Government of the People's Republic of Bangladesh
Bangladesh Water Development Board
Flood Plan Coordination Organisation

FLOOD ACTION PLAN

NORTHEAST REGIONAL WATER MANAGEMENT PROJECT (FAP 6)

FISHPASS PILOT PROJECT

IMPLEMENTATION PLAN

(Draft, September 1994)

Shawinigan Lavalin (1991) Inc.
Northwest Hydraulic Consultants

in association with

Engineering and Planning Consultants Ltd.
Bangladesh Engineering and Technological Services
Institute For Development Education and Action
Nature Conservation Movement

Canadian International Development Agency

Government of the People's Republic of Bangladesh
Bangladesh Water Development Board
Flood Plan Coordination Organisation

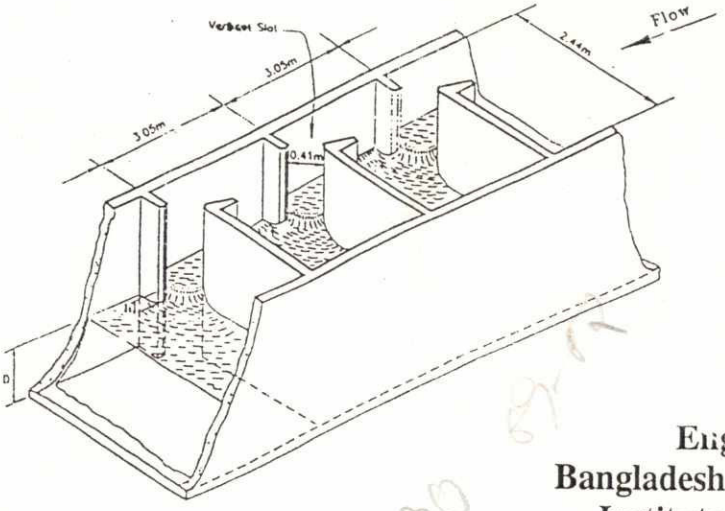
FLOOD ACTION PLAN

NORTHEAST REGIONAL WATER MANAGEMENT PROJECT (FAP 6)

FISHPASS PILOT PROJECT

IMPLEMENTATION PLAN

(Draft, September 1994)



Shawinigan Lavalin (1991) Inc.
Northwest Hydraulic Consultants

in association with

Engineering and Planning Consultants Ltd.
Bangladesh Engineering and Technological Services
Institute For Development Education and Action
Nature Conservation Movement

Canadian International Development Agency

ACRONYMS AND ABBREVIATIONS

AIDAB	Australian International Development Assistance Bureau
BWDB	Bangladesh Water Development Board
CAI	CanAgro International
CIDA	Canadian International Development Agency
DOA	Department of Agriculture
DOE	Department of Environment
DOF	Department of Fisheries
FAP	Flood Action Plan
FCDI	Flood control, drainage and irrigation
FPCO	Flood Plan Coordination Organization
FPP	Fishpass Pilot Project
GOB	Government of Bangladesh
IDA	International Development Association
PMP	Project monitoring programme of NERP
MFL	Ministry of Fisheries and Livestock
MIWDFC	Ministry of Irrigation, Water Development and Flood Control
MRP	Manu River FCDI Project
NERP	Northeast Regional Water Management Project
NHC	Northwest Hydraulic Consultants
NSWFI	New South Wales Fisheries Institute
QPR	Quarterly Progress Report
SMEC	Snowy Mountains Engineering Corporation
WBS	Work breakdown structure

TABLE OF CONTENTS

Acronyms and Abbreviations
Table of Contents

1. INTRODUCTION

1.1 Pilot Project Background, Objective and Locations

The Fishpass Pilot Project (FPP) originates from the Northeast Regional Water Management Project (NERP) study 'FISHERIES ENGINEERING MEASURES'. It is a structural initiative which is designed to mitigate negative impacts of FCD/I projects on fisheries, specifically to allow normal breeding migrations to take place during the premonsoon. This is expected to result in an increase in fish abundance and yield, and thus help to meet regional planning objectives of poverty alleviation, food self-sufficiency and economic development.

The objective of the pilot project is:

> To assess the technical feasibility of using the vertical slot type of fishpass to provide passage to migrating fish stocks across flood control embankments in the haor region of Bangladesh, and acquire information about economic and socioeconomic impacts on beneficiary communities.

Principal criteria for site selection are as follows:

- The FCD/I project area should be medium to large (in order to minimize opposition from farmers to release of water through the fishpass into the project area);
- The river channel opposite the fishpass should be perennial;
- Reliable and abundant populations of migratory fish should occur in the river;
- A number of the beels inside the FCD/I project area should be perennial;
- During the time of the premonsoon, there should be no open embankment breeches or public cuts;
- There should be no cross dams in the khal which connects to the fishpass;
- There must be evidence (local public opinion, DOF/NERP studies) that the FCD/I project has had negative impacts on fisheries, specifically that fish migration has been disrupted (usually manifested as low abundance or absence of boromaach in perennial beels);

The site selected for implementation of the pilot project meets these criteria:

Manu River FCDI Project (MRP): This is a large and complex full flood control project with pumped drainage and irrigation. Present within the project area is Kawadighi Haor, which was of outstanding regional importance as a mother fishery prior to project implementation. The project virtually decimated Kawadighi Haor as a mother fishery, resulting in a major economic loss to fishing communities in the area. FPP offers the possibility of a partial recovery of the Kawadighi Haor mother fishery. The options for fishpass location (Macuakhali, Kashimpur) are directly on the Kushiyara River which is a major regional fish migration route. There is evidence of migrating broodfish congregating at these locations (ie the Macuakhali LLP inlet, Kashimpur pumphouse and 6 vent regulator) and attempting to enter the haor. The project is easily accessible by road and river, and logistically supportable.

1.2 Implementing Authority

FPP, a component of NERP, will be implemented by the Flood Plan Coordination Organization (FPCO), the Bangladesh Water Development Board (BWDB) and the Department of Fisheries (DOF). NERP will provide technical assistance. NERP/BWDB will be responsible for undertaking civil engineering work related to construction and maintenance of the fishpass. DOF will be responsible for undertaking fish stock monitoring work related to fishpass operation. Actual operation of the fishpass (ie release of river water through the structure) will be under the joint control of BWDB and DOF, and will be responsive to issues and recommendations raised by the project area beneficiary committee. As the structure is designed to ideally remain open year round, 'operation' as such refers to closing the structure by means of a vertical gate (as a safety measure if hydrological conditions suggest that a situation dangerous to crops inside the FCD/I project area may be developing), and reopening it once the danger has passed.

1.3 Organizational Framework

The organizational framework for FPP is presented in the text figure.

1.4 Pilot Project Components

FPP implementation consists of six components:

Management. Pilot project planning, administration, procurement, reporting and liaison with other projects.

Pilot Design. Field studies at the pilot site and at functioning vertical slot fishpasses in Australia will be used to develop a design appropriate to local species and physical conditions.

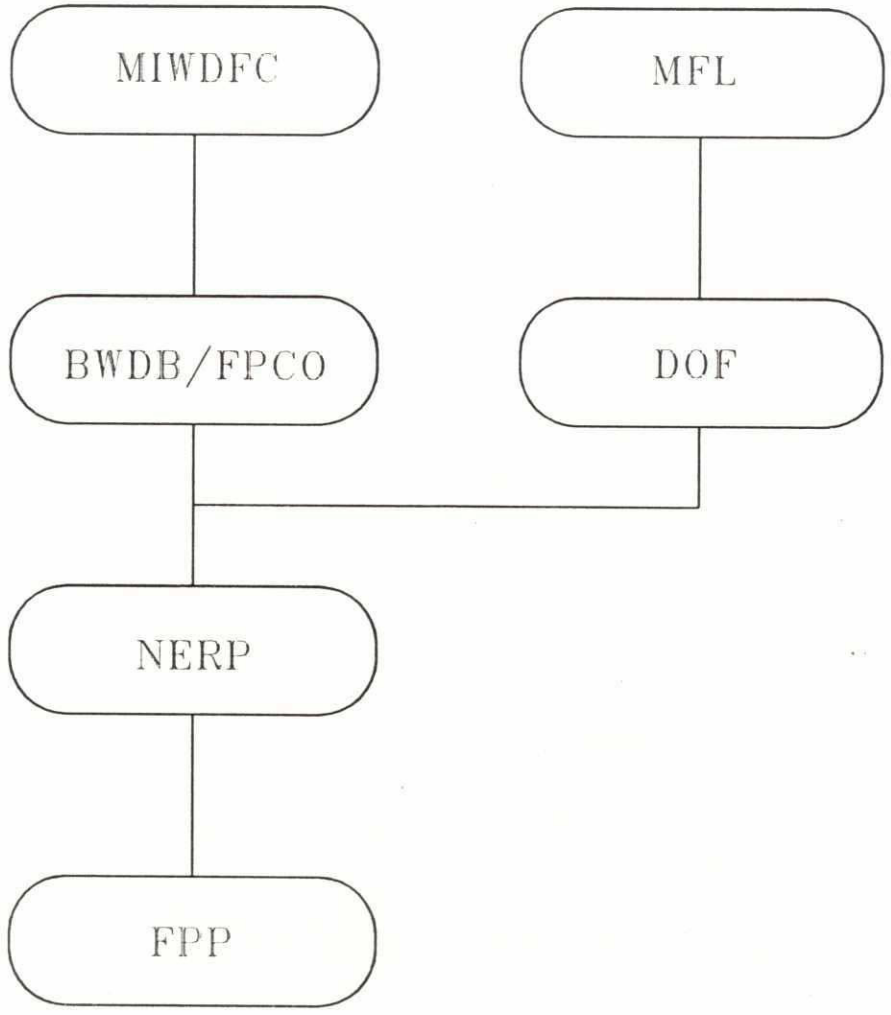
Pilot Construction. One concrete vertical slot fishpass will be constructed at MRP during year 1.

Pilot Operation. The pilot fishpass at MRP will be operated during the premonsoon. Movement of fish through the structure will be monitored, and additional optimizing adjustments will be made to the structure.

Impact Monitoring. A comprehensive baseline and impact monitoring programme will be put into place at MRP which will focus on fisheries, agriculture, hydrology and socioeconomic factors. It will build on previous monitoring results obtained by the NERP Project Monitoring Programme (PMP).

Institution Building. Training in fisheries engineering and fishpass technology will be given to a BWDB design engineer and a DOF fishery biologist through on-the-job instruction.

A more detailed description of each component is provided in Section 4.6 below.



ORGANIZATIONAL FRAMEWORK
FOR FISHPASS PILOT PROJECT

2. DESCRIPTION OF MANU RIVER FCDI PROJECT

2.1 Location

The Manu River FCDI Project lies between longitudes 91°40' and 92°00'E and latitudes 24°55'and 24°40'N. It is situated about 175 km northeast of Dhaka and about 80 km southwest of Sylhet. Administratively, it falls within Moulvibazar District of the Greater Sylhet District. The Manu River Irrigation Project lies in Chandnighat, Akhikura, and Ekatuna union parishads of Moulvibazar Thana, and in the Rajnagar, Mansurnagar, Uttar Bhagh, Panchgaon, Munshibazar, Fatehpur, and Tengra union parishads of Rajnagar Thana. The municipal area of Moulvibazar, located mainly on the left bank of the Manu River, is not within the project area.

2.2 Physical Environment

A comprehensive account of the Manu River FCDI project is presented in the NERP report entitled: ***PROJECT MONITORING PROGRAMME, MANU RIVER FCDI PROJECT (1992-94), Interim Report***. The following is a summary of relevant chapters of that report.

The project area is roughly trapezoidal in shape, with a 22.8 km southwest to northeast axis and a 14.8 km width. A 6000 ha area of the Bhatera Hills (up to 433 m PWD), drains into the project area. The Kushiyara River to the north, the foot of the Bhatera Hills to the east, and the Manu River to the south and west, form the boundaries of the 24,076 ha project area. The project area consists of a concave alluvial plain towards which the land slopes gently from the foot of the Bhatera Hills in the east, and from the surrounding river levees on the north, west and south. Elevations within the project area range from about 12.5 m PWD at the foot of the Bhatera Hills to below 4 m PWD at the centre of Kawadighi Haor. The area is dissected by numerous former distributaries of the Manu and tributaries of the Kushiyara, and by many smaller drainage khals.

Kawadighi Haor, located in the northwest of the project area, is the largest permanent water body in the area (85 km^2). Before implementation of the project 25-30% of the area was permanently and deeply inundated during the monsoon season. Now, most of the other smaller water bodies (beels), located in the northeast and northwest of the project area and including the Singua, Barkal and Dukhura beels, dry up during the winter months. The natural drainage channels which convey flood water to Kawadighi Haor, and link the beels to it, are badly silted, choked by aquatic vegetation (water hyacinth) and, in some cases, bunded by farmers and fishermen. Drainage congestion is causing severe problems at many places.

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.

Maximum temperatures vary from about 28°C to 36°C with the highest temperatures experienced during the period March to June. There is a significant diurnal fluctuation with minimum temperatures ranging from about 6°C to 23°C. The mean annual rainfall over the project area, based on the results of three local rainfall stations, is about 2,865 mm. The rainfall exhibits a seasonal pattern with up to 65% of the annual total experienced during the monsoon period June

to September. The period from December to March is significantly dry with less than 5.5% of the annual total. The relative humidity is high throughout the year, with average humidity ranging from 72 to 88%. The humidity is highest during the monsoon period June to September. The average wind speed varies from about 3.5 to 5.4 m/s with the highest speeds occurring in between March and July. Potential evapotranspiration rates reflect seasonal patterns with the highest rates of up to 4.9 mm/day during the pre-monsoon month in May. The lowest rate, 2.6 mm/day, occurs during the winter months of December and January.

The Manu, Kushiyara and Dhalai Rivers are the principal sources of water entering the project area. The Kushiyara has a huge catchment area, most of which is in India with only 520 km^2 in Bangladesh. The Manu and Dhalai Rivers originate in the Lushai Hill range in India. The Dhalai flows into the Manu about 4.6 km upstream of the Manu barrage. The Manu and Dhalai have catchment areas of 2,226 km^2 and 572 km^2 respectively in India, and of 59.5 km^2 and 292.5 km^2 respectively in Bangladesh to their confluence point.

In the past, peak flows of the Manu by-passed its Manumukh outfall by overland flow towards:

- Hakaluki Haor via the Phanai River;
- Kawadighi Haor to the Kushiyara via the Koradair River;
- Hail Haor to the Kushiyara via the Gopla River, Gunjiajuri Haor and Ratna River.

