MEKONG RIVER COMMISSION SECRITARIAT
CAMBODIA NATIONAL MEKONG COMMITTEE

IMPROVEMENT OF IRRIGATION EFFICIENCY ON PADDY FIELDS IN THE LOWER MEKONG BASIN PROJECT (IIEPF)

FINAL REPORT

Volume I

Main Report

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FIELD OBSERVATIONS AND DATA ANALYSIS FOR IMPROVEMENT OF IRRIGATION EFFICIENCY ON PADDY FIELDS AT KAMPING POUY IRRIGATION SYSTEM IN BATTAMBANG PROVINCE

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Abbreviations

ADB	: Asian Development Bank
BAPEP	: Battambang Agricultural Productivity Enhancement Project
CAE	: Command Area Efficiency
CASC	: Cambodian Agronomic Soil Classification
CE	: Conveyance Efficiency
CNMC	: Cambodia National Mekong Committee
CWR	: Crop Water Requirement
DoM	: Department of Meteorology
FAO	: Food and Agriculture Organization
FWUC	: Farmer Water User Community
GDP	: Gross Domestic Product
GPS	: Geographical Position System
GIS	: Geographical Information System
Eq	: Equation
Fig	: Figure
Ha	: Hectare
IIEPF	: Improvement of Irrigation Efficiency on the Paddy Fields
IMC	: Irrigation Management Company
IMT	: Irrigation Management Transfer
IWR	: Irrigation Water Requirement
JICA	: Japan International Cooperation Agency
MAFF	: Ministry of Agriculture, Forestry and Fishery
MCM	: Million Cubic Meter
MOWRAM	: Ministry of Water Resources and Meteorology
MRCS	: Mekong River Commission Secretariat
NPRS	: National Poverty Reduction Strategy
NSEDP	: National Socio-economic Development Plan
NGO	Non Government organisation
N1, N2, N3	: Secondary canal
O&M	: Operation and Management
OIs	: International organisation
PDRD	: Provincial Department of Rural Development
PDWRAM	: Provincial Department of Water Resources and Meteorology
PIMD	: Participatory Irrigation Management and Development
RCG	: Royal Government of Cambodia
RAP	: Rapid Appraisal Process
Q - H	: Flow rating curve (Flow discharge & Water level)
TOR	: Term of Reference
WB	: World Bank
WSF	: Water Service Fee
WUGs	: Water User Group

Final Report of the IIEPF

1. Summary of major findings

This project was funded by the Mekong River Commission under the Framework of Programme to analyze and evaluate water and ecosystem in Asia paddy fields. This Final Report has been prepared by study Team of the Ministry of Water Resources and Meteorology (MOWRAM), Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Provincial Department of Water Resources and Meteorology (PDWRAM) Team in Battambang province in collaboration with Cambodia National Mekong Committee (CNMC) in order to address about the Improvement of Irrigation Efficiency on Paddy Field in Battambang province, Cambodia. The task was conducted under the general guidance of the Mekong River Commission (MRC).

Water in Cambodia is used for agriculture, industry, hydropower, navigation, and tourism. The estimated total quantity used each year is 750 MCM/year, of which 95% (about 710 MCM/year) is used for irrigated agriculture. There is very little reliable information on the quantities used for other purposes. Groundwater potential for irrigation is an integral aspect of Cambodia's water balance, and provides a substantial natural storage of water that may be available to provide a year-round source of water. The cultivated area under wet and dry season crop production in 2003 was about 2.3 million hectares; and recently, cultivated area increases about 2.5 million hectares.

The wet and dry season paddy fields in Battambang province which locate in Northwest part of Cambodia face severe and growing challenges to the rapid growing demand for water resources. Improving the efficiency of irrigation is achieved by better matching application of water to crop needs in terms of both timing and quantity. Most of the available evidence in the region on water use efficiency is mainly based on experimental trials for mono-crop systems. Thus, it does not precisely reflect the complex production decisions at the farm level under different environmental, technological, and economic conditions. Information on on-farm water use efficiency is limited or is not available at all in Cambodia.

To address the irrigated agriculture issues, the Royal Government of Cambodia has the following strategies and policies:

1- To provide farmers with the quantity of water they need, when and where they need, at a cost that they can afford.

2- To provide farmers with: the quantity of water within the limit of available water resources, technology on O&M, and financial resources for investment;

3- To promote, where justifiable on economic or social grounds, the rehabilitation and construction of irrigation, drainage, and flood management infrastructure, in order to provide sufficient water for agricultural production and to alleviate the adverse consequences of excess water.

4- To promote the development and extension of water management technologies that are particularly suited to rain-fed agricultural areas, such as water harvesting, improvements to the moisture-holding capacities of soils, use of farm ponds, and sustainable extraction from groundwater.

5- To strengthen and expand Farmer Water User Communities, to enable them to participate in water management and allocation and to maintain irrigation infrastructure with effectiveness and sustainability.

The main objective of this study is to assess on-farm water use efficiency under rice crop by using irrigation system conditions. For the purpose of this study, water use efficiency is defined as the ratio of the required amount of water used to the amount of water used by the plant. A methodology for the assessment of on-farm water use efficiency is presented within the framework of mono-crop production system (only rice).

This Final report covers the results of field data collection and observation on farm water use efficiency in the rice paddy fields such as: Evaporation, Evapo-Transpiration, Percolation, rainfall, flow measurement, crop productivity etc.

The field data collection and observation on farm is considered very useful for improvement of irrigation efficiency on paddy fields in the Cambodia as it provides a good data and information to create the planning in management and operation of irrigation system.

The Final report consists of three volumes:

Volume 1: Main Report
Volume 2: Raw Data in Dry Season
Volume 3: Raw Data in Wet Season

1.1 Results from field observation and analysis

According to the Terms of References (TOR), Ministry of Water Resources and Meteorology (MOWRAM) and PDWRAM conducted the field data collection and observation on the water use efficiency under rice cropping by using gravity irrigation system from the reservoir conditions. Some results of data collection and observation found from the research were described as follow:

- Rice is the most important crop in the project area during wet and dry season in Battambang Province,
- 100% of cultivated Paddy field in the pilot site has relied on rice growing only. In dry season, it was started from February and harvested in June; and in wet season, it was started from June and harvested in December with the average productivity yield of about 3 tones per hectare,
- Farmers have continued to grow the traditional long season varieties during the wet season(150 days), harvested at the end of December or in early January;
- In the dry season, farmers who receive water can grow second crop which medium variety is used and grown immediately after the harvest of the wet season crop. The production of medium variety is harvested in April and early May;
- The irrigated water supply to the rice crop is used from the reservoir by gravity through intake which has10 gates structure,
- Catchment area of Kamping Pouy reservoir A = 347 km², and water storage volume W = 110,000,000m³,

  - The length of main earth dam is about 6.5Km with the height varies from 3 to 6m and width varies from 6 to 15m. It has two main intakes:

    1-Fist intake- The right main canal intake with the 10 gates structure and with total irrigated area of about 10,500ha; This intake is the most important structure for providing water to the rice paddy fields in the downstream of the reservoir and

    2-Second intake– The left main canal intake consists of 8 gates structure. Recently, this intake has not been rehabilitated yet (No function).The total irrigated area is about 3000ha,

- The length of second earth dam is about 7.5Km with the height varies from 2 to 4m and width varies from 3 to 5m. It has 4 outlet structures to supply water for a few of paddy fields in the south of the reservoir,
- One main canal with the length is 9 km and the bottom b =5m,
- Three secondary canal N1, N2 and N3 which the total length of them is 27 km,
- Total actual irrigated area which was conducted in the period of study in the dry season is 1452.5 ha and in the wet season is 2,518.37ha,
- In this year, the Kamping Pouy irrigation systems receive more water than previous year cause by the heavy rainfall. The amount of rainfall from February to December 2007 was estimated around 1336 mm,
- The average of crop water requirement: Dry 6.88 mm/day, Wet 5.11 mm/day,
- The average of percolation: Dry 2.62 mm/day; Wet 1.72 mm/day,
- The land preparation : 5.6 mm/day,
- The irrigation water requirement :Dry 11098 m^3/ha , Wet 1197 m^3/ha
- The total scheme water requirement: Dry 16.12 MCM ; Wet 30.15 MCM
- The volume of water diverted to the system: Dry 23.50 MCM; Wet 29.59 MCM,
- The volume of water delivered to the field : Dry 13.85 MCM; Wet 14.61 MCM,
- Conveyance efficiency: Dry 72.54% ; Wet 84.15 %,
- Overall project command area efficiency: Dry 72.38% ; Wet 86.28%,
- The average yield: Dry 0.371Kg/m^2; Wet 0.33 Kg/m^2,
- The water productivities: Dry 0.023 kg/m^3; Wet 0.28Kg/m^3,
- The unit price of rice per tone: 210$/T,
- The total price of rice in Dry season 1,133,167.87$ and in Wet season 1,781,192.73$.

1.2 Issues raising during field observation works

During the field observation in the Kamping Pouy Irrigation system in the dry and wet season, there were some issues occurred as follows:

- The period of rice cultivation in the Kamping Pouy irrigation scheme was not on the same time. For better condition of cultivation and for the study, it should be grown on the same time in the scheme. But this suggestion might not be accepted by farmers because they have different of interest in deciding the cultivated period due to their own times and activities,
- In the dry season, there are too heavy rain if compare to the previous dry season,
- The main road that reaches to the irrigation scheme faces some difficulties such as big hole caused by a lot of rain in this year,
- The farmers does not strongly participate to work and answer all the questions that is given by the study team, because they think that it is no useful and no benefit to them,
- The farmers does not strongly consider in monitoring or controlling water in their paddy field as well as in the scheme,
- Recorded irrigation period and field water level, Evapo-Transpiration, percolation data at 6 stations are not achieved high accuracy as expected; sometimes mistakes occurred due to unexpected condition such as heavy rainfall which make water level in the paddy field higher than the top of the Tank and flow into the Tank,
- Seepage from the siphon to the paddy field,
- Some canals have little flow caused by the slope of the canal very small. Therefore, the flow measurement is not well accurate.

1.3 Recommendations for field work improvement

Based on the field experience and some activities, which were conducted in the study in wet and dry season, we recommend and propose for the improvement of the project for the future are as follow:

- The current meter needs to be controlled for its accuracy before measurement;
- The monitoring and collecting all data from the 6 selected pilot sites need to be improved,
- Encourage farmer participation in the field data collection by proving some interest or other incentive such as money....,
- Before collecting field data, the study team should provide some basic training activities to the farmer or key persons such as the procedures and guidelines of format recording , reading the scale which is putting into the tank, using of current meter etc...,
- All evapo-transpiration apparatus should be installed higher than water level at least 20cm above the maximum water level in the paddy field; and the place to put equipment should be made smoothly,
- Wooden bridge that use to measure velocity and collect data should be strengthen,
- The period of growing rice should be on the same time,
- More rain gauge stations should be added,
- Based on the above research, we propose and request that the MRC should add one more year research in order to have more data for analysis and fill some gaps that we face in this study.

1.4 Conclusions

It is not expected that the data from the field observation is perfect. Many troubles happened when we took the data such as crab broke the levee or dike is made a hole, water overflow into the tank, there are too much rain etc... Therefore, in the process of calculation, we cancel some data or we do not take it.

These values are significantly for making the distribution plan and could not be said it is good or bad, because no old data or other standard to be compared with. But from the other standard in the region the value has been varies from 10000m^3/ha to 15000m^3/ha. Therefore we assume that this value could be reasonable for this area. From this research, we learnt and received a lot of data and experience of how to conduct water use efficiency for irrigation and also for the operation and management of irrigation system.

Kamping Pouy is the best scheme in Cambodia, but the overall command area efficiency received only 72.38% in dry and wet 86.28%. This value is not yet reach to height efficiency for irrigation system. So that for the other irrigation schemes in Cambodia we thing that the efficiency could be less than this because of these schemes were not completed (Insufficient infrastructures). Therefore we need to improve infrastructure including water management in the scheme.

In the future, the government of Cambodia (Ministry of Water Resources and Meteorology) must strongly continue this research from MRC and take the consideration on the collection of data and information related to the water use in the irrigation systems because it is very useful for irrigation water use efficiency, preparing water use planning, and also for operation and maintenance of irrigation system.

2. Background

2.1 General information of irrigation in Cambodia

Cambodia is bordered by Thailand in the West and by Lao and Thailand in the North, by Viet Nam in the East, by the gulf of Thailand in the South. The total land area is 181,035Km², consisting of 24 provinces, including 4 municipalities and 172 districts. The total population is about 14.6 million people in 2006, with the growing rate 2.4% and the density of 66 people per Km². The GDP rate is 292$; this is considered as one of the lowest in the world.

Cambodia is amongst the poorest of the South East Asian countries, and this poverty is overwhelmingly rural. Rural households where agriculture is the primary source of income, account for almost 90 percent of Cambodia's poor. Options for rural employment outside of the agricultural sector are very limited. Although agriculture accounts for 40 percent of GDP, the growing rate is slow as 2.4 percent/year on average (and with high variability) over 1996-2001; improved agricultural productivity and greater diversification of income sources have been identified at the core of strategies to raising rural incomes.

Rural issues feature prominently in the second National Socio-economic Development Plan 2001-2005 (NSEDP 2001-2005) and the National Poverty Reduction Strategy (NPRS 2001-2005), particularly in regard to improve small farmers productivity and market access. These documents identify the most important contributors to low rural incomes. In Cambodia as low agricultural productivity, inadequate rural infrastructure, poor marketing and distribution systems, inadequate access to credit and land, and lack of alternative income generating activities. In effect, this scenario provides the broad scope for any intervention by the government in the agriculture/irrigation sector.

The Government's Rectangular Strategy has emphasized establishment of an appropriate macro-economic environment, land tenure regime, community resource management through greater 'decentralization and deconcentration', and investments in irrigation and agricultural support services (research and extension, input markets development, market information and infrastructure, rural finance, etc.) to allow for the diversification of agricultural production into higher value products (industrial crops, livestock, fisheries, niche products, etc) and, more broadly, the diversification of the rural economy. While the NSEDP II and NPRS emphasize a strong focus on small farmer holdings, the RGC has also continued to promote large concessions to private sector agricultural operations and thereby establish a 'mix' of farming operations that RCG sees as important in spreading skills and encouraging crop diversification and marketing issues.

Cambodia is an agricultural country in which 85% of the population consists of farmers. After establishment of MOWRAM in 1998 irrigated area was only 18% (407,000 ha) of total cultivated area (2,253,000 ha) and in 2004-2005 irrigated area was increased more reach to 25% (594,000 ha) of total cultivated area. By year 2010 the RCG has planned continue to increase irrigated rice area to 35% (773,320 ha) of total cultivated area and at the same time increase the total rice production to 5 million metric tons with an average yield of about 2.5t/ha. Approximately 82% of the total cultivated area is fully dependent on rainfall, but given the temporal variability of rainfall patterns crop production is often threatened by drought almost every year, so that the production of supplementary crops is not possible. If it may be said that Cambodia has attained food self-sufficiency, food security is still a goal to be achieved. Irrigation plays a key role in the efforts to achieve this goal, which is part of the overall national goal of poverty reduction through socio-economic development. Given the high irrigation potential, there is ample scope for irrigation rehabilitation and for the development of irrigation in short, medium and long term.

In Cambodia, rainfall is concentrated in the wet season, often disrupted by a 2 - 3 week dry spell and inundation by floodwaters from the Mekong River and its tributaries. Rice cultivation techniques are directly related to the flood regimes of rivers, being classified into five types: (1) rainfed lowland rice, (2) rainfed upland rice, (3) floating rice, (4) dry season rice on the receding water table with supplemental irrigation (recession rice), and (5) supplementary irrigated dry season rice. While the areas of floating rice are declining, the areas of recession rice are increasing in the major flood plains.

2.1.1 Policies and strategies of irrigation development and water use

The irrigated agricultural policy of the Cambodian Government ***is to improve agricultural productivity and water management, thereby enabling the agricultural and water sector to serve as dynamic driving force for economic growth and poverty reduction***. The Government of Cambodia will invest substantial domestic resources to promote irrigated agriculture to bolster economic growth, create employment and generate income in the rural areas, and ensure nutritional improvement, food security and expansion of agricultural exports.

The Government will create a favorable environment conduciveness to private sector participation in the irrigated agricultural sector by accelerating the land distribution and the insurance of security land titles within social land concession framework, particularly in the rural area. The government improves water resources management and irrigation facilities by construction or rehabilitation the existing irrigation systems, establish and strengthen of farmer water user communities in order to reduce some responsibility in the operation and maintenance of irrigation infrastructures such as repair the water gate, repair the secondary or tertiary canal.

To address the irrigated agriculture issues, the Royal Government of Cambodia has the following strategies and policies:

1- To provide farmers with the quantity of water they need, when and where they need its at a cost they and the wider community can afford, and within the limits of available water resources, technology, and financial resources for investment,

2- To promote, where justifiable on economic or social grounds, the rehabilitation and construction of irrigation, drainage, and flood management infrastructure, in order to provide sufficient water for agricultural production and to alleviate the adverse consequences of excess water.

3- To promote the development and extension of water management technologies that are particularly suited to rain-fed agricultural areas, such as water harvesting, improvements to the moisture-holding capacities of soils, use of farm ponds, and sustainable extraction from groundwater.

4- To strengthen and expand Farmer Water User Communities, to enable them to participate in water management and allocation and to maintain irrigation infrastructure with effectiveness and sustainability.

In June 2000, MOWRAM issued the Policy for Sustainability of Operation and Maintenance of Irrigation Systems. The policy elaborates the new Participatory Irrigation Management and Development (PIMD) policy and states that its objectives are:

1- To ensure effective and sustainable management of irrigation systems,
2- To promote food security and growth of the national economy,
3- To increase the role of farmers and decrease the role of government in the management and development of irrigation systems,
4- To build capacity of the FWUC to management irrigation systems,
5- To promote awareness among farmers about the policy and facilitate the management transfer process,
6- To encourage international financing agencies to support participatory irrigation development,
7- To bring about uniformity and consistency among donors, government agencies and NGO's in the strategy for irrigation development and management.

This policy statement stresses that future development, rehabilitation or support services will be done on the basis of requests from and agreement with farmers. It prescribes a five-year period where the government phases out its funding for O&M and others repair, the farmers should contribute the fund for the above mention, as the FWUC takes over. The policy also describes the structure and functions of the FWUC and Water Users Group (WUG). WUG are the basis for calculating the irrigation water service fee; and the responsibility of government is to provide training and extension, monitoring and evaluation, environmental assessment and agency human resource development. The policy statement also includes an example form to use for water users to apply for membership in the FWUC. Also in June 2000, MOWRAM issued a brief document that explains eight steps for organizing and establishing an FWUC. It is entitled, Steps in the Formation of a Farmer Water Users Community.

At present, the sustainable irrigation management and development policy is already adopted by the government and authorized to the MOWRAM for implementation. Results so far suggest that the farmers in the flooded area which tend to be more fertile are easier to organize and more willing to participate in the project operation and maintenance. Particularly, in the pumped irrigation scheme, the farmers can pay high fee to the FWUC. The water service fee charges, which the farmers pay for using of water in Cambodia is different from one to the other scheme, 250 to 450Kg/ha for pumping system and 30 to 50 Kg/ha for the gravity system. But in the poor soil areas and for poor farmers, the government continues to assume responsibility for operation and maintenance of irrigation system, providing fuel for running the pumps and assuming responsibility for their repair.

The Participatory Irrigation Management and Development (PIMD) program is being established in Cambodia in recognition of the need for community participation and ownership of irrigation schemes in order to achieve operational sustainability. The purpose for establishing PIMD is the Government’s irrigation transfer (IMT) policy, and associated policies related to the formation of FWUC in all new or rehabilitated irrigation schemes.

The PIMD program was initiated when MOWRAM issued Decision 306 in June 2000. This gave the framework for IMT and the formation of FWUC. The Decision included several important documents related to FWUC policies and guidelines for implementation.

- Circular N0 -1 on the implementation Policy for Sustainable Irrigation system
- Policy for sustainable operation and maintenance of Irrigation systems
- Steps in the formation of a farmer water user community.

The Establishment of PIMD is a long-term objective in the general development and rehabilitation of irrigation projects in Cambodia.

“Participatory Irrigation Management and Development” means the structure and process whereby irrigation systems change to be governed by the water users associations (or communities). This means that water users will have the authority to collectively define what irrigation services they will receive, who will provide them and at what cost.

The principle of water service fee (WSF):

WSF = (X1 + X2 + X3 + X4 + X5) / Irrigation service area (ha) + 20% of the increasing rate of output per hectare in irrigation service area

Where:

X1 = Repair and Maintenance of the Irrigation System
X2 = Fuel (in case of pumping)
X3 = Support to the committee of FWUC
X4 = Administration
X5 = Miscellaneous

The collected budget shall be managed as follows:

- The communities must directly keep and manage the funds;
- Prepare accounting records;
- The expense must be on the right targets, invoiced and agreed by all members of the FWUC;
- Large amount of budgets shall be deposited in the closest bank;
- All expenses shall be inspected by the Provincial Department of Water Resources and Meteorology (PDWRAM);
- Summarize the income-expense records at the end of the season and accordingly report to FWUC and the PDWRAM.

- In the first of five years, the government takes responsibility 80% of the O&M budget and FWUC contribute budget 20% to reach 100%.
- In the second of five years, the government takes responsibility 60% of the O&M budget and FWUC contribute budget 40% to reach 100%,
- In the third of five years, the government takes responsibility 40% of the O&M budget and FWUC contribute budget 60% to reach 100%,
- In the fourth of five years, the government takes responsibility 20% of the O&M budget and FWUC contribute budget 80% to reach 100%,
- In the fifth of five year, the government no longer takes responsibility of the O&M budget and FWUC takes responsibility 100% of the O&M budget by themselves.

The contribution of O&M budget of FWUC in irrigation water management has three effects which shown as follows:

The first is the active input effect. After the FWUC is established, the water users have a sense of ownership in the water projects. Therefore, they actively invest in, maintain and manage the projects.

The second is the self-management effect. According to the roles formulated by the FWUC, the water users are managed by the role and are restrained by law. As a result, the order in irrigation has been conspicuously improved.

The third is the market effect. The community is the basic water unit. The relationship between it and the water administrative unit is that between buyer and seller. Under market rules, they cooperate with and restrain each other, which have produced excellent results in both improving the quality of irrigation and promoting returns of water expenditures.

In the Third mandate of the Royal Government of Cambodia, The Ministry of Water Resource and Meteorology have a special Rectangular Strategy for Water resources management and development in order to contribute and alleviate the poverty reduction and increase the living standard of the people, who are in the rural area as follow:

- Rehabilitate and maintain existing irrigation systems;
- Install the small, medium and large size of pumping stations;
- Construct the reservoirs and wells in areas far from surface water sources and where gravity irrigation systems cannot be reached;
- Organize irrigation programs and water-use communities in order to manage water effectively;
- Arrange means for emergency relief during drought and floods;
- Expansion of irrigation systems; and
- Train the FWUC and Farmers on operation and maintenance of irrigation systems

2.1.2 Classification and general statistic of Irrigation system

In Cambodia, most of irrigation systems are not fully completed systems. It means that some irrigation schemes have only headwork or main canal or secondary canal and some reservoirs (with damage outlet structures) and cannot guarantee the water volume during the cultivation period. In this fact, the information related to Water use including all scale of irrigation schemes was not yet formulated. Cambodian irrigation management is classified on three scales - small, medium and large -, in three major agro-ecological areas - flooded, lowland and highland. The government defines the scale of irrigation systems in terms of the command area. Irrigation schemes having a command area of up to 200 hectares are considered small, a command area of 200 hectares to 5000 hectares is medium, and above 5000 hectares is large. The Ministry of Water Resources and Meteorology (MOWRAM) inventory shows a total of 2403 irrigation systems, of which 1415 are small, 955 are medium and 33 are large scale (see annex 19). Types of Irrigation system in Cambodia was divided as follow:

gravity,
mobile pumping,
traditional lifting,
pumping station,
traditional lifting plus gravity,
gravity plus mobile pumping.

There is, however, very little double cropping, and most irrigation is only a supplement to rainfall, because many irrigation systems are not operational due to a lack of maintenance. Most operational irrigation systems fed by surface water are shallow reservoirs and small diversions; groundwater is not yet widely used for irrigation.

A. Small Scale Irrigation System: when paddy field < 200 Ha

- The system is managed by District Office of Irrigation,
- Where the system is located between two or more districts, it is managed by Provincial Department of Water resources and Meteorology (PDWRAM),
- The system is operated and maintained by the beneficiaries, with technical supervision from the PDWRAM.

