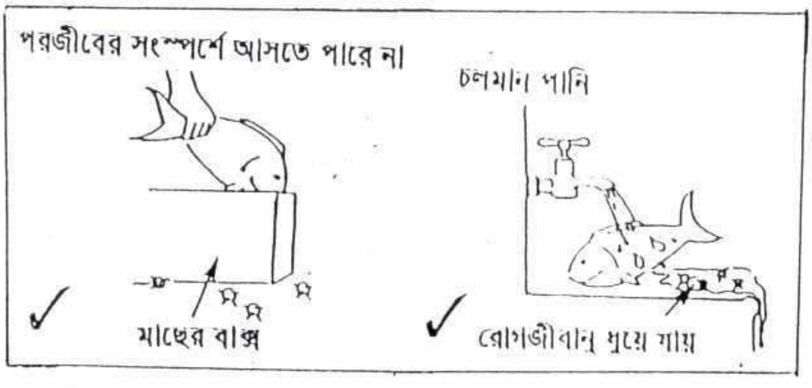
লোকটি তার মৃত মাছ বাছাই করছে এবং ছোট বড় আলাদা করছে।



একজন ক্রেতা ব'লছেন আমি বড় মাছটি ক্রয় করবো।



মাছ পরিষ্কার করার কাজে ময়লা পানি বা একই পানিতে বারবার
ধৌত করা যাবে না।



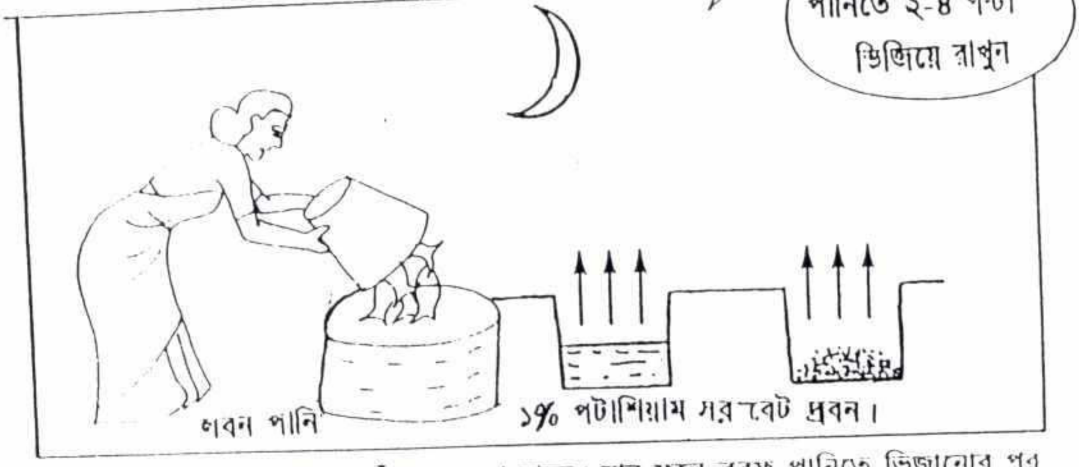
ধৌত করার পর পরিষ্কার বাক্সে নিম্ন তাপমাত্রায় সংরক্ষণ করুন।

মাটিতে বিছিয়ে রোদে শুকিয়ে শুটকী তৈরী করলে মান সম্পন্ন শুটকী তৈরী করা যায় না। এতে সময় বেশি লাগে। মাছ রোগজীবানু ধূলী বালি, পোকা মাকড় এর সংস্পর্শে সহজে আসতে পারে। শুটকী খুব সহজেই সংক্রমিত হয়।

মাচানে বিছিয়ে রোদে শুকিয়ে শুটকী তৈরী করলে মান সম্পন্ন শুটকী তৈরী করা যায়। এতে সময় কম লাগে। মাছ রোগজীবানু ধূলী বালি, পোকা মাকড় এর সংস্পর্শে সহজে আসতে পারে না। যার ফলে ক্রেতাদের চাহিদা বৃদ্ধি পায় এবং ভালো দাম পাওয়া যায়।

পানিতে ভিজিয়ে রাখার ফলে মাছ ফুলে যায়। রাতে পানিতে ভিজিয়ে রাখাই ভালো। ৪-৫ ঘন্টা ভিজিয়ে রাখুন। কিন্তু সনাতন পদ্ধতিতে মাছ পানিতে ভিজানোর ফলে অনেক সময় আংশিকভাবে পঁচে যায়

৩৭২



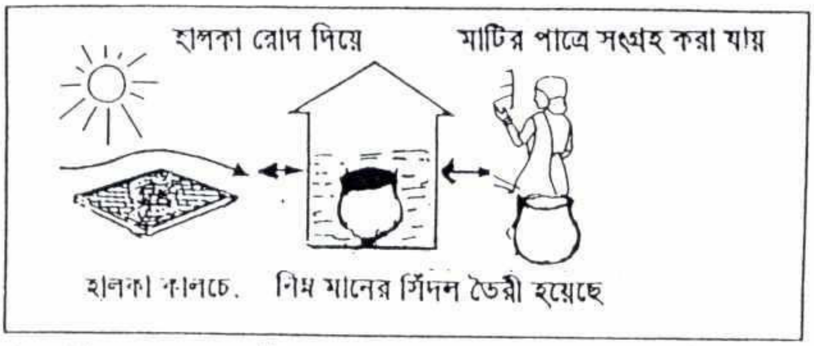
লবন ব্যবহারের ফলে মাছের আঁশের দৃঢ়তা বাড়ে। যার ফলে বরফ পানিতে ভিজানোর পর মাছ অল্প ফলে গেলেও মাছ পঁচে যায়না।

ভিজা মাছ, মাটির পাত্রে ঢেলে দেয়া হয়।এলো পাতাড়িভাবে ঢেলে রাখার ফলে শুঁটকির মান নষ্ট হয়ে যায়। মাছ থেতলে যায়। ঢাকনা ছাড়া মাটির পাত্র। মাটির পাত্র পুনঃ ব্যবহার করা যায় না।

পাত্রে ১টির পর ১টি সাজিয়ে রাখুন। প্রতিটির স্তরে কলার পাতা বা পলিথি ব্যবহার করুন। কলাপাতা বা পলিথিন ব্যবহার করার ফলে রং হলুদাব ধারন করে। ঢাকনাসহ পাত্র।

মুখ কলাপাতা দিয়ে/খড় দিয়ে এঁটেল মাটি দিয়ে শক্ত করে মুখ বন্ধ করে দিন, যাতে কোন বাতাস ঢুকতে না পারে। ২-৩ মাস মাছকে ঘরের ভিতর অন্ধকার জায়গায় রেখে দেওয়া হয়।

মুখ ঢাকনা দিয়ে এঁটে দিন। তারপর এঁটেল মাটি দিয়ে ভালোভাবে মুখ বন্ধ করে দিন। যাতে বাতাস ঢুকতে না পারে। এক থেকে দেড় মাস মাটির নীচে পুঁতে রাখুন।



