Government of Nepal
Ministry of Irrigation

Department of Irrigation

Irrigation and Water Resources Management Project (IWRMP)

Jawalakhel, Lalitpur

Asset Management Plan of Block 2 of Narayani Irrigation System

OUR CREATIVE NEPAL (P) Ltd.

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1. Historical Background

1.1 Project Realization

1.1.1 General

The government of Nepal has launched a follow project of NISP after its completion. The project is entitled as Irrigation and Water Resources Management Project (IWRMP). Component B of the IWRMP is focused on management transfer of Agency Managed Irrigation Systems (AMISs) to the farmers/ WUAs as per irrigation policy. To prepare the background for the handover of such AMISs, the present status and performance has to be assessed. In order to enhance the overall performance of the irrigation system four AMISs covering an area of around 61000 ha will be transferred to the users under the component B. Narayani Irrigation Project is one of the candidate systems. The block 8 under second phase has already been proposed for the implementation under this program while block 2 is under the process to transfer.

Unlike Industrial assets, irrigation and drainage infrastructure assets have very specific features such as dispersion and high cost in relation to the financial turnover of the managing organization. Moreover, irrigation and drainage assets have specific hydraulic characteristics in relation to the function that they have to perform. Irrigation and drainage organizations have traditionally assigned little importance of the infrastructure. However, it is critical that as organizations are required to treat irrigation and drainage as a service business, they pay a detailed attention to cost of providing services. In order to provide this service in a sustainable and cost-effective way, a life-cycle approach must be taken to manage the organization assets. This involves the implementation of an asset management program that consists of several fully integrated functions including: asset creation, planning, operation and maintenance and financial management.

Generally Asset Management Plan (AMP) has originally applied in finance and business sector and is now also applied to the irrigation &drainage sector. Traditionally, the investment made in irrigation and drainage infrastructure by the government was focused primarily on the cost planning and construction the infrastructure with little attention to the consumption of assets during their economic life. However, the management of infrastructure comprises several other types of events including maintenance, rehabilitation (replacement), modernization or implementation of the new technology, retirement and disposal of assets. All these events have specific costs which form part of the overall cost for providing a sustainable service. The AMP can be defined as a process for planning investment in infrastructure in a sustainable manner, to provide users with a reliable and affordable service.

Irrigation Water Resources Management Project (IWRMP) has been undertaken by DOI and World Bank to support the irrigation development in Nepal aiming to reduce poverty in the rural sector through the improvement of the agriculture production, also encompassing the water resources management and strengthening of the end user's organization WUA. The project is in its preparation stage and has four components for its development approach and implementation plan. Component A includes the modernization of the FMIS in three western regions targeting to develop about 168 nos. of schemes covering about 26392 ha of irrigated area with its infrastructure improvement works. Component B

comprises of management transfer of the selected AMIS in about 61,000 ha targeting to strengthen the WUA and field staff for sustainable management in the long run. Component C includes the Water Resources Management Planning and supporting Water and Energy Commission Secretariat (WECS) for its role in water regulatory authority. The component D comprises the activities on the integrated crop water management in the FMIS and AMIS system to support the agriculture sector for increase production including promotion of marketing and other assistances to the beneficiaries.

Asset Management Plan is one of the pivotal activities for the component B to assess the values of the infrastructures for management transfer and also basic requirements for the management of the systems as a whole. The components – 'B' of the proposed project would include the management transfer of a few selected AMISs. These are identified as:

(i) Kankai Irrigation System- 7000 Ha
(ii) Sunsari Morang Irrigation System- 20800 Ha
(iii) Narayani Irrigation System- 22400 Ha
(iv) Mahakali Irrigation System-10800 Ha

Altogether about 61,000 ha is primarily been selected for the transfer project. The mode of transfer of ownerships, management of the systems needs to be reviewed and finalized prior to its application. Experiences of the past management transfer projects such as IMTP, ILC, NISP, SISP, and IMP indicate that the capacity building of the user's groups of WUA's and beneficiaries are vital in the process. Otherwise, simple transferring management of the schemes to users will not resolve the issues and the problems pertaining to the system management. This component has envisaged strengthening the beneficiaries from the very grass root level and making them active and accountable in the operation and management of the turned over schemes. This would be carried out by extensive dialogue with the farmers and make their WUA responsive and accountable through assistances and capacity building activities.

The overall objective of the Irrigation Management Transfer (IMT) of the selected Agency Managed Irrigation System is to improve service performance and service delivery of the selected AMIS where management transfer to WUAs would be completed and consolidated. It comprises: a) completion/consolidation of Management Transfer Plan (MTP) including streamlining and strengthening of WUAs b) essential structural improvements, c) repair or procurement of buildings, transportation, communication, maintenance and information technology equipment and d) capacity building of WUAs and DOI.

Narayani Irrigation System (NIS) has been selected for this fiscal year for implementing the Irrigation Management Transfer in the system. A set of procedures is prepared for carrying out the transfer processes, which also includes this Asset Management Plan. The consultant also verified the secondary data at the field in the last week of December 2013. Other components as Rapid Appraisal results and O&M costing are also used in completing this Asset Management Plan.

1.1.2 Objectives of Consulting Services

The Office of the Project Director (OPD) of IWRMP, DOI invited "Our Creative Nepal (P) Ltd." to undertake the assignment to prepare the Asset Management Plan of Narayani Irrigation System block 2 in the context of the preparation of the envisaged project. Accordingly, a contract agreement was signed between "Our Creative Nepal" and OPD, Irrigation and Water Resources Management Project (IWRMP). The objective and scope of the assigned works are as follows: (Detail TOR in Annex-1)

The objective of the consulting services is to prepare Asset management Plan (AMP) including operation and maintenance plan and financial management plan of the block 2 (Approx. 2996 ha.) of Narayani Irrigation System collecting the available data from concerned office and field. The main purpose of the asset management plan (operation and maintenance plan) and its analysis is to identify the assets, assess their values and the liabilities.

1.1.3 Scope of the Consulting Services

The expected output from the consulting services will be as follows:

- Preparation of the detail status of the assets of canal network, structures, equipments, building and others its physical conditions, operational status and needs to rehabilitate for its functionality;
- Defining the valuation of the assets and the liabilities like operation and maintenance cost light rehabilitation and mainly differed maintenance and replacement requirements;
- Review of the project and WUA organizational setup, functions, procedures including human and financial status;
- Preparation of financial management plan of the Block 2 area of Narayani Irrigation Project;
- Analysis on the potential irrigation service fee collection and other funding resources available for the operation and maintenance of the system;
- Assess the operation and maintenance cost for ESI and WUA office management cost , deferred maintenance cost for DoI with actual requirements, feasible irrigation service fee for the cost recovery;
- Preparation of ESI implementation action plan for implementation of the construction activities showing involvement of WUA and agency for different time frame.

1.1.4 Historical background of NIS

Narayani Irrigation System (NIS) is a large (37400 ha) gravity flow irrigation scheme located in the central Terai region of Nepal. The command area of this scheme lies in the three districts of Terai: Parsa, Bara and Rautahat. NIS was developed by Indian government and the headwork of the scheme was built across Narayani river in Balmikinagar at Bihar state of India, diverts the flow in Eastern Main Canal called Tirhut Main Canal and then from Tirhut to 92 km long Don Branch canal (capacity 2500 cusecs) which feeds Ghorasahan Branch Canal (capacity 1650 cusecs) in India and Nepal Eastern Canal (capacity 850 cusecs) in Nepal at Inaruwa village near Indo-Nepal Boarder. This scheme was handed over to

Government of Nepal (GoN) in two phases that is in 1975 and in 1976. With the financial support from World Bank, GoN developed the command area and divided the scheme in 15 blocks. The detail of NIS is given in table-1 below.