B. Medium Scale Irrigation System: paddy field from 200 - 5,000 Ha

- Where the system is located at inter-province between two or more provinces, it is managed by the MOWRAM,
- The system is maintained by PDWRAM in cooperation with the beneficiaries and MOWRAM.

C. Large Scale Irrigation System: paddy field > 5,000 Ha

- The system is implemented and maintained by MOWRAM in consultation with the concerned ministries.

In 2006, JICA updated and developed Irrigation inventory by using Arc GIS 9.0 format and classified by river basins; and irrigated areas were classify by three categories: First category- the area between 10 - 100 Ha, Second category 100 – 5000 Ha and the third category- the area more than 5000 Ha. However, with reference to the circular No. 04, the classification of Irrigation System is classified based on the size of paddy field (Ha); and it is described as mentioned in the above. The JICA irrigation inventory survey was completed only in four river basins in the Northwest part of Cambodia (Boribo, Pursat, Dauntry and Battambang river basin) as a pilot; and the study will be continued to implement to the other river basins in the whole country later on. This data is available in MOWRAM headquarter.

According to the result of field survey by JICA in 2006, we observe that the functional status of all existing irrigation schemes is not the same condition. Some are fully functional and others are partly functional or not functional at all. In this report, we withdraw only irrigation schemes located in Battambang River Basin. Based on the result by JICA survey, in the Battambang River Basin, there are **87** irrigation systems stated in three stages (fully function, partly function and malfunction), that currently serve as complete and supplementary irrigation on ***existing areas of 21,951ha*** in which **21,194ha** in the wet season and **757ha** in the dry season; and the total ***potential areas of 43,494ha*** in which **41,882ha** in the wet season and **1,612ha** in the dry season.

The details of irrigation Inventory data collection of Battambang River Basin in Battambang province are given in the **table 2.1.2**

Table 2.1.2 Classification of Irrigation scheme by JICA 2006

River Basin	Classification Number of Irrigation System		
	10 Ha - 100 Ha	100 – 5,000 Ha	> 5,000 Ha
Battambang	66	20	1

No.	River Basin	Operational Status			Total	Existing Area (ha)			Potential Area (ha)		
		Fully func.	Partly func.	Mal func.		Wet	Dry	Total	Wet	Dry	Total
Less than 100ha											
1	Battambang	10	17	39	66	1,159	469	1,628	3,532	1077	4,609
Larger than 100ha											
1	Battambang	4	11	6	21	20,035	288	20,323	38,350	535	38,885
	Total	**14**	**28**	**45**	**87**	**21,194**	**757**	**21,951**	**41,882**	**1,612**	**43,494**

2.1.3 Present condition of irrigation in Cambodia

In Cambodia, all Irrigation Schemes have been overall responsible by Government through Ministry of Water Resources and Meteorology (MOWRAM). To ensure the sustainability of water resources & irrigation schemes, MOWRAM has been established and developed many water legislations such as: National Water Sector Profile, National Water Resources Policy, National Water Resources Strategy, Water Sector Road Map, Drafted Law on Water Resources Management and its Sub-degrees. Moreover, the Participatory Irrigation Management and Development (PIMD) has been adapting in Cambodia to empower to Farmer Water User Communities who are directly involved on water use.

The Ministry of Agriculture, Forestry and Fishery (MAFF) together with the Ministry of Water Resources and Meteorology (MOWRAM) has a target to increase rice production by 18% by the year 2005. This is to be achieved either by expansion of the cultivated area or increased yields, through better water control and intensification (more likely in the short term). The Ministry of Water Resources and Meteorology (MOWRAM) has a plan to increase the total irrigated area by 180,000 ha by 2005 (which are 36,000 ha/year). Current rates of expansion fall to meet the plan. The most likely means to promote agricultural growth in the short term can be achieved through minor repair or rehabilitation of irrigation infrastructure, improved water delivery and maintenance of irrigation schemes and extension of agricultural support services.

There is a general consensus in the Royal Government of Cambodia (RGC) and among donors in the agricultural sector that improved management, rehabilitation and modernization of existing schemes and construction of new irrigation schemes will be the most important factor for raising agricultural productivity in the future. It is expected that there will be an increase in yields and total production by 50% for the future need which will have to come from improved water management and water control in the existing irrigation schemes and irrigation expansion.

As new irrigation scheme development has a low economic internal rate of return (1-6 percent); the schemes, as large-scale schemes, have serious Operation & Maintenance (O&M) problems. The estimated potential of irrigated agriculture production is high for small-scale irrigation schemes with active community participation. Through FWUC, farmers are trained in more efficient application of water to crop and improve distribution of water on the irrigation scheme, in combination with agricultural technology packages, especially balanced fertilizer use.

Three major rice-cropping patterns are involved with irrigation:

Wet Season Lowland Rice with supplementary irrigation: Local stream or large rivers are dammed in order to divert water to the field when the rainfall fails. These areas would otherwise grow rainfed paddy. The area served by supplementary irrigation is constrained mainly by the lack of water in drought period. Yields are low (1.5 tons/ha), only slightly higher than yield on rainfed land. However, since this irrigation is spread out throughout the country, it represents the main type of irrigation in Cambodia.

Dry Season Lowland Rice with irrigation: Only a small fraction, about 12%, of the above irrigated land can be irrigated in the dry season because of the limited amount of water behind dams or from river flow. Without water, it would not be possible to grow a dry season crop in these areas. Paddy yield in reliably irrigated areas are higher (1.8-2.4 tones/ha) than under rainfed conditions as reduced risk of drought which encourages farmers to invest in inputs and because of higher solar radiations levels in the dry season.

Flood Recession Rice: This cropping pattern occurs close to the Tonle Sap – Bassac – Mekong system and relies on natural flooding of water to use in the field before land preparation. Rice is transplanted or broadcasted as the water recedes and then irrigated through the growing season using water held in small reservoir created by low dikes, and in canals. Yields are higher (2.0 – 2.2 tons/ha) than in rainfed areas for the same reasons as in the dry season.

Other systems are mainly:

- Polder improvement such as in Prey Noup, which are protected against salted sea water and benefit from supplementary irrigation,
- Colmatage System in which water fill up in the low land area and swam area (along the Bassac and Lower Mekong river)

In the past, the management of the irrigation system was the responsibility of the government at provincial level. However, due to a very tight budgetary situation, the government will no longer be able to fulfill this role. Plans are underway, which include a transfer of management responsibility for irrigation systems to farmer water user communities and groups. For new role, what farmers are expected to take on is to participate more actively in the operation and maintenance of the hydraulic infrastructure.

Creation of strong Farmer Water User Community (FWUC) to take over irrigation system management can facilitate better water control, which can in turn facilitate crop diversification. As a result, more profitable irrigated agriculture can ensure financial viability of locally-managed irrigation. In 1999, the Government issued the Circular No. 01 on Implementation Policy for Sustainable Irrigation Systems, which was signed by the Prime Minister. The main objectives of the establishing FWUC in Cambodia are to:

- increase cropping areas to improve food security in rural area;
- develop maintenance technique and attitudes to ensure the long-term sustainability of project structure;
- increase irrigation efficiency and the availability of water for irrigation;
- reduce the dependency of farmers on Government funds and staff for O&M;
- attract support from international agencies and/or non-government organizations to assist in further improvement to the projects;
- upgrade the capacity of the farmer water user community on ownership development and upgrading future irrigation management on transfer to farmer;
- monitor and evaluate all sub-projects throughout Cambodia to insure consistencies and improving efficiencies in water supplies;
- develop a national standard for the farmer water user community statute;
- improve project design to achieve optimum use of water for irrigation

2.1.4 Issues related to irrigation water use

The major issues related to irrigation water use are summarized as the following:

(i) Deteriorated irrigation and drainage facilities

Present irrigation and drainage facilities have deteriorated due to insufficient maintenance works during the civil war. At present condition with lacking of infrastructures and financial support in this sector, some irrigation systems are introduced many kinds of methodology to use such as: by gravity, propeller pump, mobile pump, pumping system and many kinds of traditional lifting (water scope, water wheel etc.). Rehabilitation of deteriorated facilities is the urgent need to boost the land productivity.

(ii) Uncontrolled water resources

Although water resources such as rainfall and river runoff are abundant, they fluctuate seasonally and annually. Low-lying paddy fields suffer from heavy inundation in the wet season and water shortage in the dry season. Almost all of agricultural lands are under the rain-fed field can not receive irrigation water, due to lack of water storage and control facilities. It is urgently required in the non-irrigated areas to accelerate water resources development to store excess water, to mitigate flooding and to provide irrigation water.

(iii) Lack of farmer organization

Insufficient management of irrigation facilities limits extension of irrigated land through proper water management. Although farmer's groups for effective agricultural activities such as operation and maintenance of irrigation facilities are trying to be organized, some technical and financial supports are needed.

(iv) Insufficient institutional capacity

Lack of financial and technical support restricts the development of irrigation project. Planning and design of the existing irrigation facilities constructed during the Pol Pot regime is poor and easy to be damaged. For rehabilitation works of their facilities, technical level of government staff in planning and design should be upgraded.

(v) Water distribution and sharing

Rule and guideline to distribute and share water in the irrigation system are limited. In general, Farmers usually use free water from the irrigation system. Therefore, they sometimes face the conflict in the competition to use water, particularly in the dry season (Upper stream and downstream along the irrigated canal.)

(VI) Inadequate financing for Rehabilitation, operation and management

Recently, Cambodia is facing the shortage of budget for rehabilitation of irrigation facilities as well as budget for operation and maintenance. So far, most of the budgets are received from the donors such as ADB, JAPAN, WB, KOREA, INDIA…etc These budgets are not sufficient for the development in this sector.

2.2 General information of IIEPF project

2.2.1 Objectives, targets of the field work under IIEPF

A- Main Objective

“ Field Observation and Data Analysis for Irrigation Efficiency on IIEPF ”

B- Target and activities of the field work

I. Preparation for data collection

(1) Identify appropriate pilot project site (irrigation scheme
(2) Prepare schematic plan of irrigation system
(3) Prepare scaled command area map of the irrigation scheme.

II. Assessment of water balance and irrigation efficiency

(4) Inflow and outflow measurements:
(5) Obtain rainfall and climate data:
(6) Calculate ETo and Kc
(7) Calculate ETc:
(8) Identify actual irrigated area:
(9) Record cropping pattern and crop calendar:
(10) Record multiple uses of irrigation water:
(11) Record water level changed in paddy field:
(12) Calculate total scheme water requirement:
(13) Conduct conveyance lost test and calculation of conveyance efficacy :
(14) Produce rated canal section curves (H-Q curves):
(15) Calculate overall command area efficiency:

III. Assessment of water productivity

(16) Obtain yield of paddy:
(17) Calculate crop water productivity:

VI. Scheme management appraisal

(18) Identify stakeholders for decision making on water distribution:
(19) Draw organizational charts of stakeholders:
(20) and (21) Record water allocation rules and practice:

V. RAPs

C- Expected Output

1- Assessment of irrigation efficiencies of the selected irrigation schemes
2-Scheme management appraisal
3-Scheme appraisal by Rapid Appraisal Process

D- Implementing Agency

The implementation agencies comprise of: Ministry of Water Resource and Meteorology (MOWRAM); Ministry of Agriculture, Forestry and Fishery (MAFF); Cambodian National Mekong Committee (CNMC); and Provincial Department of Water Resorces and Meteorology(PDWRAM).

The implementing/working team members comprise of:

1)	**Dr. Theng Tara**	(Team leader, MOWRAM)
2)	**Mr. Thach Sovanna**	(Report assistance, MOWRAM)
3)	**Mr. Meas Peov**	(Field assistance, MAFF)
4)	**Mr. Sao Sam Phors**	(Field assistance, MOWRAM)
5)	**Mr. Hong Kim San**	(Field work, Battambang PDWRAM)
6)	**Mr. Sok Khom**	(Facilitator, CNMC)

2.2.2 Background of the pilot project

The Kamping Pouy Irrigation scheme is geographically located in Banan district, about 25 km west of Battambang city, inside the Stung Mongkol Borei River Basin, in the mountainous area of Kamping Pouy, Phnom Ta Ngaen and Ta Kraim. The distance by road between Phnom Penh and Battambang Province is approximately 300km, which takes 5 hours through Route National Road No.5; and from Battambang town to the site is around 32 Km, take about 30 minutes by car. The region where the irrigation scheme is located, called Battambang Plain, is one of the most fertile areas around the Tonle Sap Great Lake, Northwest of Cambodia (See Annex 1).

Kamping Puoy irrigation scheme is one gravity type of irrigation system in Cambodia. The history of this irrigation scheme can be traced back in the Khmer Rouge Period during Pol Pot era in 1970- 1975. According to the information from Battambang PDWRAM, Kamping Pouy scheme has two main dams. First main dam has the length about 6,5 Km with dike top elevation is El. 24.0 to 26.5m; and second main dam has the length around 7,5km with dike top elevation is El. 23.0 to 24m. The facilities and dam body have leakage portion around the place where original stream flew. Water is stored in the reservoir during the wet season, flowing from it upper catchment; and it will be used for supplement irrigation in wet season and dry season in the downstream is completely by gravity. The normal reservoir capacity storage is approximately 90 millions m^3 in 1999 (recorded from Battambang PDWRAM).

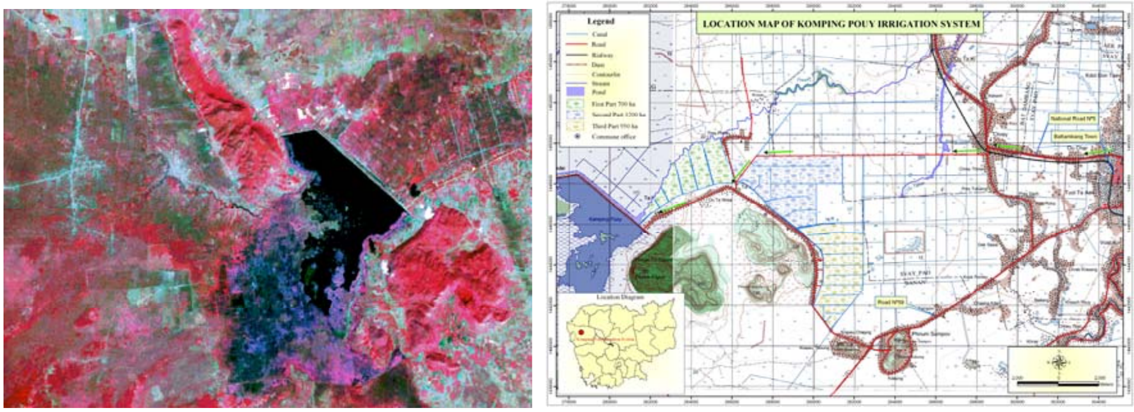
As PPTA, Northwest Irrigation Sector Project, conducted by ADB, it is planned to rehabilitate and construct link channel with the length about 25Km, connecting from Mongkol Borei River to the Kamping Pouy reservoir, in order to fulfill water in the reservoir and to ensure supplemental irrigation water in the irrigated areas. Therefore, Based on the ADB PPTA Northwest Irrigation Sector Project Battambang PDWRAM was requested financial budget to the Government of Cambodia for construction and finally was approved and has been completed construct in 2006.

The full reservoir water level is set to be 23.8m as same as original dam design. In this regard, dam height should be strengthened and upgraded to keep active storage. The top of first dam was rehabilitated by the Battambang PDRD under the assistance of World Bank in

2002 as part of rural road rehabilitation project since the top dam is being used as the main rural road in the region. However, upgrading wasn't enough so that the dam strengthening measures shall be strongly proposed as mentioned above.

With Vietnamese technical assistance from 1986 to 1988 Kamping Pouy irrigation scheme was partially rehabilitated. In middle 1990s, Technical Assistance, comprising rehabilitation of main, secondary and tertiary systems, training FWUC for water management, farming techniques, establishing micro-credit and etc., to develop 1,900 ha was implemented by the grant assistance of Italy Government. The assistance was successfully completed in November 2002; and second phase of the assistance is expected to implement from 2003 to 2005. On the other hand, from 1998 to 2002, actually to be completed by March 2003, 958 ha, in total, of the area were well rehabilitated and upgraded by the Grass Root Assistance, the assistance program of Government of Japan.

Recently FAO has been agreed to provide financial budget (Grant) around more than one million US dollars in order to continue the rehabilitation of infrastructures work and also support the capacity building on farmer water user community.
The dikes and intakes were repeatedly damaged by floods in the past and are heavily deteriorated at present. Considering the importance of the Project, the Government, through MOWRAM, rehabilitated the dike and main intake. However, the rehabilitation of the existing intake and the existing irrigation canals system are still needed in order to enable the Kamping Pouy irrigation system to function properly. In particular, the rehabilitation of the existing facilities is urgently required to protect the dikes from floods and also to keep minimum irrigation water in the dry season.



Satellite Image and General Location Map of Kamping Pouy Scheme

Kamping Puoy Reservoir **10 gates structure (Downstream)**

Outline of Kamping Pouy irrigation scheme

Dam body

Kamping Puoy irrigation scheme has two main earth dams:

1- The length of main earth dam is about 6.5Km with the high varies from 3 to 6m and wide varies from 6 to 15m, It has two main intakes:

a) Fist- The right main canal intake with the 10 gate structures and with total irrigated area of about 10,500ha; This intake is the most important structure for providing water to the rice paddy fields in the downstream of the reservoir and

b) Second – The left main canal intake consists of 8 gates structure. Recently, this intake not yet been rehabilitate (No function) .The total irrigated area is about 3000ha,

2- The length of second earth dam is about 7.5Km with the high varies from 2 to 4m and wide varies from 3 to 5m; Its has 4 outlet structures to supply water for small of paddy fields in the south of the reservoir,

Connection road

There are connection roads in moderate condition between first dam and second dam. It was even passable for motorcycle during site reconnaissance. It might be, however, obstructed to pass in wet season because the embankment height as well as operation and maintenance activities are not enough. There are, on the one hand, land mines and UXO on some of the sections and those are being cleared by the Government and other donor agencies.

Irrigation Canal and Related Structures

The irrigation canal network consists of main canal, three secondary canals, tertiary canal and some quaternary canals. The list of canals and their command area is shown in Table 2.2.2.1. The canal construction was commenced from 1985 by the assistance of Vietnam. In 1990s, Italian and Japanese Government construct and rehabilitate main canal, N-1 and N-2. Only the upstream and the downstream of structures such as regulator or turnout on main and secondary canals are lined with concrete; however, all canals are basically earthen type of canal. Secondary canals are diverted from diversion facilities on main canal. And tertiary and quaternary canals are diverted from secondary canal from turnout. Tertiary and quaternary canals, however, have been developed in the limited areas and the construction is still being continued. On the other hand, canal and drain network have not been developed on left bank of first dam as well as the downstream of second dam so that water is not provided from the reservoir.

Table 2.2.2.1 **Length of canal and its irrigated areas**

Canals type	Length (km)	irrigated Area (ha)
Main Canal	9.0	10,500
Secondary Canal N -1	13.2	2,720
Secondary Canal N-2	5.1	950
Secondary Canal N -3	9.0	5,450

Main canal

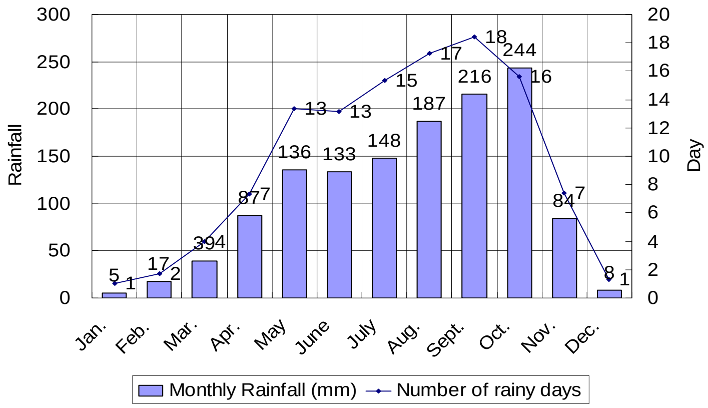
Secondary canal

Tertiary canal

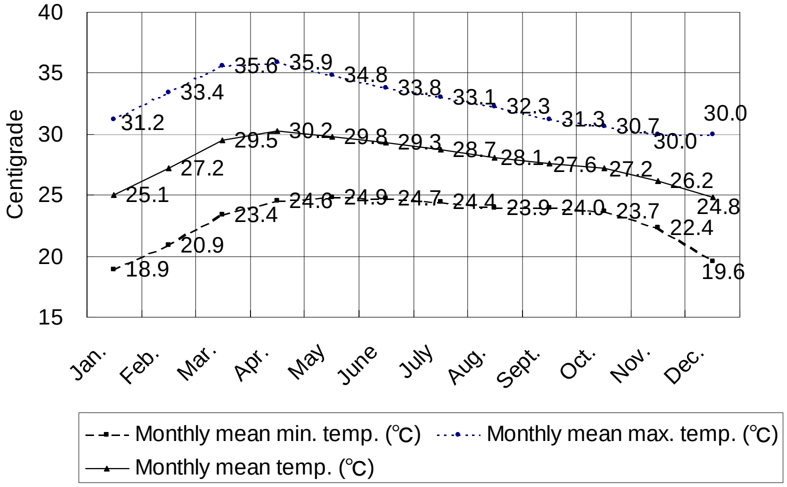
Climate

Rainfall and temperature data was also available in the Kamping Pouy irrigation scheme. Other climate data, including daily rainfall, evaporation, maximum and minimum temperature, wind speed and related humidity, are available at Bek Chan Meteorological Station, directly collected and managed by the Department of Meteorology, Ministry of Water Resources and Meteorology (MOWRAM). Rainfall data are available in the Kamping Pouy, which is, however, only for three years on a monthly basis from 2000 to 2002. The following graphs show the meteorological data in the Bek Chan station.

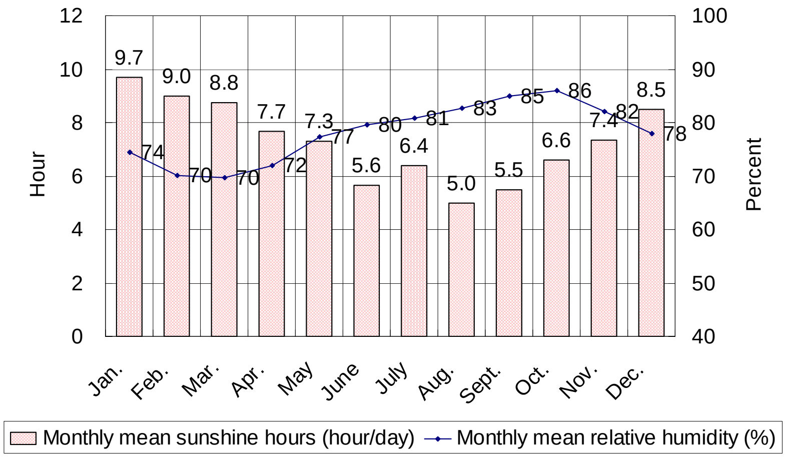
Rainfall Record at Battambang province (Bek Chan station)



Temperature Record at Battambang (Bek Chan)



Sunshine hours, Humidity Record at Battambang (Bek Chen)

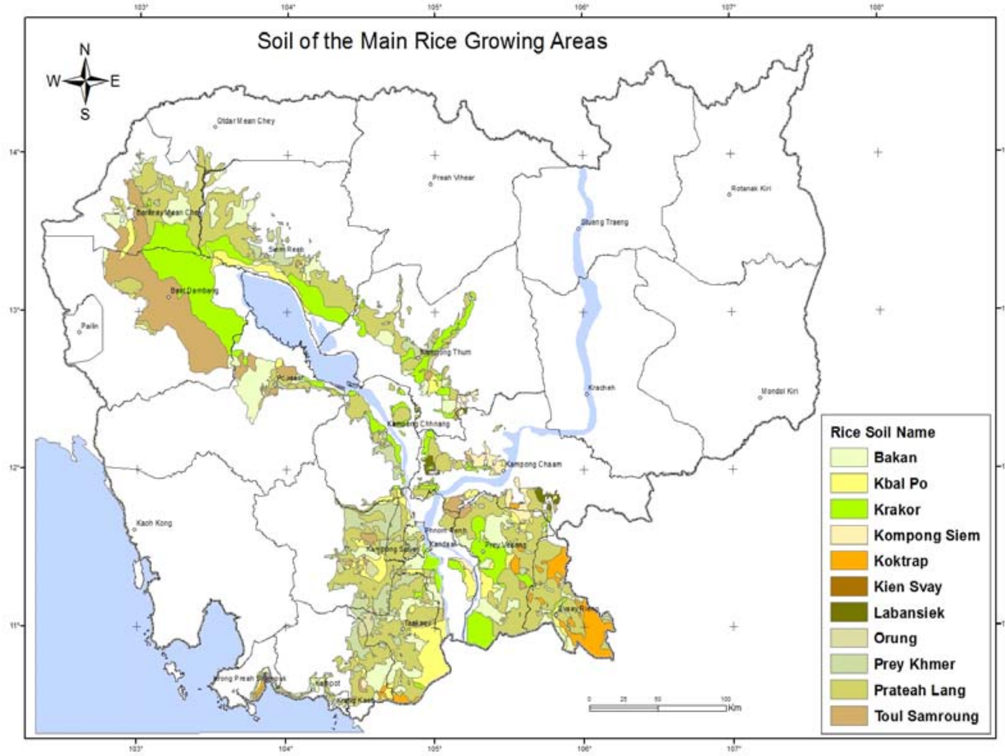


The soil

Cambodia can be visualized as a large relatively flat basin, draining gently to the Southeast into the Mekong River delta in Vietnam. The elevation drop is only 40-50 m along a 400-km axis from Banteay Meanchey (Sisophon), in the Northwest on the Thai border, to Southern Kandal, in the Southeast on the Vietnamese border. Most of the rain fed lowlands have an elevation of < 50 m above sea level even in the Northwest at Battambang province.