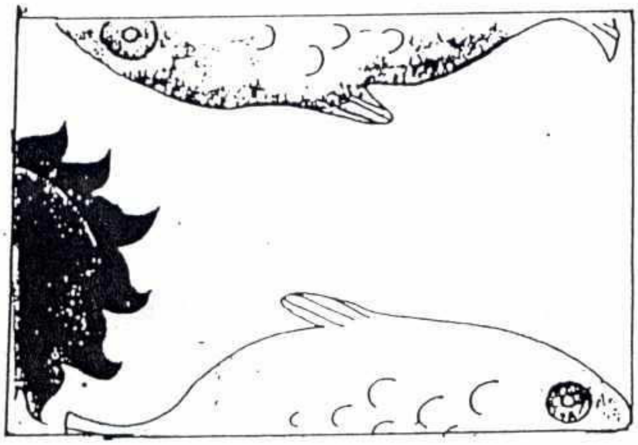
২-৩ মাস মাছকে ঘরের ভিতর অন্ধকার জায়গায় রেখে দেওয়া হয়।

২-৩ মাস সংরক্ষণ করা যায়।

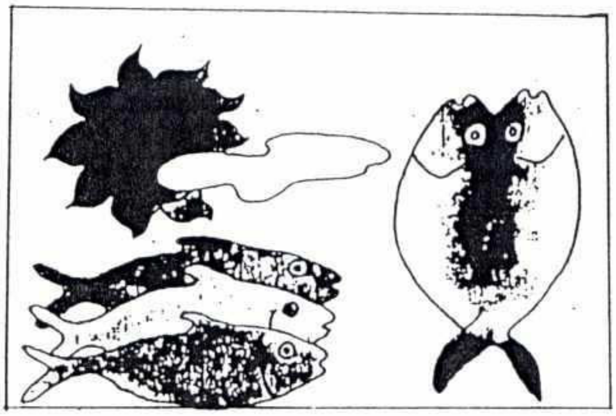
এক থেকে দেড় মাস মাটির নীচে পুঁতে রাখুন। ৩-৬ মাস সংরক্ষণ করা যায়।

৩৭৪

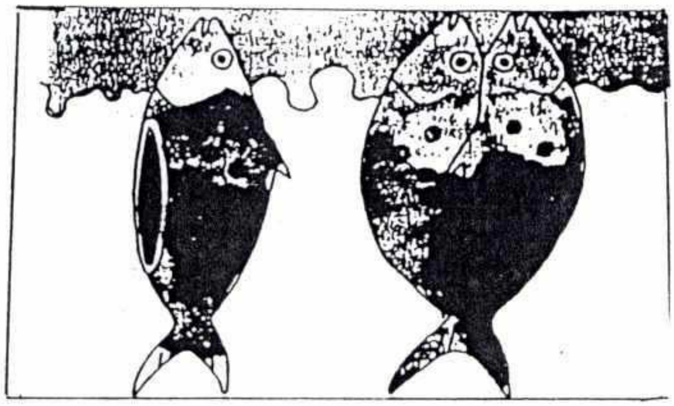
সোলার ড্রায়ার



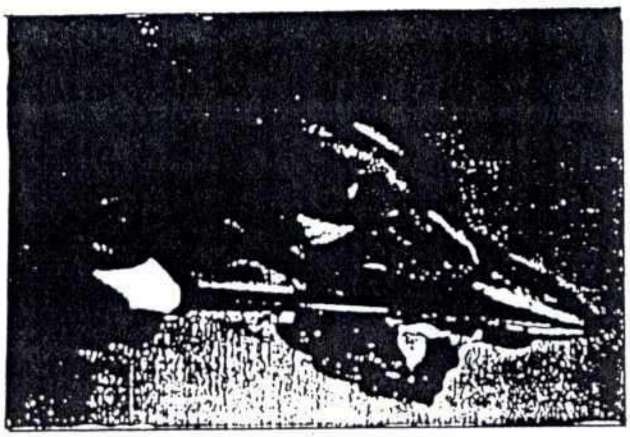
১। কিভাবে শূটকী মাছ তৈরী করা যায়/কিভাবে তাজা মাছ হতে শূটকী মাছ তৈরী করা যায়।



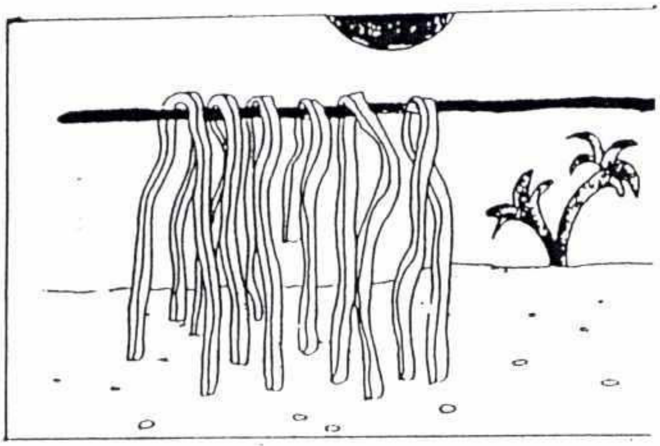
২। মাছ শুকানো নির্ভর করে ঐ এলাকার আবহাওয়ার উপর, কি ধরনের মাছ শূটকী করা হবে এবং মাছের কত অংশ খোলা অবস্থায় থাকবে।



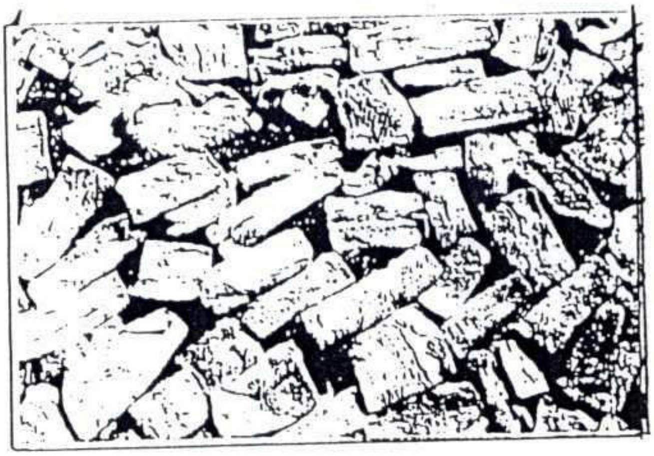
৬। মাছ মাঝখান দিয়ে কেটে পাতলা করে লেজ থেকে মাথা পর্যন্ত খোলা অবস্থায় ফালি করা হলে তাড়াতাড়ি শুকায়। এভাবে মাছ কেটে নিন।