Table 1: Details of NIS

Descriptions	Qty.	Unit	Length (in No.)
Main Canal (NEC)	1	Km	81
Main Secondary Canal (MSC)	17	Km	137
Branch Secondary Canal (BSC)	50	Km	233
Sub Secondary Canal (SSC)	Not available	Km	408.5
Tertiary Canal	Not available	Km	1468
Drainage	Not available	Km	305
Major Structures	87	Nos.	Not applicable
Other Structures	3574	Nos.	Not applicable

The Narayani Irrigation System (NIS) is part of an extensive irrigation system located in the southeast Terai of Nepal and north India. The primary source of water is the Narayani River. The designed capacity of Nepal Eastern Canal (NEC) is 24.1 m^3/s.Additional 7 m^3/s of water is drained to NEC from Tilawe River (see figure 1). During Apr/May and Nov/Dec. the system is shut down for the maintenance purpose. The service area of the project was originally planned as 37 400 ha in three stages. Only Stage I and II of three stage program was completed. Some activities of stage III program i.e. structural modification/rehabilitation of stage I and II was happened. The command area developed in stage I program was 15,980 ha. inclusive of 2,730 ha. served by ground water. It was completed in 1980 AD. While in 1986 AD stage II was completed by developing extra 12,730 ha. of command area. The command area of each blocks in the system range from 2200-3000 ha.

The NEC runs from west to east for 81 km starting at the Nepal–India border .Water Delivery is made possible only in the first 54 km i.e. Block 1 to 10. Block 11 and 12 receive irrigation water on the rare occasions when there are heavy rainfall events when farmer in the upstream consume less water.Block 13–15 in the Stage III area does not receive scheduled deliveries from the project. In these blocks, no infrastructure below the main canal has been developed by the project. The MSCs run north to south from the NEC for 3–11 km.

The system was originally designed for supplementary irrigation of paddy rice in the monsoon season. Thus, the capacity of the system was not intended to be sufficient by itself to supply the full crop water requirement to the entire command area. Similar to other large irrigation projects in Nepal and India, the NIS was intended to provide drought protection and deliver irrigation water to as many farmers as possible. However, demand for irrigation water on a year-round basis has increased steadily as farmers have moved towards rabi wheat crops and year-round vegetable crops, in addition to maize, sugar cane and other seasonal crops.

The major crops grown in the command area includes: paddy in summer; wheat, pulses (lentil, soybean, and other local varieties), oilseed crops (mustard and linseed), and vegetables (cauliflower, cabbage, eggplant, onion, tomato, etc.) in winter; and maize, vegetables and spring paddy in spring. The average landholding size is less than 1 ha per household. The mean annual rainfall is 1, 800 mm, most of which falls between June to September.

Since their establishment in 1993, WUAs have effectively taken over operation of the canals below the NEC level, while DOI is officially responsible to operate NEC.

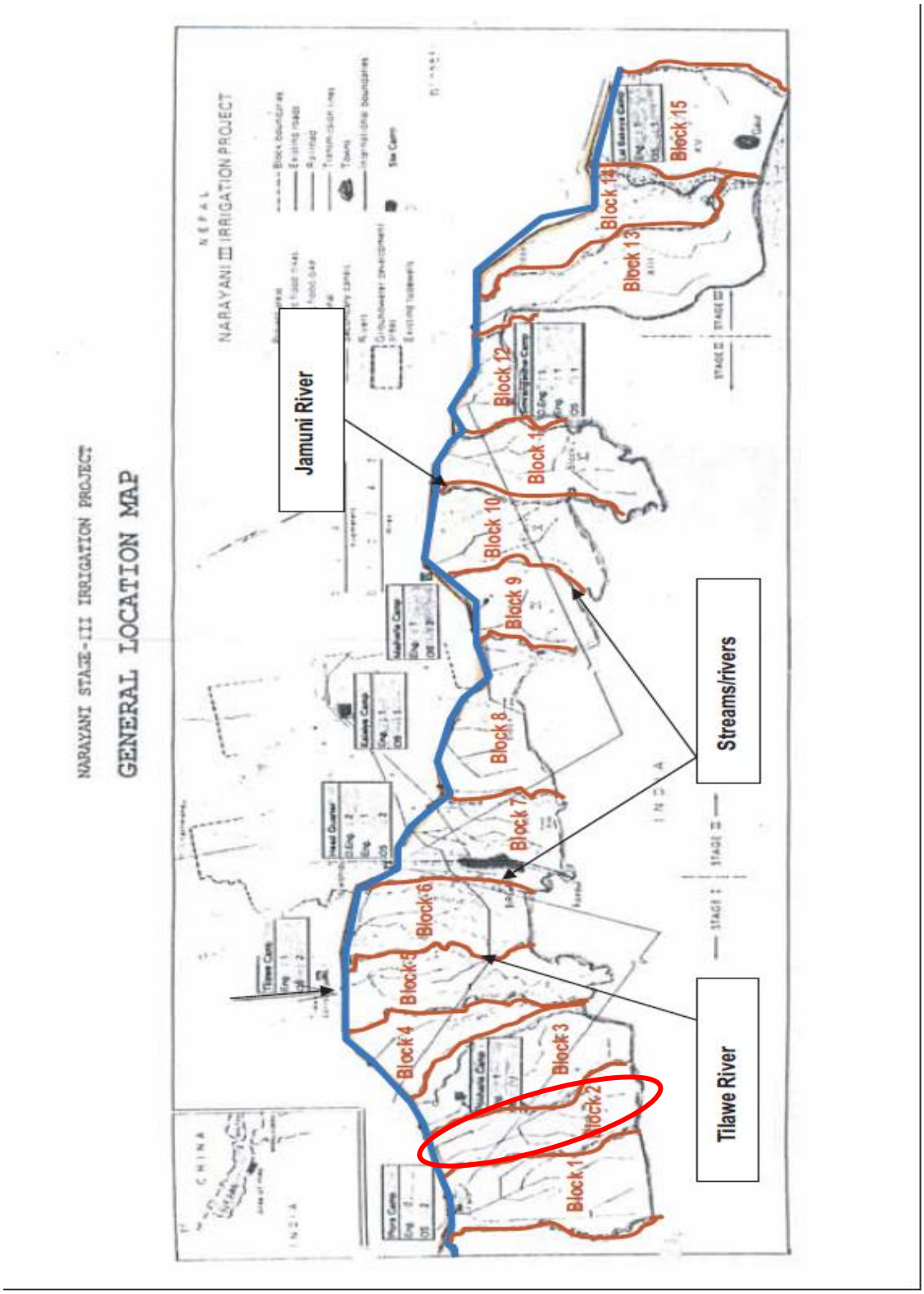


Figure 1: Layout of Narayani Irrigation System (Block 2 in red circle)

1.2 Infrastructure Development

1.2.1 Canal System

The total canal system has been divided in to two types.They are secondary (MSC, BSC, and SSC) and tertiary. The total lengths of secondary and tertiary canals of block 2 of NIS are 40 Km, 109 km respectively. Summaries of the main canal networks details are illustrated in the **Table 2.** The structure type is given in **Annex 9**

Table 2: Main Canal Network of block 2 of NIS

Chainage	Structures	Structure type/ canal type
0+000	H/R	**4**
0+002	Culvert	13
0+063	LD Syphon	22
0+070.20	Offtake (BSC 1 Intake)	5
0+071.8	Slab Culvert (C1)	13
0+093	LD Syphon	22
0+121	Outlet	21
0+170	MR1 & left tertiary (Tnr)	
0+172.40	Regulating structure	2
0+662	Outlet	21
0+662	Outlet	21
0+898.6	Drop Structure	6
1+508	Offtake (BSC 2 Intake)	5
1+510.40	Regulating structure	2
1+720	LD Siphon	22
1+746	Offtake (BSC 3 Intake)	5
1+751	Check Structure	2
1+820	Outlet (M-L1)	3
1+907	Regulating structure	2
1+907	Drop (D2) + Slab Culvert	13

2+320	LD Siphon	22
2+606	Outlet	3
2+606	Outlet	3
2+634	Outlet (ML2)	21
2+636	Regulating structure +drop	2
3+354	Offtake (BSC 4 intake)	5
3+360	VRB	13
3+429	Offtake (SSC1)	5
3+439	Outlet (ML3)	21
3+439	Outlet (one in right, one left)	21
3+456	Check Structure	2
3+460	Regulating structure	2
3+460	Drop Structure with Slab	6
3+975	Outlet (to feed MR3)	21
3+977	Regulating structure	2
4+377	Outlet (to feed ML3)	21
4+390	Outlet (to feed MR3)	21
4+512	Outlet (to feed MR3)	21
4+552	Regulating structure +drop	2
4+652	Drop Structure	6
5+269	Outlet (to feed MR3)	21
5+274	Regulating structure	2
5+678	LD Syphon	22
5+838	Culvert	13
5+900	Culvert	13
5+933	Outlet (SSC2)	5