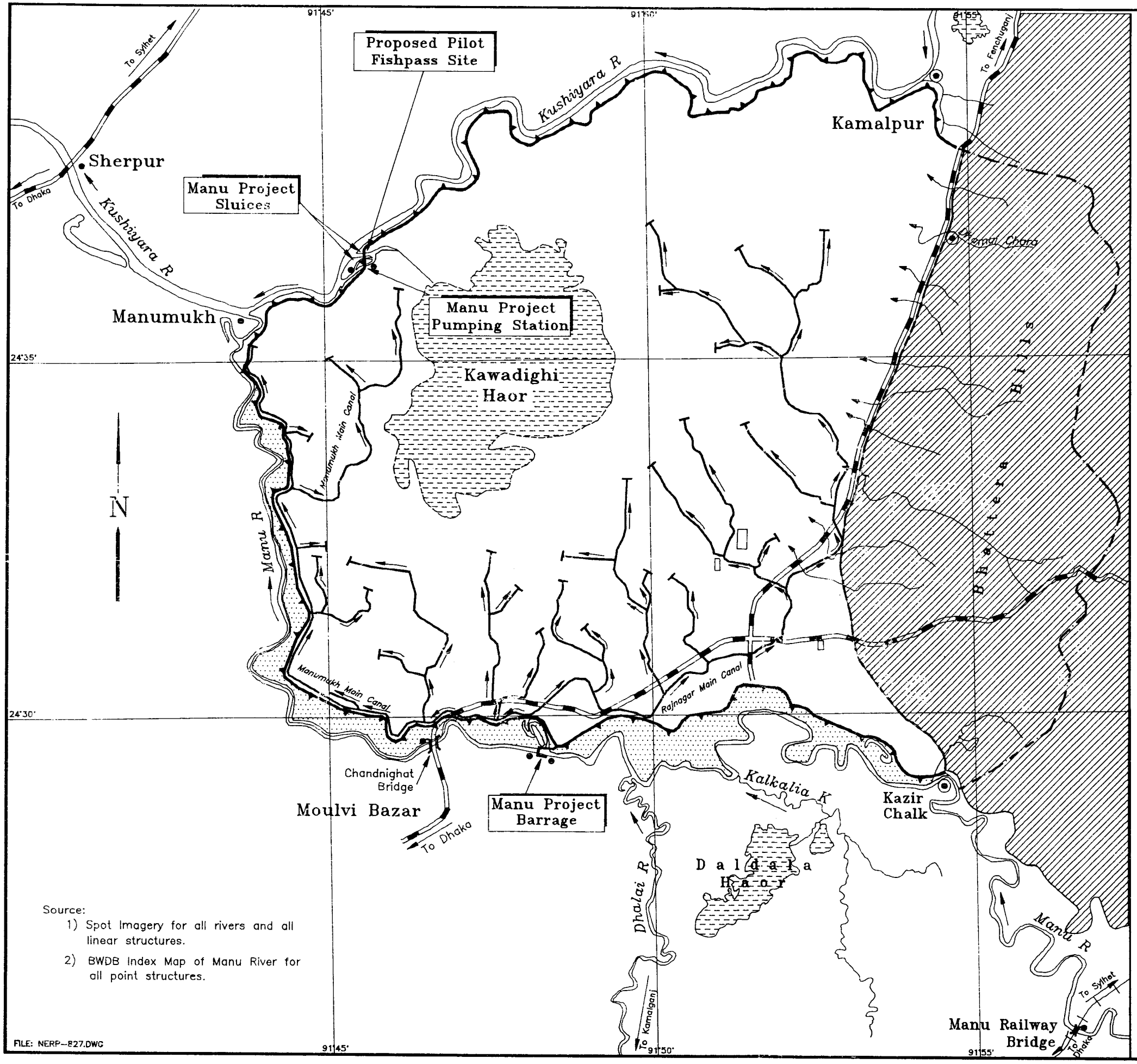
The Manu is confined by embankments along most of its length in Bangladesh. This confinement, together with further confinement and increasing deforestation in India, is resulting in steady increases in peak discharges and water levels.

2.3 Project Infrastructure

The Manu River FCDI Project is a large and complex project. It was conceived to protect about 241 km^2, and to irrigate some 125 km^2, of agricultural land between the Kushiyara and Manu Rivers. This land was subject to extensive flood damage every year caused by floods in these two rivers. The scheme was originally proposed in 1960 and a study on irrigation and flood control for the project was presented in June 1961. The feasibility, planning and design of the project was carried out between 1970 and 1975. The project was constructed between 1976 and 1983.

The project consists of a flood embankment extending along the right bank of the Manu from the southern end of the Bhatera Hills to Manumukh (Manu section), and along the left bank of the Kushiyara from the northern end of the Bhatera Hills to Manumukh (Kushiyara section). A barrage across the Manu River 3.8 km upstream of Moulvibazar, diverts water into an irrigation system supporting 11,618 ha of gravity irrigation and 877 ha of LLP irrigation. The Kashimpur pumping station, located on the left bank of the Kushiyara about 3.5 km upstream of Manumukh, has eight 4.25 m^3/s (150 cusec) electrically-driven pumps, and is used to control flood water levels within the project area. The project drainage system discharges to the Kushiyara River through two drainage sluices also located at Kashimpur.

A 59.9 km long flood embankment exists along the north, west and south sides of the project area to protect it from flooding when high floods occur in the Manu and Kushiyara Rivers. The 28.3



LEGEND

- River (Flow Direction)
- Stream (Flow Direction)
- Oxbow
- Hoar Beel
- Water Tank
- Road
- Railway
- Eastern Border of Manu River Project
- Irrigation Canal (Flow Direction)
- Embankment (Full Height)
- Pre-Project Dyke
- BWDB River Gauge
- PMP River Gauge
- Bhattera Hills Catchment Area Boundary (Project Side)
- Bhattera Hills
- Manu River Bank Floodplain

Source:

1) Spot Imagery for all rivers and all linear structures.
2) BWDB Index Map of Manu River for all point structures.

FILE: NERP-827.DWG

Scale

1km 0 1 2km

Northeast Regional Project

Manu Project

Layout of Hydraulic Structure

Prepared by: Michael E. Ibbitt	March 1994
Computer Drafting by: Mamun/Jalal	AutoCAD Drawing

km long Kushiyara section of the embankment extends along the left bank of the Kushiyara upstream from Manumukh to Mukutpur at the northern end of the Bhatera Hills, and this forms the northern project boundary. The 31.6 km long Manu section of the embankment extends along the right bank of the Manu upstream from Manumukh to Haripasha at the southern end of the Bhatera Hills, and 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 from 16.66 m PWD at Haripasha to 14.59 m PWD at Moulvibazar, and to 11.75 m PWD at Manumukh. The crest of the Kushiyara section slopes from 12.06 m PWD at Mukutpur to 10.96 m PWD at Manumukh. Both sections of the embankment have 1:2.5 riverside design slopes, 1:2 or 1:2.5 countryside design slopes, and a 4.3 m crest width.

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.

Irrigation water diverted by the Manu Barrage is conveyed to the fields via a 105.3 km canal system consisting of two main, 14 secondary and 14 tertiary canals. The 18.6 km Manumukh main canal conveys water to the west, and 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 over-

topping by flood water coming from cuts in the project embankment. Many canals are choked by aquatic vegetation, and many canal banks have been cut to facilitate drainage. Some canal lengths are badly silted as a result of flood water inundation, and bunds have been constructed in some canals for fishing. The Manumukh main canal is regularly damaged by public cuts, particularly in Moulvibazar Thana, and flood water often overtops its banks; repairs by BWDB prior to the 1991 irrigation season enabled about 69% of the command area to be irrigated. The Rajnagar main canal is less prone to flood damage as it is situated in a comparatively flood free area; however, the 1991 records show that only 67% of its command area was irrigated. This under-performance appears to be the result of high conveyance losses, and a lack of field turnouts. Further problems are being caused by borrow pits excavated adjacent to the secondary and tertiary canals; the average borrow pit is 1 m deep and 9.1 m wide. In some cases irrigation water is escaping into these pits, and in other cases the presence of the pits is preventing construction of needed additional turnouts.

Natural drainage channels (or khals) form the main drainage network within the project. The main channels include the 4.3 km Kalanova Khal which drains the northeast, the 9 km Udna Khal and the 4.0 km Binnajuri Khal which drain the southeast, the 10 km Lash Gang which drains the west, the 2 km Nandiura Khal which drains the southwest, and the 3.5 km Baliardar Khal which drains the mid-west. Drainage water from most of the area is conveyed by these channels to Kawadighi Haor, and from there it is discharged to the Kushiyara River, via the Koradair Gang, either through the two drainage sluices at Kashimpur or, during high river stages, by pumping at Kashimpur pumping station.

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.

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 the Thana structures require urgent repair and, in some cases, replacement.

The Manu barrage, located about 3.8 km upstream from Chandnighat bridge in Moulvibazar, was constructed at a loop in the Manu River; this loop became the de-silting basin for the whole irrigation system. The depth of silt which has accumulated in the de-silting basin since the start 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 1,274 m^3/s (45,000 ft^3/s). The normal pool level of the barrage is at 12.03 m PWD (38.00 ft GTS). The highest water level recorded is 12.95 m PWD (41 ft GTS). 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.

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 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. Reportedly (Halcrow, 1992), 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, and 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, and 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 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.

There are two main drainage sluices in the Kushiyara 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 at 4.1 m PWD, and the 3-vent sluice has an invert level at 1.4 m PWD. These drainage sluices allow gravity drainage of water from within the project area when water levels in the Kushiyara River permit. Considerable leakage through the 3-vent sluice into the project area has been observed during high river stages, and when pumping is in progress.

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.

From the de-silting basin, a bifurcation structure regulates water flows into the Manumukh and Rajnagar main canals. This RCC structure incorporates two head regulators for the main canals and a vehicular access bridge. Flows through the three vents of each regulator are controlled by vertical lift gates. Group regulators are provided at the junctions 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 each consist of a RCC box of varying ventage (1 to 3) fitted with vertical lift gates. In addition to the cross regulators incorporated in the group regulators, there are two other cross regulators in the Manumukh main canal, and two others in the Rajnagar main canal. Group checks are provided at the junctions 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, but are smaller in size. In addition to the cross checks incorporated in the group checks, there are five other cross checks in the Manumukh canal system, and 13 others in the

Rajnagar canal system. There are seven fall-cum-checks in the Manu canal system, and four in the Rajnagar canal system. The fall-cum-checks consist of RCC floor and walls fitted with a metal shutter upstream of the glacis. Falls are either 0.3 or 0.45 m. There are 262 turnouts delivering irrigation water to the fields from the tertiary and secondary canals and, in some cases, from the main canals. These structures consist of a single 254 mm diameter reinforced concrete pipe about 20 to 25 m in length, laid at field level between the canal and the fields. It is estimated that an additional 250 turnouts are required to improve water distribution. Construction of the additional structures is inhibited, however, by the need to fill in adjacent borrow pits to provide a foundation for the turnouts and to prevent water discharging into the borrow pits. There are 15 tail structures in the Manumukh canal system, and 14 in the Rajnagar canal system. The tail structures each consist of a RCC box of varying ventage (1 to 3) fitted with vertical lift gates. There are 19 LLP inlets through the Kushiyara 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 the inlet gates are damaged or missing. In some cases, the pipes have broken. At present farmers are not using the inlets for irrigation, but they are being used for limited drainage. During high river stage ring bunds are constructed by the farmers to prevent river water entering the project area, but this is not always effective.

Syphons are provided to drain rain-water accumulating in pockets either through the project embankment, or under an adjacent canal. There are seven syphons through the embankment, and 38 syphons through the irrigation canals; nine of the latter are in the Manu canal system and 29 in the Rajnagar canal system. Heavy silting of the syphons occurs and requires regular maintenance which is not always available. As a result, the syphons are often blocked or their capacity significantly reduced. BWDB have proposed that an additional seven syphons be provided to relieve drainage congestion locally.

Moulvibazar, Rajnagar, Kazirhat, Ekatuna, Mansurnagar, and Balaganj towns, and union parishads within and adjacent to the project, are supplied with electricity by the Power Development and Rural Electrification Boards. No piped gas supply is available for domestic use but gas cylinders are available in Moulvibazar. Firewood, kerosene, crop residues and cattle dung are used for domestic purposes in the villages.

2.4 Fisheries and FCD/I Impacts

Kawadighi Haor was one of the most important fish breeding grounds in the region (a mother fishery). Large broodfish from the Sylhet Depression used to migrate up the Kushiyara to Kawadighi haor during the premonsoon as the haor possessed an excellent natural environment for spawning. During the Pakistani period fish catches were occaisonally so large that a helicopter was used to transport the fish out of the haor to Dhaka. The haor was regarded as having the highest fish abundance and greatest spawning activity in the region. The only locally managed fish festival in Bangladesh has been held annually at Manumuk for 150-200 years. The previously large fishery resource of the haor was due to the combination of its location and special hydrological and topographical features. It was the deepest haor within the region. It is the closest haor upstream of the confluence of the Manu River (which carries a heavy silt load) and the Kushiyara (which has deep duars harbouring large boromaach broodstock downstream). It was the first and only haor which possesses substantial pure runoff rain water coming directly from the Battara hills and having little silt and no pollutants. It had less silt due to backflow of

river water as well as by the counterflowing water pressure from the Battara hill. These different water sources produced a natural water circulation in the haor which created a high quality habitat for fish spawning. Even 10 years after implementation of the project, broodfish still try to cross the embankment at Karadhair and Machuakhali River.

The embankment has resulted in a large economic loss to the fishery of the haor. Brood fish cannot enter into the haor and become easily harvested outside in the Kushiyara, resulting in a large loss of fish population within the region. The once fertile beels within the project have became unproductive. Agriculture lands are being extended into the beel area causing local conflict between farmers and fishermen/lessees. The water sources (local rainfall from Battara hill) of the haor and land use patterns of absentee land owners absent abroad were not considered during project planning. The project goal of achieving high net benefits through increased agricultural production has not been fully realized and it has damaged one of the best fish spawning grounds in the region.

An exceptional number of genuine fishing communities reside in the haor area. This is a good indicator of the magnitude of the earlier fisheries of Kawadighi haor. These fishing communities produced an elite group which dominated local politics and administration.

It was observed during PMP field work in 1992 that a large number of fish species were caught outside of the embankment, but which were not present on the project side. The species inside the project (mainly *chanda, mola, kaikka*) were observed to spawn throughout the monsoon. Carp broodfish were observed on the river side at the Kashimpur pump house trying to get in through the pump. However, massive failure of the embankment in 1993 near Macuakhali and elsewhere resulted in entry of Kushiyara River fish into Kawadighi Haor. Approximately a ten fold increase in fish catches resulted. This event gives an indication of the magnitude of the benefit that can be expected to be realized by the fisheries sector if premonsoon fish migrations from the river into the haor could be re-established by the pilot fishpass.

This event helped in the formulation of a preliminary list of target species that carry out some form of breeding migration, and would be expected to require an embankment bypass facility. Maximum and mimimum sizes, and expected maximum water velocity that can be negotiated in the upstream direction inside the fishpass have been estimated. Assuming a maximum water velocity of 150 cm/sec through the slot, not all target species would be predicted to be able to negotiate the structure. Among baromachh carp, it is predicted that all species except lachu and sarputi would be able to negotiate the fishpass at first maturity size (and larger sizes of lachu and sarputi would also be successful).