In 2004, Cambodian experts from CARDI (Cambodian Agricultural Research and Development Institute) and Australian experts from Department of Agriculture and Foods Western Australia carried out soil surveys in Kampong Cham, Takeo and Battambang provinces to assess land capability and suitability to facilitate diversification of field crops in Cambodia under various soil-landscape conditions. The project completed soil surveys in 5 districts: Ou Reang Ov and Ponhe Krek (Kampong Cham), Tramkak and Kong Pisey (Takeo and Kampong Speu), and Banan (Battambang).

Given the lack of practical guides for improving management and use of the country's soil resources, and the difficulties for researchers, agronomists and non-experts to communicate about soils in Cambodia, the Cambodian Agronomic Soil Classification (CASC) was developed to complement the first comprehensive soil taxonomy classification of Crocker 1962 (White et al., 1997a). The usefulness of CASC was restricted to the soils used for rice production which are mainly concentrated in the central lowland plain of the country. CASC identified 11 soil groups and 20 soil phases which mainly occur in the main rice growing areas of Cambodia. Soil groups were mapped at a scale of 1:900,000. The soil groups and phase have been widely know throughout Cambodia by researchers, agronomists, extension workers and even some farmers. Also, CASC allows correlation of these soil groups with other international classifications for comparison purposes.



Soil map of the main rice-growing areas in Cambodia

The soil of Kamping Pouy area was defined as a Vertisol soil according to FAO Soil Classification System. The soil is brown or grey in color and clayey topsoil that develops moderate to large cracks when dried. The subsoil usually has slightly higher clay content than the surface horizon and a lighter brown or gray color sometimes with a distinct yellowish tinge. Red, orange or black mottles are clearly visible in subsoil and iron and concretions are common. This soil is well suitable for rice production and other secondary crops such as maize, sesame, soybean, sugar cane and some other vegetables. Unfortunately, none of these secondary crops was reported planting for commercial purposes. Summary result of the soil analysis is shown in the table 2.2.2.2 below:

Table 2.2.2.2 Result from soil analysis (Kamping Pouy area)

Dept	Texture				pH	%OC	Av.P	Av.K	CEC
	%sand	%silt	%clay	Class					
0-20	11.02	25.08	59.17	Clayey	6.50	1.31	57.22	0.21	20.86
20-50	20.14	25.58	58.00	Clayey	6.84	0.69	28.60	0.14	21.80
50-80	11.58	24.35	60.42	Clayey	6.82	0.79	33.67	0.15	22.08
80-100	10.07	27.34	59.16	Clayey	6.60	1.29	26.00	0.22	20.18

2.2.3 Reasons to select the scheme as the pilot project

Irrigation system is recognized as the important mean for providing water to any kind of crops, especially rice cropping and it has been widely used in Cambodia since Angkorian Period. There are several types of irrigation, which had been constructed and used for agricultural production from primitive up to modern technology.

There are more than 2000 irrigation schemes in Cambodia as shown in the Annex 19 (data source took from Department of Planning and International Cooperation, MOWRAM, 2006). But most of these schemes, the infrastructures were not yet completed, not functional and damaged by civil war. After POL POT regime (1975- 1979), some irrigation schemes were rehabilitated gradually by the Royal Government of Cambodia and others Donors such as JAPAN, ADB, WB, AFD, FAO, ITALIA, EU etc...

Only the Kamping Pouy irrigation scheme is the most appropriate and complete scheme in the country wide. It has sufficient water storage, main canal, secondary canal drainage canal and many related structures because it was rehabilitated by the Government of Japan, Italian Government, ADB and also FAO.

The Kamping Pouy irrigation scheme was selected as a model site for the study because of:

- Site location is not so far from the town,
- good scheme if compare with the others schemes in the whole county,
- Data and information are available,
- Appropriate area for the study and soil is fertile for crop growing,
- Water storage in the reservoir is sufficient for irrigation,
- Canals and structure networks are completed and good function,
- Farmers cultivates crop in both seasons: Wet and dry seasons,
- Technical staff and labor in that area has enough capacity for implementation for research and collecting data,
- Good transportation to the site,
- Farmer Water User Community is already established,
- People are willing to cooperate with the project, and
- Good cooperation with the Local authority, especially PDWRAM.

3. Outline of field Observation

3.1 Process of conducting field work

Based on the TOR proposed by MRCS, the implementation of the project and workplan activities, which was prepared and agreed by Ministry of Water Resources and Meteorology and others line agencies related were started from January to June in the dry season and from July to December in the wet season 2007.

Before implementation, the study team was discussed all activities that described on the TOR and considered how to implement those well and successfully. The process of conducting and survey field work was described clearly in the project proposal and more detail was described as following in the table below. In the implementation work, we established two teams: one team is responsible for management and control all activities that received from the field. Mostly, this team stays permanently in the central office at Phnom Penh town. The second team is responsible for conducting all field works activities that was mentioned in work plan (See Table 3.1.1, Table 3.1.2 and Annex 18).The main field works for this team is mainly for preparation and installation of all equipment which was needed for the study: such as rainfall apparatus, Evapo-Transpiration apparatus, construction of wooden bridge across the canals for measuring velocity etc.... Beside these activities, the team also prepared and conducted training manual on velocity and ETo standard and how to note and write data into the format and sometimes interview with them. All the works, which were carried out by the second team, was checked by the first team at Phnom Penh city with a frequency of monthly basis.
The details procedures of the implantation activities in the dry season is shown in table 3.1.1

Table 3.1.1 Implementation Activities in the dry season

Activities in the dry season					
Nº	**Activities**	**Date**			**Remark**
		Start	End	Day	
I	**Preparation for data collection**				
1	Site selection (Completed)				
2	Prepare schematic plan of irrigation system				
2-1	Colleted Data	01 / 01 / 2007	02 / 01 / 2007	2	
2-2	Draw Schematic Plan	03 / 01 / 2007	03 / 01 / 2007	1	
3	Prepare scaled command area map				
3-1	Colleted Data	04 / 01 / 2007	06 / 01 / 2007	3	
3-2	Prepare Map	07 / 01 / 2007	07 / 01 / 2007	1	
3-3	**Assessment of Irrigation Efficiencies**				
4	23 inflow+18 outflow measurement points				
4 - 1	Prepare table for recoding data at field	09 / 01 / 2007	09 / 01 / 2007	1	
4 - 2	To select measurement point	10 / 01 / 2007	10 / 01 / 2007	1	
4 - 3	Prepare Map	11 / 01 / 2007	11 / 01 / 2007	1	
4 - 4	Install foot bridge for measuring	10 /01 /2007	15 / 01 / 2007	6	
4 - 5	To cross section of canal	18 / 01 / 2007	21 / 01 / 2007	4	
4 - 6	Drawing cross section of canal	20 / 01 / 2007	21 / 01 / 2007	2	
4 - 7	Measuring				
4 - 7 -1	Measuring 1st time	02 / 02 / 007	04 / 02 / 007	3	
	Entry data to computer	04 / 02 / 007	04 / 02 / 007	1	
	Calculate velocity and discharge	05 / 02 / 007	06 / 02 / 007	2	
4 - 7 -2	Measuring 2nd time	20 / 02 / 2007	22 / 02 / 2007	3	
	Entry data to computer	22 / 02 / 2007	22 / 02 / 2007	1	
	Calculate velocity and discharge	23 / 02 / 2007	24 / 02 / 2007	2	
4 - 7 -3	Measuring 3rd time	06 / 03 /2007	08 / 03 /2007	3	
	Entry data to computer	08 / 03 /2007	08 / 03 /2007	1	
	Calculate velocity and discharge	09 / 03 /2007	10 / 03 /2007	2	
4 - 7 - 4	Measuring 4th time	19 / 03 / 2007	21 / 03 / 2007	3	
	Entry data to computer	21 / 03 / 2007	21 / 03 / 2007	1	
	Calculate velocity and discharge	22 / 03 / 2007	23 / 03 / 2007	2	
4 - 7 -5	Measuring 5th time	28 / 03 / 2007	30 / 03 / 2007	3	
	Entry data to computer	30 / 03 / 2007	30 / 03 / 2007	1	
	Calculate velocity and discharge	31 / 03 / 2007	01 / 04 / 2007	2	
4 - 7 - 6	Measuring 6th time	11 / 04 / 2007	13 / 04 / 2007	3	
	Entry data to computer	13 / 04 / 2007	13 / 04 / 2007	1	
	Calculate velocity and discharge	14 / 04 / 2007	15 / 04 / 2007	2	

4 - 7 - 7	Measuring 7th time	27 / 04 / 2007	29 / 04 / 2007	3	
	Entry data to computer	29 / 04 / 2007	29 / 04 / 2007	1	
	Calculate velocity and discharge	30 / 04 / 2007	01 / 05 / 2007	2	
4 - 7 - 8	Measuring 8th time	29 / 05 / 2007	31 / 05 / 2007	3	
	Entry data to computer	31 / 05 / 2007	31 / 05 / 2007	1	
	Calculate velocity and discharge	01 / 06 / 2007	02 / 06 / 2007	2	
5	Obtain rainfall and other climate data	01 / 02 / 2007	01 / 07 / 2007	22	
6	Calculate potential (ETo, Kc,)	01 / 07 / 2007	05 / 07 / 2007	6	
7	Calculate crop evapotranspiration (ETc)	06 / 07 /2007	06 / 07 /2007	1	
8	Identify actual irrigated areas				
8-1	Preparation work	17 / 04 / 2007	17 / 04 / 2007	1	
8-2	To collect data	18 / 04 / 2007	20 / 04 / 2007	3	
8-3	Office work	21 / 04 / 2007	21 / 04 / 2007	1	
9	Record cropping pattern and crop calendar				
9-1	Prepare table for community to recode	29 / 01 / 2007	29 / 01 / 2007	1	
9-2	To collect data	01 / 02 /2007	10 / 07 / 2007	16	
9-3	Prepare crop calendar	10 / 07 /2007	11 / 07 /2007	1	
10	Record multiple use of irrigation water quantity				
11	6 points of recording water level in paddy fields				
11-1	Prepare model table	24 / 01 / 2007	25 / 01 / 2007	1	
11-2	Equipment prepare	25 / 01 / 2007	27 / 01 / 2007	3	
11-3	To draw model plan	27 / 01 / 2007	28 / 01 / 2007	1	
11-4	To train member	30 / 01 / 2007	30 / 01 / 2007	1	
11-5	To control installation equipment in field	22 / 02 / 2007	22 / 03 / 2007	6	
11-6	Colleted data	22 / 02 / 2007	28 / 06 / 2007	15	
11-7	Put raw data to computer	23 / 02 / 2007	29 / 06 / 2007	15	
11-8	Element calculated	05 / 06 /2007	30 / 06 / 2007	6	
12	Calculate total scheme water requirement				
12-1	Calculate Crop water Requirement	08 / 07/ 2007	08 / 07/ 2007	1	
12-2	Calculate Percolation	09 / 07 /2007	09 / 07 /2007	1	
12-3	Calculate volume water for land preparation	10 / 07 /2007	10 / 07 /2007	1	
13	Conduct conveyance losses test				
	and calculate conveyance efficiency				
13-1	To select measurement point	14 / 04 / 2007	14 / 04 / 2007	1	
13-2	To cross section of canal	14 / 04 / 2007	14 / 04 / 2007		
13-3	Drawing cross section of canal	14 / 04 / 2007	14 / 04 / 2007		
13-4	Measuring	15 / 04 / 2007	15 / 04 / 2007	1	
13-5	Entry data to computer	16 / 04 / 2007	16 / 04 / 2007	1	
13-6	Calculate velocity and discharge	16 / 04 / 2007	16 / 04 / 2007		
13-7	Calculate discharge to lose	17 / 04 / 2007	17 / 04 / 2007	1	

14	Produce H-Q Curves of 3 gates				
14-1	Prepare table for recoding data at field	15 / 04 / 2007	15 / 04 / 2007	1	
14-2	Definite height of gate to open	15 / 04 / 2007	15 / 04 / 2007		
14-3	Equipments preparation	15 / 04 / 2007	15 / 04 / 2007		
14-4	Measuring	16 / 04 / 2007	16 / 04 / 2007	1	
14-5	Entry data to computer	17 / 04 / 2007	17 / 04 / 2007	1	
14-6	Draw H&Q curve	17 / 04 / 2007	17 / 04 / 2007		
15	Calculate overall command area efficiency	11 / 07 / 2007	11 / 07 / 2007	1	
III	**Assessment of water productivity**				
16	Obtain paddy yield				
	To measure dimension of rice field	07 / 06 /2007	07 / 06 /2007	1	
	To weigh the rice	07 / 06 /2007	04 / 07 /2007	6	
	Calculate average yield	04 / 07 /2007	05 / 07 /2007	1	
17	Calculate crop water productivity	12 / 07 /2007	12 / 07 /2007	1	
IV	**Scheme management appraisal**				
18	Identify stakeholders (document)	01 / 06 /2007	07 / 06 /2007	7	
19	Draw organizational charts of stakeholders	08 / 06 /2007	15 / 06 /2007	7	
20	Record water allocation rules	20 / 06 /2007	27 / 06 /2007	7	
21	Record actual water distribution and practice	28 / 06 /2007	05 / 07 /2007	7	
V	**RAPs**				
22	Conduct final RAP	15/12/07	31/12/07		
VI	**Other**				
23	Monitoring and Backstopping by MRCS	20/12/07	24/12/07		

For the wet season, all activities are almost the same as in the dry season; but only the schedule and time is difference from dry season. (See table 3.1.2)

Table 3.1.2 Implementation Activities in the wet season

Activities in wet season					
Nº	**Activities**	**Date**			**Remark**
		Start	End	Day	
I	**Preparation for data collection**				
1	Site selection (Completed)				
2	Prepare schematic plan of irrigation system				
2-1	Colleted Data				Use dry
2-2	Draw Schematic Plan				Use dry
3	Prepare scaled command area map				
3-1	Colleted Data				Use dry
3-2	Prepare Map				Use dry

3-3	**Assessment of Irrigation Efficiencies**				
4	25 inflow+20 outflow measurement points				
4 - 1	Prepare table for recoding data at field	09 / 06 / 2007	09 / 06 / 2007	1	
4 - 2	To select measurement point	10 / 06 / 2007	10 / 06 / 2007	1	
4 - 3	Prepare Map	11 / 06 / 2007	11 / 06 / 2007	1	
4 - 4	Install foot bridge for measuring	10 /06 /2007	15 / 06 / 2007	6	
4 - 5	To cross section of canal	18 / 06 / 2007	21 / 06 / 2007	4	
4 - 6	Drawing cross section of canal	20 / 06 / 2007	21 / 06 / 2007	2	
4 - 7	Measuring				
4 - 7 -1	Measuring 1 time	28 / 07 / 2007	30 / 07 / 2007	3	
	Install data to computer	30 / 07 / 2007	30 / 07 /2 007	1	
	Calculate velocity and discharge	31 / 07 / 2007	01 / 08 / 2007	2	
4 - 7 -2	Measuring 2 time	27 / 08 / 2007	29 / 08 / 2007	3	
	Install data to computer	29 / 08 / 2007	29 / 08 / 2007	1	
	Calculate velocity and discharge	30 / 08 / 2007	31 / 08 / 2007	2	
4 - 7 -3	Measuring 3 time	20 / 09 / 2007	22 / 09 / 2007	3	
	Install data to computer	22 / 09 / 2007	22 / 09 / 2007	1	
	Calculate velocity and discharge	23 / 09 / 2007	24 / 09 / 2007	2	
4 - 7 - 4	Measuring 4 time	08 / 10 / 2007	10 / 10 / 2007	3	
	Install data to computer	10 / 10 / 2007	10 / 10 / 2007	1	
	Calculate velocity and discharge	11 / 10 / 2007	12 / 10 / 2007	2	
4 - 7 -5	Measuring 5 time	26 / 10 / 2007	28 / 10 / 2007	3	
	Install data to computer	28 / 10 / 2007	28 / 10 / 2007	1	
	Calculate velocity and discharge	29 / 10 / 2007	30 / 10 / 2007	2	
4 - 7 - 6	Measuring 6 time	20 / 11 / 2007	22 / 11 / 2007	3	
	Install data to computer	22 / 11 / 2007	22 / 11 / 2007	1	
	Calculate velocity and discharge	23 / 11 / 2007	24 / 11 / 2007	2	
5	Obtain rainfall and other climate data	01 / 07 / 2007	30 / 12 / 2007	25	
6	Calculate potential (ETo,Kc,)	15 / 12 / 2007	17 / 12 / 2007	3	
7	Calculate crop evapotranspiration (ETc)	18 / 12 / 2007	22 / 12 / 2007	5	
8	Identify actual irrigated areas				
8-1	Preparation work				No action
8-2	To collect data				No action
8-3	Office work	10 / 09 / 2007	11 / 09 / 2007	2	
9	Record cropping pattern and crop calendar				
9-1	To collect data	01 / 06 /2007	10 / 01 /2008	16	
9-2	Prepare crop calendar	10 / 07 /2007	11 / 07 /2007	1	

10	Record multiple use of irrigation water quantity				No action
11	6 points of recording water level in paddy fields				
11-2	Equipment prepare	25 / 07 / 2007	27 / 07 / 2007	3	
11-5	To control installation equipment in field	01 / 08 / 2007	2 / 08 / 2007	6	
11-6	Colleted data	04 / 08/ 2007	13 / 12 / 2007	21	
11-7	Put raw data to computer	05 / 08/ 2007	14 / 12 / 2007	21	
11-8	Element calculated	09 / 08/ 2007	14 / 12 / 2007	6	
12	Calculate total scheme water requirement	25 / 12 /2007	26 / 12 / 2007	2	
13	Conduct conveyance losses test				No action
	and calculate conveyance efficiency	26 / 12 /2007	26 / 12 / 2007	1	
14	Produce H-Q Curves of 3 gates				No action
15	Calculate overall command area efficiency	27 / 12 /2007	27 / 12 / 2007	1	
III	**Assessment of water productivity**				
16	Obtain paddy yield				
	To measure dimension of rice field	17 / 11 /2007	17 / 11 /2007	1	
	To weigh the rice	18 / 11 /2007	23 / 11 /2007	6	
	Calculate average yield	24 / 11 /2007	24 / 11 /2007	1	
17	Calculate crop water productivity	25 / 11 /2007	25 / 11 /2007	1	
IV	**Scheme management appraisal**				
18	Identify stakeholders (document)				Use dry
19	Draw organizational charts of stakeholders				Use dry
20	Record water allocation rules				Use dry
21	Record actual water distribution and practice				Use dry
V	**RAPs**				
22	Conduct final RAP				
VI	**Other**				
23	Monitoring and Backstopping by MRCS				

3.2 Methods applied to conduct field work

3.2.1 Procedure, map and equipments preparation

a) Identify appropriate pilot project site (irrigation scheme)

Before the project implementation, MOWRAM and others members in the line ministry concern such as Ministry of Agriculture, Forestry and Fishery (MAFF), Cambodia National Mekong Committee (CNMC) and with technical assistance from MRC expert discussed about the selection of pilot site (Fig 3.2.1). After discussion in the office in Phnom Penh, we went to the Provincial Department of Water Resources and Meteorology in Battambang province in order to discus and select the actual pilot site, that will appropriate and suitable for the study. Finally, we together agreed and selected the Kamping Pouy irrigation scheme, which locates in Battambang province Norwest of Cambodia.

The general location map of Kamping Pouy irrigation scheme is shown in the Annex 1

Fig 3.2.1 Discussion with the PDWRAM staff and Field visit before project implementation

b) Prepare schematic plan of irrigation system

Schematic plan of Kamping Pouy irrigation system was prepared based on the existing information and maps (JICA map scale 1:100,000 in 2003) which are available at MOWRAM Headquarter and Battambang PDWRAM office. The schematic plan of Kamping Pouy irrigation system was prepared without scale, but it consists of the following details:

- Canal alignment and canal network (main, secondary, tertiary, and quarterly canals) with diversion structure points,
- Kilometer marking point at each diversion structure and others from the head of their parent canal,
- Data and information of design irrigated areas, design discharge, command area, number of household, and
- Boundary of design irrigated areas.

Related to do this work, we used one irrigation engineer and one irrigation technician.
The detail of schematic plan is shown in the Annex 3.

c) Prepare scale command area map of the irrigation scheme:

The preparation of scaled command area map was plotted by using existing maps 1:100000 which produced by JICA in 2003, together with the program of Arc GIS 9.0, Map Info, AutoCAD 2004 and also topographical maps. The scaled command area map was prepared in Arc GIS file and PDF file with appropriate scale and included the main following information:

- Project location,
- Design irrigated areas (command areas) with appropriate scale, and
- Reservoir and canal alignments with scale

The detail of Scale command area map is shown in Annex 2

3.2.2 Assessment of water balance and irrigation efficiency

(1) Conducting inflows and outflows measurements

To monitor water balance and to assess the overall irrigation efficiency, 23 points inflows and 18 points outflows were selected for measurement. Location map of all measurement points are shown in Fig 4.2.2 & Annex 10. In the selection period the team has consulted and selected the place which is appropriate for measurement with MRCS before working. For measuring velocity in the canal we took 8 times for dry and 5 time for wet season Intensive measurement of 1 time/week was conducted and 1 time measurement was spend for 3 days continually. One set of current meter that received from MRCS was used by the team to conduct inflow and outflow quantity (include velocity) at all the above selected points. Methods of measurement and calculation was followed the backstopping note that was provided by MRC.