5+935	Regulating structure	2
6+274	Outlet	21
6+276	Regulating structure	2
6+643	VRB	13
6+773	Outlet	21
7+075	Culvert	13
7+154	LD Syphon	22
7+193	Offtake (BSC 5 Intake)	5
7+195	Regulating structure	2
7+895	Outlet	21
8+021	Offtake (BSC 6 inlet)	5
8+022	Regulating structure	2
8+036	Parshal flume	7
8+268	Culvert	13
	Outlet	
8+679	Culvert	13
8+707	Outlet	3
8+710	Regulating structure	2
9+164	Outlet (right)	3
9+164	Outlet (L)	3
9+223	Regulating structure	2
9+658	Outlet	3
9+661	Outlet	3
9+661	Outlet	3
9+662	Culvert	13
10+162	Outlet (right)	3

10+162	Outlet (L)	3
10+163	Regulating structure	2
10+649	Outlet	3
10+649	Outlet	3
10+515	Culvert	13
10+649	Regulating structure	2

BSC-1

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+019	Parshall Flume	7
0+312	B1-R1	3
0+497	Foot Bridge	13
0+808	Offtake (to BSC 1A)	5
0+810	Regulating structure	2
0+825	LD syphon	22
1+220	Aqueduct	8
1+220	Culvert	13
1+537	B1-R2	3
1+539	Check Structure	2
1+761	Culvert	13
1+969	LD syphon	22
2+048	Culvert	13
2+085	LD syphon	22
2+214	B1-R3 and B1-L1	3
2+215	Check Structure	2
2+608	Culvert	13

2+716	Culvert	13
2+894	LD syphon	22
3+140	B1-R4	3
3+141	Check Structure	2

BSC-2

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+026	Parshall Flume	7
0+055	B2-L1	3
0+095	LD syphon	22
0+137	B2-R1	3
0+139	Regulating structure	2
0+383	Culvert	13
0+733	B2-L2 & B2-R2	3
0+734	Regulating structure	2
1+189	Culvert	13
1+312	B2-L3 & B2-R3	3
1+358	Regulating structure	2
1+625	B2-L4	3
1+625	B2-R4	3
1+627	Regulating structure	2
	B2-L5	3

BSC-3

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+047	Parshall Flume	7

0+198	LD syphon	22
0+352	LD syphon	22
0+743	Offtake (SSC5)	5
0+793	Regulating structure	2
0+984	B3-R1	3
1+036	Culvert	13
1+223	LD syphon	22
1+413	Culvert	13
1+750	B3-L1 & B3-R2	3
1+753	Regulating structure	2
2+195	Offtake (SSC 6)	5
2+197	Regulating structure	2
2+430	LD syphon	22
2+467	Culvert	13
2+545	B3-L2 & B3-R3	3
2+694	Regulating structure	2
2+903	Culvert	13
3+262	LD syphon	22
3+278	Culvert	13
3+368	B3-L3 & B3-R4	3
3+465	Regulating structure	2
3+782	Culvert	13
3+937	B3-L4 & B3-R5	3
3+940	TS	
4+340	CD siphon	

BSC-4

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+037	B4-L1	3
0+108	Escape (spiilway)	17
0+270	culvert	13
0+346	FS	6
0+445	Regulating structure	2
0+800	CD	22
1+125	CD	22
1+153	B4-L2	3
1+161	Culvert	13
1+300	Bridge (to go to temple)	13
1+472	Culvert	13
1+598	Offtake (SSC 7)	5
1+610	CD	22
1+610	Lined Canal	4
1+779	B4-R1	3
1+780	Check Structure	2
1+968	Culvert	13
1+986	Offtake (SSC8)and B4-R2	5
1+987	Regulating structure	2
2+426	Check Structure	2
2+580	Culvert	13
2+841	B4-L3	3
2+843	Regulating structure	2
3+252	Culvert	13

3+290	L (FS)	12
3+750	Culvert	13
3+750	B4-L4 & B4-R3	3
3+830	B4-L5	3
3+875	Check Structure	2
4+487	B4-L6	3
4+853	B4-L7 +outlet	3
4+853	Check Structure	2
5+348	B4-L8	3
5+468	Check Structure	2
5+721	B4-R4	3
5+825	CD	22
5+901	B4-L9	3
5+901	Check Structure	2
6+111	CD	22
6+125	Culvert	13
4+420	B4-L10/B4-R5	3
6+422	Check Structure	2
6+780	CD	22
7+015	Culvert	13
7+015	B4-R6	3
7+150	Culvert	13
7+482	B4-L11/B4-R7	3
7+482	TS	2

BSC-5

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+025	Parshall flume	7
0+049.85	B5 - L1/B5 - R1	3
0+050.75	Check Structure	2
0+183.25	Culvert	13
0+581.70	B5 - L2	3
0+586	B5 - L3	3
0+588	Check Structure	2
0+761	Culvert	13
1+079	B5 - R2	3
1+156	B5 - R3	3
1+158	Check Structure	2
1+334	CD	22
1+340	Culvert	13
1+603	Check Structure	2
2+068	B5 - R4	3
2+088	Check Structure	2
2+224	CD	22
2+529	B5 - R5	3
2+549	B5 - L4	3
2+551	Check Structure	2
3+019	B5 - R6	3
3+019	Check Structure	2
3+119	CD	22
	Culvert	13

BSC-6

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+015	Parshal flume	7
0+169	B6 - R1/B6 - L1	3
0+169	Check Structure	2
0+380	Culvert	13
0+868	B6 - L2	3
0+869	Check Structure	2
1+400	CD	22
1+442	B6 -R2/B6 - L3	3
1+442	Check Structure	2
1+598	Culvert	13
1+700	CD	22
1+735	CD	22
1+738	Culvert	13
1+973	CD	22
2+051	CD	22
2+244	B6 - R3	3
2+565	CD	22
2+679	B6 -R4/B6 - L4	3
2+682	Check Structure	2
3+220	B6 - R5	3
3+222	Check Structure	2

BSC-1A

Chainage	Structures	Structure type/ canal type

0+000	H/R	4
0+025	New B1A - L1 (By chinese)	3
0+025	CD	22
0+316	B1A - R1	3
0+506	Division Box (DB)	2
0+738	TS	

SSC-1

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+024	Culvert	13
0+144	CD	22
0+357	Culvert	13
0+567	S1 - L1	3
0+775	TS (S1 - R1) (S1 - L2)	3
0+775	TS	

SSC-2

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+022	S2 - L1/S3 - R1	3
0+025	CD	22
0+750	S2 - L2	3
0+750	TS	

SSC-3

Chainage	Structures	Structure type/ canal type
0+000	H/R	4

0+025	Division Box (DB)	
0+113	CD	22
0+188	Culvert	13
0+195	DB	
0+300	TS	2

SSC-4

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+065	S4 - L1	3
0+115	Culvert	13
0+670	S4 - R1/S4 - L2	3
0+670	TS	

SSC-5

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+025	Outlet	
0+220	Culvert	13
0+303	CD	22
0+320	S5 - R1	3
0+322	Regulating structure	2
0+422	Outlet	
0+480	Outlet	
0+652	Culvert	13
0+680	S5 - L1/S5 - R2	3
0+680	TS	

0+800	CD siphon	22
0+950	S5-R2-2	
1+100	S5L2	

SSC-6

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+056	S6 - L1	3
0+058	Regulating structure	2
0+267	Culvert	13
0+353	CD	22
0+364	Culvert	13
0+633	CD	22
0+636	Culvert	13
0+686	Culvert	13
0+765	S6 - R1	3
0+767	Regulating structure	2
0+991	S6 - L2/S6 - L3	3
0+991.5	TS	

SSC-7

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+044	S7 - R1	3
0+047	Culvert	13
0+810	S7 - R2	3

1+150	TS	2

SSC-8

Chainage	Structures	Structure type/ canal type
0+000	H/R	4
0+045	S8 - L1	3
0+770	S8 - L2	3
0+941	TS	2
1+100	Pipe culvert	13
1+115	CD	22

1.2.2 Buildings

Within Block 2 of NIS, there exist a two roomed one storied building with compound. It was constructed for WUA operation purpose. It seems the building was not in use from last few years.