TARGET CARP BAROMACHH SPECIES FOR FISHPASS

Group	Species	Type	Minimum Size *			Maximum Size **		
			TL	Vc	Vm	TL	Vc	Vm
Native Carp	Rui	P	43	150	300	85	300	600
	Catla	P	43	150	300	90	315	330
	Mrigel	P	38	135	270	80	280	560
	Kalibaush	P	28	100	200	50	175	350
Minor Carp	Gonia	P	22	80	160	40	140	280
	Lachu	P	17	60	120	25	90	180
	Sarputi	P	14	50	100	25	90	180
Exotic Carp	Carpio	P	24	85	170	50	175	350
	Silver Carp	P	38	135	270	80	280	560
	Grass Carp	P	53	185	370	85	300	600

P Pelagic species; B Benthic species; TL Total length (cm);
* Average size at first maturity; ** Average size of largest individuals in stock;
Vc Cruising swimming speed (cm/sec), estimated as 3.5 times body length per sec for pelagic species, and 0.75 times body length per sec for benthic species;
Vm Maximum swimming speed (cm/sec) is estimated as 2 times cruising speed. Vm is assumed to be the maximum water velocity that can be negotiated through the fishpass.

TARGET NON-CARP BAROMACHH SPECIES FOR FISHPASS

Group	Species	Type	Minimum Size *			Maximum Size **		
			TL	Vc	Vm	TL	Vc	Vm
Large Catfish	Boal	B	48	35	70	115	85	170
	Air	B	43	30	60	85	65	130
	Ghagot	B	43	30	60	80	60	120
	Baghair	B	80	60	120	180	135	270
	Rita	B	33	25	50	55	40	80
Knifefish	Chital	P	43	150	300	100	350	700
Herring	Ilish	P	28	100	200	45	160	320
SpinyEel	Baim	B	38	30	60	80	60	120

TARGET BARBS AND CATFISH CHHOTOMACHH SPECIES FOR FISHPASS

Group	Species	Type	Minimum Size *			Maximum Size **		
			TL	Vc	Vm	TL	Vc	Vm
Small Barbs	Puti	P	3.5	10	20	10	35	70
	Mola	P	4.5	15	30	9	30	60
	Chela	P	5.5	20	40	15	55	110
Small Catfish	Kani Pabda	P	11	40	80	18	65	130
	Pabda	P	14	50	100	25	90	180
	Bacha	P	17	60	120	25	90	180
	Garua	P	16	55	110	25	90	180
	Baspata	P	7.5	25	50	10	35	70
	Batashi	P	5.5	20	40	7	25	50
	Tengra	B	9	5	10	15	10	20
	Gulsha	B	11	10	20	18	15	30

TARGET OTHER CHHOTOMACHH SPECIES FOR FISHPASS

Group	Species	Type	Minimum Size *			Maximum Size **		
			TL	Vc	Vm	TL	Vc	Vm
Loach	Rani	B	7.5	5	10	12	10	20
Spiny Eel	CirkaBaim	B	14	10	20	25	20	40
	TaraBaim	B	14	10	20	28	20	40
Knifefish	Foli	P	21	75	150	27	95	190
Needlefish	Kaikka	P	18	65	130	25	90	180
Sardine	Chapila	P	11	40	80	15	55	110

Among non-carp baromachh, only chital and ilish could successfully negotiate the fishpass at first maturity size. Larger boal and baghair would also be successful, but air, ghagot, rita, and baim are expected to be completely unable to pass upstream. Among the chhotomachh, only foli is expected to be successful at first maturity size, but larger individuals of pabda, bacha, garua and kaikka are also expected to be successful. Puti, mola, chela, kani pabda, baspata, batashi, tengra, gulsha, rani, cirka baim, tara baim and chapila are not expected to be able to move up the fishpass.

Altering the design to reduce water velocity to 125 or 100 cm/sec would allow more of the excluded species through, but this may not be cost-effective. Study of the hydrograph indicates that water velocities inside the fishpass will be highest during the premonsoon when the water level difference (head loss) between river and haor is greatest. Velocities inside the fishpass will be lower (or close to zero) during the full monsoon flood when river and haor water levels are similar, thus favouring the passage of slow swimming small species. Flow reversals within the structure can be expected during the second half of the monsoon, and the impact this will have is not clear at present.

All species could be expected to be able to move successfully in the downstream direction through the fishpass. This is likely to include passive drift of hatchlings from the river during the premonsoon through the fishpass into the haor.

3. DEVELOPMENT TARGETS

3.1 Pilot Project Outputs

FPP will yield the following tangible and intangible outputs:

Pilot fishpass. One functioning vertical slot fishpass at Manu River FCDI Project.

Expertise. A body of expertise residing with civil engineering staff at BWDB and fishery biology staff at DOF (as well as individual professional consulting personnel contracted by NERP) on planning, designing, constructing, operating, maintaining and monitoring vertical slot fishpasses for application in FCD/I projects.

Technical Manual on Fishpasses.

During the lifetime of FPP it is expected that a measurable increase in fish production will be realized at MRP.

3.2 Long Term Possibilities

MRP. Over the space of 5 to 10 years it is anticipated that a significant portion of the mother fishery functions of Kawadighi Haor will recover. This will manifest itself as spawning migrations of carp, large catfish and other species entering the haor from the Kushiyara River during the premonsoon. This will result in a significant increase (possibly in the order of 5 to 10 fold) in fish abundance and catches, and a major increase in incomes of fishermen. The restoration of spawning migrations into Kawadighi Haor could attract further investment in fisheries-oriented engineering works, such as khal re-excavation and beel embankment, which could further improve fish producing habitats inside MRP and yield further increases in fish production.

It is expected that the benefits of increased fish abundance will accrue to all categories of fishermen and fisherwomen: professional, part-time, subsistence - during the monsoon full flood fishing season, and during the dry season beel and khal fishing. Benefits will also accrue to investors (ie leaseholders) in so far as they continue to play a role in the haor fisheries. In the absence of any other initiatives, it is likely that the local communities will attribute these benefits to the presence of the fishpass. It is expected that a sense of common property ownership, management and protection will develop within the haor communities towards the fishpass, which will be seen as a technical device which benefits all (ie high equity output). At the same time, interfering with fish migrations through the fishpass and poaching in the access khals for the purpose of catching broodfish during the premonsoon will likely be seen as socially irresponsible and undermining the equitable benefits accruing from the fishpass.

NORTHEAST REGION/NATIONAL. In the Northeast region as a whole, there are some 65 BWDB FCD/I projects, and numerous other locally initiated FCD/I projects. Within Bangladesh there are some 700 BWDB FCD/I projects, and the total number of all FCD/I projects nationally is probably over 1,000. Fish production in many of these projects would probably benefit from installation of fishpasses in order to re-open blocked fish spawning migration routes. Therefore

many opportunities exist for construction of fishpasses in Bangladesh. A significant body of experience will gradually build up as more fishpasses are commissioned. Possibilities will present themselves to improve designs, reduce costs and increase efficiency, at the same time as reducing any negative impacts which may arise. Practical experience will also be gained in solving management and social impacts issues. A general nation-wide enhancement of openwater/floodplain fish production might thus be achieved, and this could attract further investment in other types of fisheries engineering measures as well as support for better openwater fisheries management and fish biodiversity conservation. Conditions would thus be created for long term sustainability of openwater fish production at a high level of volume and value output.

4. PILOT PROJECT WORK PLAN

4.1 Introduction

This chapter describes how FPP will reach its objective and produce the outputs listed in Section 3.1.

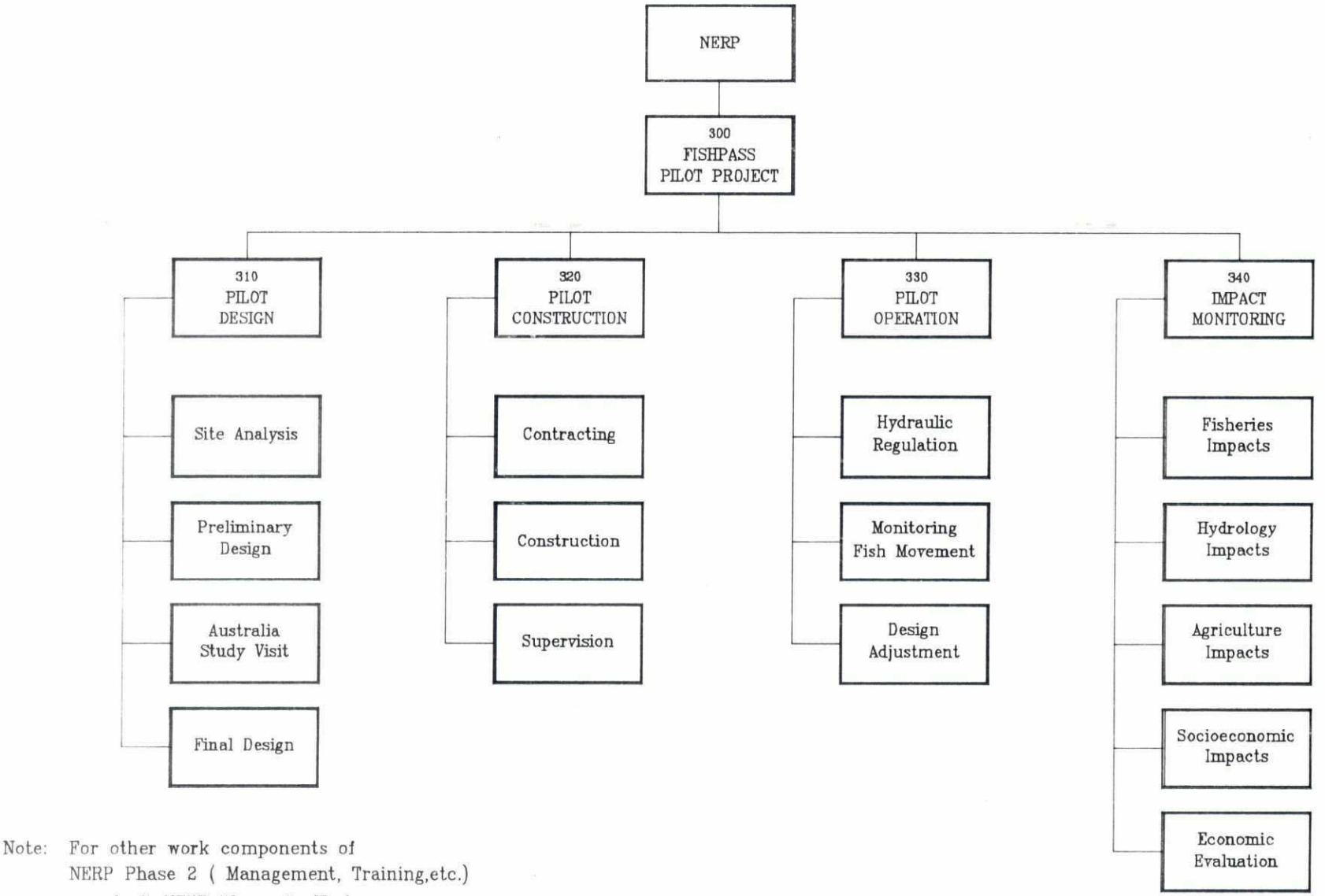
4.2 Work Breakdown Structure

The Work Breakdown Structure (WBS) for the pilot project is presented in the text figure. The pilot project is broken down into six major work packages called components. Component names and objectives are presented in the following table:

CODE	COMPONENT	GOAL
100	Management	Effective and timely fulfilment of FPP objective
310	Pilot Design	Development of a fishpass design which will need, at most, only minor adjustments once operational
320	Pilot Construction	Construction of one fishpass at MRP
330	Pilot Operation	Successful testing of pilot fishpass under premonsoon conditions and final optimizing adjustment of parameters
340	Impact Monitoring	Comprehensive understanding of impacts of fishpass at MRP
700	Institution Building	Improve institutional capabilities as related to fisheries engineering (fishpass technology)

Each component is further subdivided into second-order work packages called elements through which FPP will be managed, monitored and costed. What will be done under each of these components and elements is summarized in Section 4.6 below. A Master Schedule is provided in the accompanying table.

During project year 1, work will be initiated on all six FPP components.



Note: For other work components of
NERP Phase 2 (Management, Training,etc.)
see draft NERP Phase 2 Work programme

FPP Work Breakdown Structure

4.3 Pilot Project Implementation Team Composition and Organization

The FPP Implementation Team consists of the following positions:

BANGLADESH STAFF

Pilot Project Coordinator (Fisheries Specialist)	Full time
Hydrologist	Part time
Junior Fishery Biologist (2)	Full time
Community Organizers (2)	Full time
EIA Specialist	Part time
Senior Economist	Part time
Fishery Biologist (seconded from DOF)	Full time
Civil Engineer Design (seconded from BWDB)	Part time

EXPATRIATE STAFF

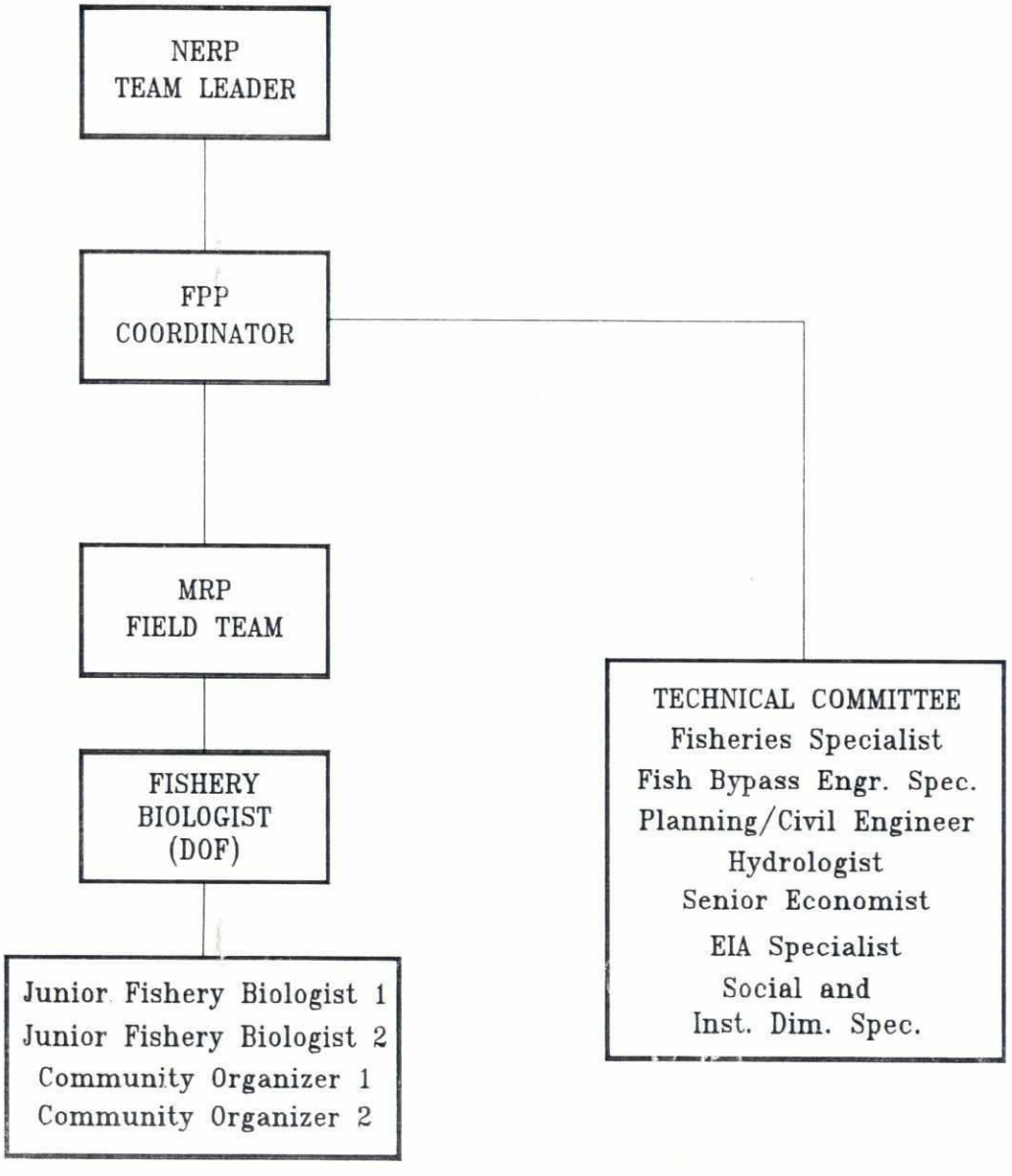
Team Leader	Part time
Fisheries Specialist	Part time
Planning/Civil Engineer	Part time
Fish Bypass Engineer Specialist	Part time
Community Partcipation Specialist	Part time
Social and Institutional Dimensions Specialist.	Part time

The organizational structure of the FPP team is presented in the accompanying text figure. The FPP team is organized into three groups:

- FPP technical committee: Coordinator (fisheries specialist), fisheries specialist, fish bypass engineer, BWDB civil engineer, planning/civil engineer, hydrologist, senior economist.