Fig 3.2.2 MRC expert (Mr. Fongsamuth) provided training to the Team **Study Team conducted Flow measurement**

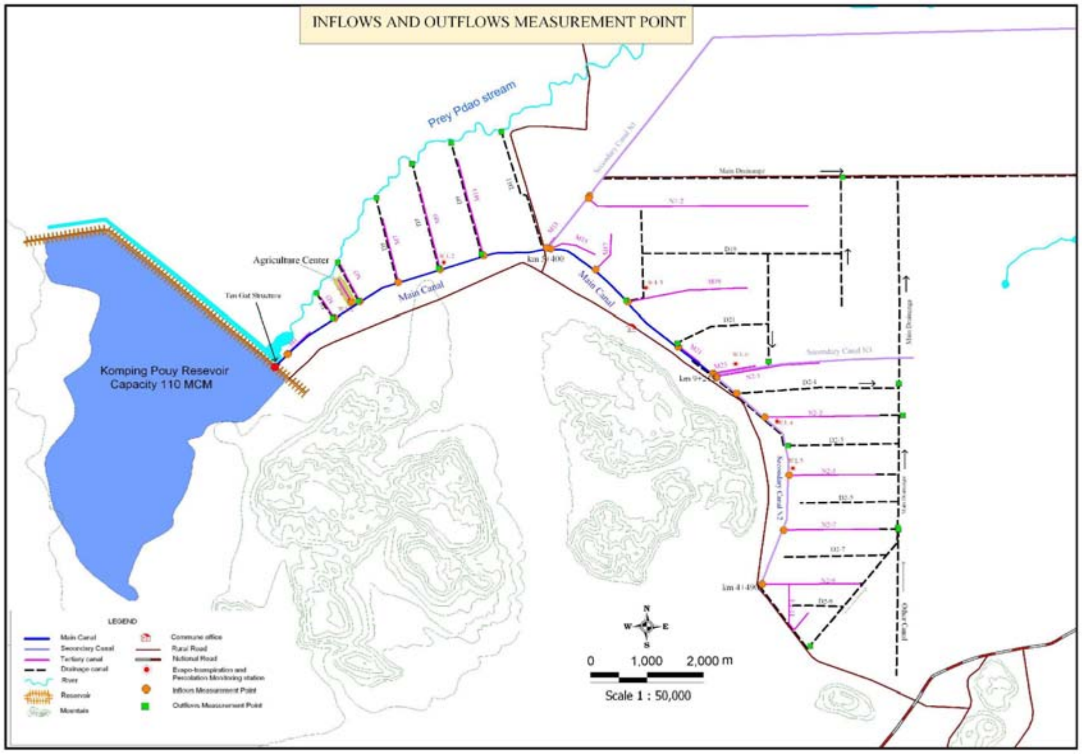


Fig 3.2.3 Total location of flow measurement (Dry and Wet)

Method of Measuring inflows and outflows Velocity:

1-1 : Measuring responsibility

We have one set of current meter and used 3 people to work:

- Technician (1 person)
- Staff employment (1 person)
- Farmer (1 person)

1-2 : Preparation Work

- Prepare table for recording data
- Select measurement point
- Install foot bridge for measuring made from wood
- Measuring and Drawing cross section of canals at the selected point
- Define depth points of canal from left to right
- Define points to measure water velocity at each part
- Measure depth of canal from bridge to bottom
- Drawing cross section of canal by AUTOCAD software
- Equipments preparation (current meter, Meter …)

1-3 : Operation

- One time of measuring we used 3 days
- Measure all the points(in3days) when water flow from reservoir (based on the water use planning in Kamping Pouy reservoir)
- Measure height from bridge to water surface in the canal
- Calculate the water height of each part
- Calculate the height of sensor of part
- Record the velocity data into the format table

1-4 : Office Work

- Entry data into the computer
- Calculate water area of each part
- Calculate average velocity
- Calculate discharge of each part
- Calculate total discharge of each canal

(2) Record water level in rice paddy field:

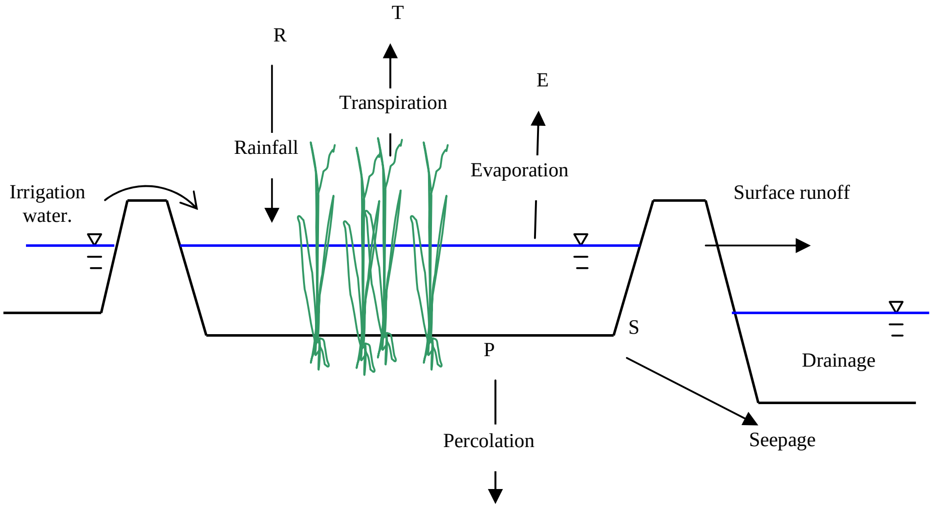


Fig 3.2.4 Schematic of water requirement for rice paddy field

Fig 3.2.5 ETo, ETc, water level and percolation station (agriculture center)

Water level in rice paddy fields was observed everyday (24 hours after previous record). Six locations were selected (see Fig 3.2.6). Daily measurements are written on record sheets by the observer. Items to be recorded include the period, date, weather, rainfall, evaporation, the time of beginning and the end of measurement, readings, and water level loss.

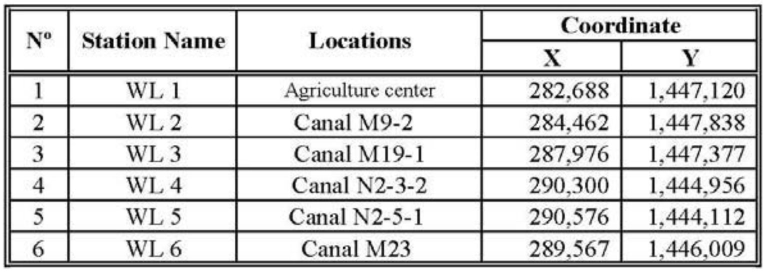
The period of recording and results from the six stations are shown in the Annex 5, 6 and 7.

Observation method for Water Level in paddy field

- ✧ Preparation Instrument Work
  - Prepare model table for recording data ,
  - Prepare measuring apparatus (Tank Equipment):

A-Tank with bottom with rice	**E + T +R**
B-Tank without bottom with rice	**E + T + P + R**
C-Wooden Staff gate with scale in paddy field	**E + T + P + S + R**
D-Tank with bottom without rice	**E + R**
e- Rainfall recorder	**R**

- Drawing model plan (installation equipment plan)
- Selecting 6 observation Stations



Nº	Station Name	Locations	Coordinate	
			X	Y
1	WL 1	Agriculture center	282,688	1,447,120
2	WL 2	Canal M9-2	284,462	1,447,838
3	WL 3	Canal M19-1	287,976	1,447,377
4	WL 4	Canal N2-3-2	290,300	1,444,956
5	WL 5	Canal N2-5-1	290,576	1,444,112
6	WL 6	Canal M23	289,567	1,446,009

- Selecting people who will work in the site
  1- Mr. CHHEANG Houn for W.L 1
  2- Mr. PHAT Phoeur for W.L 2

3- Mr. CHEN Chot for W.L 3
4- Mr. RORM Choi for W.L 4
5- Mr. DENG Deab for W.L 5
6- Mr. LAT Leab for W.L 6

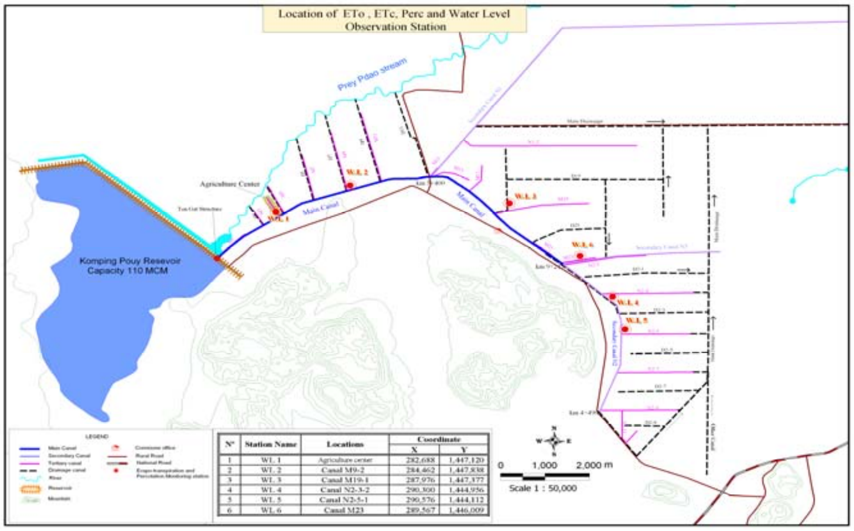
- Preparing Map

✧ Operation

- Train all members
  - Install all equipments
  - Observation staff gate
  - Recording method
  - Add water method
- Control installation of all equipments in paddy field
- Training observation staff gate in paddy field
- Control recording data in table format
- Collecting record data every day and sent to office every week (usually on Thursday)

✧ Element Calculation

- Put raw data into computer
- Take level yesterday to revoke the level today, we take once level
  - Staff gate in paddy field to provide the once level is assumed equation (a).
  - Tank without bottom to provide the once level is assumed equation (b)
  - Tank with bottom to provide the once level is assumed equation (c)
  - Tank with bottom and without rice to provide the once level is assumed equation (d)
  - And rainfall is assumed equation (e)
- Take the equation (a) revoke (b) so we obtains the value of seepage (S)
- Take the equation (b) revoke (c) so we obtains the value of percolation (P)
- Take the equation (c) revoke (d) so we obtains the value of (T)
- Take the equation (d) revoke (e) so we obtains the value of evaporation(E)
- Take the equation (c) revoke (e) so we obtains the value of (ETo)



N°	Station Name	Locations	Coordinate	
			X	Y
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2	WL 2	Canal M9-2	284,462	1,447,838
3	WL 3	Canal M19-1	287,976	1,447,377
4	WL 4	Canal N2-3-2	290,300	1,444,956
5	WL 5	Canal N2-5-1	290,576	1,444,112
6	WL 6	Canal M23	289,567	1,446,009

Fig 3.2.6 Location of 6 Etc, WL and Percolation station

(3) Calculate Reference Crop Evapo-transpiration (ETo)

Reference Crop Evapo-transpiration (ETo) information was obtained only from one pilot Stations, namely Agricultural Center Station (A-C) in the Kamping Pouy irrigation system. One engineer and one technician were responsible for collecting data from the field in wet and dry seasons.

More detail information about the ETo are shown in the Annex 5.

(4) Calculation of crop coefficient (Kc) and crop water requirement (ETc)

Crop coefficient (Kc) was calculated based on climate data and information obtained from FAO guide book, backstopping note provided by MRCS and some experiences in Cambodia such as IRRI.
The crop water requirement or Evapo-transpiration requirement (ETc) in Kamping Pouy irrigation scheme was calculated by two methods:

1- Averaging from field measurement and
2- FAO formula

$$ETc = ETo \times Kc \qquad (1)$$

Where:

ETc : crop water requirement or Evapo-transpiration requirement mm/day
ETo : reference crop Evapo-transpiration mm/day
Kc : Crop coefficient

One engineer and one technician are inputted for this task with 2 home working days in each season.

More details of data calculation is shown in the Annex 6

(5) Calculation of Percolation in paddy field

The percolation of paddy field is determined by using the percolation apparatus at a certain point from the Evapo-Transpirometer in the experimental paddy fields. Therefore, the measurement calculation method is:

$$\text{Percolation} = \text{Water loss in depth} - \text{Evapo-Transpiration} \qquad (2)$$

The detailed percolation calculation is provided in the Annex 7

Fig 3.2.7 Percolation apparatus

(6) Calculation of Land preparation in paddy field (LP)

No data for land preparation in the Kamping Pouy scheme. Therefore, based on the FAO study for water requirement (FAO Guideline Book on water requirement) and experiences of the farmers in this area for land preparation in the paddy field, we assumed 5.6mm/day for 20 days in the period of crop growing.

(7) Calculation Irrigation water requirement (IWR)

Irrigation Water Requirement was calculated by the formula as follow:

$$IWR = ETc + P + LP \qquad (4)$$

Where:

IWR : Irrigation water requirement
ETc : Crop water requirement or Evapo-transpiration requirement mm/day
LP : Land preparation
P : Percolation

(8) Calculation of Scheme Water Requirement (SWR)

The total scheme water requirement was calculated by formula as follow:

$$SWR = \text{Total irrigated area} \times IWR \qquad (5)$$

Detailed scheme water requirement calculation is provided in annex 8

(9) Rainfall and effective rainfall

Rainfall and climate data was collected from the nearest station i.e. Battambang Meteorological Station, located inside PDWRAM office and Battambang Agricultural Productivity Enhancement Project (BAPEP- JICA), located inside project area (Fig 3.2.7). On the other hand, in the project site we have only one rainfall station that was collected the rainfall data for the study. The effective rainfall is the most rainfall which falls during the crop growing period and being utilized to meet water requirement. As the crops are not able to fully utilize the total amount of the rainfall available in the growing period, effective rainfall can not be expressed in term of total precipitation.

In this study the effective rainfall for rice crop was calculated following by the method that was use by FAO.

$$Pe = (1- 0.0006\ Ri)\ Ri, \qquad Ri\text{- Rainfall} \qquad (6)$$

The study team went to collect the data continually 4 times every month.
One technician is required for working (4 days/month).

The results of rainfall and effective rainfall data collection are shown in Annex 9

Fig 3.2.7 Rainfall apparatus near BAPEP office in Agriculture center

3.2.3 Record cropping pattern and crop calendar

The preparation of format table for recording cropping pattern and crop calendar data collection was prepared and provided to each water user group in the study area in order to record the cropping pattern and crop calendar for their own groups. The information was crosschecked by conducting field observation through 10 days in one time. The table or form will include the main information as follows.

- Kinds and hectares of crops to be grown
- Date/ time and length (number of days) of land preparing, translating and harvesting periods

- ✧ Crop Calendar
  - Prepare table for farmers and community to record
  - Train the farmers and community about how to fill up data into the table
  - Control the recording data
  - Collect data every 10 days
  - Entry data into computer
  - Prepare crop calendar.

The result of cropping pattern and crop calendar are shown in Fig 4.1.2.

3.2.4 Identify actual irrigated area

To identify the total actual irrigated areas, 1time (3 days) of field observation in wet and dry seasons was conducted to record actual planted areas. The GPS equipment was used to record the points and boundaries of actual irrigated areas in the project site. At the time of recording of actual irrigated areas, the head of FWUC and community were interviewed and contributed to mark their own actual boundary of irrigated areas. The collected information was then plotted into schematic ground plan of irrigation scheme by using Arc GIS 9.0.

One engineer and 2 technicians are needed for 3 working days for observation and interview.

Identify Actual Area Map

- ✧ Preparation Work
  - Cultivate report (Reference)
  - Scale Command Area Map (Reference)
  - Picture map of Kamping Pouy from Internet (Goggle Earth)

        - GPS (GARMIN`s GPS 76)
        - Software *Arc GIS 9.1* for map preparation
        - Software *Map Source* for transfer data from GPS to Arc GIS

✧ Operation

We spend one day to use GPS in order to take boundary points of cultivated rice field at part one. After, at office work, we transfer data to computer and draw map.

Office Work

- Transfer data from GPS to Arc GIS
- Draw boundary of actual area
- Calculate irrigated area
- Prepare Actual Area Map.

The detailed result of actual planted area is shown in Annex 4.

3.2.5 Record multiple uses of irrigation water

In the Kamping Pouy irrigation scheme is mostly used only for rice growing; and water use for other crop such as non-paddy crop (water melon, corn, soy been etc...) is not used.

3.2.6 Conduct conveyance lost test along the canals

Method to calculate Conveyance test along the canals

✧ Location

1. On main Canal: “I-1”, Bridge M-9, Bridge M-19, Bridge M21
2. On secondary canal N2 :
3. On tertiary canal M9 : “I-6” , PK 0+482 , PK 1+540

✧ Date

1. One time use 1 day
2. Started 14 April 2007

✧ Member

There are 3 members who are in workability:

1. Technician (1 person)
2. Staff employment (1 person)
3. Farmer (1 person)

✧ Preparation Work

1. Prepare table for recording data
2. Select measurement point
3. Draw cross section of canal
4. Define depth point of canal from left to right
5. Define point to measure water velocity of part
6. Measure depth of canal from bridge to bottom
7. Draw cross section of canal by AUTO CAD software
8. Equipments preparation (Current meter instrument, Meter ……)

✧ Operation

1. Methodology
    - Measure height from bridge to water surface
    - Calculate the height water of each part
    - Calculate the height of sensor of part
    - Record the velocity into table
    - Measure distance from the station to another station.

2. Office Work
   - Entry data to computer
   - Calculate water area of each part
   - Calculate average velocity
   - Calculate discharge of each part
   - Calculate losing discharge of each canal (2 conditions: has structure and non structure).

The result of conveyance loss test along the canal is shown in the Annex 11

3.2.7 Produce rating canal section curves (H-Q curves)

Method to Produce H - Q curves

Location

1. 10 gates structure
2. Gate N1 (I- 8)
3. Gate N2 (I-18).

There are 3 members who are in workability:

1. Technician (1 person)
2. Staff employment (1 person)
3. Farmer (1 person).

Preparation Work

1. Prepare table for recording data at field
2. Define height of gate to open (0.05 m , 0.10m ,0.15m , 0.20 m , 0.25 m)
3. Equipments preparation (current meter, Meter ……).

Operation

Methodology

1. To close the gate to halt the water
2. To open the gate at first height (0.05m)
3. To measure height from bridge to surface water
4. Calculate the height water of each part
5. Calculate the height of sensor of part
6. Record the velocity into table
7. To measure height from slap of bridge to surface water (In front structure and behind structure)
8. To open gate at second height (0.10m) and do one more time; this action continues until complete all height grates of gate to define

Office Work

1. Entry data into computer
2. Calculate water area of each part
3. Calculate average velocity
4. Calculate discharge of each part
5. Calculate total discharge for all height grates of gate
6. Draw H-Q curve and produce equation of discharge for each gate

The results of rating canal section H –Q curve is shown in the Annex 12

4. Analysis, results and discussions

4.1 System Water Requirement (SWR)

The system water requirement is calculated only for rice cropping in the command area. Based on the Equation (4), the calculated results are shown in Annex 8

In order to obtain water requirement results, numbers of items are identified and calculated including rainfall, cropping pattern, irrigation days, and actual crop areas, ETc, and so on .These items are described as follows.

Actual planted Areas

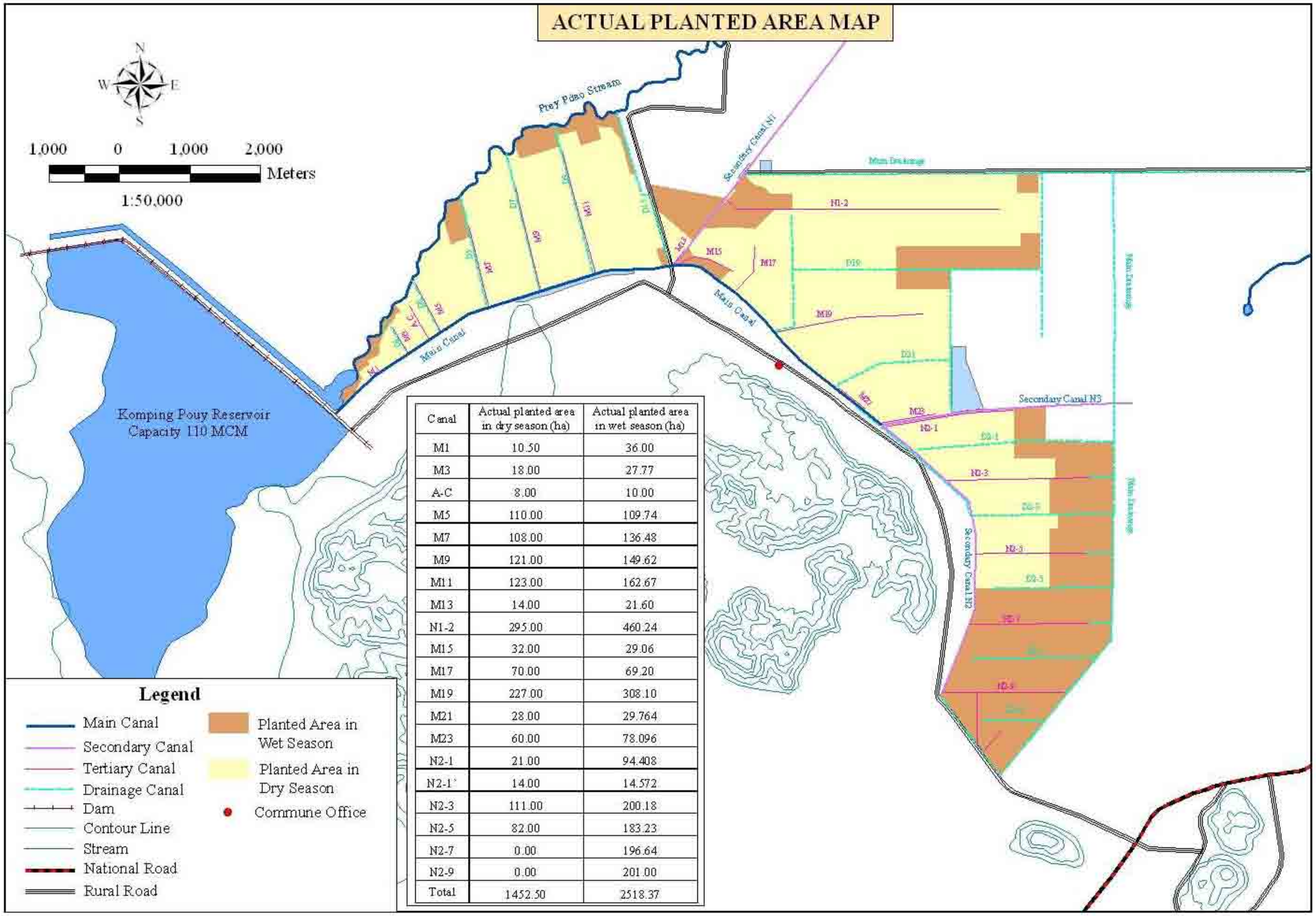
As shown in table 4.1.1 & Annex 4, the total planted area was estimated at 1452.50 ha in dry season and 2518.37 in the wet season. Both dry and wet seasons are smaller than original capacity-designed command areas (2850 ha), especially for dry season which is accounted only 50% of total designed command areas. The major reasons observed are due to insufficient water in reservoir to irrigate for whole command areas and due to the poor irrigation infrastructures that resulting water loss along canal making far distance cultivated areas could not reach water. Sometime the actual irrigated area in dry season could be fluctuated depend on the volume of water storage in the reservoir. Example in 2004 the actual irrigated area increase more than this year (around 1600ha) .The actual cultivated areas in wet season suppose to be the same as designed capacity .but the gap might be the error from data collection or designed work. The larger cultivated areas in wet season are mainly the reason of available water by rainfall and lower investment in this season cultivation.

Rice is major crop grown in the project area which is accounted for 100% of total cultivated areas in dry season and in wet season. For the cash crops (e.g. long been, soy been, sweet corn, cucumber, water melon, etc) will promoted by the government in this project area later on by using rotation methodology. Skills and capacities of farmers to develop to industrial crops in large scale are still limited and also the market issues is also not yet well implemented. Farmers some times face difficulty of inflection of market price. This is the main issue for Government into consideration.

The actual planted areas, which were observed by GPS and interviewed with FWUC are shown in the table 4.1.1, Fig 4.1.1 and annex 4.

Table 4.1.1

Crop type	**Dry season**		**Wet Season**	
	(ha)	**(%)**	**(ha)**	**(%)**
Rice Paddy	1452.50	100	2518.37	100
Other crops	None	None	None	None
Total	**1452.50 ha**		**2518.37 ha**	



Canal	Actual planted area in dry season (ha)	Actual planted area in wet season (ha)
M1	10.50	36.00
M3	18.00	27.77
A-C	8.00	10.00
M5	110.00	109.74
M7	108.00	136.48
M9	121.00	149.62
M11	123.00	162.67
M13	14.00	21.60
N1-2	295.00	460.24
M15	32.00	29.06
M17	70.00	69.20
M19	227.00	308.10
M21	28.00	29.764
M23	60.00	78.096
N2-1	21.00	94.408
N2-1'	14.00	14.572
N2-3	111.00	200.18
N2-5	82.00	183.23
N2-7	0.00	196.64
N2-9	0.00	201.00
Total	1452.50	2518.37

Fig 4.1.1

Cropping calendar and irrigation days

Based on field observation, cropping pattern is shown in Fig 4.1.2. The dry season paddy starts from beginning of February to early July and the wet season paddy starts from beginning June to the end of December. The total period of rice growing in the dry season is 105days.The period of rice cultivation in this area is different for each paddy field according to the water management plan .No rotation of cultivated time was made from one zone to another zone.

The cultivated schedule in the wet season is overlap with the schedule in dry season approximately one month. That is why harvesting in the dry season farmer need to be hurry to harvest in order prepare land for growing rice in wet season. This is the traditional method of cultivation in this area. From the Fig 4.1.2 the period of rice variety in wet season has longer than dry of about 50 days.