1.3 Organizational development

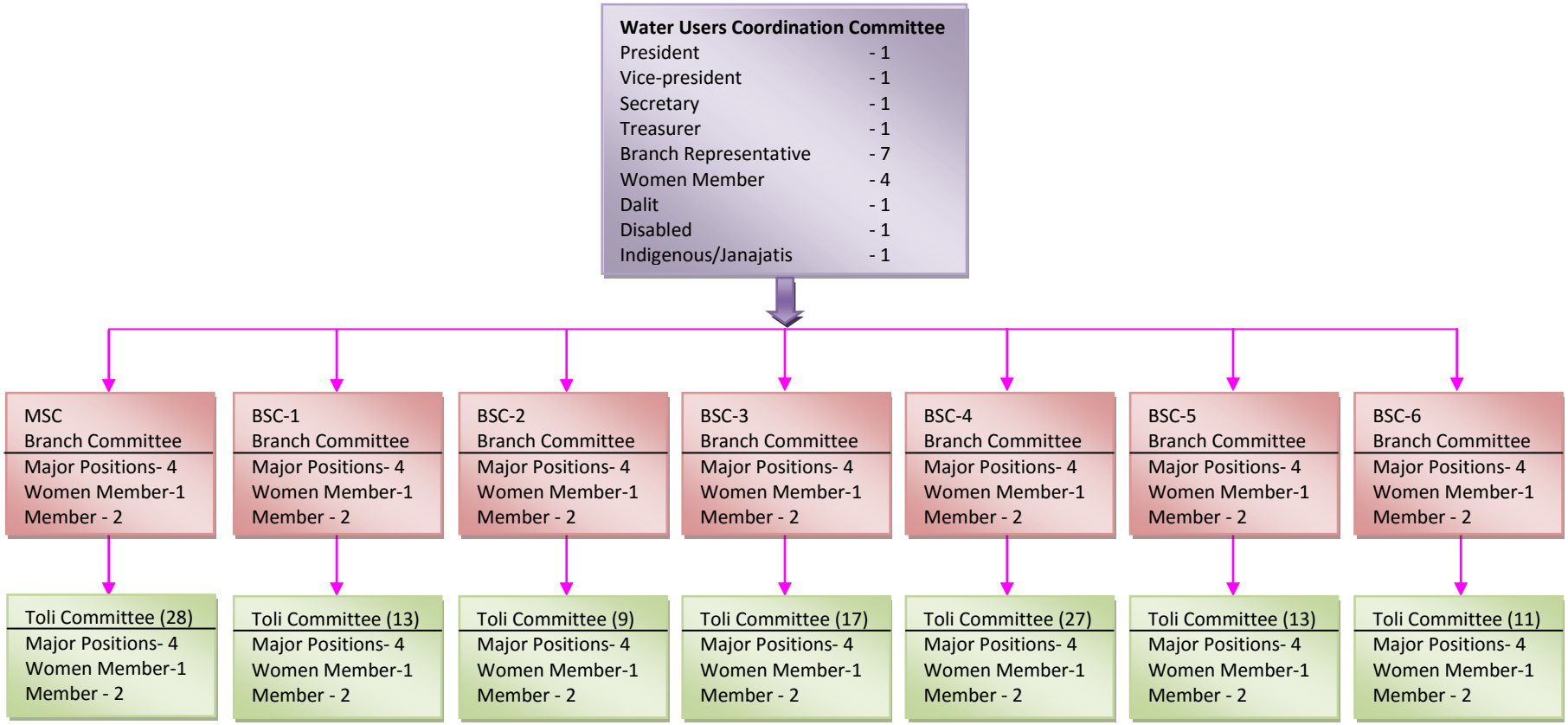
1.3.1 WUA Organization/Structure

At present, the block 2 is supervised by Management Division No.5 Office, Birgunj, Parsa. The present status of WUA in block 2 of NIS is given in table-7 below.

Table 3: Status of WUA

Block	Toli Committee	Branch Committee	WUC (block)	No. of HH
2	118	7	1	3100

NIS block 2 consisted of three tiers of organization. The smallest unit of this is Toli Committee. There are one hundred and eighteen "Toli Committee" in Block 2. On top of it is a Branch Committee. There are 7 Branch Committee. At the top is the Water users' coordination committee (WUCC), which is responsible to look after the whole block. The schematic representation of the entire tier is shown in Fig -2 below.



Water Users Coordination Committee	**Branch Committee**	**Toli Committee (Tertiary canal Water Users Group)**
From 118 GA memberToli committee 4 majors is selected (President, Vice-President, Secretary, Treasurer) Coordination committee Member -7 (From Branch Committee From 7 Branch Committee women representatives, 4 is selected (From Women Members)	Major Positions i. President ii. Secretary iii. Treasurer & iv. Coordination Committee Member Women Member: Selection is made from Toli Committee of respective toil Committee. For instance, Women member for BSC-4 is selected from 27 women member from 27 Toli Committee.	Major Positions i. President ii. Secretary iii. General Assembly Member & iv. Branch Representative-1

Figure 2Organizational Chart of WUCC

2. Valuation of the Assets (Transferable and non- Transferable)

2.1. Canal Systems (Head-works to tertiary canal)

The valuation of the system is carried out by the consultant team with the help of NIMD technicians. Head work and structure at NEC is not taken in the valuation because it is handled and controlled by the government of India and government of Nepal. Other infrastructures are taken in consideration for valuation. The total replacement cost at the present price is NRs 65.2Millions (It is completely WUA part). Asset values of system structures of Block 2 of Narayani Irrigation System are presented in **table 4.**

2.2 Land area

The lands required for the canals and the offices were acquired by the government. The values of the lands were estimated based on the current transactions. The average rate taken was NRs. 4.5millions per hectare. The ownership of the land remains with the department; however a defined set of the assets could be handed over on long term lease for the use to WUA.These assets could be finalized with mutual understanding between the WUA and DOI. It is recommended that all the secondary canals and its related lands can be handed over on lease basis. The land acquired by canal and its related land is about 63.934 ha. The area covered by the WUA building and its associated land is 525 m^2.

Table 4*: *Asset Values of the System Infrastructures

Asset	**Physical Quantity**	**Replacement Cost value at the present price in NRs. Million**
DOI Part (Not to be handed over)		
6.0 Acquired Land	63.934 ha	287.703*
Sub Total DOI Part		***287.703***
WUA Part (To be turn over)		
8.0 Secondary Canals	40 Km	40
9.0 Tertiary Canals	108 Km	96.12
10.0 Trunk Roads	30 Km	30
11.0 Buildings	1nos	0.5
12.0 Secondary canal structure	316nos	65.2
Sub Total WUA Part		***231.82***
TOTAL		**519.523**

Source: Field Data and NIMD-5, 2013

2.3 Buildings

The WUA building and the lands acquired by the building can be turn over to the WUA for their use.

2.4 Equipments

There is no such defined equipment for the present use for block 2 of NIS. New handy equipment should be purchased for the WUA

3. Inclusions of Management Transfer Agreement

3.1 The concept

The Irrigation Management transfer in block 2 of NIS may be two types a) Complete – meaning that the users take over all functions of operation, maintenance and management – or b) Partial – meaning that, after transfer, some defined functions continue to be performed by the government. Usually, these functions that are retained by government are those that require higher levels of technical skill, such as operation of headwork or main canals. It is envisaged that the operation of the H/W will remain with the Indian government, whereas the operation of the main canal will be the responsibility of Division Office. The canal systems down to Secondary level will be fully transferred to the WUA for its operation and management. The Maintenance of the main canal will be the responsibility of the government. The office will directly assist the WUAs in the management for two to three years assisting in building their capacity through trainings and other technical support. Their performance and ability to manage will give way for higher-level management transfer.

Before any management transfer can be done, certain levels of organizational structure and management capacity must exist in the user community that is going to receive the transfer. There is some clear evidence that shows, there is a general consensus among these users, willingness for the transfer, readiness to accept the responsibilities and contribute the resources.

3.2 justification for transfer

There are two major reasons for undertaking irrigation management transfer in a government-built irrigation system such as Block 2 of Narayani:

- From the farmers' viewpoint, management transfer gives them ownership and control of the irrigation facilities that they use. They will control the sharing of available water among themselves, and they can decide about the future evolution of their system.
- From the government's point of view, management transfer enables the government to disengage from daily operation of the system, and thereby it releases government funds, which thereafter can be applied to new developments.