- MRP field team: DOF fishery biologist, two junior fishery biologists, two community organizers.

The FPP Coordinator (Fishery Specialist) will be responsible for project management and task execution and completion. He will provide overall direction for the pilot project, and report directly to the NERP Team Leader. Senior technical staff will be responsible for designing and supervising execution of work elements by field staff in their disciplines. The MRP field team will be responsible for executing tasks defined in the WBS and as assigned by the FPP Coordinator. The middle level DOF fishery biologist will act as officer-in-charge at the MRP field site, and will administer field activities on a day-to-day basis. Field staff will liaise on technical matters with the appropriate senior technical staff (who will also be responsible for quality checks on their outputs).



FPP IMPLEMENTATION TEAM ORGANIZATION

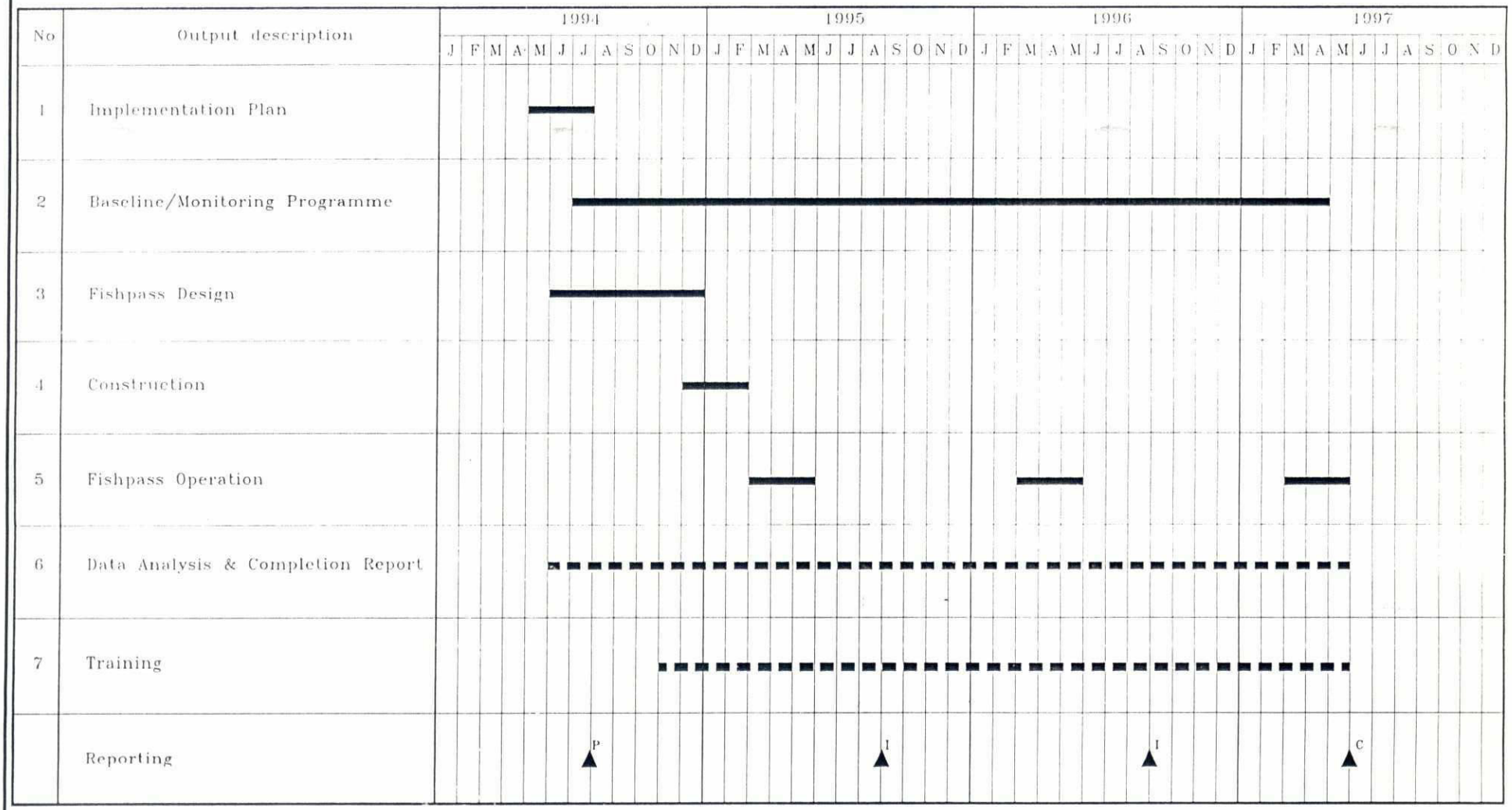
4.4 Pilot Project Master Schedule

The total duration of FPP will be 37 months (1 May 1994 - 31 May 1997). The project timetable is divided into 3 intervals, with the following general activities:

TIME PERIOD	DATES	ACTIVITIES
Year 1	1 May 94 - 30 April 95	Finalize design; Construction and operation of fishpass at MRP.
Year 2	1 May 95 - 30 April 96	Final adjustments and operation of fishpass; Impact monitoring.
Year 3	1 May 96 - 31 May 97	Fishpass operation; Monitoring; Technical manual; Pilot project completion.

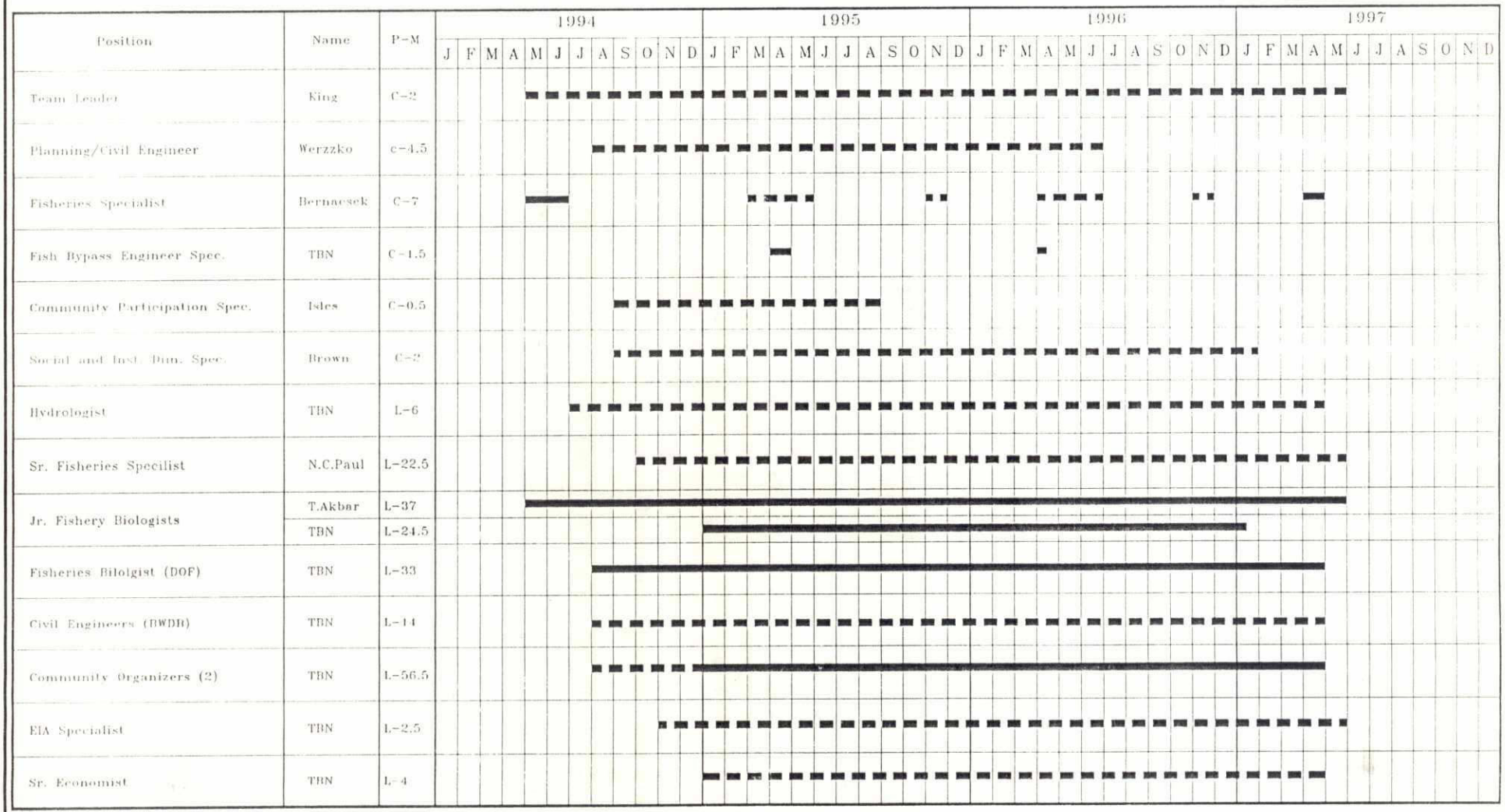
The Master Schedule for FPP is shown in the text-figure. The schedule shows the timeframe for each project component and element.

FISHPASS PILOT PROJECT
SCHEDULED ACTIVITIES



Note: P= Implementation Plan, C= Completion Report, I= Interim Report

FISHPASS PILOT PROJECT
SCHEDULED PERSONNEL



Position	Name	P-M
Team Leader	King	C-2
Planning/Civil Engineer	Werzzko	c-4.5
Fisheries Specialist	Bernacsek	C-7
Fish Bypass Engineer Spec.	TBN	C-1.5
Community Participation Spec.	Isles	C-0.5
Social and Inst. Dim. Spec.	Brown	C-2
Hydrologist	TBN	L-6
Sr. Fisheries Specilist	N.C.Paul	L-22.5
Jr. Fishery Biologists	T.Akbar	L-37
	TBN	L-24.5
Fisheries Bilolgist (DOF)	TBN	L-33
Civil Engineers (BWDB)	TBN	L-14
Community Organizers (2)	TBN	L-56.5
EIA Specialist	TBN	L-2.5
Sr. Economist	TBN	L-4

Note: C – Canadian Staff, L – Local Staff

Important aspects of the Master Schedule are:

- In general, the order of activities is sequential, and is determined by rigid and narrow windows of opportunity controlled by the pre-monsoon/monsoon annual fish migration patterns, the fishing calendar and the dry season construction calendar. Failure to execute a task in the prescribed time period can mean a one year delay in execution of downstream dependant activities.

- The preliminary design of the pilot fishpass to be completed by the end of September 1994.

- Identification of the construction contractor to be completed by the end of October 1994.

- The field study visit to Australia must take place in late-November/early-December 1994, as this is the brief time period of the year when carp are migrating and making use of the fishpasses in New South Wales.

- Preparation of the pilot fishpass site (ie excavation, construction of coffer dam) to be completed by the end of December 1994.

- Finalization of pilot design must be completed by the end of December 1994.

- Construction of the pilot fishpass at MRP must be completed prior to the onset of the pre-monsoon floods (circa mid-March 1995) in order to allow operational tests to take place during the 1995 pre-monsoon flood period.

4.5 Allocation of Professional Resources

The deployment of implementation team professional resources over the life of the pilot project is shown in the text-figure. A person-months total is given for each position. Overall totals are 153 Bangladeshi (plus an additional 47 for seconded personnel), 17.5 Canadian person-months.

4.6 Pilot Project Work Plan

This section describes the methodology for each Work Package. Each work package has a standard format under the following headings:

- Purpose
- First Year Targets
- Work Description

Work packages are grouped into components (numbered 100, 300, etc) and elements (110, 120, 210, 220, etc). During the First Project Year, from May 1994 to April 1995, work will be initiated on all six components.

COMPONENT 100: MANAGEMENT

Purpose: Ensure best value for resources applied, by monitoring, coordinating and controlling inputs to, and outputs from, the project.

First Year Targets: Establish administrative and financial management systems; complete procurement for field site and equipment; identify and contract FPP staff.

Work Description: The Management Component is broken down into four elements:

- Planning (110)
- Liaison & Coordination (120)
- Administration (130)
- Reporting (140)

Element 110: Planning

Purpose: Achieve effective resource deployment to realize project objectives and outputs in an efficient and timely manner.

First Year Targets: Maintain updated project schedule and detailed resource deployment schedules.

Work Description: Standard project management tools will be used to assist the overall long term scheduling and planning of all project activities.

- Master Schedule. A Master Schedule has been prepared for the pilot project. This schedule will be regularly updated throughout the project, and progress will be measured against milestones stated in the TOR or later agreed to by NERP, FPCO, CIDA, BWDB and DOF. The pilot project Master Schedule is supported by a professional resource bar chart showing planned resource deployment. This will be updated as required to reflect changes resulting from resource availability, project requirements or external events.

- Detailed WBS Component Schedules. These schedules will be used to monitor all activities (third level) of the pilot project.

- Work Plan. The Work Plan contains the Master Schedule. Summaries of important updates of the Work Plan will be made quarterly and included in the Quarterly Progress Reports. The complete Work Plan will be updated annually in the Interim Reports.

Element 120: Liaison and Coordination

Purpose: Assist meeting the project objective by ensuring regular and effective communication with other projects concerned with fishpasses in Bangladesh and elsewhere.

First Year Targets: Establish contact with all fishpass-concerned projects in Bangladesh, and relevant fisheries institutions in countries using vertical slot fishpasses for warm water fish species (ie Australia, China, etc).