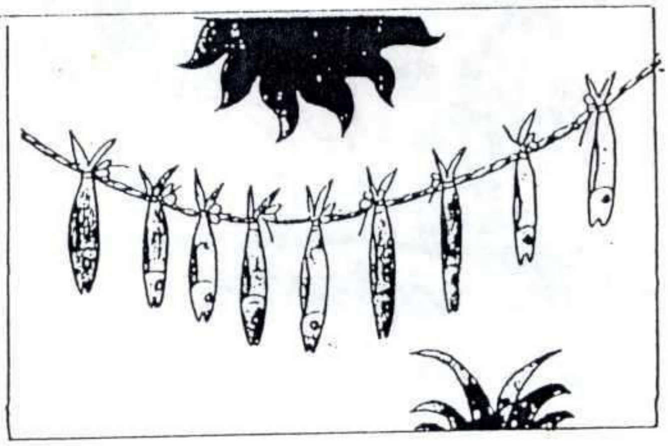
৪। মাছ শূটকী তৈরীর পূর্বে নাড়িভুড়ি ফুলকা সবসময় এভাবে পরিষ্কার করে নিন।



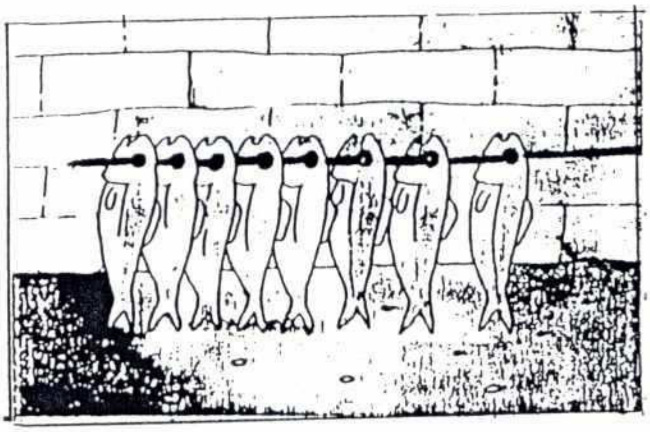
৫। বড় মাছ ১ ইঞ্চি পুরু করে এভাবে ফালি করুন।



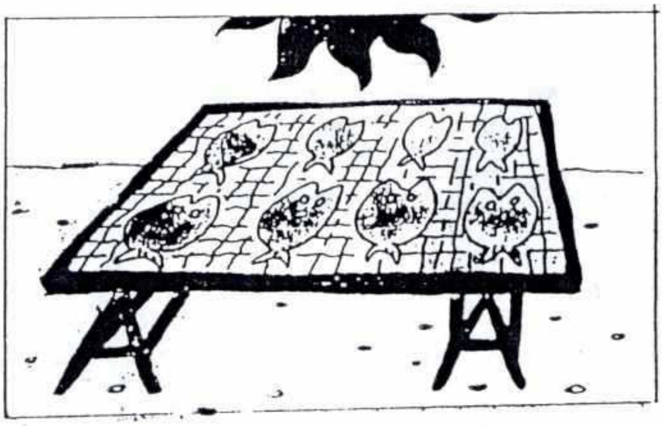
৬। অথবা এভাবে টুকরা করুন।



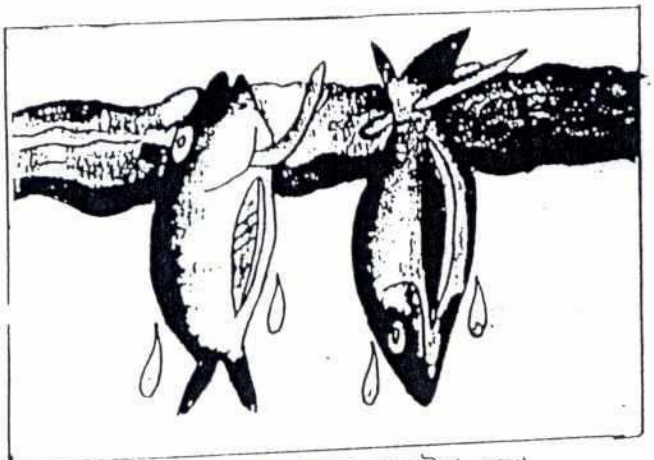
৭। ছোট মাছ অনেক দেশে এভাবে শুকানো হয়ে শুধু নাড়িভুড়ি পরিষ্কার করে।



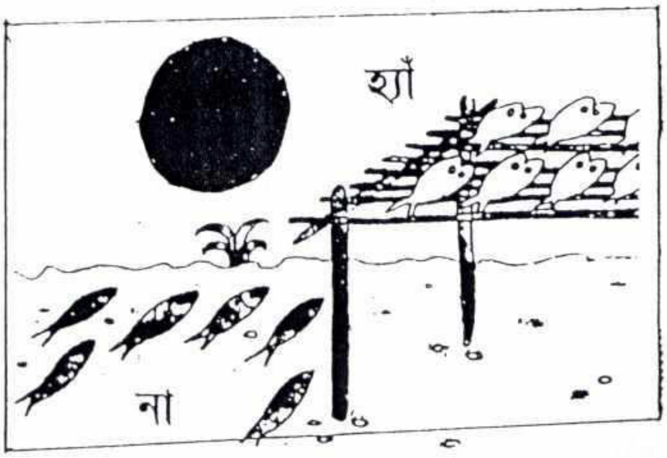
৮। ছোট মাছ সাধারণতঃ এভাবে সোজাসোজি মুখের কাছ থেকে পেট পর্যন্ত কেটে কাঠিতে এভাবে ঝুলিয়ে শুকানো হয়।



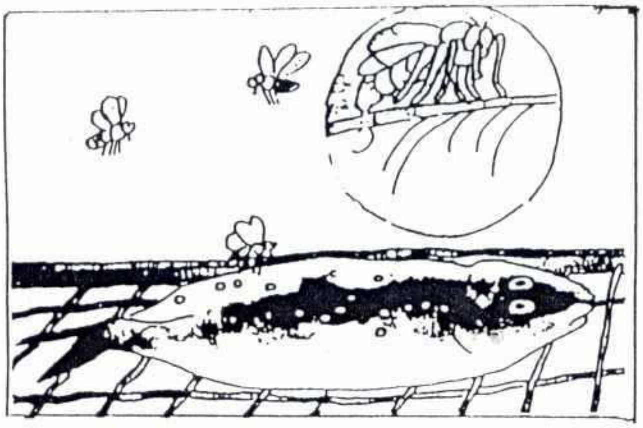
৯। রেকে মাছ শুকান বা মাচানে শুকানো।



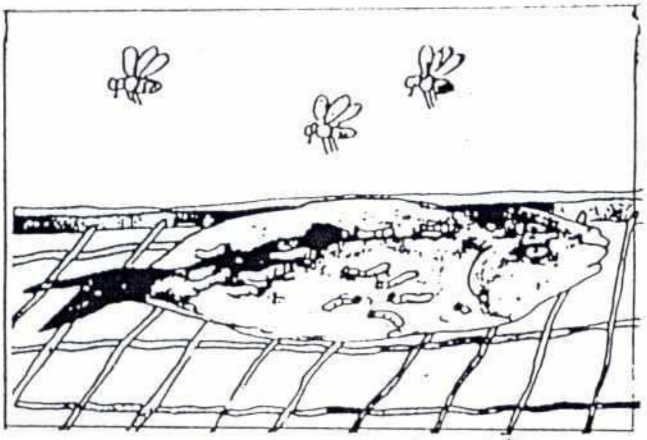
১০। অথবা মাছকে এভাবে ঝুলাইয়া দেয়া হয় দিন।