3.3 Transferable assets

It has been envisaged and planned that the infrastructures below the secondary level will be transferred fully to the WUA for their management. It will be accompanied with the required WUA offices of the project, logistic support to run the offices, equipment for maintenance, and a working capital to start the operation and for hiring gate operators. The whole canal networks of block 2 of

NISwith their infrastructures as well as related structures will be handed over to WUAs. The ownership of the lands and infrastructures will remain with the government, The WUAs will be given full authority for its O&M and if necessary to rebuilt or renovate. It will be like a lease contract for its utilization. The management transfer agreement has such provision for empowering the WUA. In addition to the Canal networks in block 2, the proposed transferable lists of the items are as follows:

- Vehicle for movement for block committee.
- One heavy equipment as JCB with back hoe and loading facility and one dump truck.
- Logistics support for office management including one computer and printer.
- Working capital for running the O&M to start, this will be decided mutually during the transfer process.

3.4 Non- Transferable assets

For office purposes of the WUA one building of NIMD office, especially constructed for block committee could be transferred for the better interaction within WUCC, so that interactions between the office and the main committee will be smooth and conducive.

3.5 WUA's responsibilities

The responsibilities of the WUA according to the draft management transfer agreement are delivered as follows:

1) To receive assigned quantity of water and distribute water equitably and judiciously is the duty of WUA

2) Essential Structural Improvement (ESI) shall be undertaken jointly by the Project and WUA of respective units in the process of strengthening IMT in the system. The cost for ESI will be shared between Project and WUA. Project here referred to denote the external support to the IMT implementation. Duration of the project shall be for limited period. Ratio of cost sharing will be mutually agreed.

3) After the transfer agreement or from the date of signing this agreement, the management and operation of the Secondary shall be the responsibility of WUA like maintenance and protection of the infrastructures. The irrigation office will continue the grant support for a period as mentioned in IMT document

4) The appropriate maintenance and supervision of the system shall be the duty of WUA

5) To ensure, receive and distribute assigned quantity of water in a judicious manner to the users shall be the duty of WUA. The water distribution as mentioned in the provision 5 and other conditions shall be discussed and general principle of water distribution shall be agreed in the general assembly. The report has to be submitted to DOI after one month of the FY. If such report is not submitted, DOI can take necessary action against that WUA.

6) Within the provision of the Constitution of WUA, water fee rate for thesystem O&M shall be recommended by WUA to the Water Fee Determination Committee. Water fee thus fixed shall be collected by WUA bymobilizing tertiary units along with other service fee fixed by thegeneral assembly of the WUA. The amount thus collected should beenough for operation and maintenance of the systems below maincanal.

7) Emergency Fund Establishment to meet the emergency situation shall be established and management of that fund shall be done by the WUA.

8) It shall be the duty of the WUA to protect, maintain and use infrastructures after transfer.

9) The transferred structure which requires repair beyond the capacity of the WUA shall be repaired on cooperative basis. Between the WUA and Department the procedure for this will be jointly decided.

10) The Association shall seek approval of the Annual Maintenance Plan from the General Assembly before implementation

11) It shall be the responsibility of the WUA to repair the damages caused by human beings or by animals. Under such condition, penalty can be imposed to these concerned parties.

12) Except for regular maintenance, the WUA shall not be allowed to alter the design of infrastructure without the prior approval of the Department.

3.6 DOI's duties and responsibilities

1) It will be the responsibility of DOI to transfer the irrigation system in an appropriate operational form

2) It is the duty of the Department to supply agreed quantity of water to WUA

3) If agreed quantity of water could not be delivered within the agreed timeframe, compensation to WUA will be given to the extent of liability of the WUA.

4) If the maintenance is not properly done or the water fee is not collected, the Department has right to suspend the supply of water to that secondary canal WUA.

4 Rehabilitation / ESI Plan

4.1 Asset Inventory Collection

The inventory of the structures of the main secondary canal, branch secondary canals, and tertiary canals with their structures was carried out during desk study and which were verified at the field during interactions with the office personnel, the farmers, WUAs and walk through survey.

4.1.1 Status evaluation norms

The asset inventory survey and reports are prepared on the five criteria suggested by the World Bank missions; these criteria for assessing the physical conditions of the structures are as below

Rating	Condition
5	Practically new and fully serviceable
4	Generally good with no damage only routine maintenance required, performs assigned function satisfactorily
3	Generally good but with some deterioration or damage. Need attention. Still performing assigned functions satisfactorily
2	Significantly damaged or deteriorated. Suffering from deferred maintenance. Serviceability is impaired. Needs urgent rehabilitation
1	Very poor and dilapidated condition. Non-functional. Requires partial restoration or complete replacement to restore serviceability

4.1.2 Physical status of the infrastructure (canal system)

Main Secondary Canal

Most of the structures in main canals are in good conditions rating 5 to 3 especially in main secondary canal structure. The serious most structure are outlets at the tail end of the MSC and a culvert at chaingae 8+679 and 9+662, regulating structure at chainage 6+276 (no sign of indication if structure exists few years back), 10+649. Remaining structures are in good conditions. Summary of the findings are illustrated in the table 6 below

Secondary and Tertiary canal

There are 6 nos. of branchsecondary canal off-takes and 118 tertiary canals off takes from different reaches of the secondary canal. All these canals are trapezoidal and unlined. All these canals are earthen canals and in variable state with deposition of silts. It is not properly maintained in general.

Summary of the structures in the main and secondary canals with their code is presented in the table 6

Table 5 : Physical Status of the Secondary Canal structures

Structure in Main Secondary Canal			
Type	**Number**	**Physical condition and Rating**	Remarks
Head Regulator	1	Generally good and minor repair and maintenance Requirement Rating 3 & 4. Few structures are rated below 3.	Silt deposition is the major problem. As no water flow in the tail section, people started deteriorating the canal section or do not maintenance work
culvert	12		
Syphon	6		
Offtake for BSCs & SSCs	6		
Regulating Structures	15		
Check Structures	1		
Check Drop Structures	5		
Direct Outlets + tertiary offtakes	28		
Offtake for SSC	2		
VRB	2		
Parshall Flume	1		
Total Structures	**79**		
Structures in Branch Secondary Canal			
Type	**Number**		
Parshall flume	5	Generally good and minor repair and maintenance Requirement Rating 3 & 4. Few structures are rated below 3.	Silt deposition is the major problem
Tertiary offtakes	60		
offtakes to SSC	6		
Foot Bridge	1		
Regulating structures	13		
Syphon/ Cross drainage	26		

Check Structure	22		
slab/Pipe Culvert	31		
Aqueduct	1		
Tail Section (TS)	2		
Escape (spillway)	1		
Total Structures	**168**		
Structure in Sub-Secondary Canals			
Type	**Number**		
Division Box	3	Generally good and minor repair and maintenance Requirement Rating 3 & 4. Few structures are rated below 3.	Drainage is the major problem
Tertiary offtakes	23		
Pipe Culvert	12		
Syphon/CD	9		
Tail Section (TS)	9		
Outlet	4		
Regulating Structure	3		
Total Structures	**63**		

Source: Field Survey

4.2 Proposed improvement plan

Main Secondary Canal

The MSC of block 2 of NarayaniIrrigation System is almost unlined. Around 250m of main secondary canal is lined both side. There are 28 direct tertiary canals off take from the MSC. Water do not reaches to the tail the main secondary canal due to excessive silt deposition along the canal length and the growing bushes/plants in different chainage, household garbage. In earthen canal section, reshaping of the canal at different chainage are essential (most of the canal length). Most of the structures are in good conditions (i.e. functioning) except in some regulating structures, check structures, outlets, culvert especially in the tail reach. Other structures need minimal maintenance. Few of the structure are damaged completely (regulating structure at chainage 6+276 do not exist anymore).

Branch Secondary Canal

There are 6branch secondary canals and 8 sub secondary canals. The total length of branch secondary canal is 29.34 km. Reshaping of the canal is required for proper functioning of canal. D/s protection is required in some of the drop and other structures. Tertiary canal are already ungated by the Chinese intervention. There are 118 tertiary canals off-taking from secondary canals. The tentative estimate of light maintenance of secondary canals of block 2isNRs.23.69 millions. Detail Breakdown of Rehabilitation Cost is provided in **Annex 9**.