Work Description: The following projects/institutions will contacted and exchanges of information initiated:

COUNTRY	INSTITUTION / PROJECT	RELEVANCE TO FPP
Bangladesh	FAP 17 (Fisheries Study and Pilot Project)	Has carried out work on over-shot regulators for passage of carp fry.
Bangladesh	FAP 20 (Compartmentalization Pilot Project)	Investigating the use of over-shot regulators for passage of carp fry at Tangail Compartmentalization Project.
Bangladesh	BWDB/IDA (Kaliagota Haor Regulator Project)	Planning to incorporate a vertical slot fishpass into a regulator design.
Australia	NSW Fisheries Institute	Leading fisheries research institute working on use of vertical slot fishpasses for warm water fish species.
Bangladesh/ Australia	SMEC/AIDAB	Australian organizations in key positions for more general transfer of Australian fishpass technology to Bangladesh.
China	Nanjing Hydraulic Research Institute, Mininstry of Water Resources	Use of vertical slot fishways on some rivers.

Element 130: Administration

Purpose: Administer the project effectively.

First Year Targets: Contracting of all FPP staff; procurement of equipment.

Work Description: All operations such as accounting, banking, transport arrangements, duplicating, communications, graphics, equipment procurement, and personnel contracting (mobilization, salaries, demobilization) will be carried out through NERP.

Element 140: Reporting

Purpose: Inform GOB and CIDA regularly and adequately of pilot project status, progress and results.

First Year Targets: Prepare the Implementation Plan.

Work Description: The Interim Report will contain a progress statement comparing work forecast with achievements, as well as a statement of resources used, remaining, required and committed. It will describe problems encountered and the approaches adopted for their resolution.

Three months prior to pilot project completion, a draft Project Completion Report will be prepared for CIDA, and GOB for comment. It will contain an account of the pilot project's history, and discuss the extent to which it has met the stated objective. More specifically, it will include details on how resources were utilized, summaries of reviews/evaluations, personnel deployed, special investigations, a capsule summary of components and recommendations regarding unfinished or further work.

Element 310: Pilot Design

Purpose: Define the optimal settings for such parameters as gradient, cell size, cell number, slot width, head loss, water velocity, etc for fishpasses to be used at FCD/I projects.

First Year Targets: To complete all elements of this component during the first year.

Work Description: The Pilot Design consists of:

- Site Analysis
- Preliminary Design
- Australia Study Visit
- Final Design

These are discussed in detail in the following sections.

Site Analysis

Purpose: Acquire comprehensive environmental, social and economic data to be used for planning activities under all pilot project components.

Work Description: All available documentation for the pilot site will be studied. All available hydrological, meteorological, sociological and environmental data will be analyzed. Information collected by the NERP PMP at MRP will utilized. Several field visits will be undertaken to the intended fishpass site to study existing conditions to generate information required for design preparation. Outputs from activities under 540 will also be utilized.

Preliminary Design

Purpose: Prepare preliminary design of pilot fishpass.

Work Description: Engineering staff will review available literature on the design of vertical slot fishpasses. Fisheries staff will review all available literature relating to fish swimming abilities and behavioural factors relevant to fishpass design. Futher data will be collected in the field as required. Both groups will work together to produce a preliminary design for MRP which will have its parameters set at what are judged to be the optimal functional levels. A maximum/minimum range for each parameter will also be defined, and the pilot design will be fully adjustable within this full range for each parameter.

Australia Study Visit

Purpose: To study the design and operation of Australian vertical slot fishways used for carp and other warm water species in order to improve FPP staff understanding of design principles involved and practical application considerations.

Work Description: One person assigned to the fishpass project (possibly the Bangladeshi Fisheries Specialist) will visit the NSW Fisheries Institute at Cronulla, Sydney, New South Wales in late-November 1994. Discussions will be held with institute professional staff involved in the design and monitoring of vertical slot fishways. Field visits will be made to study carp migration at existing fishpasses in the state. Working models of fishpasses will also be studied. The preliminary design for the MRP pilot fishpass will be reviewed with NSWFI staff.

Final Design

Purpose: To produce a final pilot fishpass design.

Work Description: Based on findings of the Australia study visit, the preliminary design will be modified and finalized. While certain parameters (ie floor gradient) cannot in practice be easily altered once cast in concrete, the final pilot structure design will be such that certain parameters will be adjustable (ie baffles fabricated out of metal to allow easy altering of baffle position and slot width) in order to allow the maximum possible flexibility in testing of the pilot under real working conditions. The design will be rendered into drawings which will be used for construction.

Element 320: Pilot Construction

Purpose: To construct one pilot vertical slot fishpass at MRP.

Targets: This activity will be completed during the First Year of the pilot project.

Work Description: The Pilot Construction consists of:

- Contracting
- Construction
- Supervision

These are discussed in detail in the following sections.

Tendering and Contract Negotiations

Purpose: To award the construction contract to the best available construction firm.

Work Description: The contractor selection process will use the following criteria:

- Demonstrated ability to complete the construction under a tight time schedule.
- Proven record of adhering faithfully to design drawings.
- Reputation for delivering high quality product within budget.

Construction

Purpose: Carry out construction of pilot fishpass at MRP.

Work Description: The selected contractor will complete construction of the pilot fishpass at MRP during the period January to mid-March 1995.

Supervision

Purpose: To ensure that all aspects of the construction contract are correctly carried out.

Work Description: FPP engineering and fisheries staff will assist the contractor's site engineers in supervising the construction works. FPP staff will help to ensure that design and quality aspects of construction are faithfully executed, and that the construction is completed on time (mid-March 1995).

Element 330: Pilot Operation

Purpose: To monitor the movement of fish through the pilot fishpass, carry out optimizing adjustments to the structure and gain experience in hydrological regulation of the fishpass under real working conditions.

Targets: This activity will be initiated during the First Year of the pilot project. It will be completed during the premonsoon of the third year.

Work Description: The Pilot Operation consists of:

- Hydrological Regulation
- Monitoring Fish Movement
- Design Adjustment

These are discussed in detail in the following sections.

Hydrological Regulation

Purpose: To define a set of hydrological operating rules for vertical slot fishpasses.

Work Description: Unregulated release of river water through the fishpass into the FCD/I project area will be monitored, and compared to changes in the unutilized water storage capacity of the project's beels and khals. The magnitude of the potential threat to rice production will then be estimated, and a set of hydrological regulation operating rules will be formulated.

Monitoring Fish Movement

Purpose: To determine the magnitude and timing of migration of various fish species through the fishpass.

Work Description: Removable wire screens will be used to block off various cells of the fishpass so as to allow sampling and monitoring of fish moving both upstream and downstream within the fishpass. Species, body length, numbers, direction of movement, diurnal timing and meteorological/hydrological migration triggers will be determined. Automatic enumeration devices will also be used to count the numbers of fish passing through the structure. Tagging of boromaach broodstock captured inside the fishpass will also be carried out in order to test the homing hypothesis.

Design Adjustment

Purpose: To fully optimize the operation of the fishpass for a short list of target fish species.

Work Description: Based on the findings of elements 410 and 420, adjustments will be made to certain fishpass design parameters in order to optimize their status. If the findings of element 420 suggest that a single design cannot adequately accommodate all species attempting to utilize the fishpass, consultations will be held with the local fishing communities and the DOF in order to draw up a short list of fish species for which optimal fishpass facilities will be provided. The design will be adjusted to provide the best possible access conditions for the species on the short list.

Element 340: Impact Monitoring

Purpose: To monitor the impacts of the pilot fishpass on fisheries, agriculture, hydrology and socioeconomic factors within the FCDI project area.

First Year Targets: Community participation in FPP; set up routine monitoring programmes for fisheries, agriculture, hydrology and socioeconomic factors to establish baseline conditions. Work under the Impact Monitoring will continue throughout the Second and Third Years of FPP.

Work Description: The Impact Monitoring consists of:

- Fisheries Impacts
- Hydrology Impacts
- Agriculture Impacts
- Socioeconomic Impacts

These are discussed in detail in the following sections.

Fisheries Impacts

Purpose: To determine the impacts of the pilot fishpass on fisheries production within the FCDI project area.

Work Description: Fisheries impact monitoring work will consist of seven activities:

- Regular catch assessment surveys inside the haor during the monsoon full flood period.
- Catch assessment in adjacent river fisheries during the premonsoon.
- Frame survey of fishing effort inside the haor.
- Monitoring of beel fishing during the dry season.
- Stock sampling inside the haor during the monsoon full flood season and biological analysis of the samples.
- Stock sampling near the fishpass site (riverside and haorside) during the premonsoon.
- Recovery of tags attached to boromaach broodstock under element 330.

Hydrology Impacts

Purpose: To determine the patterns of external hydrological sources impinging on the project area, and how the operation of the fishpass interacts with these sources.

Work Description: Hydrological monitoring will consist of three activities:

- Daily reading of water level staff gauges at the pilot fishpass site (riverside and haorside).
- Monitoring of water flow volumes (and rainfall) into and out of the project area through the regulator, pilot fishpass, across embankment crests and through public cuts.
- Monitoring of water levels (and water utilization) in beels during the dry season and premonsoon.

Agriculture Impacts

Purpose: To determine what impacts operation of the pilot fishpass has on agricultural production within the project area.

Work Description: Monitoring of rice planting, irrigation and harvesting patterns near beels inside the project area, and determination of impacts on rice production of water releases through the pilot fishpass during the premonsoon.

Socioeconomic Impacts

Purpose: To promote community participation in the planning and management of FPP and determine impacts of the pilot fishpass and socioecomic conditions inside the MRP area.

Work Description: The socioeconomic programme in FPP will consist of three activities:

- Public meeting in all villages to explain the objectives of FPP and seek inputs to FPP planning and operation.
- Appointment of village representatives to FPP to act as two-way information conduits between FPP and local communities. The village representatives will act as an ad-hoc beneficiary committee which will oversee the implementation of FPP and advise the FPP team on any matters arising from FPP activities.
- Regular monitoring of selected socioeconomic factors at household level (ie person-days spent fishing, purchase of fishing gears, sale/cash income from fishing, subsistence consumption of fish, attitude towards FPP, etc).

Economic Evaluation

Purpose: To evaluate in economic and financial terms the costs and benefits to the MRP area beneficiary communities of the pilot fishpass.

Work description: The FPP economics programme will collect various data on fisheries, agriculture and socio-economic impacts required to carry out a cost/benefit analysis of FPP.

COMPONENT 700: INSTITUTION BUILDING

Purpose: To strengthen the capabilities of government institutions to plan and implement fishpass projects, and to strengthen the capabilities of NGOs to work generally in the openwater fisheries sector, specifically in the area of FCD/I impact mitigation.

First Year Targets: Initiate training of BWDB and DOF professional staff.

Work Description: The Institution Building Component consists of four elements:

- DOF Training (710)
- BWDB Training (720)
- Fishpass Seminars (730)
- Technical Manual (740)

These are discussed in detail in the following sections.

Element 710: DOF Training

Purpose: To train one DOF staff middle level fisheries biologist in applied fishpass technology.

Work Description: Training will consists of the following activities:

- Study of available literature on fish migration and fishpasses with emphasis on warm water species.
- Short training course in Australia in fishery engineering related subjects (through AIDAB scholarship, if available)
- Correspondence with fisheries biologists working elsewhere on fishpass applications of possible use to Bangladesh.
- On-the-job training during execution of FPP.

Element 720: BWDB Training

Purpose: To train one BWDB staff middle level civil engineer in fisheries engineering related to fishpass design.

Work Description: Training will consists of the following activities:

- Study of available fisheries engineering literature on fishpass design.
- Short training course in Australia in fishery engineering related subjects (through AIDAB scholarship, if available)
- Correspondence with fisheries engineers working elsewhere on fishpass applications of possible use to Bangladesh.
- On-the-job training during execution of FPP.

Element 730: Fishpass Seminars

Purpose: To disseminate information acquired through FFP to a larger professional audience in Bangladesh.

Work Description: Seminars (possibly one each in the Second and Third Years) will be held in Dhaka/Sylhet to present FPP findings to interested agencies and organizations (ie BWDB, DOF, FPCO, DOA, DOE, NGOs, other FAP projects, other FCD/I projects, other fisheries projects, consulting companies, donor agencies, etc).

Element 740: Technical Manual

Purpose: To make FPP findings and general fishpass technology principles available to engineering and fisheries professionals in Bangladesh in an applied pedagogical format.

Work Description: A technical manual will be written which covers the following topics:

- Fish migration patterns in Bangladesh.
- FCD/I impacts on fisheries.
- Utility of fishpasses in assisting fish migrations.
- Review of different types of fishpass designs.
- Conceptual designs for vertical slot fishways.
- Detailed design of fishway parameters.
- Use of field and laboratory calibration models.
- Operation and maintenance of fishways.
- Case study of FPP at MRP.
- Case studies of other fishpasses in Bangladesh.
- Case studies of fishpasses for warmwater species elsewhere (ie Australia, China, etc).

4.7 Administration and Logistical Requirements

4.7.1 Office, Field Stations and Support Staff Requirements

The team will operate out of the following facilities:

Dhaka NERP office: Most office-type activities including planning, design, literature reviews, data analysis and storage, reporting, management, etc.

MRP field station: Logistic support for field operations, routine baseline/impact monitoring at MRP, staff eating/sleeping quarters, equipment storage, laboratory work. It is proposed that facilities be sought at the Kashimpur pumphouse compound.

MRP site camp: Fishpass model/pilot operation during premonsoon, supervision of construction during dry season. The field camp will be erected in December immediately adjacent to the fishpass and disassembled and removed in May of each year. Facilities required are eating areas, equipment storage and resting areas.

4.7.2 Office and Laboratory Equipment and Materials

- 1 binocular dissecting microscopes
- 3 weighing scales (various ranges)
- 2 sets of dissecting instruments
- plastic specimen jars
- formalin
- 3 laboratory tables
- 3 storage cabinets

4.7.3 Field Equipment

- various hydrological gauges
- 1 portable generator with lights (for night work)
- 1 fish counter
- 1 Kona jal net
- 1 Ber jal net
- 1 gillnet gang
- 1 longline
- fish tags

ANNEX A

HYDRAULIC AND HYDROLOGICAL ANALYSIS

ANNEX A

HYDRAULIC AND HYDROLOGIC ANALYSIS

1. LOCATION

The proposed Manu River Project Fishpass site is located within the Kashimpur Pump House compound between the 6-vent and 3-vent Drainage Regulators, about 160 m east from the pumping plant.

A short link canal will provide connection with the Koradair River, which is the largest drainage channel of the Manu River Project area. It connects the Kawadighi Haor with the Kushiyara River. The 6-vent Regulator checks the flow of the Koradair River. The location of the Fishpass structure is shown in Figure A1.

2. DESIGN DATA

Long term water level data in the Kushiyara River are available at Manumukh Station No. 175 located 3 km downstream of the Kashimpur Pump Station, and at Fenchuganj St. No. 174 which is about 30 km upstream from the Kashimpur Pump Station.

The river and haor side water levels have been recorded twice daily at the Pumping Station since the opening of the MR FCDI Project in March 1983. The Pump Station gauges are set in terms of Pakistan datum, which is 0.457 m below the Public Works Department (PWD) datum. Daily pumping hours and energy costs have also been recorder.

Topographical data, engineering designs and operation of the MRP are available in the *Manu River Project, Definite Project Report*, prepared in October 1971 by Associated Consulting Engineers Ltd. Present status of the MRP is presented in the *BWDB Systems Rehabilitation Project, Feasibility Report of Manu River Project*, February 1993.