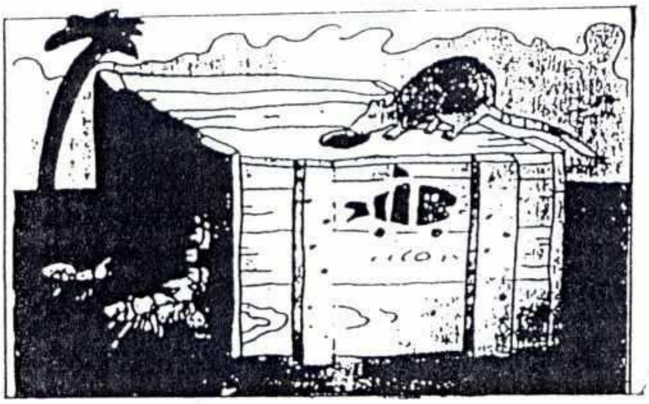
১১। মাটিতে মাছ শুকানো যাবে না, ইহাতে অনেক সময় লাগে এবং মাছ সংক্রমিত হয়। এবং ধূলা বালি দ্বারা সংক্রামিত হয়। মাটিতে না, মাচানে হ্যাঁ।



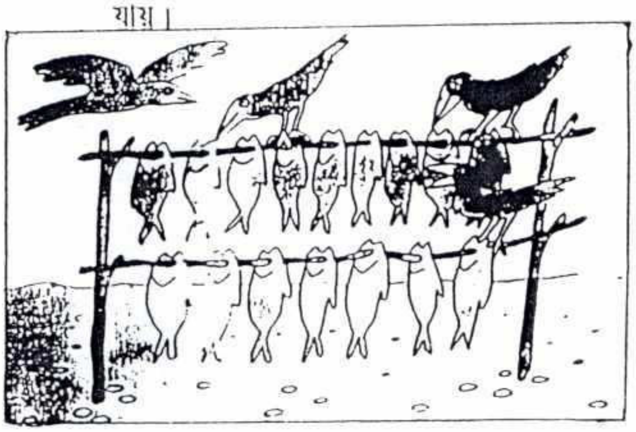
১২। উন্মুক্ত অবস্থায় মাছ শুকানোর সময় শুরুতে, মাছি এভাবে মাছের গায়ে ডিম পাড়ে এবং রোগ জীবানু ছড়ায়।



১৩। যার ফলে মাছের সাড়া গায়ে খুবই তাড়াতাড়ি। পোকার জন্ম (মেগট) নেয় কেননা পরজীব মাছ হতে খাদ্য গ্রহন করে এবং যার ফলে মাছ পঁচে যায়।



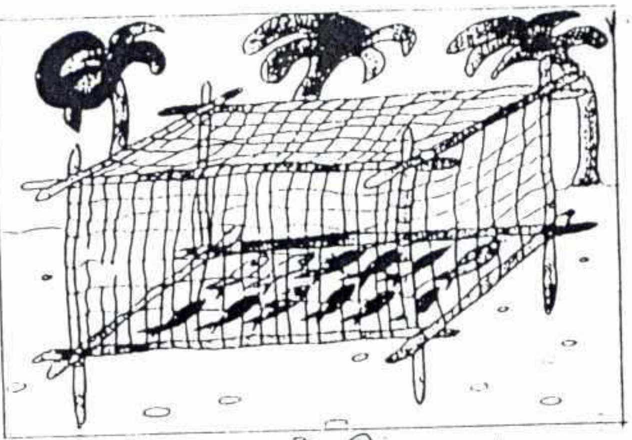
১৪। পোকামাকড়, ইঁদুর, ছেচো শুকনা মাছ খেতে পছন্দ করে। সঠিকভাবে মজুদ করা না হলে এগুলো দ্বারা সংক্রমিত হয়।



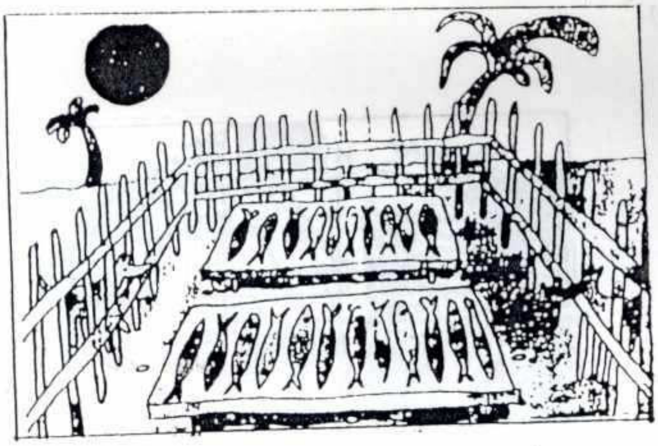
১৫। কাক ও অন্যান্য পাখি উন্মুক্ত অবস্থায় শূটকী তৈরীর ক্ষেত্রে সব সময় সমস্যার সৃষ্টি করে। শুকানোর সময় এভাবে শূটকীকে শংক্রমিত করছে।

১৬। পোকা, মাকড়, ইঁদুর, বিড়াল এবং পাখি স্বাভাবিক ভাবেই পরজীব বহন করে, এ ধরনের শূটকী খাওয়ার ফলে অনেক সময় মানুষ নানা রোগে আক্রান্ত হয়।

১৭। গৃহ পালিত পশু যেমন বিড়াল, কুকুর শূটকী মাছ খুবই পছন্দ করে এদেরকে শূটকী হতে দুরে রাখতে হবে।

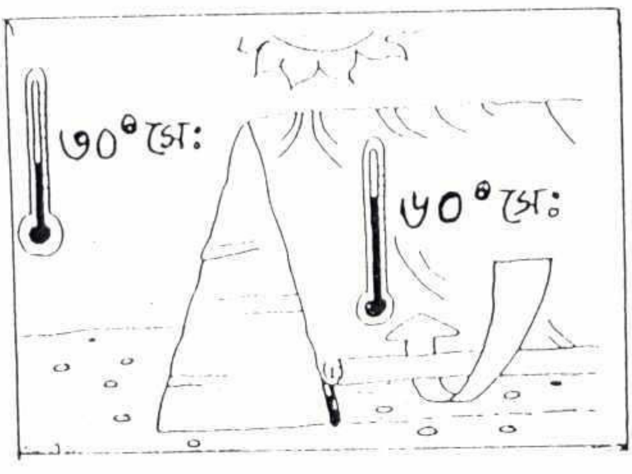


১৮। এ ধরনের বেষ্টনী দিয়ে আমরা পোকামাকড় পাখি ফেরাতে পারি, কিন্তু ধূলা বালি ও বাতাসের সহিত বাহিত রোগ জীবানু প্রতিরোধ করা যায় না।