Scope of Works for ESI

- At Secondary Canals the following items of works are proposed:
  - Reshaping of the canals at various places as required estimated about 33.6 km.
  - Structural protection works at various places.
  - Repair and painting of gates.
  - Drainage work protection and enhancement of water way of drainage canal.
  - Service road maintenance

It is anticipated that the above works will be adequate to bring the system in proper operable state.

4.2.1Tentative cost estimate for improvement.

The detail regarding the quantity estimate and the abstract of costs are shown in the Annex 9

The total light maintenance cost is estimated NRs.23.69 millionswhich is NRs.7,909.49/ha.The details are illustrated in the attached **Annex 9**

Total rehabilitation cost of differed maintenance of assets of block 2 of NIS is NRs **11.35 millions.** Detail breakdown of rehabilitation cost of differed maintenance of assets of block 2 of NIS is presented in **Annex 9**

Table…...Detail Breakdown of Rehabilitation Cost of Light Maintenance of Assets of Block 2 of NIS

Canal	MSC				BSC				SSC		Total
	Reshaping	Lining	Structure	Trunk road	Lining	Reshaping	Trunk road	Structure	Reshaping	Structure	
MSC	923,230	-	5,673,230	750,000							7,346,460
BSC					375,000	923,230	2,100,000	11,343,230			14,741,460
SSC									161,961	1,446,961	1,608,922
Total	**923,230**	**-**	**5,673,230**	**750,000**	**375,000**	**923,230**	**2,100,000**	**11,343,230**	**161,961**	**1,446,961**	**23,696,842**

5. Summary findings of rapid Appraisal Survey - existing strength and constraint.

5.1 Proposed of Rapid Appraisal- Performance status of physical, institutional, agricultural and water management sub-system.

Rapid Appraisal Survey was carried out for the Block 2 of Narayani Irrigation System to evaluate its performances in physical condition, water delivery, irrigation coverage, institutional status, and agriculture practices, which has given a clear understanding of the existing conditions. The physical systems are in good condition and it has been under-utilized for its irrigation services. Water availability through the canal in block 2 is a big question. The only branch canal that enjoys water is BSC 4. From last few years, rest of the BSCs and tail section of MSC did not get water for its command area. If canal networks are maintained properly, water may be available for full command area. The cleaning of the canals is rarely done in the whole system in block 2. The last record of work done in block 2 was in 2064 BS when reshaping of the canal was done. On the other hand, collection of irrigation service fee (ISF) is not satisfactory. There was a record of ISF collection for 2064 BS and 2068/069 BS. In 2068/069 BS, the amount of NRs. 2,78,000.00 was collected which is about 44%of total ISF that they could collect from the whole command area. In 2064BS, they have collected NRs 61,000. WUA coordination committee is not able to maintain ISF collection.

5.2 physical sub systems - performance features

The MSC of block 2 of NIS is fed by NEC through head regulators with the help of gates. Since the NIS has launched the massive rehabilitation program which will carry out rehabilitation of many damaged structures and canal reshaping work. However the present status of the block 2 as seen in field is explained below.

The length of main secondary canal of block 2 is 10.65 km. Almost all part of the canal length is unlined, except the u/s and d/s of structures and few places in MSC 2 where the canal is lined. The structures in MSC 2 are in working condition but need some rehabilitation for proper functioning. The shape of the canal in u/s is so far not disturbed or damaged, however the d/s shape is totally deteriorated. The right bank in tail end is almost disappeared and has come to the level of field. Reshaping is needed in headreach and middle reach structures where the off-take structures lies. The outlet has to be regulated with gates. Most gates are damaged or stolen and the off-take remainedgateless causing inequitable water distribution. Only the frame of the outlet exists and the gate needs to be installed. More than 98% of tertiary canal in the system is gone. Only the off-takes for tertiary canal can be observed. Due to heavy siltation and insufficient water, 4 out of 6 branch secondary canals (BSC 1,2,3, and 6) are mal-functioned. They are not in operation from last 4/5 years.

5.3 Agricultural sub-system

Paddy and wheat are major crops in practice in summer and winter. Presently, the yield of the paddy varies from 5 to 6.5 ton per ha whereas this value for wheat is 1.5 to 2.5 ton per ha. The data for the Fiscal Year (FY) 2070/071 for block 2 shows that the average production was 5.118 ton per hectare which has a value of NRs. 102360 in market. In such case, the total benefit that the farmer received is

NRs. 65,594 per hectare (after deducting input cost). With the expectation of greater benefit, nowadays, interest on sugarcane is also increasing. The talk with farmers and agriculture officer from NIMD no 5 revealed that farmers can produces 90 tons of sugarcane in a hectares of land whose values in NRs is around 450,000 (with the rate NRs 500 per quintal). The traditional labor intensive system is gradually changing into mechanization system. Marketing system for the crops is found satisfactory and market is easily available at an interval of 1 – 2 km.

5.4 Institutional sub-system

After the promulgation of Irrigation Regulation 1989, farmers participation became mandatory at all levels of irrigation development, from the project identification; design and construction; to operation and maintenance of the completed system. Unlike other surface irrigation schemes, NIS block 2 have no strong WUAs in the pastto perform the irrigation management activities. Last year (2069 BS) an election for WUCC was made with the idea that the new WUCC will be able to handle the system setup properly. The organizational setup is generally designed in line with structural system of the canal and the rotational water supply principle. The canal of NIS block is divided in to three categories.

- Main Secondary canal
- Branch Secondary Canal
- Tertiary Canal

Vision: The management of each levels of the system is controlled by functionaries who are elected at the respective tier in the system. Meetings are held at each tier to direct the functionaries, resolve conflicts, discuss financial matters and adjust rules and operational policies.

5.5 Water Management sub- system

Water Delivery

The system has no major problem of water acquisition and water right because Nepal gets its water share from India as per the agreement. However water paucity is a major problem in NIS. For the supplementary of NEC, Tilawe barrage has been constructed. Another barrage in Jamuni River to irrigate the tail end of Rautahat district is in plan and may be implemented soon. There is a possibility of draining water from Sikta river to NEC to further support irrigation in block 2 especially in winter season.

During the water scarcity, the rotation practice has been developed by office and farmers. The NIS office make schedule to deliver the water as soon as it gets information from Indian side. Since the water has to travel long way in India, the Indian feeder canal to Nepal plays major role to receive the agreed amount of water.

The block 2 lies in head reach of NEC. So far, the office has regulated water to these blocks in spite of various technical difficulties. One of the major technical difficulties arose due to missing of regulating gates in various off-takes. Once the gate is established, calibration is needed in all gates so that it will be easier to farmers to understand the quantity of water they receive.

Operation and Maintenance

The operation of the system deals with the water allocation, distribution and their monitoring. The Indian authorities at the Barrage control water allocation in the main canal and its operation and supply of water is based on the Bilateral Agreement of the project. The main canal runs continuously throughout the year except when main canal head regulator is closed for head works repair.

Already made rotational irrigation schedules exist in NIS. For three days of a week, Block 1-6 of NIS get water (Phase I), while for rest of the days in a week water is left for Block 7-12 (phase II). Also the availability of the water and the water demand for crops indicate that the canal could be made rotational during the transplanting period to cover maximum demands for land preparation and transplantation of paddy. During winter season the canal must be operated in rotational or demand basis, because excess water might damage the crop itself. In case of NIS block 2, the only canal in operation is BSC 4 where $3/4^{th}$ of the water that flows to MSC 2 is drawn.

Regular and Emergency maintenance activities are necessary to run the system properly and in good functioning. This system has entered in operation and maintenance stage since 1994-95 and it is supposed to be followed the joint management strategy. However, due to the gap of information between government and farmers it has been realized that the system has been fully operated by government alone. NIS do not have sufficient fund to maintain its network annually. Every monsoon flood and deposition of silt in canal has reduced its efficiency causing deterioration in canal system.

The responsibility of tertiary maintenance lies with the tertiary canal committee. Farmers need to de-silt or clean the canal for its proper functioning. Due to no water flow in the majority of tertiary canal, there is a big question mark on the existence of tertiary canal. The adjoining landowners have already turned these sections into the part of their land.