NERP have carried out a comprehensive multidisciplinary analyses of the Manu River Project over a two-year period from May 1992 to May 1994, and are preparing a report entitled *Project Monitoring Programme, Manu River FCDI Project (1992-1994)*.

3. WATER LEVELS ANALYSIS

The Kushiyara River water levels at the Kashimpur Pump Station vary from 3.2 m PWD to 10.3 m PWD. The haor (country) side water levels vary from about 3.5 m PWD to about 10.5 m PWD.

Under normal operation of the Manu River Project, the haor flood levels should remain below the Kushiyara levels during the monsoon season as the area is embanked. However, due to breaches and public cuts in the embankment along the Manu River the haor is flooded to a level above the outfall river. In such cases, the Kushiyara River embankment is also cut at al later date to relieve flooding in the protected area.

The MRP is design to maintain the Haor WL at elevations, (i) below 4.5 m PWD during the pre-monsoon for protection of boro crops, and (ii) below 8.0 m PWD during the monsoon for protection of aman crops.

The river and haor side hydrographs analyzed over the last two years are shown in Figure A2.

4. HYDRAULIC DESIGN

The objective of the MRP Fishpass Structure is to allow migration of the target fish species during breading periods.

The hydraulic factors controlling the movement of fish through fishpass are, flow velocity through the slot, minimum water depth and water turbidity. The flow velocity is governed by hydraulic head, the minimum water depth on baffles is set by the structure invert elevation, and the water turbidity by dimensions of the fishpass pools.
It is important that the flow velocity remain constant through the fishpass baffles; this can be obtained under the same water depths at the upstream and downstream ends of the structure.

Study of the hydrographs indicates that the greatest hydraulic heads (difference between river and haor water levels) occur during the pre-monsoon flash floods. During monsoon the difference in water levels decrease to zero and some time water in the haor is above the river level, which is the result of flood inflows from the Manu River.

Under normal operation of the Manu Irrigation Project, i.e., with pumps operating and without unauthorized inflow through cuts in embankments, the pre-monsoon and monsoon season hydraulic heads would remain similar. The observed maximum hydraulic head at the Kashimpur Pump Station is about 2.7 m.

The discharge through vertical slot varies with depth and is calculated by Equation 1, the velocity of the water flow through the slot in the baffle is determined by Equation 2, as follows:

(1) $Q = C_d(D+h)W(2gh)^{0.5}$

(2) $v = C_d(2gh)^{0.5}$

Where:

Q = discharge (m^3/s)
C_d = coef. of discharge through orifices = 0.75
W = total width of slot (m)
D = depth of water at downstream side of baffle (m)
h = drop in water surface from the upstream to the downstream side of a baffle (m)

The parameters adopted for the design of the MRP Fishpass structure are:

Maximum hydraulic head (H)	2.7 m
Maximum water velocity (v)	1.3 m/s
Minimum depth of water (D)	1.0 m
Slot width (W)	0.41 m
Size of pool	2.44 x 3.05 m
River side invert elevation	5.00 m PWD
Haor side invert elevation	3.00 m PWD

A single vertical slot fishway with 18 baffles and 19 pools is proposed for the MRP Fishpass Pilot Project. A line drawing of the fishpass design is shown in Figure A3.

The performance of the proposed structure has been evaluated through a simulated operation over a 2-year period (May 1992-April 1994), using the daily hydrographs recorded at the Kashimpur Pump Station. The flow velocity varied from 0 to 1.3 m/s, and from 0.8 to 1.3 m/s under the operating depth above 1.0 m. The maximum daily water inflow through the fishpass from the Kushiyara into the Kawadighi Haor reached about 120,000 m^3 during the pre-monsoon and about 90,000 m^3 during the monsoon season.

Tables 1 to 4 illustrate the simulation results for the 1993 season.

Table 1: MRP Fishpass Structure
Hydraulic Operation (February 1993)

Day	Water Levels		Head D(m)	Drop h(m)	Depth D(m)	Vel. v(m/s)	Disch. Q(m3/s)	Inflow (m3/d)
	h/s	r/s						
1	4.10	3.51	-0.59	-0.03	-1.49	0.00	0.00	0
2	4.09	3.51	-0.58	-0.03	-1.49	0.00	0.00	0
3	4.09	3.51	-0.58	-0.03	-1.49	0.00	0.00	0
4	4.07	3.48	-0.59	-0.03	-1.52	0.00	0.00	0
5	4.05	3.46	-0.59	-0.03	-1.54	0.00	0.00	0
6	4.05	3.46	-0.59	-0.03	-1.54	0.00	0.00	0
7	4.05	3.44	-0.61	-0.03	-1.56	0.00	0.00	0
8	4.05	3.41	-0.64	-0.04	-1.59	0.00	0.00	0
9	4.05	3.41	-0.64	-0.04	-1.59	0.00	0.00	0
10	4.04	3.40	-0.64	-0.04	-1.60	0.00	0.00	0
11	4.02	3.38	-0.64	-0.04	-1.62	0.00	0.00	0
12	4.02	3.35	-0.67	-0.04	-1.65	0.00	0.00	0
13	3.99	3.35	-0.64	-0.04	-1.65	0.00	0.00	0
14	3.99	3.34	-0.65	-0.04	-1.66	0.00	0.00	0
15	3.96	3.32	-0.64	-0.04	-1.68	0.00	0.00	0
16	3.96	3.34	-0.62	-0.03	-1.66	0.00	0.00	0
17	3.96	3.37	-0.59	-0.03	-1.63	0.00	0.00	0
18	3.99	3.54	-0.45	-0.03	-1.46	0.00	0.00	0
19	4.42	5.64	1.22	0.07	0.64	0.86	0.43	37359
20	4.57	6.43	1.86	0.10	1.43	1.0	0.81	70327
21	4.36	6.66	2.30	0.13	1.66	1.19	1.12	96704
22	4.41	6.77	2.36	0.13	1.77	1.20	1.16	100512
23	4.44	6.72	2.28	0.13	1.72	1.18	1.10	95445
24	4.47	6.63	2.16	0.12	1.63	1.15	1.02	88010
25	4.48	6.55	2.07	0.12	1.55	1.13	0.96	82567
26	4.48	6.43	1.95	0.11	1.43	1.09	0.87	75492
27	4.30	6.42	2.12	0.12	1.42	1.14	0.99	85576
28	4.21	6.40	2.19	0.12	1.40	1.16	1.04	89850
							Total Inflow:	821841

Table 2: MRP Fishpass Structure
Hydraulic Operation (March 1993)

Day	Water Levels		Head D(m)	Drop h(m)	Depth D(m)	Vel. v(m/s)	Disch. Q(m3/s)	Inflow (m3/d)
	h/s	r/s						
1	4.39	6.42	2.03	0.11	1.42	1.12	0.93	80185
2	4.36	6.16	1.80	0.10	1.16	1.05	0.77	66951
3	4.31	6.04	1.73	0.10	1.04	1.03	0.73	63084
4	4.24	5.76	1.52	0.08	0.76	0.96	0.60	51954
5	4.24	5.49	1.25	0.07	0.49	0.88	0.45	38745
6	4.16	5.27	1.11	0.06	0.27	0.82	0.38	32422
7	4.27	5.12	0.85	0.05	0.12	0.72	0.25	21726
8	4.27	4.94	0.67	0.04	-0.06	0.00	0.00	0
9	4.24	4.69	0.45	0.03	-0.31	0.00	0.00	0
10	4.33	4.59	0.26	0.01	-0.41	0.00	0.00	0
11	4.27	4.51	0.24	0.01	-0.49	0.00	0.00	0
12	4.27	4.47	0.20	0.01	-0.53	0.00	0.00	0
13	4.27	4.41	0.14	0.01	-0.59	0.00	0.00	0
14	4.33	4.33	0.00	0.00	-0.67	0.00	0.00	0
15	4.30	4.28	-0.02	0.00	-0.72	0.00	0.00	0
16	4.30	4.24	-0.06	0.00	-0.76	0.00	0.00	0
17	4.31	4.21	-0.10	-0.01	-0.79	0.00	0.00	0
18	4.21	4.34	0.13	0.01	-0.66	0.00	0.00	0
19	4.24	4.42	0.18	0.01	-0.58	0.00	0.00	0
20	4.22	4.60	0.38	0.02	-0.40	0.00	0.00	0
21	4.22	4.56	0.34	0.02	-0.44	0.00	0.00	0
22	4.21	4.48	0.27	0.02	-0.52	0.00	0.00	0
23	4.21	4.36	0.15	0.01	-0.64	0.00	0.00	0
24	4.22	4.34	0.12	0.01	-0.66	0.00	0.00	0
25	4.19	4.41	0.22	0.01	-0.59	0.00	0.00	0
26	4.19	4.57	0.38	0.02	-0.43	0.00	0.00	0
27	4.21	5.55	1.34	0.07	0.55	0.91	0.50	43004
28	4.22	5.88	1.66	0.09	0.88	1.01	0.69	59294
29	4.19	6.01	1.82	0.10	1.01	1.06	0.79	68070
30	4.22	6.01	1.79	0.10	1.01	1.05	0.77	66394
31	4.24	5.85	1.61	0.09	0.85	0.99	0.66	56636
							Total Inflow:	648465

Table 3: MRP Fishpass Structure
Hydraulic Operation (April 1993)

Day	Water Levels		Head D(m)	Drop h(m)	Depth D(m)	Vel. v(m/s)	Disch. Q(m3/s)	Inflow (m3/d)
	h/s	r/s						
1	4.18	5.73	1.55	0.09	0.73	0.97	0.62	53499
2	4.34	5.59	1.25	0.07	0.59	0.88	0.45	38745
3	4.18	5.46	1.28	0.07	0.46	0.89	0.46	40148
4	4.18	5.26	1.08	0.06	0.26	0.81	0.36	31116
5	4.18	5.03	0.85	0.05	0.03	0.72	0.25	21726
6	4.18	4.91	0.73	0.04	-0.09	0.00	0.00	0
7	4.18	4.76	0.58	0.03	-0.24	0.00	0.00	0
8	4.18	4.67	0.49	0.03	-0.33	0.00	0.00	0
9	4.12	4.36	0.24	0.01	-0.64	0.00	0.00	0
10	4.15	4.25	0.10	0.01	-0.75	0.00	0.00	0
11	4.15	4.30	0.15	0.01	-0.70	0.00	0.00	0
12	4.34	4.50	0.16	0.01	-0.50	0.00	0.00	0
13	4.48	5.49	1.01	0.06	0.49	0.79	0.33	28141
14	4.53	5.75	1.22	0.07	0.75	0.86	0.43	37359
15	4.54	5.79	1.25	0.07	0.79	0.88	0.45	38745
16	4.60	5.72	1.12	0.06	0.72	0.83	0.38	32861
17	4.51	5.61	1.10	0.06	0.61	0.82	0.37	31985
18	4.50	5.60	1.10	0.06	0.60	0.82	0.37	31985
19	4.47	5.40	0.93	0.05	0.40	0.75	0.29	24864
20	4.51	5.34	0.83	0.05	0.34	0.71	0.24	20964
21	4.45	5.18	0.73	0.04	0.18	0.67	0.20	17292
22	4.42	5.18	0.76	0.04	0.18	0.68	0.21	18368
23	4.37	4.86	0.49	0.03	-0.14	0.00	0.00	0
24	4.36	4.79	0.43	0.02	-0.21	0.00	0.00	0
25	4.47	4.89	0.42	0.02	-0.11	0.00	0.00	0
26	4.28	4.85	0.57	0.03	-0.15	0.00	0.00	0
27	4.39	4.94	0.55	0.03	-0.06	0.00	0.00	0
28	4.42	5.26	0.84	0.05	0.26	0.72	0.25	21344
29	4.42	5.72	1.30	0.07	0.72	0.89	0.48	41093
30	4.44	6.25	1.81	0.10	1.25	1.05	0.78	67510
							Total Inflow:	597743

Table 4: MRP Fishpass Structure
Hydraulic Operation (May 1993)

Day	Water Levels		Head D(m)	Drop h(m)	Depth D(m)	Vel. v(m/s)	Disch. Q(m3/s)	Inflow (m3/d)
	h/s	r/s						
1	4.50	6.43	1.93	0.11	1.43	1.09	0.86	74334
2	4.48	6.55	2.07	0.12	1.55	1.13	0.96	82567
3	4.50	6.71	2.21	0.12	1.71	1.16	1.05	91083
4	4.89	7.13	2.24	0.12	2.13	1.17	1.08	92944
5	6.33	8.08	1.75	0.10	3.08	1.04	0.74	64181
6	6.49	8.38	1.89	0.11	3.38	1.08	0.83	72035
7	6.56	8.61	2.05	0.11	3.61	1.12	0.94	81373
8	6.56	8.67	2.11	0.12	3.67	1.14	0.98	84972
9	6.54	8.75	2.21	0.12	3.75	1.16	1.05	91083
10	6.51	8.69	2.18	0.12	3.69	1.16	1.03	89235
11	6.63	8.69	2.06	0.11	3.69	1.12	0.95	81969
12	6.80	8.86	2.06	0.11	3.86	1.12	0.95	81969
13	7.12	8.99	1.87	0.10	3.99	1.07	0.82	70895
14	7.26	8.99	1.73	0.10	3.99	1.03	0.73	63084
15	7.26	8.93	1.67	0.09	3.93	1.01	0.69	59831
16	7.26	8.89	1.63	0.09	3.89	1.00	0.67	57694
17	7.42	8.89	1.47	0.08	3.89	0.95	0.57	49411
18	7.68	8.93	1.25	0.07	3.93	0.88	0.45	38745
19	7.61	8.96	1.35	0.08	3.96	0.91	0.50	43486
20	7.68	8.87	1.19	0.07	3.87	0.85	0.42	35989
21	7.59	8.87	1.28	0.07	3.87	0.89	0.46	40148
22	7.56	8.75	1.19	0.07	3.75	0.85	0.42	35989
23	7.56	8.66	1.10	0.06	3.66	0.82	0.37	31985
24	7.51	8.54	1.03	0.06	3.54	0.79	0.34	28981
25	7.50	8.49	0.99	0.06	3.49	0.78	0.32	27309
26	7.47	8.38	0.91	0.05	3.38	0.75	0.28	24066
27	7.54	8.32	0.78	0.04	3.32	0.69	0.22	19098
28	7.53	8.26	0.73	0.04	3.26	0.67	0.20	17292
29	7.47	8.20	0.73	0.04	3.20	0.67	0.20	17292
30	7.47	8.14	0.67	0.04	3.14	0.64	0.18	15204
31	7.47	8.08	0.61	0.03	3.08	0.61	0.15	13208
						Total Inflow:		1677453

5. IMPACTS OF THE FISHPASS

The inflow through the fishpass may cause potential raise of water levels in the protected area and increase flood damage to the standing crops. In case of the Manu River Project the water will be pumped out without loss to agriculture. However, with the fishpass in operation the cost of pumping will also increase.

5.1 Increased Water Levels in the MRP area.

The increases in the Haor levels have been derived by superimposing the inflow volumes over the Area-Storage Volume curves of the MRP area, shown in Figure A4.