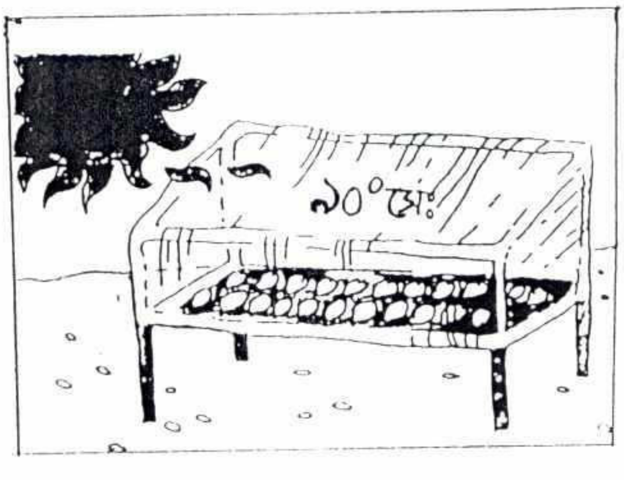


১৯। শুকনা মাছের রেক বা চালুনীর চতুর্দিকে এধরনের ঘের দিয়ে গৃহ পালিত পশু পাখি ফেরানো যায়।

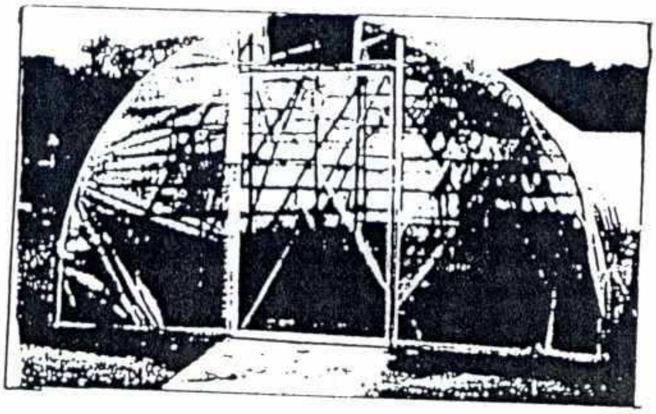
* এধরনের অবস্থা থেকে রক্ষা পাওয়ার জন্য আমরা সোলার ড্রায়ারের ব্যবহার করতে পারি।



২০। সোলার ড্রায়ার মাছ শুকানোর জন্য খুবই কার্যকর। তাপমাত্রা ৩০° সেঃ থেকে বেড়ে ৫০° সেঃ এমনকি অনেক সময় ৬০° সেঃ হয়ে যায়। কোন মাছে যদি মাছি ডিমও পাড়ে তাহলে এ ধরনের সোলার ড্রায়ারে শুকানোর সময় ৩-৪ ঘন্টার মধ্যে সকল ডিম নষ্ট হয়ে যায়। ২৪ ঘন্টার মধ্যে মাছ শুকিয়ে যায়।



২১। এ ধরনের সোলার ড্রায়ার সাহয্যে তাপমাত্রা ৯০° সেঃ পর্যন্ত উঠে। যার ফলে প্রায় ২ ঘন্টার মধ্যে মাছ শুকিয়ে যায়।



২২। একটি ভিন্ন ধরনের সোলার ড্রায়ার খুবই সুন্দর, স্থায়ীভাবে ব্যবহার করা যায় স্বাস্থ্য সম্মত। ২৪ ঘন্টার মধ্যে মাছ শুকিয়ে যায়।

সোলার ড্রায়ার ঃ

পাতলা পলিথিন দ্বারা সোলার ড্রায়ার তৈরী করা হয়। ত্রিকোনাকার তাবুর মত করে ড্রায়ার বানাতে হয়। তাবুর একদিকে কালো রংগের পলিথিন ব্যবহার করা হয়। নিম্নে একটি সোলার ড্রায়ার কিভাবে বানানো যায় তা দেখানো হলো।

সোলার ড্রায়ার ব্যবহারের সুবিধা ও অসুবিধা সমূহঃ

সুবিধাঃ

১। সোলার ড্রায়ার ব্যবহার করলে মাছের গায়ে ধূলাবালি লাগতে পারে না।

২। সোলার ড্রায়ার ব্যবহার করলে মাছের সংস্পর্শে কোন মশা মাছি পোকা-মাকড়, পশু-পাখি প্রবেশ করতে পারে না।

৩। রোগজীবানুর হাত থেকে রক্ষা পায়

৪। সোলার ড্রায়ারের ভিতরের তাপমাত্রা বেড়ে যায় ফলে মাছ অধিক তাড়াতাড়ি শুকায়।

৫। মান সম্পন্ন শুটকী তৈরী হয় বিধায় অধিক মূল্য পড়িয়া যায়।

অসুবিধাঃ

১। বেশী বাতাসে ব্যবহার করা যায় না।

২। অধিক মাছ একসাথে শুকানো যায় না,

৩। সহজে এক জায়গা থেকে অন্য জায়গায় নেয়া যায় না।

৪। সনাতন পদ্ধতির চেয়ে উৎপাদন খরচ একটু বেড়ে যায়।

নিম্নে সোলার ড্রায়ার কিভাবে বানানো যায় তার বিস্তারিতভাবে উল্লেখ করা হলোঃ

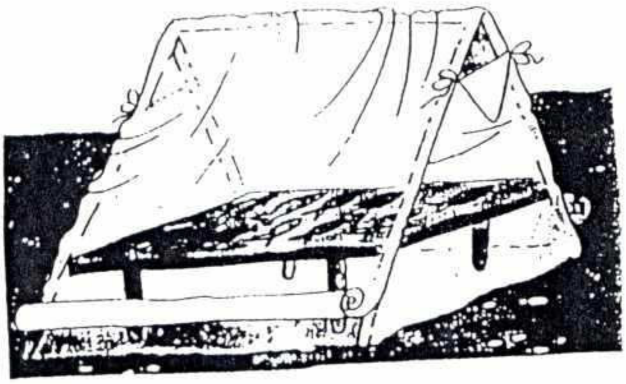
১. ১৫ ফুট লম্বা ১টি সাদা পলিথিনের ফ্রেম তৈরী করি।