6. Proposed Operation and maintenance plan after Management Transfer

6.1 Approximate water demand (seasonal)for existing cropping pattern.

The study had calculated crop water requirement for the whole command area assuming one cropping pattern suitable to the site condition. The study has found the maximum requirements at the head works are 1.50 litre/sec/ha in the summer season and 0.05 litre/sec /ha in the winter season. Even in spring season if the farmers cultivate other than the spring paddy crop, the available water is sufficient to cover all the area. It seems that the networks of the canal system are not well maintained according to their capacity, which does not allow them to cover the desired area. The existing cropping intensity is reported to be less than 200% however it can be increased beyond 200% in consultation with the farmers. The study team has observed that the operation of the gates in the system is not controlled with defined flow rates. Proper calibration of the gates with adequate supply for the crops with controlled mechanism could cover sufficient areas for irrigation. The proposed project IWRMP has planned to employ water management experts for resolving all its water distribution problems. The farmers would require on farm water management training and demonstration to teach them to apply just amount for optimum production. Water distribution methods as suitable also should be taught to the farmers for efficient use of available water. The existing cropping pattern is as follows:

Summer	Winter
Paddy	Wheat
Paddy	Oilseed
Paddy	Lentils
Paddy	Vegetables
Paddy	Others
	Sugarcane

6.2 Proposed vision and plan for improved canal operational plan

The availability of the water source at the river and the water demand for crops indicate that the canal could be made rotational during the transplanting period to cover maximum demands for land preparation and transplantation of paddy. During maintenance period of the paddy crop the system could be operated on continuous basis. Likewise during winter and the spring season canal must be operated in rotational or demand basis. It is recommended to introduce crop diversification, which certainly will boost up the income of the farmers. However, the market and other economic factors will always govern the end product. The consultant on the water management and on-farm crop water management will study and introduce new improved water management plan including operational practices.

6.3 Proposed Annul Maintenance Plan-vision of maintenance needs

In the present context of Management Transfer to WUA, the annual maintenance plan should be designed to be based on actual needs for the system. The present plan of system management transfer has been designed to transfer the secondary canal network of block 2 of NIS to WUA's.

Maintenance Plan for Secondary Canal Network

a) Main secondary Canal

The present condition of the main secondary canal is in poor state. About 30% sedimentation along its length and thick vegetation cover at the bed and sides at the middle and tail part of the canal. The canal should be brought into a designed shape and then regular maintenance works need to carry out annually to keep it in proper shape to convey desired flow of water. The regular maintenance required for main canal could be assessed as below:

- Regular greasing, painting and repair of the gates before summer irrigation and winter irrigation.

- Prior to the operation of the canal during summer the banks should be checked thoroughly to find any pot holes, weak parts where breaching might occur, and weak sections due to animal crossing. These should be listed and proper section of the canal should be maintained prior to release of the irrigation water.

- Need to inspect the cross drainage structures carefully to find possible erosion or retrogression possibility. Preventive measures might save a serious disaster of structural failures.

- Preventive measures should be taken at vulnerable spots.

b) Branch Secondary and Tertiary Canal System

Under regular maintenance these canals are easier to maintain as only earthworks and minor structural repairs works will suffice to keep them in proper shape. However, the farmers and the agencies are not serious about canal reshaping in block 2 of NIS, which thus results to poor performance and reduction of conveyance capacity. It is envisaged that once the secondary committees are made active and responsible for the operation and maintenance of their systems, they will carry out regular maintenance as required. Several types of its regular maintenance are as follows:

- Al least two times a year say from April to May, and October to November prior to the summer and winter irrigation the canal bank and bed must be cleaned or dressed. If sediments are deposited in large quantity, this has to be removed prior to operation.

- Similarly to the main secondary canal, the gates of the systems also required regularly maintenance with greasing, paintings, and repairing minor defects as replacement of worn out parts, nuts and bolts etc. Efficiency of the system can be achieved only with regular maintenance and strict vigilance during the canal operation. Vandalism, children playing, or other undesirable activities which has direct impact on canal network must be checked with penalty.

- Inspection of cross drainage structures is vital for its safety and prevention from major damage. The cross drainage structures especially should be inspected regularly during the rainy seasons, after events of every high intensity rain and its subsequent flooding. If the cases may be beyond

the capacity of the WUA, which should be reported to NIS assistance immediately

- Similarly the adjacent river training works also should be inspected regularly for its strengthening and repairs works to prevent from erosion.

7. Proposed financial plan for future O&M Program.

It is proposed to have a financial plan of WUA for the operation and maintenance of the system. The following items and activities should be considered to operate and maintain the system in a regular basis:

7.1 Administration and logistic requirement for new DOI and WUA's setup.

Assessment has been made to find the cost of the WUA expenditures in Annex-14. The estimate is presented below:

At Block Level

Office Assistant/Accountant 1 no for 1 year	@ Rs. 10000/month	= NRs, 120,000
Office Peon 1 no for 1 year	@ Rs. 5000/month	= NRs, 60,000
Logistic expenditures.	L.S.	= NRs. 40,000
Fuel for 1 motor cycle	200 lit per year@ Rs, 130/lit.	= NRs. 26,000
Maintenance of cycle	2 nos@ Rs. 1000/no	= NRs. 2,000
Sub-total		=NRs.248000

Total WUA office Operation Cost =NRs 248000/year = NRs 83/ha

7.2 Annul operational cost of run the Canal System,

WUA is responsible for this cost.

Secondary Canal System - NRs. 116,000

WUA ⟶ NRs 116000 – NRs. 39 per ha.

7.3 Annual Regular Maintenance Cost

Distributaries, Branch and Tertiary Canal: WUA is responsible for this cost

O & M cost of secondary canal = NRs 2288507.6

WUA ⟶ NRs 2288507.6 – NRs. 764 per ha.

7.4 Assessment for emergency and differed Maintenance requirements

The nature of emergency and deferred maintenance works depends on the extent of damage caused by natural calamity and mismanagement operation resulting extensive damage to the system. As such this fund and estimate is not possible at present condition. Calculateddiffered maintenance cost for NIS is about NRs 11.35millions. Conducting actual survey and assessing the required rehabilitation works the estimate should be carried out for realistic assessment. As the envisaged project does not have scope for such activities, it is the responsibility of DOI to carryout necessary works.

Table 6: Assessment of Annual O & M Cost for WUA

Organization	Activities	Total Cost of O & M in NRs.	Per Ha Cost in NRs.
WUA	a. Administrative Expenditure WUA	248000	83
	b. Operation Cost of Secondary and Tertiary Canal system	116000	39
	c. Regular Maintenance Cost of Secondary and Tertiary Canal System	2288507.6	764
	Total WUA	**2,652,507.6**	***886***

The Cost of de-silting of the secondary canal systems could be reduced, if the farmers contribute the maintenance works in kind. The cost scenario comes out to be as follows for WUA

De-silting Cost

Secondary canal: NRs 1389207.6

Cost per ha in Secondary canal: 1389207.6/2996 = NRs 463.69 = say NRs 467.0

The WUA will have to contribute in cash at least NRs 419 per hectare to meet the requirement of whole system excluding their contribution for de-silting.

***Table 7*: Proposed Annual Budget for WUA's**

WUA		Tentative Estimate
a. Administrative Budget	**-**	**NRs. 250,000**
b. Operation Cost for Secondary		
and Tertiary Canals	-	NRs. 120,000
c. Regular Maintenance	**-**	**NRs. 2,290,000**
Total WUA	**-**	**NRs. 2,660,000**

The above analysis in table 7 has indicated that at the present price value the total operation and maintenance requirement comes out to be NRs 886 per ha (about 4 to 5 percent of their total income), which is quite reasonable value. At the initial two to three years the WUAs should be persuaded to meet the O&M requirement of the secondary canal system, and then it could be phased out to increase their portion and decrease the DOI contribution. The proposed phase out planning could be arranged as follows:

Table 8: ***Proposed Phase out Budgeting Plan***

Year	Proposed Budget Provisions in NRs '000	Cost per ha. (NRs)
	WUA	
1	1200	400.53
2	1800	600.80
3	2500	834.45
4	2800	934.58

8. Resource /fund Management plan

8.1 Identified potential sources of incomes in WUA

The budget required for the regular operation and maintenance of the secondary and tertiary system will be managed by the WUAs with their own possible resources, remaining will be provided by the project as subsidy up to three years. The tasks of the deferred maintenance works might continue beyond the project period based on the government's allocation for the works. To meet these requirements of funds the WUAs must know how they will get the resources and how to manage it. Several sources of income could be recognized from the irrigation system as follows:

- Irrigation service fee as the main component for its sustainability.
- Transport charges levied for the use of the service road of the canals.
- Membership Fee
- Custom hiring of JCB and Dump truck during off period
- Penalty from the defaulters,
- Kind contribution by the beneficiaries,
- Subsidy from the government.