During the pre-monsoon season when the haor area and storage volumes are smaller the internal flood level would raise by a greater amount, but would affect a smaller area. During the monsoon the haor area is larger and the additional inflow would result in a smaller increase in flood level, but the corresponding affected area is larger.

On a daily basis, the maximum inflow of about 120,000 m^3 would result in approximately 0.003 m increase in the haor level; during monsoon, the figures are 90,000 m^3 inflow and 0.001 m increase in the haor level. The corresponding flooded areas are about 5 hectares in both seasons.

The potential increase in haor level by about 3 mm per day is below the daily evaporation rates in the area, ranging from about 2 to 7 mm per day.

The increases in water levels on monthly and seasonal basis are presented in Table 5.

5.2 Increased Pumping Requirement

As per the Kashimpur Pump House records for the 1993 season, 119,000,000 m^3 of water was pumped out during a total of 7,777 pump-hours, with a total cost for electricity of Tk 5,774,000.

With the Fishpass in place, the pumping demand would be increased by 4,144,750 m^3, which represents an increase of about 3.5 %. **The corresponding increase in the cost of electricity is Tk 202,090.**

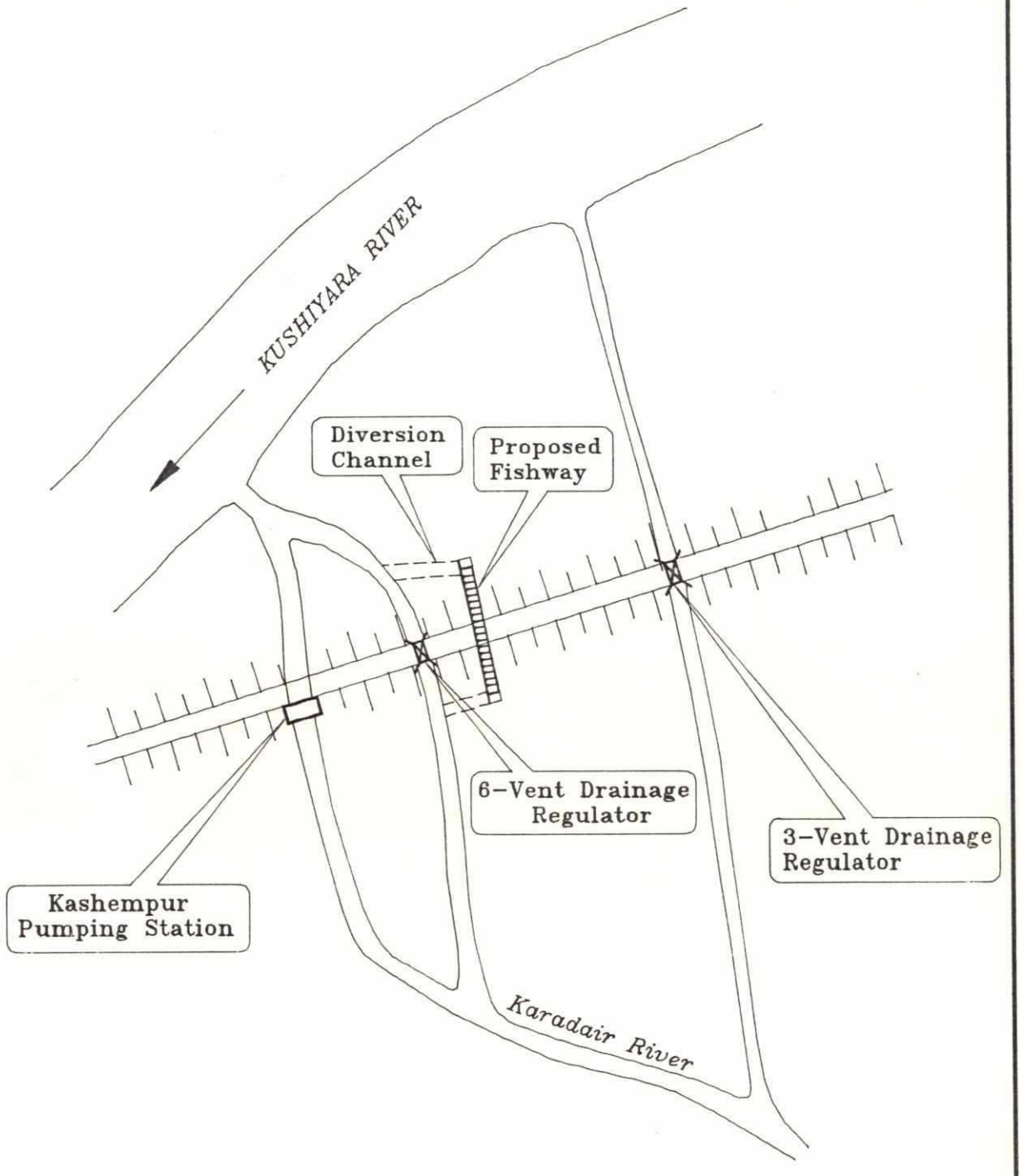
Table 5: Impact of Fishpass Inflow on Flooding in MRP (1993)

Month	Inflow (m^3)	Cumulative Inflow (m^3)	Cumulative Increase in WL (m)	Affected Area (ha)
Pre-monsoon: Reference Area 2600 - 3200 ha				
Feb	821841	821841	0.027	41
March	648465	1470306	0.049	75
April	597743	2068049	0.069	106
to 15 May	1181556	3249605	0.109	167
Monsoon Season: Reference Area 8600 - 13000 ha				
to 31 May	459897	3709502	0.033	154
June	435248	4144750	0.037	173

Notes: (1) From mid June the haor levels remained equal or exceeded the Kushiyara water levels.

(2) Outflows from the haor through the fishpass not included in the above calculations.

Figure A1



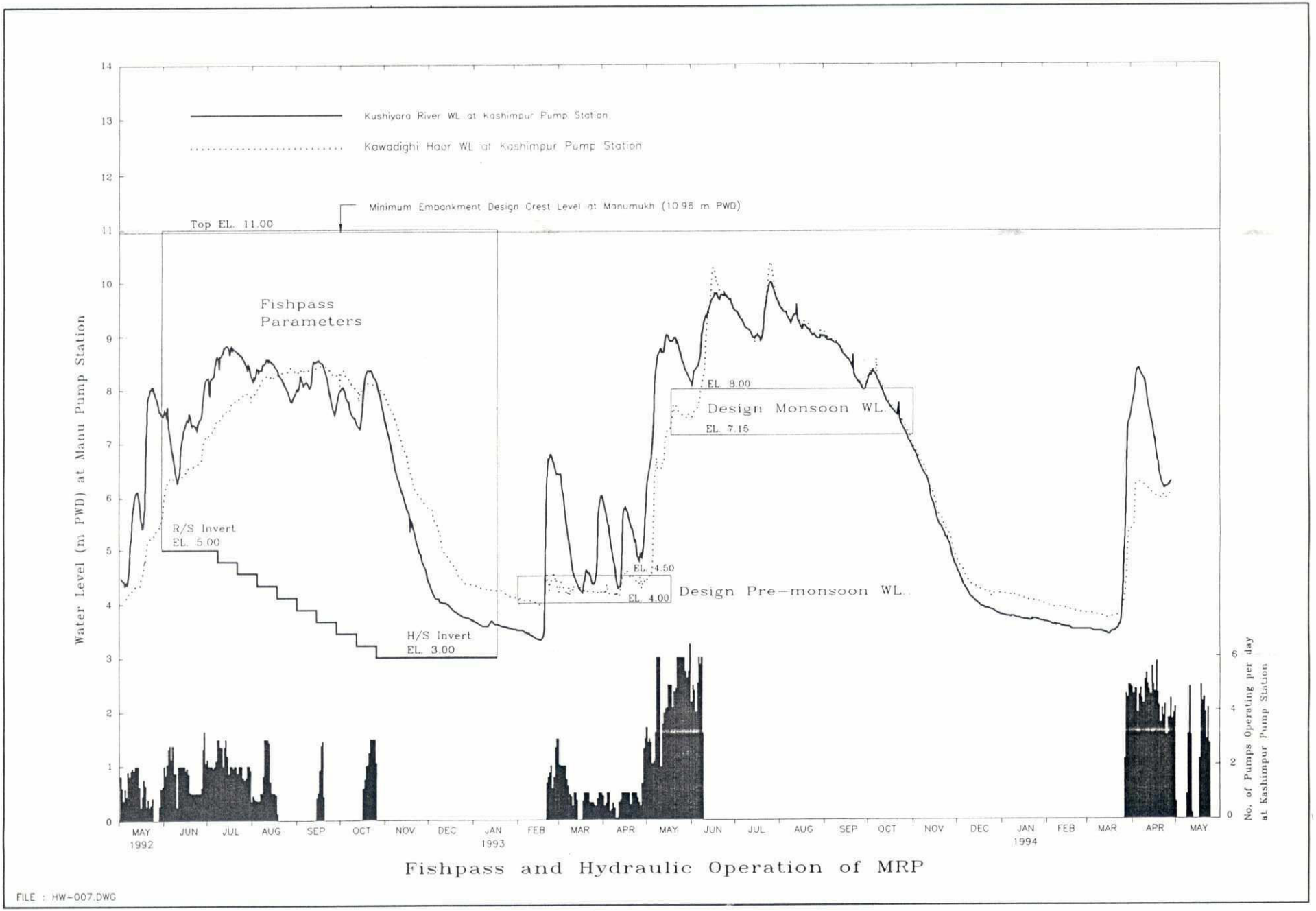
Not to Scale

Northeast Regional Project

Proposed Location of the Pilot Fishpass at Kashempur BWDB Pumping Station

Prepared by: HW	September 1994
Computer Drafting by: Mamun	AutoCAD Drawing

FILE: NERP-876.DWG



Fishpass and Hydraulic Operation of MRP

FILE : HW-007.DWG

Figure A2

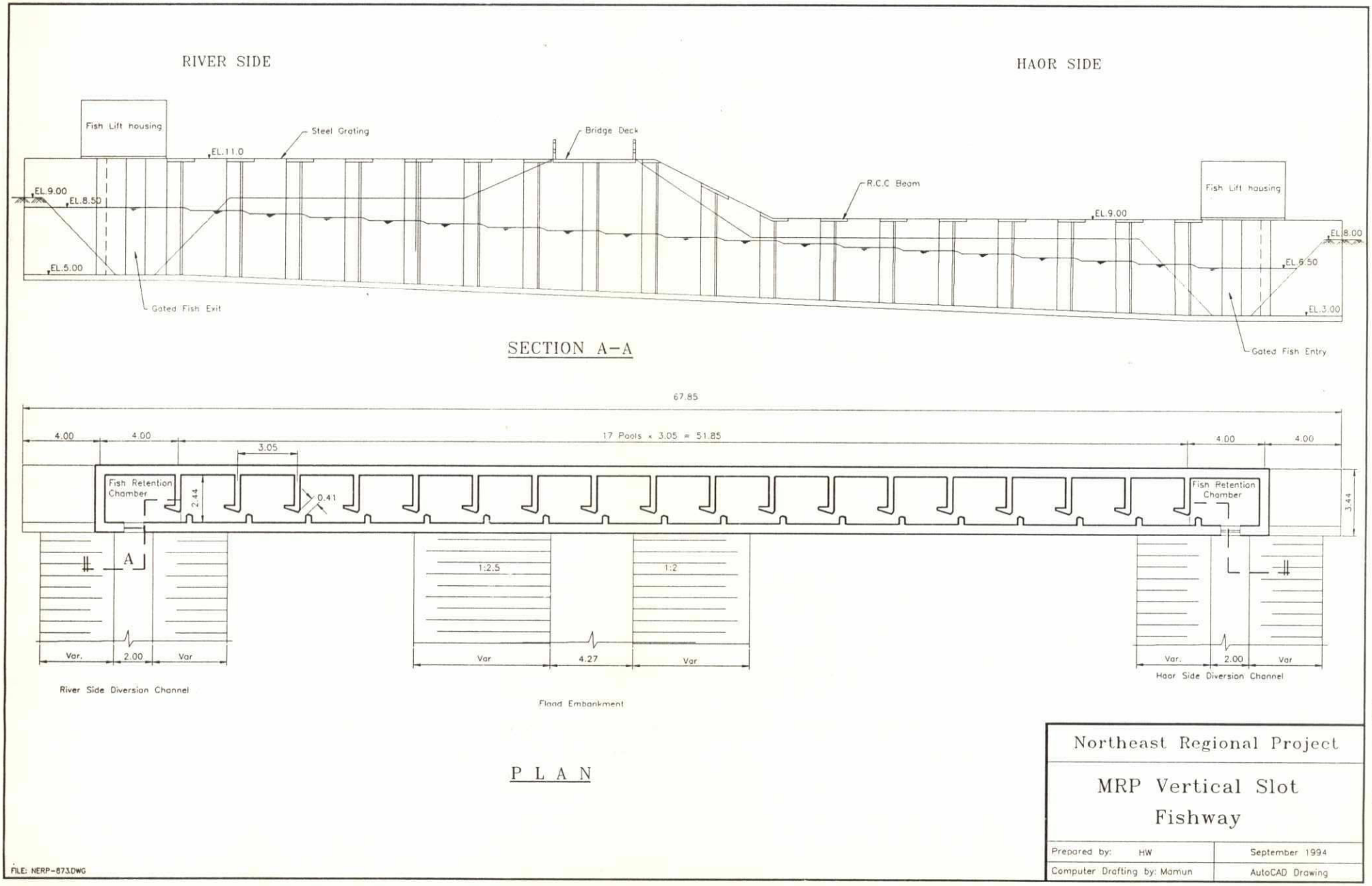
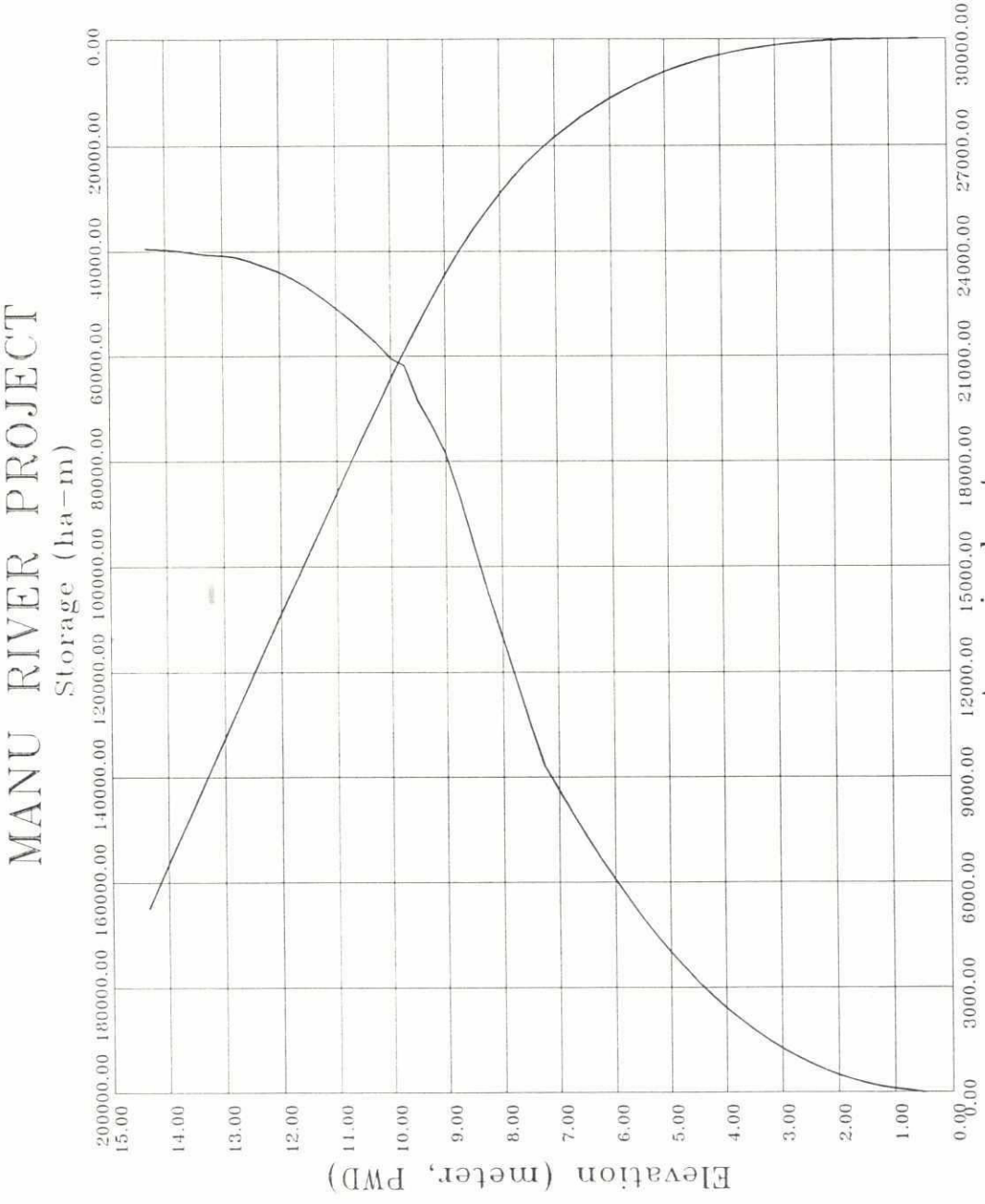