২. ১৫ ফুট লম্বা ১টি কালো পলিথিনের ফ্রেম তৈরী করি।

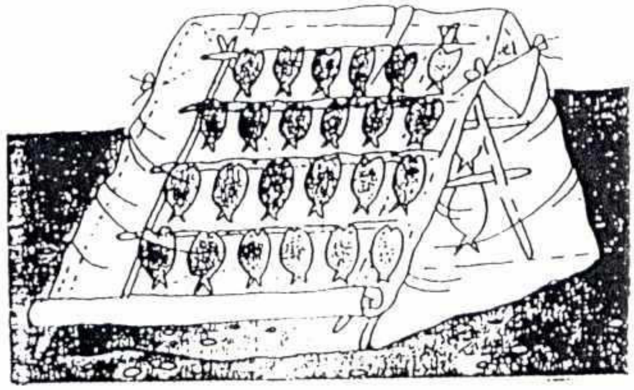
৩. ৭ ফুট উচু ত্রিকোনাকৃতি ২টি সাদা পলিথিনের ফ্রেম তৈরী করি।

৪. নীচের ছবির মত করে ১টির সাথে আর ১টির যোগ করে তাবুর মত বানাই।
এই তাবুটিই সোলার ড্রায়ার।

৫. এ ধরনের ১টি ড্রায়ারে এককালীন ২৫-৩০ কেজি মাছ শুকানো যায়।



২৩। সোলার ড্রায়ারে মাছ শুকান। রেকে মাছ বিছিয়ে দিন।



২৪। ঝুলন্ত মাচান, সমতল মাচানে শুকানো রেকের চেয়ে উত্তম। এতে অধিক মাছ শুকানো যায় এবং মাছ ভালো শুকায় বা তাড়াতাড়ি শুকায়।

আমরা কিভাবে স্বাস্থ্যসম্মত শুটকী তৈরী করতে পারি ?

১. কম চর্বিযুক্ত মাছ শুটকী তৈরীর জন্য বেছে নিতে হবে। মৃত মাছের নাড়িভুড়ি ফুলকা ফেলে দিতে হবে। বড় মাছ ২ ইঞ্চি পুরু করে ফালি করতে হবে।

২. যেখানে আলো/রোদ ও বাতাস সহজে পৌঁছাতে পারে এমন পরিষ্কার জায়গায় মাচানে একটু কাত করে মাছ রোদে দিতে হবে।

৩. বৃষ্টি এবং পোকামাকড়, পশু পাখি থেকে রক্ষা করতে হবে।

৪. রোদের তীব্রতা বেশী থাকলে ১ম কয় ঘন্টা হালকা ছায়ায় শুকাতে হবে এবং রাতে মাছ বাক্সে সংরক্ষণ করতে হবে।

৫. রাতে বাতাসের আদ্রতা বেশী থাকার কারণে মাছকে বাক্সে ভরে রাখতে হবে।

৬. ভালোভাবে শুকানোর পর ছিদ্রহীন পলিথিনে বা ছিদ্রহীন বাক্সে সংরক্ষণ করতে হবে। ছিদ্রহীন পলিথিনের থলিতে মাছ রাখার ফলে পোকা-মাকড় বা অন্য কোন প্রাণী দ্বারা সংক্রমিত হবে না।

৭. গুদামজাত করার পূর্বে খেয়াল রাখতে হবে ভালোভাবে ব্যাগ/থলি/বাক্সের মুখ বন্ধ করা হয়েছে কিনা। প্যাকেট বা থলিতে ছিদ্র থাকলে বাতাসের সংস্পর্শে এসে শুটকীর গায়ে ছাতা পড়ে। যা শুটকীর খাদ্যমান নষ্ট করে দেয়। অনেক সময় বেঁচে যায়।

* অস্বাস্থ্যকর পরিবেশে শুটকী তৈরী করা ও ক্ষতিকর প্রভাব

ক

আমাদের দেশের গ্রামে গঞ্জে দেখা যাবে বাচ্চারা যেখানে সেখানে মলত্যাগ করছে। গৃহপালিত পশুপাখি আমাদের বাড়িঘরে অবাদ বিচরন করছে। প্রতিদিন নিয়ন্ত্রনহীন অবস্থায় যেখানে খুশি সেখানে মল বিষ্টা, লেদা/গোবর ত্যাগ করছে। এ সকল নোংরা ময়লাই প্রধানতঃ পরিবেশকে দুষিত করছে। মৎস্য প্রক্রিয়াজাত করন কাজে নিয়োজিত জেলে, মৎস্যজীবিরা অনেকেই জানেন না এ সকল দুষিত বিষ্টা কিভাবে আমাদের পরিবেশকে দুষিত করছে এবং নানা ধরনের রোগ জীবনু ছড়াচ্ছে। উপরের ছবিতে আমরা দেখতে পাচ্ছি এলোপাতাড়িভাবে মলত্যাগ করছে। পার্শ্বেই শুটকী তৈরী করছে। মশা মাশি নোংরা ময়লা হতে তাদের খাদ্য গ্রহন ও বংশ বৃদ্ধি করে থাকে। নোংরা ময়লা হতেই মশা মাছির গায়ে লেগে নানা রোগ জীবানু আমাদের দৈনন্দিন জীবনে ছড়াচ্ছে। যার ক্ষতিকর প্রভাব সম্পর্কে আমরা মোটেই সচেতন নই।