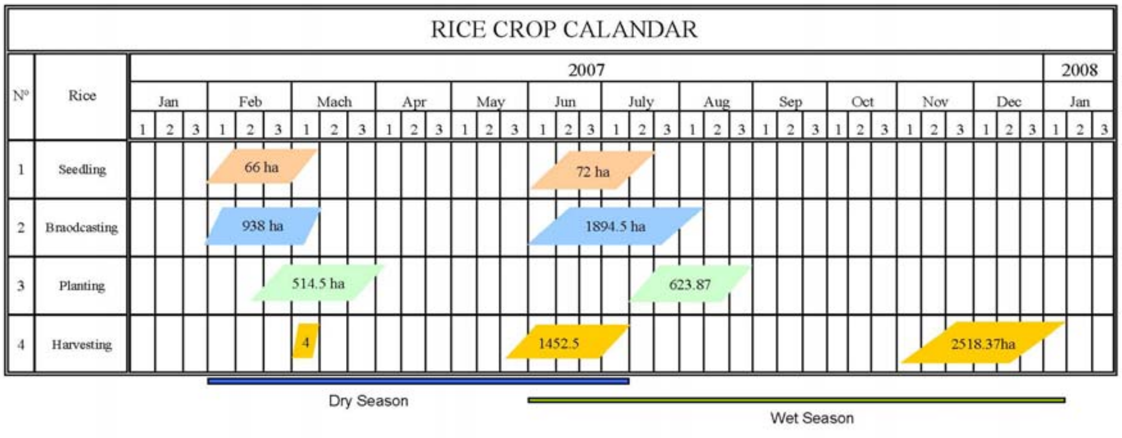


Fig 4.1.2

Evaporation (ETo)

The Fig 4.1.3 shows the monthly average of ETo recorded from March to June (dry season) and from August to December 2007(wet season). The average ETo was estimated at 5.44 mm/d in dry season and 3.78 mm/d in wet season. Only one evaporation station was installed in the project area (Agriculture station). The detailed observed value is provided in Annex 5.

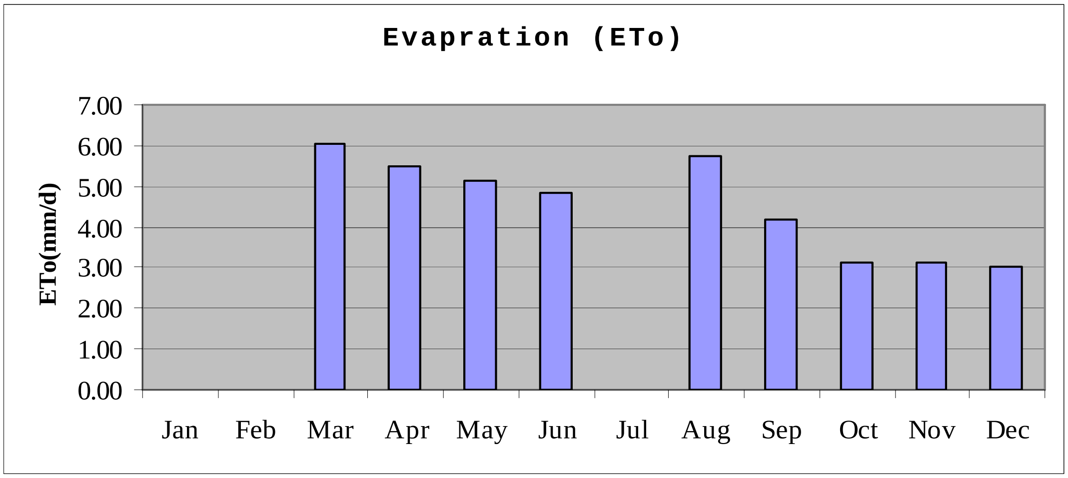


Fig 4.1.3

Rainfall

The Fig 4.1.4 also shows the rainfall observed at the same period. From the figure shows that almost every month of year 2007 has rainfall except December. The average rainfall in dry season was 3.93 mm/d, while 21.09 mm/d in wet season. The peak rain in 2007 is occurred in May (227mm). This data if compare with the previous record is higher (1920-2004 the maximum only 161.2mm). For January and February also very strange, it is too big amounts (record from1920-2004 January only 4.6 mm and in February only 17.4 mm recorded by the DoM at Phnom Penh City. The detailed daily recorded value is made available in Annex 9.

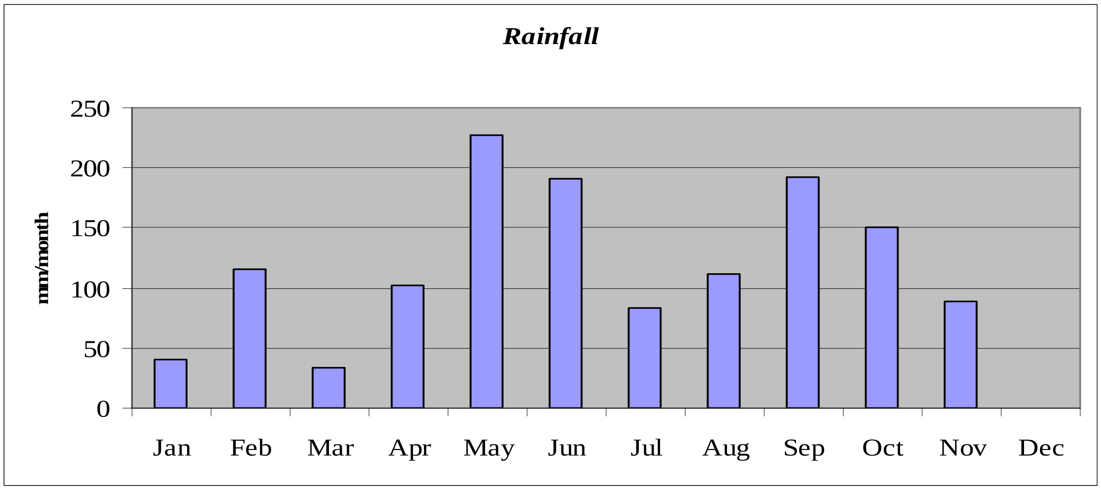


Fig 4.1.4

Effective rainfall

The effective rainfall was estimated according to the Eq (5). The total effective rainfall estimated from dry season is **6.10** MCM, but **17.54** MCM in wet season. The effective rainfall is used to calculate overall command area efficiency. The detailed calculated value is given in Annex 9.

Evapo-transpiration (ETc)

The Evapo-Transpiration (ETc) **or** Crops Water Requirements was calculated by Eq (1).

The total ETc is shown in Fig 4.1.5 covering dry and wet seasons. The average of 6, 88 mm/d was obtained in dry season and 5.11 mm/d in wet season. The high period of ETc was occurred from May to June for the dry season and from November in Wet season. The ETc is generally high in dry season.

The ETc was recorded in 6 stations within the command areas at up-middle, and–down stream command area. The detailed and calculation of each station is referred to Annex 6

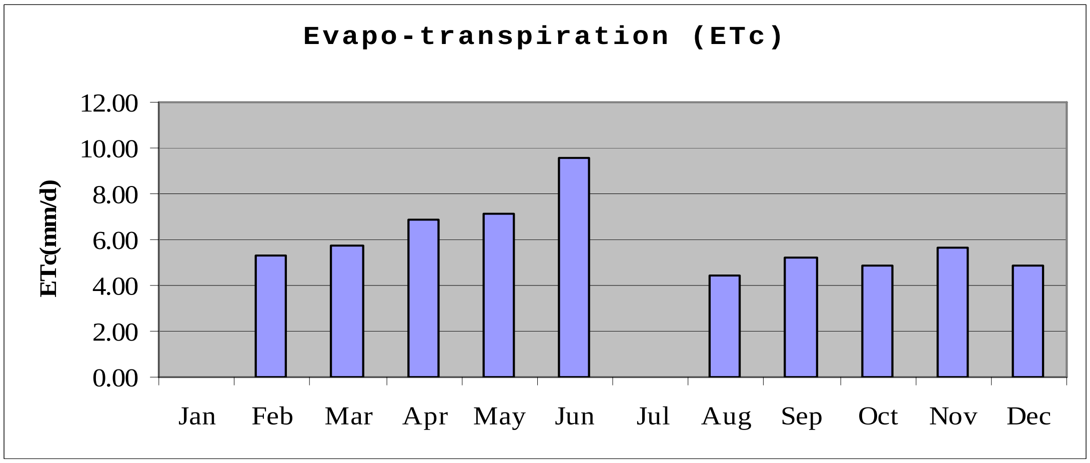


Fig 4.1.5

Percolation

The Percolation was calculated by Eq(2). The Fig 4.1.6 also shown the average monthly percolation recorded in the same station with ETc The percolation is higher in dry season 2.61 mm/d, but only 1.71 mm/d in wet season. This reason could be the deep of ground water level in dry season and in May percolation is high also cause by water supply from reservoir and rainfall.

The value of percolation at 6 stations that was collected is differences cause might by the different of soil type in the command areas.

The highest percolation is observed in February and may in dry season when the climate is hottest in Cambodia. Detailed percolate calculate is provided in Amex 7.

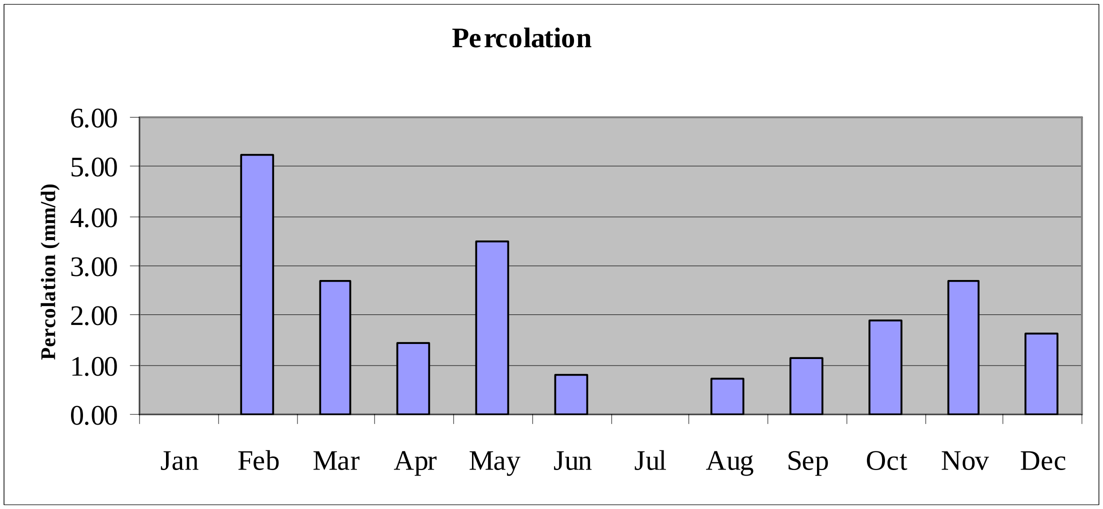


Fig 4.1.6

System Water requirement

Taking all items considered above, system water requirement is calculated by Eq (4) and results are summarized in the Table 4.1.2. The detailed analysis data is attached in annex 8.

Total system water requirements for dry season was estimated at 16.12 MCM (11, 098 m3/ha or 1109.80 mm) at on-farm level. In the wet season, the value is estimated 30.15 MCM (11, 971m3/ha or 1197.10 mm). From the analysis shows that the higher water requirement is in wet season, this due to longer period of rice variety in the wet season (150 days). According to the long period and more water requirement of rice crop in the wet season the Government of Cambodia has a policy to improve from long period of rice (traditional variety150days) to short period (e.g.IR-36, IR 42 etc..) of rice in order to save water, especially the time. Recently, some places already implemented by cultivated short variety (90days) and farmers can be grown 3 times per year.

These values are significantly for making the distribution plan and could not be said it is good or bad, because no previous data or other standard to be compared with. But from the other standard in the region the value has been varies from 10000m³/ha to 15000m³/ha. Therefore we assume that this value could be reasonable for this area.

Table 4.1.2

System Water requirement for rice cropping		Dry season	Wet season
Rice Paddy (MCM)		16.12	30.15
Total	MCM	16.12	30.15
	mm	1109.80	1197.10

Water Requirement and Irrigation Water Supply

Figs 4.1.7 and 4.1.8 shows the daily and weekly water requirement against irrigation water supply for dry and wet seasons. The water supply is calculated at the on-farm level based on the actual flow data at main intake multiply by conveyance efficiency conducted in the project.

In the dry season (Fig 4.1.7), high water requirement is observed at the land preparation stage. At the beginning in the dry season of rice growing land preparation is higher than wet season cause by the hot climate condition. On the other hand in the wet season land preparation is lower than dry because the ground water level is not so deep from the ground surface and soil already saturated.

The peak water requirement is obtained at the beginning of February to End of February, while the lowest value is appeared in development stage from End of February to beginning of March. As compare to irrigation water supply, there is a big gap between required and supplied amount. The water supply is generally higher than supplied amount, particularly from Beginning of February to End of February. The low required by crops in observed, but high supply was made in this period.

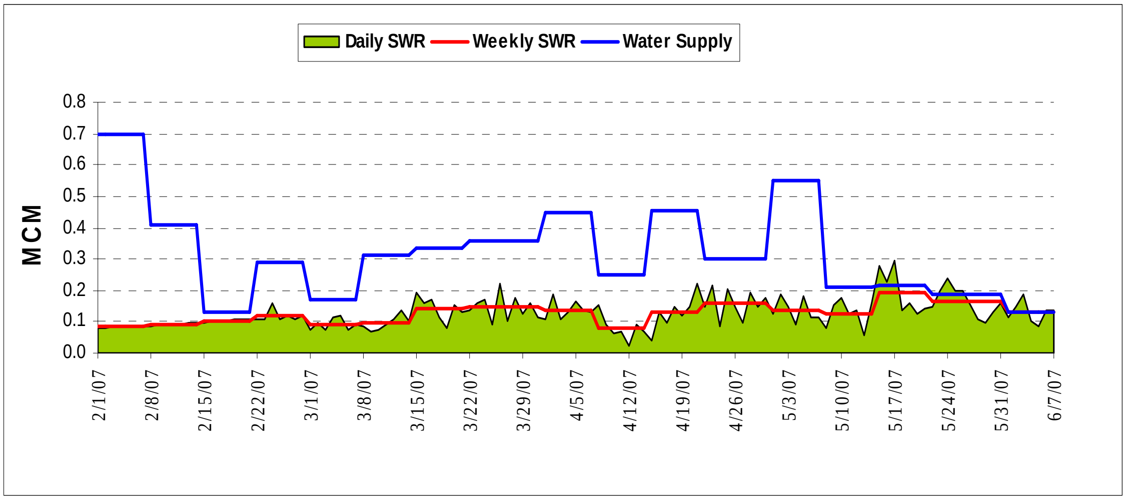


Fig 4.1.7

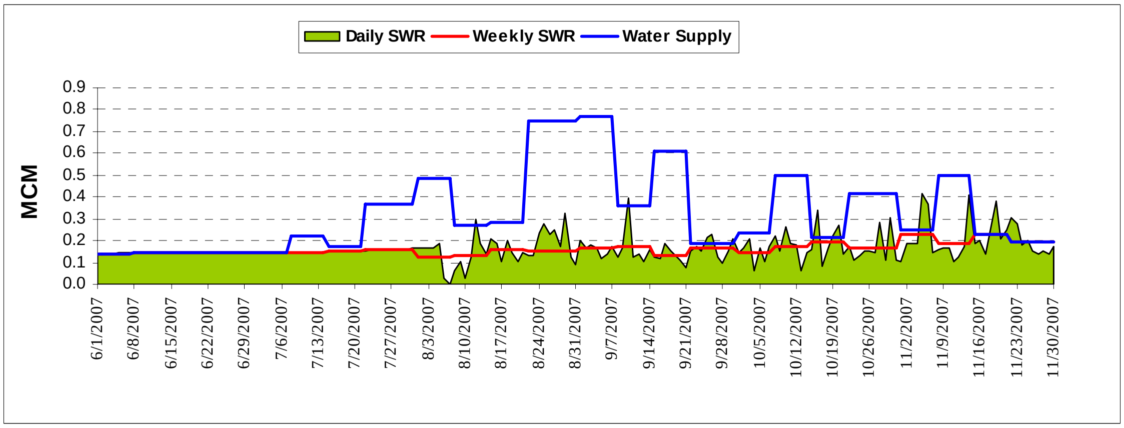


Fig 4.1.8

In the wet season (Fig4.1.8), the estimated water requirement is largely fluctuated. The heavy rainfall affects to the observed value and it is difficult for estimation. The high water requirement is clearly observed, mainly from beginning of August and mid of September.

The irrigation was not supplied for the whole wet season, but as supplementary for land preparation and transplanting stage from June to July. For the rest stages, the supply water is filled mainly by rainfall.

4.2 Water balance

Surface Inflow and Outflows

Figs 4.2.1 & 4.2.2 show the results of flow monitoring in dry and wet seasons conducted at the boundary of command areas as water balance at irrigation scheme level. Two major kinds of flows is clearly identified including inflow from irrigation water delivered main canal and outflow (drainage) from irrigation scheme.

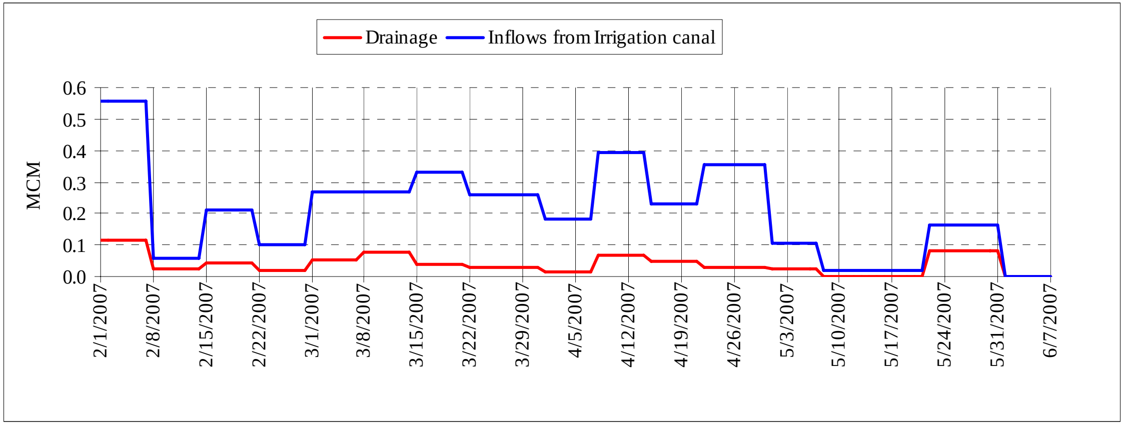


Fig 4.2.1

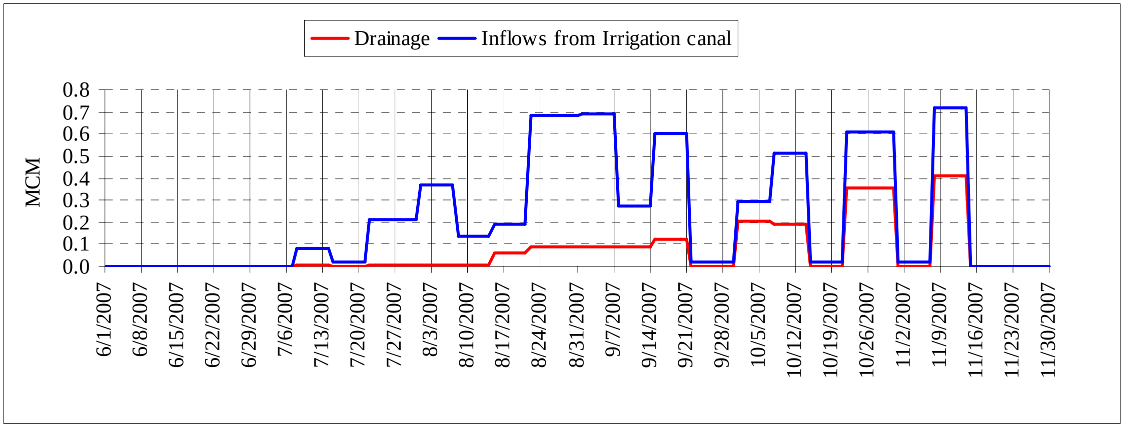


Fig 4.2.2

All of inflow and outflows components and calculation are summarized and detailed in Annex 10

Water available in the scheme

Table **4.2.1** summarized all component of all inflows and outflows of scheme command area for both dry and wet season. In dry season the total inflows are 29.60 MCM and 47.13 MCM in wet season and for total outflow 17.34 MCM in dry season and 33.25 MCM in wet season.

Table 4.2.1

Flows	**Water Balance Component**	**Dry Season (MCM)**	**Wet Season (MCM)**
Inflows	Effective Rainfall	6.10	17.54
	Irrigation from main canal	23.50	29.59
	Total Inflows	**29.60**	**47.13**
Outflows	Evapo-transpriration of paddy	10.24	17.19
	Percolation	3.90	5.78
	Drainage	3.20	10.29
	Total Outflows	**17.34**	**33.25**
Available Water Supply		**12.26**	**13.88**

As a result, the water balance or net available water supply in the scheme is almost the same between dry and wet seasons of 12.26 MCM and 13.88 MCM respectively. These results are sued to calculate water productivity.

4.3 Efficiencies

In this study, the two efficiencies are analyzed i.e. conveyance efficiency and overall-command area efficiency. The analysis results are described as follows.

Conveyance test at selected point along the canals

In order to calculate the conveyance lose test along the canals in the study area, 3 types of canals was selected as follow: Main canal, Secondary canal and Tertiary canal.

1- For the Main canal took 2 places with certain length: with structure (Pk 0+300 to Pk 3+465) and without structure (Pk 7+535 to Pk 8+380).
2- For secondary canal took 2 places: with structure (Pk 2+140) and without structure (Pk 0+020 to Pk 0+530).
3-For Tertiary canal took 2 places: with structure (Pk 1+540) and without structure (Pk 0+33 to Pk 0+482). (See Annex 11)

According to the calculation based on flow measurement and cross section formula, the conveyance lose per kilometer of canals is summarize in the table 4.3.1 and annex 11. As mentioned in the methodology section, the conveyance lose 3 test was conducted only one time in dry season because it is assumed that the value is not so much different between dry and wet season. The detailed analysis of conveyance test is attached in annex 11.

Table 4.3.1 Conveyance test at selected point along the canals

Canal level	**Canal Name**	Length (Km)	Lose/km (m³ /s)
Main Canal	MC	3.165	0.181 (with structure)
Secondary canal		0.845	0.128 (without structure)
	N2	2.120	0.097 (with structure)
		0.510	0.077 (without structure)
Tertiary Canal	M9	1.507	0.202 (with structure)
		0.449	0.071 (without structure)

Rating section curve (H-Q curves)

Flows at the main hydraulic structures are proposed to calibrate. The calibration curve will be useful for flow monitoring when some data is missing. They will be also used as important data for project operation, in particular for water distribution and management. The task is not required labor input since flow data will be obtained from water balance and conveyance lost conducting. These data will be put daily and curves will be produced. The main points of a main intake canal and 2 secondary intake canals are selected to produce H-Q curves.

Three locations were selected to Produce H - Q curves:

1- 10 gates structure
2- Gate N1 (I- 8)
3- Gate N2 (I-18).

The H-Q curve was calculated by the formula and showing in the figure below:

$$Q = \mu.\ S.\ \sqrt{2.g.Z} \quad (6)$$

Q: Discharge (m^3/s)
S: Area of opening gate (m^2)
μ: Discharge Coefficient
g: Gravitational Acceleration 9.81 m/s^2
Z: Head Loss (difference water level upstream and downstream) (m)

Secondary canal N1 and Secondary canal N2 rating curve (H-Q curves)

For Secondary canal N1 and Secondary canal N2, the H-Q curve was calculated by the measurement flow and cross section of these canals from the field.

The detailed result of H-Q curve is provided in the Annex 12.

Conveyance Efficiency

Below formula is used to calculate the Conveyance efficiency**:**

$$\textbf{Conveyance Efficiency (CE)} = \frac{\text{Volume of water delivered by the system}}{\text{Volume of water of diverted into the system}} \times 100$$

According to the above formula, the conveyance efficiency is summarized as table 4.3.2 and annex11.