RIVER SIDE
HAOR SIDE
Fish Lift housing
Steel Grating
Bridge Deck
EL.11.0
EL.9.00
EL.8.50
EL.5.00
R.C.C Beam
EL.9.00
Fish Lift housing
EL.8.00
EL.6.50
EL.3.00
Gated Fish Exit
Gated Fish Entry
SECTION A-A
67.85
4.00
4.00
3.05
17 Pools x 3.05 = 51.85
4.00
4.00
Fish Retention Chamber
2.44
0.41
Fish Retention Chamber
3.44
A
1:2.5
1:2
Var.
2.00
Var
Var
4.27
Var
Var.
2.00
Var
River Side Diversion Channel
Flood Embankment
Haor Side Diversion Channel
P L A N
Northeast Regional Project
MRP Vertical Slot Fishway
Prepared by: HW
September 1994
Computer Drafting by: Mamun
AutoCAD Drawing
FILE: NERP-873.DWG

Figure A3

Figure A4

Elev. (m Pwd)	Area (ha)	Storage (ha-m)
0.50	0	0.100
0.75	55	4.682
1.00	105	24.395
1.25	175	59.044
1.50	264	113.476
1.75	374	192.804
2.00	506	302.368
2.25	660	447.715
2.50	836	634.560
2.75	1040	868.866
3.00	1286	1156.632
3.25	1517	1504.088
3.50	1794	1917.578
3.75	2098	2403.578
4.00	2427	2968.604
4.25	2784	3619.612
4.50	3169	4363.186
4.75	3581	5206.339
5.00	4022	6158.104
5.25	4491	7219.613
5.50	4989	8404.092
5.75	5517	9716.856
6.00	6075	11165.316
6.25	6663	12750.956
6.50	7281	14499.350
6.75	7930	16400.150
7.00	8610	18467.087
7.25	9296	20704.850
7.50	10464	23173.482
7.75	11734	25946.796
8.00	12976	29034.280
8.25	14212	32431.632
8.50	15503	36154.709
8.75	16993	40225.544
9.00	18206	44624.551
9.25	19010	49276.106
9.50	19714	54116.381
9.75	20738	59127.666
10.00	20935	64291.669
10.25	21349	69577.098
10.50	21709	74959.215
10.75	22056	80429.733
11.00	22374	85983.423
11.25	22662	91612.810
11.50	22948	97313.921
11.75	23184	103080.362
12.00	23400	108903.381
12.25	23559	114773.248
12.50	23709	120681.702
12.75	23824	126623.358
13.00	23871	132585.641
13.25	23899	138557.266
13.50	23944	144537.669
13.75	24015	150532.537
14.00	24052	156540.904
14.25	24069	162555.978
14.35	24076	164963.224



ANNEX B

MONTHLY WORK SCHEDULE

ANNEX B

MONTHLY WORK SCHEDULE

YEAR 1: May 1994 - April 1995

May 1994
Write draft TOR and Work Plan.
Set up project schedules.

June 1994
Write draft FPP Implementation Plan.
Define biological and engineering parameters.
Finalize project schedules.
Discuss FPP with FPCO, BWDB and DOF.

July 1994
Establish field station at MRP.
Begin procurement of equipment.
Begin liaison with other fishpass projects (Bangladesh and international).
Carry out site analysis field visit.
Begin baseline monitoring programme.
Community Organizers begin work.

August 1994
Analyze available hydrological data.
Complete site analysis.
Complete preliminary engineering design of pilot fishpass.
Baseline monitoring programme.
Hold public meetings in villages.
Seconded BWDB and DOF staff begin work.

September 1994
Identify construction contractors.
Baseline monitoring programme.

October 1994
Start contract procedures.
Baseline monitoring programme.

November 1994
Undertake field study visit to Australia.
Award contract
Contractor to begin site preparation.
Baseline monitoring programme.

December 1994
Erect site camp.
Complete field study visit to Australia.
Finalize design of pilot fishpass.
Complete site preparation.
Complete procurement of equipment.
Baseline monitoring programme.

January 1995
Begin construction of pilot fishpass.
Supervise construction.
Baseline monitoring programme.
Junior fishery biologist 2 and junior community organizer 2 begin work.

February 1995
Continue construction of pilot fishpass.
Supervise construction.
Baseline monitoring programme.

March 1995
Supervise construction.
Complete construction of pilot fishpass.
Baseline monitoring programme.

April 1995
Monitor movement of fish through fishpass.
Hydrological regulation of fishpass.
Adjust structure to optimize.
Baseline monitoring programme.

YEAR 2: May 1995 - April 1996

May 1995
Monitor movement of fish through fishpass.
Monitor impacts.

June 1995
Monitor movement of fish through fishpass.
Monitor impacts.
Begin short training courses for BWDB engineer and DOF fishery biologist in Australia.

July 1995
Monitor movement of fish through fishpass.
Monitor impacts.
Complete short training courses for BWDB engineer and DOF fishery biologist in Australia.

August 1995
Monitor movement of fish through fishpass.
Monitor impacts.
Write Interim Report.

September 1995
Monitor movement of fish through fishpass.
Monior impacts.

October 1995
Monitor movement of fish through fishpass.
Monitor impacts.

November 1995
Monitor impacts.

December 1995
Monitor impacts.

January 1996
Monitor impacts.
Repair and modify structure as necessary.

February 1996
Monitor impacts.

March 1996
Seminar on preliminary FPP findings.
Monitor impacts.

April 1996
Monitor movements of fish through fishpass.
Hydrological regulation of fishpass.
Adjust structure as necessary.
Monitor impacts.

YEAR 3: May 1996 - May 1997

May 1996
Monitor movements of fish through fishpass.
Monitor impacts.

June 1996
Monitor movements of fish through fishpass.
Monitor impacts.

y2

July 1996
Monitor movements of fish through fishpass.
Monitor impacts.

August 1996
Monitor movements of fish through fishpass.
Monitor impacts.
Write Interim Report.

September 1996
Monitor movements of fish through fishpass.
Monitor impacts.

October 1996
Monitor movements of fish through fishpass.
Monitor impacts.

November 1996
Monitor impacts.
Begin writing Technical Manual on Fishpasses.

December 1996
Monitor impacts.
Complete draft of Technical Manual on Fishpasses.

January 1997
Monitor impacts.
Repair and modify structure as necessary.
Write draft Project Completion Report

February 1997
Monitor impacts.

March 1997
Seminar on FPP findings.
Monitor impacts.

April 1997
Monitor Impacts.

May 1997
Monitor movements of fish through fishpass.
Hydrological regulation of fishpass.
Adjust structure as necessary.
Close down field station and site camp.
Finalize Technical Manual on Fishpasses.
Finalize Project Completion Report.

ANNEX C

DRAFT CONSULTANT TERMS OF REFERENCE

DRAFT TERMS OF REFERENCE

This Section describes the specific elements of professional services required for the Fishpass Pilot Project to proceed.

Overall Project Organization and Management

The organizational structure and the roles of the agencies involved in NERP are described in the Management Plan, dated May, 1991. As stated in the Management Plan the Project will be implemented jointly by the Canadian Executing Agency (CEA) and the Bangladesh Water Development Board (BWDB). BWDB is linked to the Technical Committee of the Flood Action Plan through the Flood Plan Coordination Organization (FPCO). CIDA headquarters would monitor the technical acceptability of activities and outputs by reviewing Project reports, fielding review and supervisory missions, and conducting Project evaluations. Responsibilities of the Canadian High Commission, Dhaka would include providing liaison between CIDA, BWDB, CEA and FPCO. FPCO is responsible for coordinating and implementing the Flood Action Plan Components and Activities as directed by the Technical Committee. Bangladesh Water Development Board will be the executing agency for the Project. Day to day coordination, review, and monitoring will be provided by the Project Director appointed by GOB. Responsibilities of the CEA head office include establishing quality control procedures and providing quarterly progress reports to CIDA. The CEA in-country team is responsible for the management, training, and the work described for the following four initiatives.

1.0 FISHPASS PILOT PROJECT:

SPECIFIC ELEMENTS OF PROFESSIONAL SERVICES REQUIRED TO PROCEED WITH THE FISHPASS PILOT PROJECT

1.1 Background

The Fish Pass Pilot Project originates from the NERP study *Fisheries Engineering Measures*. It is a structural initiative which is designed to mitigate negative impacts of FCD/I projects on fisheries, specifically to allow normal breeding migrations to take place during the pre-monsoon season. This is expected to result in an increase in fish abundance and yield, and thus help to meet regional planning objectives of poverty alleviation, food self-sufficiency and economic development.

CIDA together with FPCO and BWDB have decided to proceed with pilot work on the Fish Pass Pilot Project, which is one of the NERP priority projects.

1.2 Purpose

To test the technical feasibility of using the vertical slot type of fishpass to provide passage for migrating fish stocks across flood control embankments during the pre-monsoon season in the haor region of Bangladesh.

1.3 Outputs

The outputs produced by the Consultant shall conform to the Guidelines issued by the FPCO, the stipulations of the present Terms of Reference, and the findings of relevant FAP studies and activities. The required outputs are:

Output #1: Fishpass Pilot Project (FPP) Implementation Plan

Output #2: Baseline/Impact Monitoring Programme

Output #3: Fishpass structure design (one unit)

Output #4: Functional full size fishpass structure

Output #5: Optimization of fishpass operation under real conditions

Output #6: Fishpass Pilot Project Completion Report including an Environment Assessment Report

Output #7: Training of one or two BWDB engineers in fisheries engineering, and one or two DOF fisheries biologists in fishpass operation and monitoring.

1.4 Activities

To produce Output #1:

- Identification of a FCD/I project for fishpass construction, including dialogue and input of views of beneficiary communities.
- Drafting of preliminary design of fishpass.
- Writing of FPP Implementation Plan, including literature review. The Implementation Plan should demonstrate the technical feasibility of the construction and operation of the fishpass structure, detail the organizational setup and rules for its operation, and quantify the expected effects of its operation on fisheries and agriculture. The literature review is to include engineerng aspects, mitigation, and monitoring, including tagging methodologies.

To produce Output #2:

- Contracting of FPP staff.
- Continued consulting/sensitization of communities inside the FCD project area to objectives and expected benefits of FPP.
- Baseline monitoring of fish abundance and fishing activity/catches inside the FCD project during full flood openwater period and beel harvesting period.

- Baseline monitoring of water levels inside FCD project area and in river.

- Baseline monitoring of agricultural activities and general fisheries related socioeconomic factors inside FCD project area.

To produce Output #3:

- Visit to New South Wales Fisheries Institute (Cronulla, Sydney, Australia) to study the design and operation of a vertical slot type fishpass for warm water species.

- Prepare detailed design drawings of the fishpass structure.

To produce Output #4:

- Fabrication and installation of one fishpass structure at a FCD project.

To produce Output #5:

- Operation/adjustment of fishpass during premonsoon and monitoring of fish passage through structure, including tagging of broodstock. Two Interim Reports on the operation of the fishpass will be produced immediately after the premonsoon migration seasons (May 1995 and May 1996).

To produce Output #6:

- Analysis of field data collected.

- Writing of FPP Completion Report with recommendations for future application of vertical slot fishpasses in Bangladesh. The Completion Report is to include an Environment Assessment Report.

To produce Output #7:

- Study visit to Australia

- On-job training during design, construction and operation of full size fishpass.

1.5 Organization and Management

The CEA in-country team will be responsible for management, training, negotiations with prospective contractors, selection of a contractor for the construction of the fishpass, progress payments to the contractor (through BWDB), and other work as defined herein. BWDB will be responsible for maintenance of the fishpass. DOF will be responsible for undertaking fish stock monitoring work related to the fishpass operation. The roles of the DOF and BWDB in the Fishpass Pilot Project and in future fishpass operations are to be clearly defined in the Implementation Plan (Output # 1).

During the community sensitization activity noted above, representative individuals will be assembled into an ad-hoc committee (ie Village Committee) which will oversee the implementation of FPP and act as a two way information conduit between FPP and the local communities.

Actual operation of the fishpass (ie release of river water through the structure) is to be reviewed and may be under the joint control of BWDB and DOF, and responsive to issues and recommendations raised by the Village Committee. As the structure is designed to ideally remain open year round, 'operation' as such refers to closing the structure by means of a vertical gate (as a safety measure if hydrological conditions suggest that a situation dangerous to crops inside the FCD project area may be developing), and reopening it once the danger has passed.

FPP will liaise with other projects in Bangladesh involved in fishpass work, specifically FAP 20, Tangail Compartmentalization Project, and an IDA regulator/fishpass project near Sunamganj.

1.6 Schedule

A sequential set of activities will be undertaken whose timetable is determined by rigid windows of opportunity controlled by the pre-monsoon/monsoon annual fish migration patterns, fishing calender and dry season construction calendar. An additional constraint is that the optimal time for a field visit to Australian fishpasses is during the annual carp migration in late November-early December. The project is to start in June 1994 and is scheduled for completion in May 1997.