ছবির সাহায্যে দেখানো হলো কিভাবে মশামাছিও অন্যান্য গৃহপালিত পশুপাখি রোগ ছড়ায়।

* ছেলেটি পায়খানা করছে। * ছাগল লেদা ত্যাগ করছে। * মুরগীর বিষ্টা ত্যাগ করছে।

এগুলো সাধারণতঃ নিম্নলিখিত জটিল রোগজীবানু বহন করে।

১। স্যালমোনিলা -- টাইফয়েড জ্বরের জীবানু

২। সিজোলা -- আমাশয়ের জীবানু

৩। ভি -কলেরা -- কলেরার জীবানু।

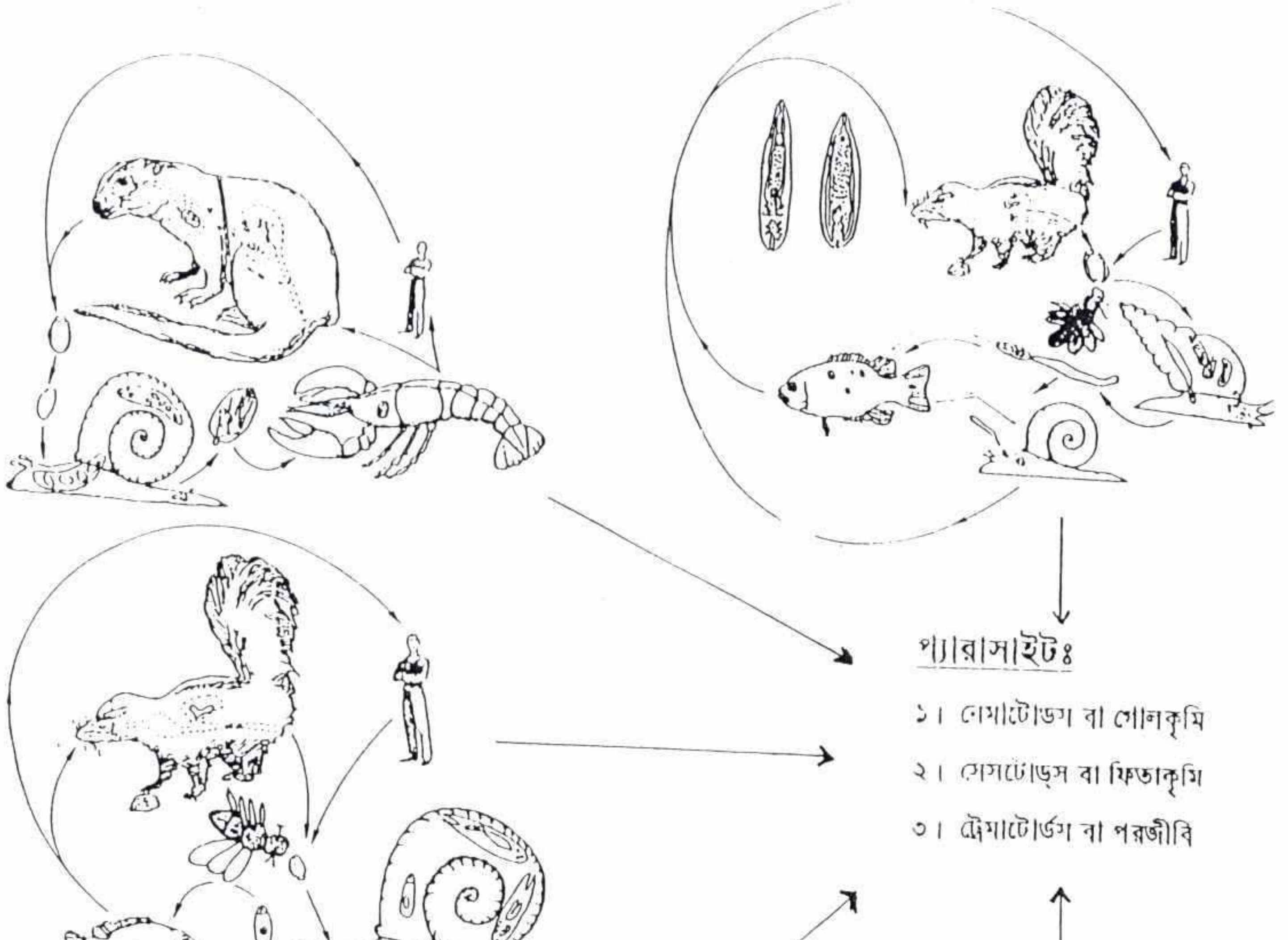
৪। ই-কলি -- পেট খারাপের জীবানু

৫। স্টেপওরাস -- খাদ্য বিষাক্ত বা বিষ ক্রিয়া, ভোমেটিং, ডাইরিয়া, জ্বর এর জীবানু।

(ক) মানুষের মল বা পশুপাখির বিষ্টা থেকে নানা রোগজীবানু বহন করে মাছি বা পোকা মাকড় মাছের গায়ে বসছে। এবং মাছকে সংক্রমিত করছে।

উল্লেখিত ছবি দেখে আমরা বুঝতে পারি প্যারাসাইট আমাদের কিভাবে ক্ষতি করে।

৯২



খ

প্যারাসাইট আমাদের কি ক্ষতি করে।

সাধারণতঃ আমাদের দেশে গ্রামেগঞ্জে দেখা যায় যে ছোট বাচ্চাদের পেট বড় হয়ে গেছে। বাচ্চাদের খাবার রুচি নাই। ঘুম কম, রাতে চিৎকার দিয়ে উঠে। এ ধরনের উপসর্গ হতে বুঝা যায় যে বাচ্চার পেটে কৃমি বাসা বেধেছে। আর এই কৃমির প্রধান উৎস হচ্ছে অস্বাস্থ্যকর পরিবেশে তৈরী শুটকী মাছ খাওয়া। বাচ্চা সহ বড়দেরও অনেক সময় শুটকী মাছ দিয়ে ভাত খাওয়ার পর দেখা যায় যে পেট ব্যাথা, বমি, এবং বদহজম হয়ে পাতলা পায়খানা হচ্ছে। এ ধরনের উপসর্গ সাধারণতঃ ট্রেমাটোডস বা পরজীব যুক্ত শুটকী বা অন্যান্য সংক্রামিত খাবার খাওয়ার ফলেই হয়ে থাকে। শুটকী মাছ তৈরীর সময় নিম্নলিখিত প্রক্রিয়ায় লবনাক্ত করা হলে এর ক্ষতিকর প্রভাব হতে রক্ষা পাওয়া যায়।

কিভাবে শুটকী মাছকে প্যারাসাইটের হাত হতে রক্ষা করা যায়।

৪-৫% লবনের দ্রবনে —	> ১৭ সপ্তাহ বাঁচতে পারে
৬-৭% লবনের দ্রবনে —	> ১০-১২ সপ্তাহ বাঁচতে পারে
৮-৯% লবনের দ্রবনে —	> ৫-৬ সপ্তাহ বাঁচতে পারে
>১০% লবনের দ্রবনে —	> ৩ সপ্তাহ বাঁচতে পারে

তাপ দিলে মরে যায়। ৫৫° সেঃ-
২৪ ঘন্টা বাঁচে।

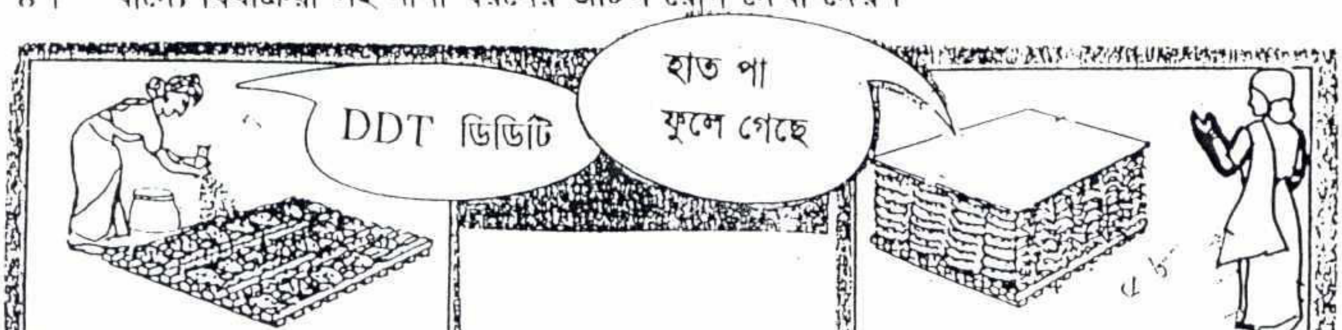
শুটকীতে বিভিন্ন রাসায়নিক দ্রব্যের ব্যবহার ও তার ক্ষতিকর প্রভাব