8.2 Irrigation Service fee

Among these resources the irrigation service fee and the kind contribution by the beneficiaries are the prime resources for the funding resources. Total cost for operation and maintenance of the secondary system has been estimated as Nrs886 per ha on the WUA's part. Excluding the desilting part of the activities other expenditures work out to be Nrs 419 per ha. However this desilting activity also is vital in running the system so proper recordings also have to be made for this works. The total man days spent for this activity should be recorded to evaluate the kind contribution of the beneficiaries. It is envisaged that the farmers will pay in cash for the service fee and in addition some kind contributions have to be made to meet the O&M requirements. So the WUA and WUGs of the system must be transparent and updated with the records of the each beneficiary with their contributions in cash as well as in kind. Reliability and authenticity of the WUA's and WUG's work performance will indicate the success and failure of the system turnover. The records must be updated with the financial as well as administrative records regarding the contribution of the farmer; it will convince the users on their organization. It is planned that the WUA will be able to recover full O&M requirements within three years period. Until such time the government will have to give subsidy to the organization for maintaining the required expenditure of O&M. Tentative estimate of the budget requirements and resource generation has been prepared for the block 2 of NIS system on the O&M part of the secondary and tertiary canal systems. Phase out planning of the budget requirements also has been done. The following table will depict the resource mobilization plan for the WUA in the operation and maintenance of the secondary and tertiary system; in addition the operation of the main canal structures also comes under its jurisdiction.

The subsidy to the WUA for running the systems will be phased out in three years. It is anticipated that the recovery will be made during the period with full control of the WUA. .

9. Asset Management Schedule

The total asset management of block 2 of NIS has been categorized in to five activities as: (i) Deferred Maintenance of the system, (ii) Auctioning the junk equipments, (iii) Procurement of the logistics and new equipments, (iv)Regular operation and Maintenance of the systems, and (v) Light Rehabilitation works for management transfer. The category wise cost requirements for these activities were calculated for five years terms on the basis of the available data from NIS. The deferred maintenance works for the secondary canals are the responsibility of the NIS/DOI to complete within the scheduled five years terms. The WUA and user farmers will carry out the deferred maintenance required for the tertiary canals. The details regarding the costs with categories are shown in the table 13, and their descriptions are elaborated in the subsequent para.

Table 9: ***Details of the Activities with their Costing and Responsibilities.***

Category	Transferred to WUA	Cost (NRs.)
A. Deferred Maintenance	MSC Reshaping	895950
	MSC Lining	200000
	MSC Structure	750000
	MSC Trunk road	600000
	BSC Lining	400000
	BSC Reshaping	597300
	BSC Trunk road	1500000
	BSC Structure	2965000
	SSC Reshaping	71676
	SSC structure	2375950
Total Amount		**10355876**
B. Light Maintenance Works	MSC Reshaping	923230
	MSC Structure	5673230
	MSC Trunk road	750000
	BSC Lining	375000
	BSC Reshaping	923230
	BSC Trunk road	2100000
	BSC Structure	11343230
	SSC Reshaping	161960.92
	SSC structure	1446960.92
Total Amount		**23696841.84**
C. Regular O & M	Secondary canal	2,001,207.60
	Tertiary Canal	651,300
Total Amount		**2,652,507.60**

Source: Calculated Amount, 2014

9.1 Deferred maintenance of the system-schedule of cost and responsibility

It is envisaged that the IWRMP/DOI will carry out the deferred maintenance works of the whole system except the tertiary canals such that functional and reliable infrastructures are built for smooth and efficient operation. The year wise planning for implementation with required funds are shown in the **table below**. The asset of NIS has been differentiated in to H/W, Border weir, main canal and main canal Reach A to E blocks. The priority for the secondary canals is made according to their existing

conditions of operational state, and the related tertiary canals are included under the same year of its implementation.

The related infrastructures selected for the deferred maintenance carried out in five years period are as shown in the table 15.

Table 10: Implementation Plan for Deferred Maintenance and Related Infrastructures

Year	Infrastructures planned	Remarks
1st	Secondray canals of each block as per need(coordination between Division office and WUAof concern block committee) Tertiary canal of each Block WUA Responsibility	Related Tertiary Canals
2nd	Secondray canals of each block as per need(cordination between Division office and WUAof concern block committee) Tertiary canal of each Block WUA Responsibility	Related Tertiary Canals
3rd	Secondray canals of each block as per need(cordination between Division office and WUAof concern block committee) Tertiary canal of each Block WUA Responsibility	Related Tertiary Canals
4th	Secondray canals of each block as per need(cordination between Division office and WUAof concern block committee) Tertiary canal of each Block WUA Responsibility	Related Tertiary Canals

9.2 Auctioning the junk equipments

There is no such segregated equipment for block 2 of NIS.

9.3 Procurement of the logistics and new equipments

The envisaged project concept includes the provision of logistic and equipment support to the WUA to deliver their services efficiently. The proposed provisions are as follows-

WUA Offices

Motor cycle	-	1 No. for WUA main committee office
Bicycles	-	2 No.

Heavy equipment	-	1 No, JCB
Dump Truck	-	1 No,
Computer with printer	-	1 set
Other logistics as required		

9.4 Regular operation and maintain of the system

These activities will be carried out on annual basis so each year they have to manage the works on a regular basis. A set of scheduling of the activities are to be planned matching with the crop calendar and the management of the resources for the works. The details of the activities are also described above.

9.5 Light rehabilitation works for management transfer.

This activity is envisaged to bring the system in to an operable and functional state. A detailed analysis has been done and the cost estimate is prepared.This activity will be performed within first two years of the implementation.

10. Recommendation

The mode of transfer of the management of block 2 of NIS has been planned to handover. The handover is basically only the block 2 of NIS and the secondary canal and its structureswill be retained with WUA for its maintenance. Hence, the Asset Management Plan has been prepared to focus on the responsibility of WUA only. The WUA's on their part will have to be active and strong enough to take care of the system operate and maintain it diligently to cover maximum area under irrigation. It is anticipated that the IWRMP Project will support and strengthen WUA to bring their capacity up to the required level. Trainings, orientation, dissemination of the information of the system management transfer should be conducted to create awareness to every farmer to demonstrate their ownership of the canals. Defaulters should be penalized to keep the system discipline intact. It is aimed to make the WUA organization as self governing, self regulating, and self financing sustainable institution. For this to achieve, the efforts from DOI has vital role for the success of the management transfer. Summarizing the recommendations for the successful management transfer, the following points could be made:

- Defining transferable and non-transferable items and infrastructures, the agreement should clearly state, the arrangements and responsibilities of the both parties.

- NIS must carry out intensive interaction and consultations with the WUA to disseminate the "Management Transfer" mode to the grass root level farmers, so that the representation from the user's will be wide spread;

- The farmers must be convinced that the contribution NRs 886/Ha from their income from irrigated land.

- It is proposed that the block committee should be made more responsive and made other branch and toil committee active to collect ISF. The enforcement of rules and water distribution schedule could be applied by this organization more efficiently;

- Technically the system is sound and well designed although, the maintenance fund input in the past few years was nil and the system has not been maintained properly. Proper utilization of the fund could be made by providing training to the WUA's and keep the expenses "transparent";

- The system has been operated with the mutual understanding with the WUA's and NIS office. The water distribution is not satisfactory. The water management plan could be applied during the implementation of the project. Water management expert should provide a simple workable and understandable water delivery schedule and plan for better irrigation management;

- In order to monitor the function of WUA's, it is recommended to form an ad hoc committee from the users and NIS as independent evaluators of the performances of WUA,s activities. This could be appointed annually from the general assembly meeting (independent user). The members of the committee must be independent and respected figures from the vicinity or the command area. They should not be affiliated with any political organization or groups, to give independent opinions.