Table 4.3.2 System Conveyance Efficiency

Canal level	Canal Name	Dry Season Efficiency (%)	Average (%)	Wet Season Efficiency (%)	Average (%)
Main Canal	MC	81.29%	81.29%	72.38%	72.38%
Secondary Canal	N1	82.80%	68.10%	130.60%	95.77%
	N2	53.40%		60.95%	
Tertiary Canal	M9	72.67%	72.67%	72.67%	72.67%
System conveyance efficiency			**74.02%**		**80.27%**

Overall-command area efficiency

Table 4.3.3 summarized the results of overall command areas efficiency based on the below. In order to compute the efficiency, the calculation of water delivered to the fields is necessary. The result of this calculation is also shown in table 4.3.3.The values obtained are not so big different between dry and wet seasons.

The overall command area efficiency (CAE) was calculated by the formula below:

$$\textbf{CAE} = \frac{\text{Total scheme water requirement - Effective rainfall}}{\text{Total water diverted to use}} \text{x } 100$$

The overall command area efficiency was calculated at **86.28**% in dry season and **72.38**% in wet season. These estimated values are generally could not say it is high or low because no data to be compared with.

Summarized and detailed of overall command area efficiency are shown in Annex 13

Table 4.3.3

Overall Command Area Efficiency

Items	Unit	Dry Season	Wet season
Total System Water Requirement (SWR)	MCM	16.120	30.15
Effective Rainfall (ER)	MCM	6.098	17.54
Total diverted water	MCM	23.500	29.59
Total drained water	MCM	3.201	10.29
Conveyance efficiency	%	72.540	84.15
Water delivered to the fields (WDF)	MCM	13.846	14.614
Overall Command Area Efficiency	%	**72.38**	**86.28**

4.4 Water Productivity

Table 4.4.1 shows the estimation of total economic value of production dry and wet seasons. As shown in the Table, yields of dry season are generally higher than wet season. The prices are also higher. As a result, the total production cost is higher although much smaller area of paddy was cultivated.

The net water available water supply is from table 4.1.3 the water productivity is then estimated at US$0.048/m3 in dry season and US$0.060/m3 in wet season.

Summarized and detailed of water productivity are shown in Annex 14

Table 4.4.1

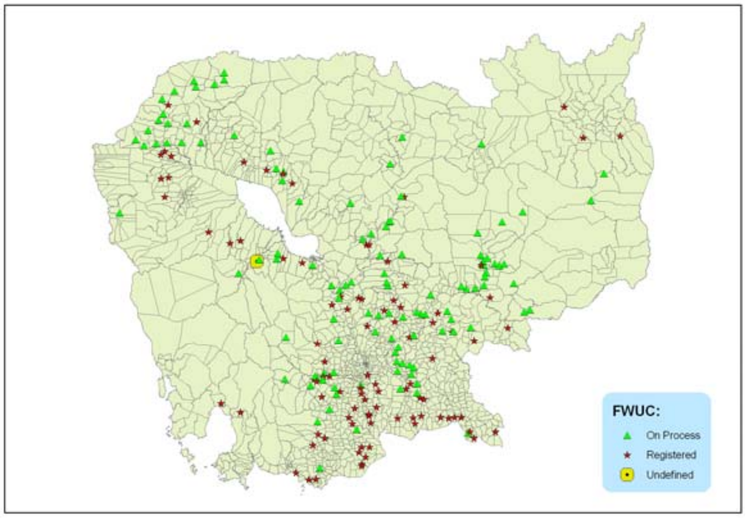
<table>
<tr><th>Item</th><th>Areas (ha)</th><th>Yield (T/ha)</th><th>Price (US$/T)</th><th>Total Cost (US$)</th></tr>
<tr><td colspan="5">Out put of Dry Season</td></tr>
<tr><td>Rice</td><td>1452.5</td><td>3.715</td><td>210</td><td>1,133,167.87</td></tr>
<tr><td colspan="5">Out put of Wet Season</td></tr>
<tr><td>Rice</td><td>2518.37</td><td>3.368</td><td>210</td><td>1,781,192.73</td></tr>
<tr><td rowspan="2">Water Productivity (US$/m3)</td><td colspan="2">Dry Season</td><td colspan="2">Wet season</td></tr>
<tr><td colspan="2">0.048</td><td colspan="2">0.060</td></tr>
</table>

4.5 Project water management appraisal

In Cambodia, irrigation systems cannot guarantee the water storage during the cultivation period because most of them are not fully completed systems. In this condition, the data and information related to the Water use including all scale of irrigation schemes was not yet operated and functioned. It means that the farmers always use water for irrigation free from the schemes without water use planning.

There are several hundred irrigation systems in varying states of operation in Cambodia, mostly small to medium in scale. It is difficult to generalise about system management, because management approaches and effectiveness vary widely. The relative roles of the various provincial authorities (the provincial Department of Water Resources and Meteorology, Ministry of Rural Development(MRD), Ministry of Agriculture Forestry and Fisheries), NGOs, international organisations (IOs), and the farmers themselves also vary. There is a strong push to establish Farmer Water User Communities (FWUC) to take responsibility for management of irrigation systems, and a National Policy on Participatory Irrigation Management and Development has been promulgated. Therefore The RGC recognizes the need for farmers to be involved in irrigation system operation and maintenance in order to ensure the long-term sustainability of systems. FWUC is responsible for operating and maintaining agricultural water supply facilities and managing the supply of water, in compliance with Circular No. 1 of the RGC on the Implementation Policy for Sustainable Irrigation Systems. The Circular and associated draft Irrigation Policy provide, inter alias, for FWUC constitutions, water service fees, and allocation of responsibilities and duties. Recently, in order to strength of water management, the Government of Cambodia has to update Circular No1 and Prokas 306 to be a Sub Decree on Farmer water user community.

According to MOWRAM as of the end of 2007 there are some 328 FWUCs established nationally of which a total of 114 FWUCs have been registered by MOWRAM. Depending upon the source of project support, some water user organizations have been registered at provincial level only. Map below is presenting the localization of FWUCs in Cambodia.



Localization of FWUCs in Cambodia

(a)-Identify stakeholders for decision making on water distribution

The Kamping Pouy irrigation scheme is owned by Battambang PDWRAM under supervision of the MOWRAM. The Farmer Water User Community (FWUC) is responsible for the whole scheme management activities and plays an important role in the operation and maintenance works in consultation with PDWRAM. The organization chart of FWUC is shown in the Annex14. Before every cultivation season, FWUC community organized meeting with the head of WUG to make a plan as follow:

1- Dry Season Rice

- Meeting of Farmer Water User Community Committee of Kamping Pouy Irrigation System and Canal Farmer Water User Group Committees to review, prepare principle and plan for dry season rice Implementation,
- All Canal Farmer Water User Group Committees meets and extends on dry season rice principles and plan to their members,
- Farmer Water User Community Committee of Kamping Pouy Irrigation System and Canal Farmer Water User Group Committees meet and make decision on principle and plan for dry season rice implementation,
- Farmer Water User Community Committee of Kamping Pouy Irrigation System prepare water sharing and distribution calendar and submit to Battambang Provincial Department of Water Resources for decision and approval ,
- Farmer Water User Community Committee of Kamping Pouy Irrigation System and Canal Farmer Water User Group Committees meet and design plan to clear forest, repair and improve all canals consisted in dry season rice Plan
- Farmer Water User Community Committee of Kamping Pouy Irrigation System and Canal Farmer Water User Group Committees meet and review water fee collection service for the season before starting the dry season rice implementation
- Implement the plan

2- Wet Season Rice

- Meeting of Farmer Water User Community Committee of Kamping Pouy Irrigation System and Canal Farmer Water User Group Committees to review, prepare principle and plan for wet season rice Implementation,
- All Canal Farmer Water User Group Committees meets and extends on wet season rice principles and plan to their members,
- Farmer Water User Community Committee of Kamping Pouy Irrigation System and Canal Farmer Water User Group Committees meet and make decision on principle and plan for wet season rice implementation
- Farmer Water User Community Committee of Kamping Pouy Irrigation System prepare water sharing and distribution calendar and submit to Battambang Provincial Department of Water Resources for decision,
- Farmer Water User Community Committee of Kamping Pouy Irrigation System and Canal Farmer Water User Group Committees meet and design plan to clear forest, repair and improve all canals consisted in the system,
- Farmer Water User Community Committee of Kamping Pouy Irrigation System and Canal Farmer Water User Group Committees meet and review water fee collection service for the season before starting the wet season rice implementation,
- Implement the plan

Farmer Water User Community is responsible for service collection of all irrigated system usages by collaborate with local authority and relevant departments. According to FWUC's rule, all members shall pay water service fee. If anyone can not pay for any reasons with approved by stakeholder, FWUC can make decision for this one either not to pay or discount.

1). Service fee Collection determined by types of Rice Yield

a- All members who receive the rice yield over 2.5 t/ha shall pay

- In Wet Season, all members shall pay 20,000 riel/ha.
- In Dry Season, all members shall pay 40,000 riel/ha.

b- If the rice yield is between 2t/ha to 2.5 t/ha, members shall pay

- In Wet Season, all members shall pay 15,000 riel/ha.
- In Dry Season, all members shall pay 30,000 riel/ha.

c- If the rice yield is less than 2t/ha, members shall pay

- In Wet Season, all members shall pay 10,000 riel/ha.
- In Dry Season, all members shall pay 20,000 riel/ha.

2). Rice Field Register

All members shall register their rice field correctly:

- Actual size of rice fields shall pay service that comply with measured size and recognized by FWUC and commune leader,
- Any rice field has hill land that can not grow rice or any unused rice field shall report to FWUC, before starting of service collection of system usages.

3). Family Crisis

During service collection, if there is any member get sick, sick in hospital and get poor or died and family with inability to pay shall be exceptional not to pay for service in one season, if approved by FWUC.

(b) Draw organizational charts of stakeholders

The management organization chart of the Farmer Water User Community (FWUC) and Water User Groups (WUG) in Kamping Pouy irrigation system was plotted into diagram and shown in the Annex 17.

(c) Water allocation rules and practice:

The practice and experiences of operation procedure at Kamping Pouy Irrigation
are based on:

- Seasonal Cropping Calendar
- Seasonal water Distribution
- Seven day Water Distribution

- At the end of wet season, FWUC and WUG prepare a meeting in order to set up water distribution plan,

- After the preparation of water distribution plan, they submit the plan to PDWRAM for approval,

- After approval from PDWRAM, FWUC will inform WUG again about the plan and discussing how to implement it,

- Based on their experiences about water distribution plan, the FWUC has divided water distribution into 8 times for the whole period of rice growing in the dry season (See annex15). This plan is not used in the wet season,

- The water distribution to the main canal and secondary canal is responsible by the FWUC; while the water distribution to the tertiary and quartery canal is responsible by the WUG and Farmers,

- Before distribution of water to the paddy field from the 10 Gate Structure, the FWUC committee has to check the real situation and the requirement from farmers in order to consider how much water can be provided and released to the paddy field.

- After checking, FWUC committee will open the 10 Gate Structure according to the water distribution plan. For Example, in the first time, FWUC committee open 3 gates with 0.2m-height in one week,

- When the water flows into the main and secondary canal, WUGs and farmers start to open the gate in order to collect water into their paddy field by themselves. But these activities also need to be controlled and monitored by FWUC. After that, WUG and farmers will observe the water level in the paddy field and along the tertiary canal based on their traditional practice.

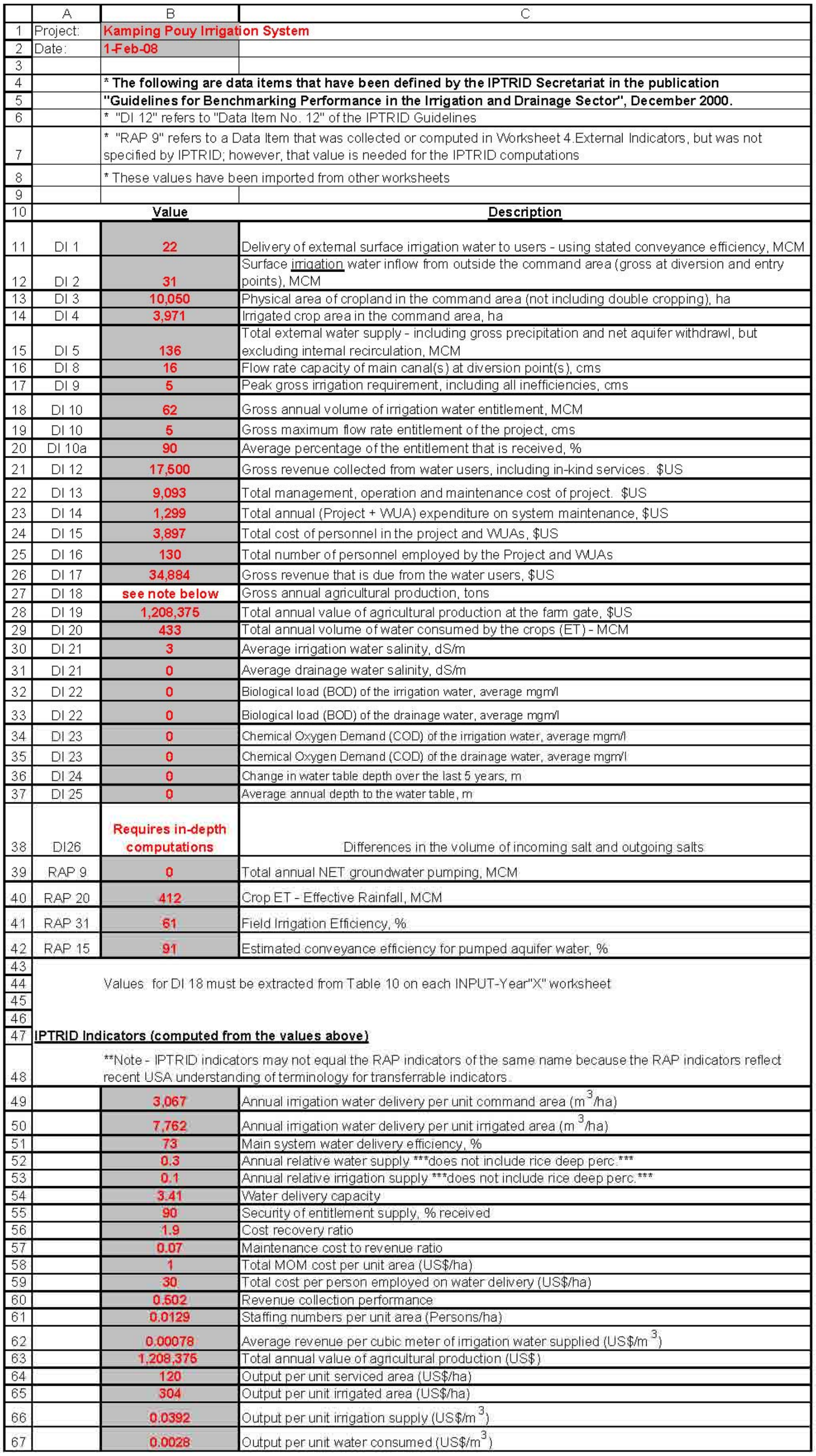
- If there is insufficient water in their paddy field, WUGs will request to the FWUC for additional supplied water through telephone or direct face to face talking. On the other hand, if the water are sufficient in their field, WUGs also report to the FWUC for closing the water gate.

- The main principle of methodology of water sharing or distribution to the paddy field is flowed directly from one field to another field

- Based on their experiences over 4 years, there is no problem or conflict about water allocation or distribution to the rice paddy field in the scheme, recently.

- All members shall contribute for the operation and maintenance of all facilities irrigation system in the tertiary or quartery canal, but for main canal and Secondary canal and all related structures are responsible PDWRAM or MOWRAM
- Upper members should allow water flow to the lower part.
- All committees shall have a water allocation plan,
- The water allocation shall follow according to the water allocation plan and also refer to the meeting,
- The water utilization shall follow to the irrigation condition,
- If the land is not smoothly, higher and far from the water source, this land has a first priority for irrigation,
- When the gate open and water flow to the paddy field, all members should wait and see until water sufficient in the field and also look at the losing of water through the dike,
- The members do not have a right to open the water without permission from the committee

4.6 RAP

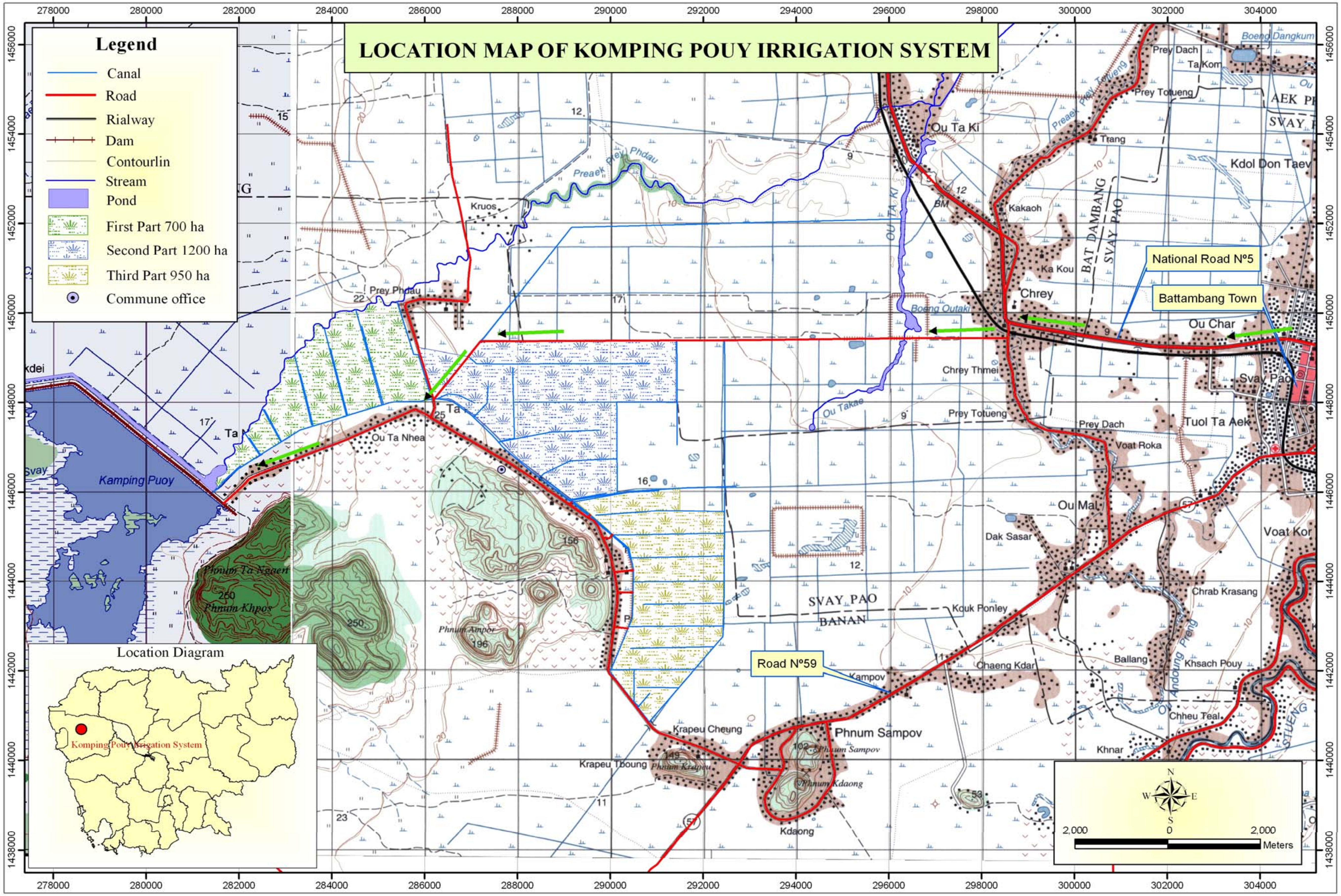


	A	B	C
1	Project:	Kamping Pouy Irrigation System	
2	Date:	1-Feb-08	
3			
4		*** The following are data items that have been defined by the IPTRID Secretariat in the publication**	
5		**"Guidelines for Benchmarking Performance in the Irrigation and Drainage Sector", December 2000.**	
6		* "DI 12" refers to "Data Item No. 12" of the IPTRID Guidelines	
7		* "RAP 9" refers to a Data Item that was collected or computed in Worksheet 4.External Indicators, but was not specified by IPTRID; however, that value is needed for the IPTRID computations	
8		* These values have been imported from other worksheets	
9			
10		**Value**	**Description**
11	DI 1	22	Delivery of external surface irrigation water to users - using stated conveyance efficiency, MCM
12	DI 2	31	Surface irrigation water inflow from outside the command area (gross at diversion and entry points), MCM
13	DI 3	10,050	Physical area of cropland in the command area (not including double cropping), ha
14	DI 4	3,971	Irrigated crop area in the command area, ha
15	DI 5	136	Total external water supply - including gross precipitation and net aquifer withdrawl, but excluding internal recirculation, MCM
16	DI 8	16	Flow rate capacity of main canal(s) at diversion point(s), cms
17	DI 9	5	Peak gross irrigation requirement, including all inefficiencies, cms
18	DI 10	62	Gross annual volume of irrigation water entitlement, MCM
19	DI 10	5	Gross maximum flow rate entitlement of the project, cms
20	DI 10a	90	Average percentage of the entitlement that is received, %
21	DI 12	17,500	Gross revenue collected from water users, including in-kind services. $US
22	DI 13	9,093	Total management, operation and maintenance cost of project. $US
23	DI 14	1,299	Total annual (Project + WUA) expenditure on system maintenance, $US
24	DI 15	3,897	Total cost of personnel in the project and WUAs, $US
25	DI 16	130	Total number of personnel employed by the Project and WUAs
26	DI 17	34,884	Gross revenue that is due from the water users, $US
27	DI 18	see note below	Gross annual agricultural production, tons
28	DI 19	1,208,375	Total annual value of agricultural production at the farm gate, $US
29	DI 20	433	Total annual volume of water consumed by the crops (ET) - MCM
30	DI 21	3	Average irrigation water salinity, dS/m
31	DI 21	0	Average drainage water salinity, dS/m
32	DI 22	0	Biological load (BOD) of the irrigation water, average mgm/l
33	DI 22	0	Biological load (BOD) of the drainage water, average mgm/l
34	DI 23	0	Chemical Oxygen Demand (COD) of the irrigation water, average mgm/l
35	DI 23	0	Chemical Oxygen Demand (COD) of the drainage water, average mgm/l
36	DI 24	0	Change in water table depth over the last 5 years, m
37	DI 25	0	Average annual depth to the water table, m
38	DI26	Requires in-depth computations	Differences in the volume of incoming salt and outgoing salts
39	RAP 9	0	Total annual NET groundwater pumping, MCM
40	RAP 20	412	Crop ET - Effective Rainfall, MCM
41	RAP 31	61	Field Irrigation Efficiency, %
42	RAP 15	91	Estimated conveyance efficiency for pumped aquifer water, %
43			
44		Values for DI 18 must be extracted from Table 10 on each INPUT-Year"X" worksheet	
45			
46			
47	**IPTRID Indicators (computed from the values above)**		
48		**Note - IPTRID indicators may not equal the RAP indicators of the same name because the RAP indicators reflect recent USA understanding of terminology for transferrable indicators.	
49		3,067	Annual irrigation water delivery per unit command area (m^3/ha)
50		7,762	Annual irrigation water delivery per unit irrigated area (m^3/ha)
51		73	Main system water delivery efficiency, %
52		0.3	Annual relative water supply ***does not include rice deep perc.***
53		0.1	Annual relative irrigation supply ***does not include rice deep perc.***
54		3.41	Water delivery capacity
55		90	Security of entitlement supply, % received
56		1.9	Cost recovery ratio
57		0.07	Maintenance cost to revenue ratio
58		1	Total MOM cost per unit area (US$/ha)
59		30	Total cost per person employed on water delivery (US$/ha)
60		0.502	Revenue collection performance
61		0.0129	Staffing numbers per unit area (Persons/ha)
62		0.00078	Average revenue per cubic meter of irrigation water supplied (US$/$m^3$)
63		1,208,375	Total annual value of agricultural production (US$)
64		120	Output per unit serviced area (US$/ha)
65		304	Output per unit irrigated area (US$/ha)
66		0.0392	Output per unit irrigation supply (US$/$m^3$)
67		0.0028	Output per unit water consumed (US$/$m^3$)