সাধারনতঃ শুটকী মাছ তৈরীর পর বা তৈরীর সময়, মাছি, মশা, পোকা মাকড়, ইদুর, থেকে রক্ষা করার জন্য-

১। পলি ক্লোরোনেটেড বাইফিনাইল (PCPS)
২। কেপন (Kepone) (৬) লেড/Lead
৩। ক্লোরোডেন (Chlorodane) (৭) মারকারী/পারদ
৪। ডাই-এলড্রিন (Di-eldrine)
৫। ডিডিটি (Di-Chloro-di-Phenyl-Tri-Chloro Ethaine) ব্যবহার হয়।

এ সকল রাসায়নিক দ্রব্য ব্যবহারের ক্ষতিকর দিক গুলো হলো-

১। ক্যান্সার
২। ক্ষতরোগ
৩। আলসার
৪। খাদ্যে বিষক্রিয়া সহ নানা ধরনের জটিল রোগ দেখা দেয়।

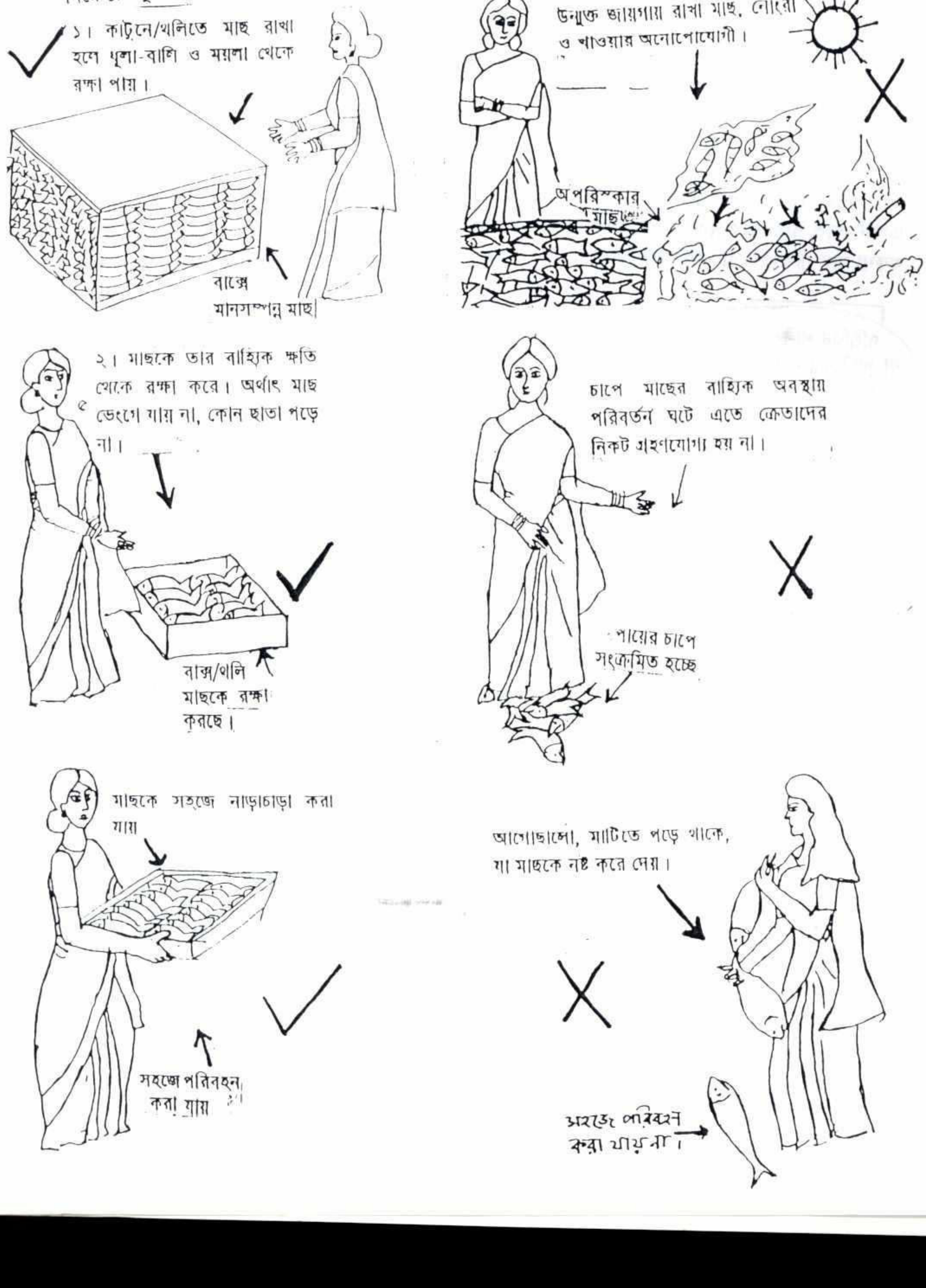


DDT যুক্ত শুটকী
খাবারের আগের অবস্থা

পরের অবস্থা
শুকিয়ে গেছে

প্যাকিং করাঃ
মৎস্য পণ্য উৎপাদনের পর তা সুষ্ঠু সুন্দরভাবে প্যাকিং/মোড়কজাত করা না হলে তা খুব তাড়াতাড়ি নষ্ট হয়ে যায়।

নিম্নে ১টি তুলনামূলক চিত্র প্রদান করা হলো।



৩৭৬

প্যাকিং দ্রব্য কি ধরনের হবে তা নির্ভর করে কি ধরনের মাছ প্যাকিং করা হবে।

১। কি ধরনের মাছ যেমন- শুকনা মাছ, তাজা মাছ

২। কতদূরে এবং কিভাবে পরিবহন করা হবে।

৩। প্যাকিং সামগ্রীর দাম ও সহজে প্রাপ্য কিনা

৪। প্যাকিং সামগ্রী পুনঃ ব্যবহার যোগ্য কিনা?

তাজা মাছ পরিবহন বা বাজারজাতকরণঃ

তাপনিরুদক পাত্র/ বাক্স বরফ সহ ব্যবহার করুন

শুকনা মাছ পরিবহন বা বাজারজাতকরণ

প্লাষ্টিকের মোড়ক সামগ্রী বা পলিথিনের মোড়ক সামগ্রী ব্যবহারে শুকনা মাছকে আদ্রতা হতে রক্ষা করে। তাছাড়া প্লাষ্টিকের মোড়ক সামগ্রী পুনঃ ব্যবহার করা যায়।

ভালোভাবে না শুকালে পলিথিন থলিতে মুখবন্ধ করে রাখলেও মাছে ছাতা পড়বে এবং শুটকীর মান নষ্ট করে দিবে। বাহিরের তাপমাত্রায় মাছের ভিতরের পানি বের হয়ে প্লাষ্টিকের থলিতে জমা হয়। ফলে শুকনা মাছ ভিজে স্যাত স্যাতে হয়ে আস্তে আস্তে পচেযায়।