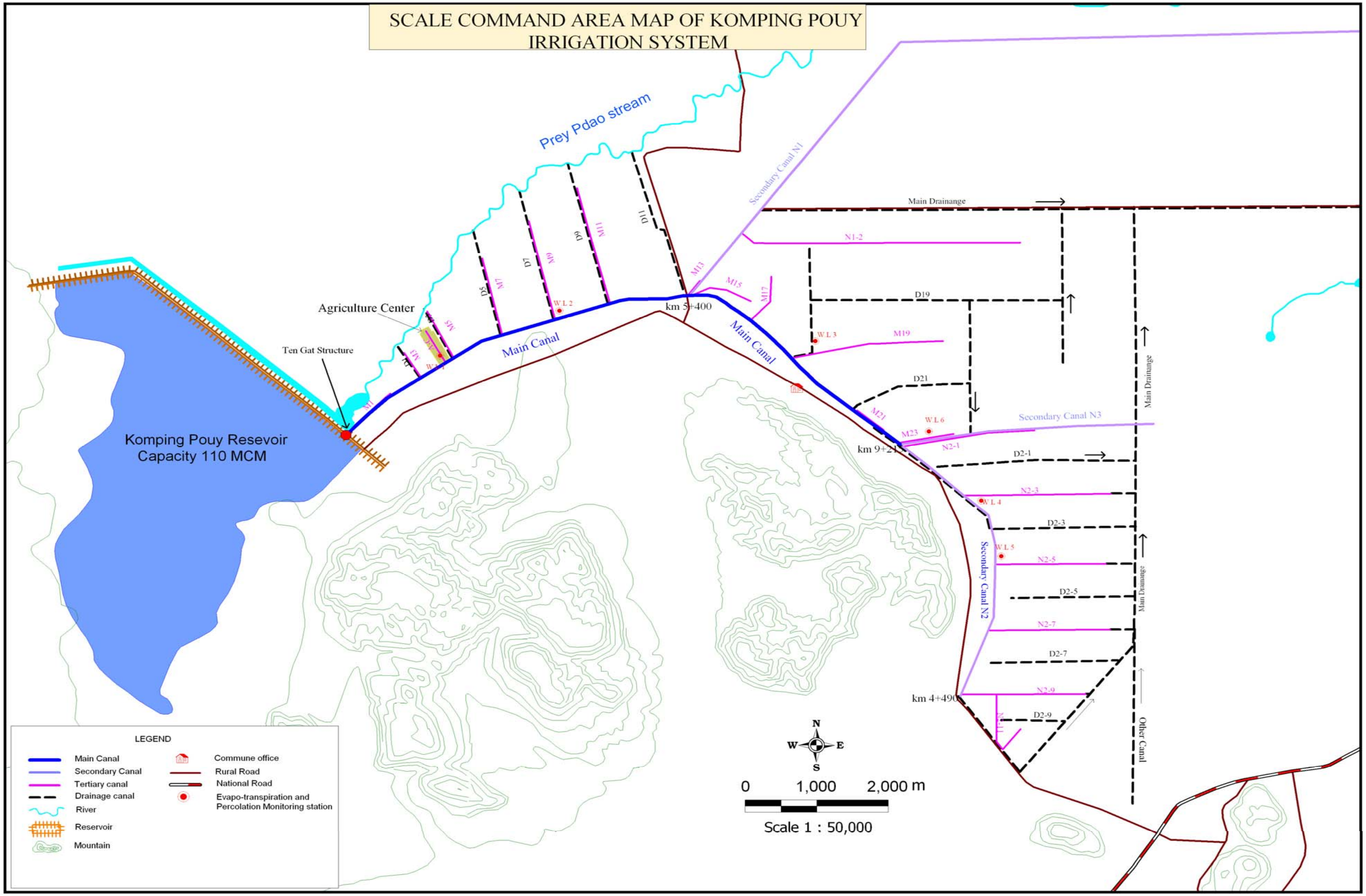
The detailed analysis of RAP is attached in annex 16.

5. Annexes

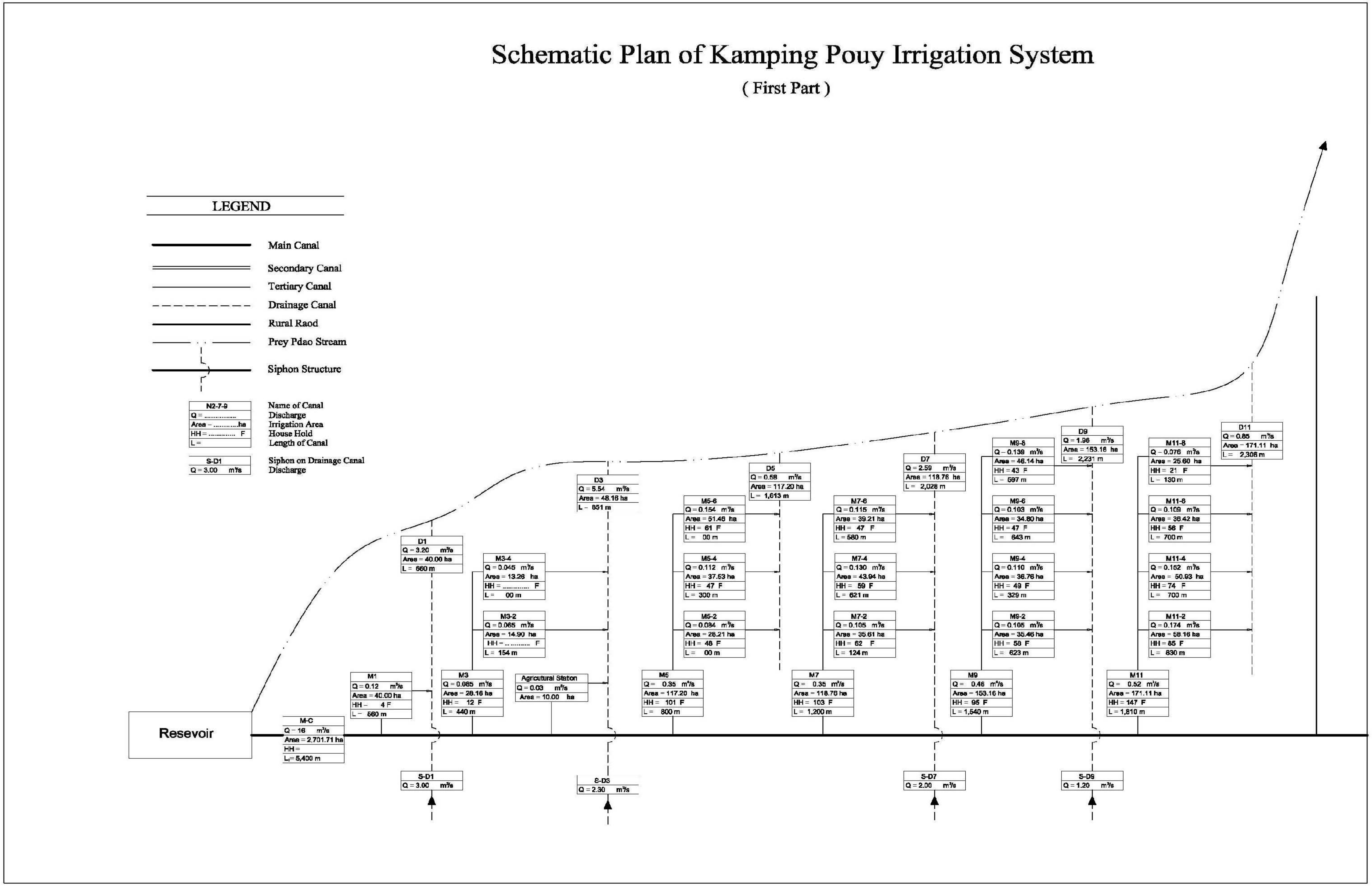
Annex 1. General Location Map of project site



Annex 2. Scale command area map

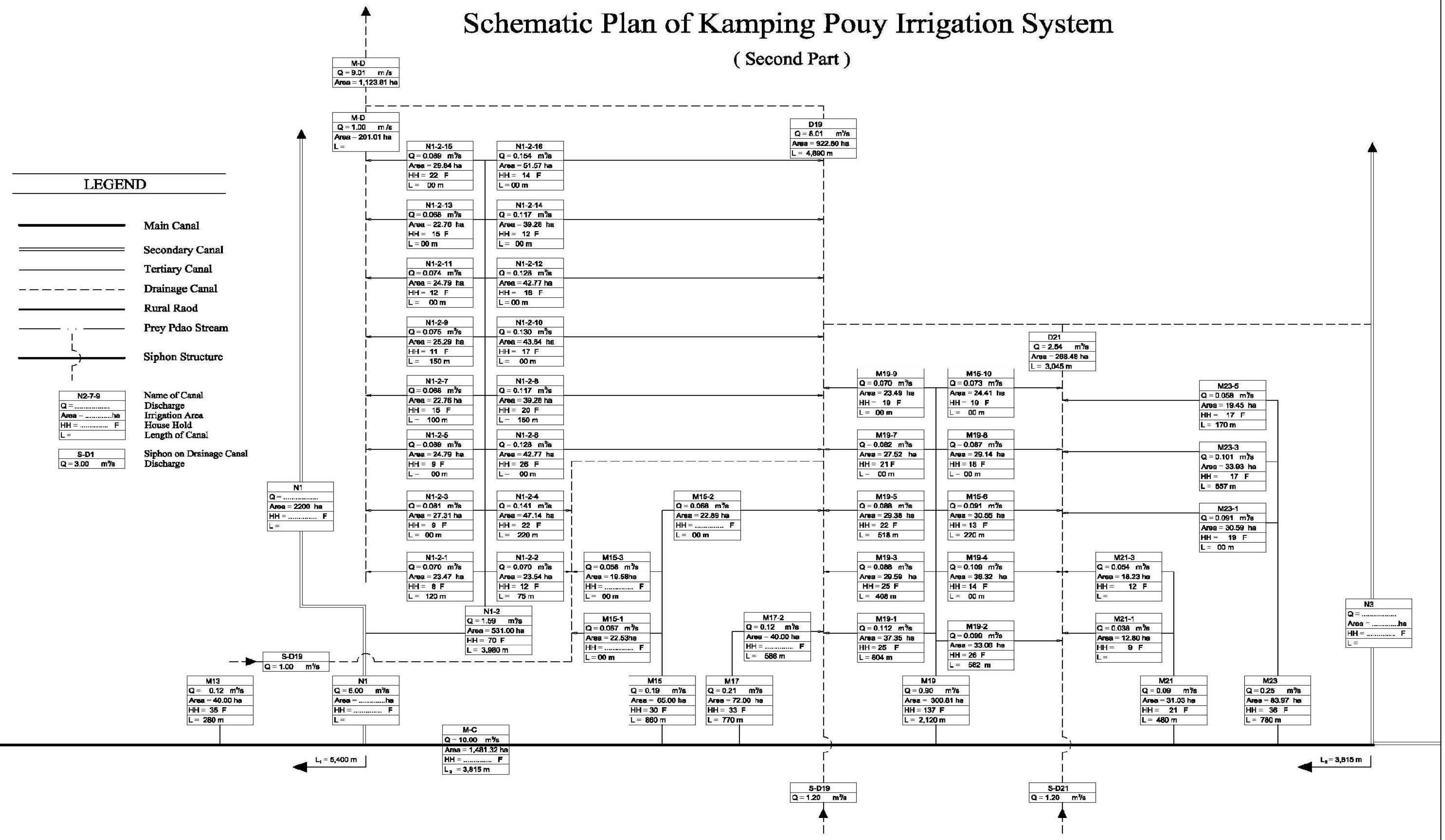


Annex 3. Schematic area Map



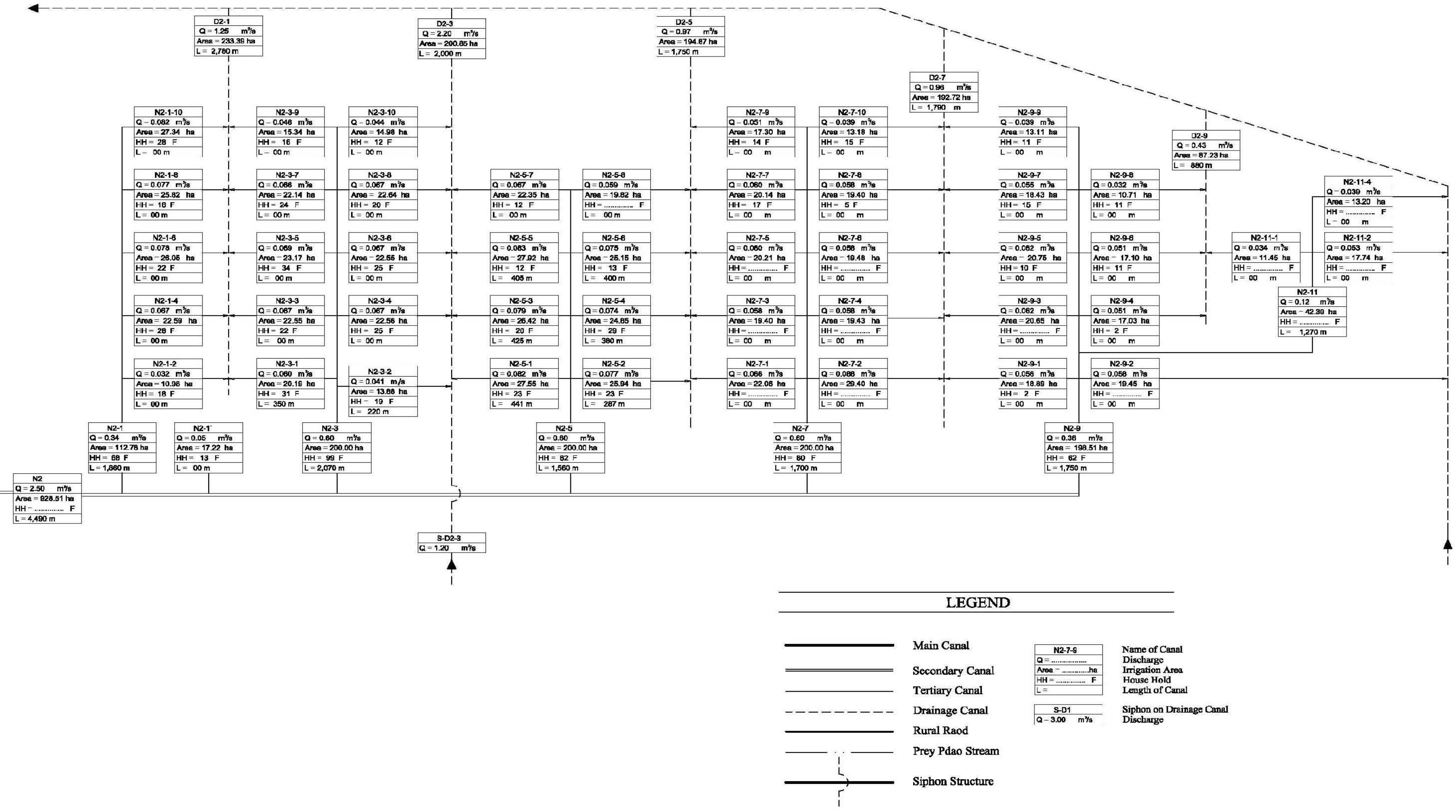
Schematic Plan of Kamping Pouy Irrigation System

(Second Part)

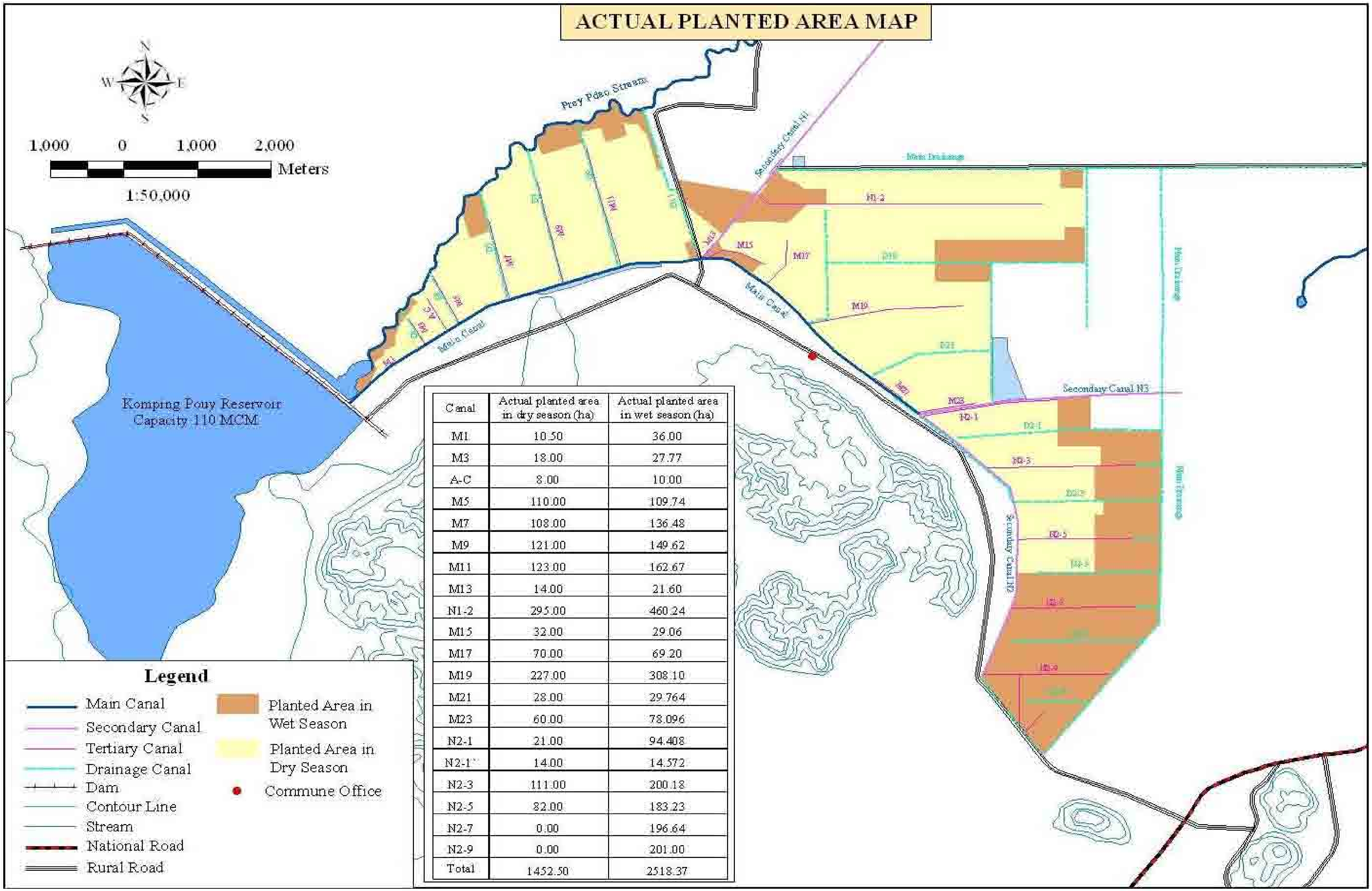


Schematic Plan of Kamping Pouy Irrigation System

(Third Part)



Annex 4. Actual planted area map



Canal	Actual planted area in dry season (ha)	Actual planted area in wet season (ha)
M1	10.50	36.00
M3	18.00	27.77
A-C	8.00	10.00
M5	110.00	109.74
M7	108.00	136.48
M9	121.00	149.62
M11	123.00	162.67
M13	14.00	21.60
N1-2	295.00	460.24
M15	32.00	29.06
M17	70.00	69.20
M19	227.00	308.10
M21	28.00	29.764
M23	60.00	78.096
N2-1	21.00	94.408
N2-1''	14.00	14.572
N2-3	111.00	200.18
N2-5	82.00	183.23
N2-7	0.00	196.64
N2-9	0.00	201.00
Total	1452.50	2518.37

Annex 5. Evaporation (ETo) and Kc

Dry Season 2007

Date	ETc=Kc*ETo			Date	ETc=Kc*ETo		
	ETo	Kc	ETc		ETo	Kc	ETc
	mm		mm		mm		mm
12-Mar-07	6.00	0.9	5.4	25-Apr-07	9.00	1	9.0
13-Mar-07	7.00	0.9	6.3	26-Apr-07	5.00	1	5.0
14-Mar-07	6.00	0.9	5.4	27-Apr-07	6.00	1	6.0
15-Mar-07	7.00	0.9	6.3	28-Apr-07	4.00	1	4.0
16-Mar-07	8.00	0.9	7.2	29-Apr-07	4.00	1	4.0
17-Mar-07	8.00	0.9	7.2	30-Apr-07	4.00	1	4.0
18-Mar-07	7.00	0.9	6.3	1-May-07	4.00	1	4.0
19-Mar-07	2.00	0.9	1.8	2-May-07	N/A	1.1	N/A
20-Mar-07	2.00	0.9	1.8	3-May-07	3.00	1.1	3.3
21-Mar-07	5.00	0.9	4.5	4-May-07	4.00	1.1	4.4
22-Mar-07	5.00	0.9	4.5	5-May-07	8.00	1.1	8.8
23-Mar-07	6.00	0.9	5.4	6-May-07	4.00	1.1	4.4
24-Mar-07	6.00	0.9	5.4	7-May-07	2.00	1.1	2.2
25-Mar-07	6.00	0.9	5.4	8-May-07	4.00	1.1	4.4
26-Mar-07	8.00	0.9	7.2	9-May-07	3.00	1.1	3.3
27-Mar-07	6.00	0.9	5.4	10-May-07	5.00	1.1	5.5
28-Mar-07	8.00	0.9	7.2	11-May-07	10.00	1.1	11.0
29-Mar-07	10.00	0.9	9.0	12-May-07	N/A	1.1	N/A
30-Mar-07	2.00	0.9	1.8	13-May-07	5.00	1.1	5.5
31-Mar-07	6.00	0.9	5.4	14-May-07	0.00	1.1	0.0
1-Apr-07	6.00	0.9	5.4	15-May-07	11.00	1.1	12.1
2-Apr-07	8.00	1	8.0	16-May-07	14.00	1.1	15.4
3-Apr-07	7.00	1	7.0	17-May-07	N/A	1.1	N/A
4-Apr-07	6.00	1	6.0	18-May-07	5.00	1.1	5.5
5-Apr-07	4.00	1	4.0	19-May-07	3.00	1.1	3.3
6-Apr-07	6.00	1	6.0	20-May-07	3.00	1.1	3.3
7-Apr-07	5.00	1	5.0	21-May-07	3.00	1.1	3.3
8-Apr-07	6.00	1	6.0	22-May-07	3.00	1.1	3.3
9-Apr-07	4.00	1	4.0	23-May-07	4.00	1.1	4.4
10-Apr-07	1.00	1	1.0	24-May-07	5.00	1.1	5.5
11-Apr-07	N/A	1	N/A	25-May-07	6.00	1.1	6.6
12-Apr-07	N/A	1	N/A	26-May-07	2.00	1.1	2.2
13-Apr-07	9.00	1	9.0	27-May-07	4.00	1.1	4.4
14-Apr-07	3.00	1	3.0	28-May-07	2.00	1.1	2.2
15-Apr-07	4.00	1	4.0	29-May-07	7.00	1.1	7.7
16-Apr-07	7.00	1	7.0	30-May-07	3.00	1.1	3.3
17-Apr-07	6.00	1	6.0	31-May-07	5.00	1.1	5.5
18-Apr-07	7.00	1	7.0	1-Jun-07	7.00	1.1	7.7
19-Apr-07	5.00	1	5.0	2-Jun-07	4.00	0.95	3.8
20-Apr-07	5.00	1	5.0	3-Jun-07	2.00	0.95	1.9
21-Apr-07	5.00	1	5.0	4-Jun-07	3.00	0.95	2.9
22-Apr-07	5.00	1	5.0	5-Jun-07	3.00	0.95	2.9
23-Apr-07	8.00	1	8.0	6-Jun-07	10.00	0.95	9.5
24-Apr-07	4.00	1	4.0	7-Jun-07	N/A	0.95	N/A
				Average	**5.44 mm/d**		**5.46 mm/d**

Evaporation (ETo) and Kc (Wet Season 2007)

Date	ETc=Kc*ETo			Date	ETc=Kc*ETo		
	ETo	Kc	ETc		ETo	Kc	ETc
	mm		mm		mm		mm
10-Aug-07	5.00	0.85	4.3	4-Oct-07	2.00	1	2.0
11-Aug-07	6.00	0.85	5.1	5-Oct-07	1.00	1	1.0
12-Aug-07	13.00	0.85	11.1	6-Oct-07	3.00	1	3.0
13-Aug-07	8.00	0.85	6.8	7-Oct-07	3.00	1	3.0
14-Aug-07	5.00	0.85	4.3	8-Oct-07	2.00	1	2.0
15-Aug-07	9.00	0.85	7.7	9-Oct-07	2.00	1	2.0
16-Aug-07	N/A	0.85	N/A	10-Oct-07	5.0	1	5.0
17-Aug-07	N/A	0.85	N/A	11-Oct-07	2.00	1	2.0
18-Aug-07	7.00	0.85	6.0	12-Oct-07	6.00	1	6.0
19-Aug-07	7.00	0.85	5.9	13-Oct-07	3.00	1	3.0
20-Aug-07	7.00	0.85	6.0	14-Oct-07	2.00	1	2.0
21-Aug-07	6.00	0.85	5.1	15-Oct-07	2.0	1	2.0
22-Aug-07	5.00	0.85	4.3	16-Oct-07	3.00	1	3.0
23-Aug-07	6.00	0.85	5.1	17-Oct-07	5.00	1	5.0
24-Aug-07	3.00	0.85	2.6	18-Oct-07	2.00	1	2.0
25-Aug-07	7.00	0.85	6.0	19-Oct-07	3.00	1	3.0
26-Aug-07	4.00	0.85	3.4	20-Oct-07	4.00	1	4.0
27-Aug-07	5.00	0.85	4.3	21-Oct-07	4.00	1	4.0
28-Aug-07	8.00	0.85	6.8	22-Oct-07	3.00	1	3.0
29-Aug-07	0.00	0.85	0.0	23-Oct-07	6.00	1	6.0
30-Aug-07	4.00	0.85	3.4	24-Oct-07	2.00	1	2.0
31-Aug-07	0.00	0.85	0.0	25-Oct-07	4.00	1	4.0
1-Sep-07	6.00	0.9	5.4	26-Oct-07	3.00	1	3.0
2-Sep-07	5.00	0.9	4.5	27-Oct-07	2.00	1	2.0
3-Sep-07	5.00	0.9	4.5	28-Oct-07	1.00	1	1.0
4-Sep-07	6.00	0.9	5.4	29-Oct-07	2.00	1	2.0
5-Sep-07	4.00	0.9	3.6	30-Oct-07	8.00	1	8.0
6-Sep-07	5.00	0.9	4.5	31-Oct-07	N/A	1	N/A
7-Sep-07	5.00	0.9	4.5	1-Nov-07	2.00	1.1	2.2
8-Sep-07	5.00	0.9	4.5	2-Nov-07	2.00	1.1	2.2
9-Sep-07	5.0	0.9	4.5	3-Nov-07	2.00	1.1	2.2
10-Sep-07	14.0	0.9	12.6	4-Nov-07	5.00	1.1	5.5
11-Sep-07	10.00	0.9	9.0	5-Nov-07	3.00	1.1	3.3
12-Sep-07	N/A	0.9	N/A	6-Nov-07	5.00	1.1	5.5
13-Sep-07	1.00	0.9	0.9	7-Nov-07	2.00	1.1	2.2
14-Sep-07	1.00	0.9	0.9	8-Nov-07	2.00	1.1	2.2
15-Sep-07	3.00	0.9	2.7	9-Nov-07	4.00	1.1	4.4
16-Sep-07	2.00	0.9	1.8	10-Nov-07	3.00	1.1	3.3
17-Sep-07	4.00	0.9	3.6	11-Nov-07	2.00	1.1	2.2
18-Sep-07	4.00	0.9	3.6	12-Nov-07	1.00	1.1	1.1
19-Sep-07	3.00	0.9	2.7	13-Nov-07	2.00	1.1	2.2
20-Sep-07	2.00	0.9	1.8	14-Nov-07	2.00	1.1	2.2
21-Sep-07	N/A	0.9	N/A	15-Nov-07	2.00	1.1	2.2
22-Sep-07	3.00	0.9	2.7	16-Nov-07	3.00	1.1	3.3
23-Sep-07	3.00	0.9	2.7	17-Nov-07	4.00	1.1	4.4
24-Sep-07	4.00	0.9	3.6	18-Nov-07	3.00	1.1	3.3
25-Sep-07	3.00	0.9	2.7	19-Nov-07	5.00	1.1	5.5
26-Sep-07	4.00	0.9	3.6	20-Nov-07	9.00	1.1	9.9
27-Sep-07	1.00	0.9	0.9	21-Nov-07	4.00	1.1	4.4
28-Sep-07	1.00	0.9	0.9	22-Nov-07	2.00	1.1	2.2
29-Sep-07	7.00	0.9	6.3	23-Nov-07	4.00	1.1	4.4
30-Sep-07	1.0	0.9	0.9	24-Nov-07	2.00	1.1	2.2
1-Oct-07	2.00	1	2.0	25-Nov-07	4.00	1.1	4.4
2-Oct-07	3.00	1	3.0	26-Nov-07	2.00	1.1	2.2
3-Oct-07	3.00	1	3.0	27-Nov-07	3.00	1.1	3.3

Evaporation (ETo) and Kc

Wet Season 2007

Date	ETc=Kc*ETo		
	ETo	Kc	ETc
	mm		mm
28-Nov-07	3.00	1.1	3.3
29-Nov-07	3.00	1.1	3.3
30-Nov-07	3.00	1.1	3.3
1-Dec-07	3.00	0.9	2.7
2-Dec-07	3.00	0.9	2.7
3-Dec-07	2.00	0.9	1.8
4-Dec-07	3.00	0.9	2.7
5-Dec-07	3.00	0.9	2.7
6-Dec-07	1.00	0.9	0.9
7-Dec-07	2.00	0.9	1.8
8-Dec-07	3.00	0.9	2.7
9-Dec-07	6.00	0.9	5.4
10-Dec-07	4.00	0.9	3.6
11-Dec-07	3.00	0.9	2.7
12-Dec-07	3.00	0.9	2.7
13-Dec-07	3.00	0.9	2.7
Average	**3.78 mm/d**		**3.58 mm/d**

Annex 6. Evapo-Transpiration (ETc) **Dry Season 2007**

Date	**ETc** (by measurement)						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	ETc
	mm	mm	mm	mm	mm	mm	mm
23-Feb-07		N/A					N/A
24-Feb-07		N/A					N/A
25-Feb-07		6.0					6.00
26-Feb-07		0.0					0.00
27-Feb-07		N/A					N/A
28-Feb-07		10.0					10.00
1-Mar-07		2.0					2.00
2-Mar-07		3.0					3.00
3-Mar-07		2.0					2.00
4-Mar-07		6.0					6.00
5-Mar-07		N/A					N/A
6-Mar-07		N/A		3.0			3.00
7-Mar-07		6.0		5.0			5.50
8-Mar-07		8.0		6.0	6.0		6.67
9-Mar-07		5.0	5.0	1.0	1.0		3.00
10-Mar-07		6.0	6.0	-90.0	3.0		5.00
11-Mar-07		5.0	4.0	5.0	5.0		4.75
12-Mar-07		5.0	8.0	18.0	4.0		5.67
13-Mar-07		9.0	5.0	7.0	6.0		6.75
14-Mar-07		3.0	5.0	14.0	8.0		7.50
15-Mar-07		8.0	10.0	2.0	10.0		7.50
16-Mar-07		6.0	N/A	16.0	5.0		9.00
17-Mar-07		9.0	N/A	N/A	11.0		10.00
18-Mar-07	8.0	8.0	7.0	1.0	6.0		6.00
19-Mar-07	1.0	1.0	2.0	N/A	2.0		1.50
20-Mar-07	6.0	16.0	N/A	N/A	N/A		11.00
21-Mar-07	4.0	8.0	1.0	N/A	N/A		4.33
22-Mar-07	5.0	4.0	11.0	7.0	7.0		6.80
23-Mar-07	N/A	5.0	0.0	6.0	6.0	N/A	4.25
24-Mar-07	5.0	11.0	2.0	9.0	5.0	N/A	6.40
25-Mar-07	5.0	N/A	7.0	7.0	6.0	7.0	6.40
26-Mar-07	7.0	N/A	8.0	6.0	6.0	N/A	6.75
27-Mar-07	4.0	16.0	5.0	1.0	N/A	N/A	6.50
28-Mar-07	7.0	15.0	2.0	9.0	5.0	N/A	7.60
29-Mar-07	5.0	N/A	8.0	4.0	7.0	N/A	6.00
30-Mar-07	9.0	N/A	9.0	8.0	8.0	N/A	8.50
31-Mar-07	4.0	N/A	6.0	14.0	10.0	10.0	8.80
1-Apr-07	7.0	N/A	9.0	8.0	5.0	N/A	7.25
2-Apr-07	7.0	N/A	11.0	15.0	8.0	N/A	10.25
3-Apr-07	8.0	N/A	8.0	5.0	8.0	10.0	7.80
4-Apr-07	8.0	N/A	7.0	11.0	8.0	N/A	8.50
5-Apr-07	6.0	N/A	13.0	N/A	N/A	N/A	9.50
6-Apr-07	7.0	8.0	4.0	6.0	8.0	N/A	6.60
7-Apr-07	5.0	7.0	4.0	N/A	6.0	10.0	6.40
8-Apr-07	5.0	10.0	9.0	16.0	4.0	0.0	7.33
9-Apr-07	4.0	1.0	5.0	8.0	5.0	5.0	4.67
10-Apr-07	3.0	5.0	8.0	3.0	5.0	5.0	4.83
11-Apr-07	0.0	N/A	4.0	N/A	N/A	N/A	2.00
12-Apr-07	3.0	N/A	2.0	4.0	N/A	0.0	2.25
13-Apr-07	2.0	N/A	8.0	N/A	10.0	7.0	6.75
14-Apr-07	3.0	N/A	10.0	0.0	5.0	5.0	4.60
15-Apr-07	4.0	N/A	1.0	0.0	5.0	5.0	3.00
16-Apr-07	8.0	N/A	11.0	N/A	10.0	5.0	8.50
17-Apr-07	6.0	N/A	8.0	1.0	N/A	5.0	5.00
18-Apr-07	7.0	N/A	8.0	15.0	1.0	N/A	7.75

Date	**ETc** (by measurement)						
	Canal AC	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	ETc
	mm	mm	mm	mm	mm	mm	mm
19-Apr-07	8.0	5.0	9.0	5.0	9.0	N/A	7.20
20-Apr-07	5.0	5.0	4.0	5.0	8.0	5.0	5.33
21-Apr-07	7.0	7.0	11.0	10.0	7.0	5.0	7.83
22-Apr-07	7.0	8.0	5.0	8.0	13.0	5.0	7.67
23-Apr-07	6.0	12.0	N/A	N/A	N/A	15.0	11.00
24-Apr-07	6.0	3.0	2.0	N/A	N/A	N/A	3.67
25-Apr-07	10.0	11.0	12.0	12.0	7.0	7.0	9.83
26-Apr-07	8.0	8.0	10.0	8.0	10.0	5.0	8.17
27-Apr-07	7.0	N/A	8.0	9.0	0.0	5.0	5.80
28-Apr-07	2.0	N/A	N/A	N/A	16.0	14.0	10.67
29-Apr-07	11.0	N/A	7.0	2.0	12.0	N/A	8.00
30-Apr-07	4.0	N/A	16.0	N/A	N/A	N/A	10.00
1-May-07	1.0	N/A	N/A	N/A	2.0	12.0	5.00
2-May-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3-May-07	3.0	5.0	1.0	6.0	N/A	5.0	4.00
4-May-07	7.0	0.0	13.0	11.0	N/A	5.0	7.20
5-May-07	7.0	9.0	4.0	9.0	11.0	6.0	7.67
6-May-07	6.0	4.0	1.0	2.0	7.0	2.0	3.67
7-May-07	3.0	3.0	11.0	6.0	0.0	5.0	4.67
8-May-07	6.0	4.0	N/A	7.0	3.0	N/A	5.00
9-May-07	4.0	1.0	11.0	10.0	5.0	0.0	5.17
10-May-07	8.0	11.0	N/A	N/A	1.0	N/A	6.67
11-May-07	3.0	2.0	8.0	9.0	N/A	13.0	7.00
12-May-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13-May-07	4.0	4.0	0.0	N/A	N/A	N/A	2.67
14-May-07	4.0	5.0	4.0	9.0	6.0	4.0	5.33
15-May-07	6.0	N/A	12.0	12.0	N/A	16.0	11.50
16-May-07	14.0	N/A	14.0	13.0	N/A	11.0	13.00
17-May-07	N/A	N/A	N/A	15.0	N/A	16.0	15.50
18-May-07	10.0	5.0	N/A	11.0	5.0	10.0	8.20
19-May-07	6.0	7.0	N/A	3.0	N/A	5.0	5.25
20-May-07	6.0	6.0	N/A	N/A	N/A	N/A	6.00
21-May-07	9.0	1.0	N/A	8.0	5.0	0.0	4.60
22-May-07	11.0	8.0	N/A	11.0	5.0	0.0	7.00
23-May-07	12.0	9.0	N/A	14.0	10.0	10.0	11.00
24-May-07	15.0	10.0	16.0	15.0	17.0	12.0	13.60
25-May-07	10.0	7.0	9.0	N/A	10.0		9.00
26-May-07	13.0	6.0	12.0	13.0	12.0		11.20
27-May-07	7.0	6.0	8.0	3.0	13.0		7.40
28-May-07	7.0	N/A	N/A	N/A	N/A		7.00
29-May-07	N/A	N/A	3.0	3.0	N/A		3.00
30-May-07	7.0	3.0	12.0	N/A	5.0		6.75
31-May-07	10.0		N/A	N/A	N/A		10.00
1-Jun-07	1.0			13.0			7.00
2-Jun-07	9.0			11.0			10.00
3-Jun-07	9.0			N/A			9.00
4-Jun-07	7.0			N/A			7.00
5-Jun-07	8.0			15.0			11.50
6-Jun-07	13.0			N/A			13.00
7-Jun-07	N/A						N/A
Average	6.45mm/d	6.27 mm/d	7.14 mm/d	7.86mm/d	6.62mm/d	6.85mm/d	**6.88mm/d**
Total ETc							**10.24 MCM**

Evapo-Transpiration (ETc) (Wet Season 2007)

Date	**ETc** (by measurement)						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	ETc
	mm	mm	mm	mm	mm	mm	mm
5-Aug-07					6.0		6.00
6-Aug-07					1.0		1.00
7-Aug-07					0.0		0.00
8-Aug-07					3.0		3.00
9-Aug-07					5.0		5.00
10-Aug-07	2.0				0.0		1.00
11-Aug-07	6.0				4.0		5.00
12-Aug-07	2.0				5.0		3.50
13-Aug-07	2.0				5.0		3.50
14-Aug-07	5.0				5.0		5.00
15-Aug-07	4.0				7.0		5.50
16-Aug-07	N/A				N/A		N/A
17-Aug-07	8.0				3.0		5.50
18-Aug-07	6.0				7.0		6.50
19-Aug-07	7.0			6.0	6.0		6.33
20-Aug-07	5.0			4.0	2.0		3.67
21-Aug-07	6.0			N/A	4.0		5.00
22-Aug-07	5.0			2.0	7.0		4.67
23-Aug-07	6.0			7.0	6.0		6.33
24-Aug-07	2.0			10.0	10.0		7.33
25-Aug-07	6.0			N/A	9.0		7.50
26-Aug-07	4.0		10.0	16.0	9.0	11.0	10.00
27-Aug-07	5.0	4.0	10.0	10.0	8.0	5.0	7.00
28-Aug-07	7.0	0.0	7.0	5.0	9.0	6.0	5.67
29-Aug-07	N/A	10.0	7.0	N/A	N/A	N/A	8.50
30-Aug-07	2.0	6.0	N/A	2.0	5.0	N/A	3.75
31-Aug-07	0.0	3.0	5.0	3.0	2.0	5.0	3.00
1-Sep-07	6.0	N/A	N/A	N/A	N/A	12.0	9.00
2-Sep-07	4.0	5.0	10.0	5.0	4.0	4.0	5.33
3-Sep-07	5.0	4.0	3.0	5.0	5.0	5.0	4.50
4-Sep-07	6.0	7.0	5.0	1.0	5.0	5.0	4.83
5-Sep-07	3.0	6.0	2.0	N/A	4.0	3.0	3.60
6-Sep-07	5.0	4.0	8.0	6.0	8.0	4.0	5.83
7-Sep-07	7.0	5.0	6.0	6.0	10.0	5.0	6.50
8-Sep-07	4.0	6.0	6.0	5.0	7.0	5.0	5.50
9-Sep-07	7.0	6.0	9.0	N/A	N/A	0.0	5.50
10-Sep-07	6.0	16.0	N/A	16.0	N/A	9.0	11.75
11-Sep-07	6.0	4.0	N/A	N/A	N/A	N/A	5.00
12-Sep-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13-Sep-07	4.0	5.0	2.0	N/A	N/A	N/A	3.67
14-Sep-07	5.0	5.0	6.0	N/A	5.0	5.0	5.20
15-Sep-07	5.0	5.0	8.0	5.0	6.0	5.0	5.67
16-Sep-07	3.0	3.0	2.0	6.0	4.0	3.0	3.50
17-Sep-07	3.0	6.0	N/A	N/A	6.0	N/A	5.00
18-Sep-07	6.0	5.0	3.0	N/A	3.0	N/A	4.25
19-Sep-07	4.0	5.0	5.0	2.0	1.0	3.0	3.33
20-Sep-07	5.0	3.0	3.0	N/A	N/A	N/A	3.67
21-Sep-07	N/A	N/A	N/A	N/A	2.0	N/A	2.00
22-Sep-07	4.0	5.0	7.0	5.0	6.0	N/A	5.40
23-Sep-07	7.0	6.0	4.0	6.0	7.0	2.0	5.33
24-Sep-07	5.0	7.0	3.0	5.0	9.0	3.0	5.33
25-Sep-07	5.0	6.0	5.0	6.0	4.0	9.0	5.83
26-Sep-07	6.0	7.0	5.0	5.0	6.0	6.0	5.83
27-Sep-07	3.0	N/A	N/A	8.0	7.0	3.0	5.25
28-Sep-07	2.0	4.0	N/A	N/A	N/A	N/A	3.00

Date	**ETc** (by measurement)						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	ETc
	mm	mm	mm	mm	mm	mm	mm
29-Sep-07	4.0	7.0	3.0	1.0	4.0	1.0	3.33
30-Sep-07	7.0	6.0	4.0	7.0	8.0	4.0	6.00
1-Oct-07	3.0	N/A	N/A	3.0	N/A	8.0	4.67
2-Oct-07	8.0	7.0	N/A	4.0	N/A	2.0	5.25
3-Oct-07	4.0	3.0	N/A	4.0	13.0	9.0	6.60
4-Oct-07	3.0	2.0	2.0	2.0	3.0	2.0	2.33
5-Oct-07	6.0	4.0	4.0	3.0	5.0	4.0	4.33
6-Oct-07	3.0	6.0	0.0	N/A	N/A	N/A	3.00
7-Oct-07	6.0	4.0	5.0	N/A	N/A	N/A	5.00
8-Oct-07	4.0	7.0	2.0	2.0	5.0	2.0	3.67
9-Oct-07	3.0	2.0	4.0	N/A	3.0	2.0	2.80
10-Oct-07	5.0	12.0	5.0	N/A	14.0	16.0	10.40
11-Oct-07	5.0	N/A	N/A	N/A	N/A	N/A	5.00
12-Oct-07	5.0	4.0	N/A	5.0	7.0	3.0	4.80
13-Oct-07	3.0	3.0	4.0	N/A	N/A	0.0	2.50
14-Oct-07	2.0	2.0	N/A	1.0	4.0	2.0	2.20
15-Oct-07	N/A	3.0	N/A	10.0	0.0	N/A	4.33
16-Oct-07	10.0	12.0	N/A	15.0	N/A	N/A	12.33
17-Oct-07	4.0	6.0	N/A	N/A	3.0	N/A	4.33
18-Oct-07	3.0	4.0	N/A	N/A	-1.0	N/A	3.50
19-Oct-07	6.0	6.0	N/A	5.0	N/A	N/A	5.67
20-Oct-07	5.0	9.0	2.0	2.0	N/A	3.0	4.20
21-Oct-07	7.0	4.0	2.0	3.0	N/A	4.0	4.00
22-Oct-07	5.0	7.0	6.0	13.0	N/A	4.0	7.00
23-Oct-07	5.0	3.0	N/A	N/A	N/A	N/A	4.00
24-Oct-07	5.0	5.0	N/A	N/A	3.0	N/A	4.33
25-Oct-07	5.0	6.0	2.0	4.0	7.0	2.0	4.33
26-Oct-07	3.0	10.0	1.0	3.0	4.0	5.0	4.33
27-Oct-07	6.0	4.0	6.0	3.0	1.0	6.0	4.33
28-Oct-07	N/A	N/A	8.0	9.0	8.0	9.0	8.50
29-Oct-07	6.0	3.0	6.0	1.0	4.0	3.0	3.83
30-Oct-07	10.0	14.0	11.0	7.0	6.0	10.0	9.67
31-Oct-07	N/A	1.0	2.0	N/A	0.0	N/A	1.00
1-Nov-07	2.0	3.0	2.0	3.0	4.0	1.0	2.50
2-Nov-07	5.0	2.0		N/A	5.0	2.0	3.50
3-Nov-07	5.0	6.0		14.0	4.0	5.0	6.80
4-Nov-07	8.0	8.0			7.0	11.0	8.50
5-Nov-07	6.0	38.0			N/A	7.0	6.50
6-Nov-07	4.0	13.0			16.0	5.0	9.50
7-Nov-07	8.0	N/A			6.0	5.0	6.33
8-Nov-07	4.0	N/A			5.0	3.0	4.00
9-Nov-07	7.0	N/A			7.0	4.0	6.00
10-Nov-07	5.0	N/A			5.0	7.0	5.67
11-Nov-07	4.0	N/A			5.0		4.50
12-Nov-07	2.0	N/A			N/A		2.00
13-Nov-07	3.0	8.0			1.0		4.00
14-Nov-07	2.0	15.0			11.0		9.33
15-Nov-07	2.0	5.0			N/A		3.50
16-Nov-07	5.0				6.0		4.50
17-Nov-07	6.0				5.0		5.50
18-Nov-07	5.0				8.0		6.50
19-Nov-07	N/A				N/A		N/A
20-Nov-07	N/A				N/A		N/A
21-Nov-07	10.0				7.0		8.50
22-Nov-07	14.0				4.0		9.00
23-Nov-07	N/A				4.0		4.00
24-Nov-07	3.0				8.0		5.50

Date	**ETc** (by measurement)						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	ETc
	mm	mm	mm	mm	mm	mm	mm
25-Nov-07	7.0				4.0		5.50
26-Nov-07	6.0				8.0		7.00
27-Nov-07	4.0				4.0		4.00
28-Nov-07	7.0				6.0		6.50
29-Nov-07	4.0				5.0		4.50
30-Nov-07	3.0				5.0		4.00
1-Dec-07	6.0				5.0		5.50
2-Dec-07	3.0				5.0		4.00
3-Dec-07	4.0				2.0		3.00
4-Dec-07	8.0				5.0		6.50
5-Dec-07	3.0				5.0		4.00
6-Dec-07	4.0				5.0		4.50
7-Dec-07	6.0				3.0		4.50
8-Dec-07	4.0				5.0		4.50
9-Dec-07	6.0				5.0		5.50
10-Dec-07	5.0				5.0		5.00
11-Dec-07	5.0				5.0		5.00
12-Dec-07	4.0				5.0		4.50
13-Dec-07	4.0				5.0		4.50
Average	4.91mm/d	5.73mm/d	4.83mm/d	5.62mm/d	5.33mm/d	4.89mm/d	**5.11mm/d**
Total ETc							**17.19MCM**

Annex 7. Deep Percolation **(Dry Season 2007)**

Date	Deep percolation						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	Average
	mm	mm	mm	mm	mm	mm	mm
23-Feb-07		N/A					N/A
24-Feb-07		9.0					9.00
25-Feb-07		N/A					N/A
26-Feb-07		10.0					10.00
27-Feb-07		2.0					2.00
28-Feb-07		0.0					0.00
1-Mar-07		3.0					3.00
2-Mar-07		4.0					4.00
3-Mar-07		N/A					N/A
4-Mar-07		N/A					N/A
5-Mar-07		N/A					N/A
6-Mar-07		N/A		2.0			2.00
7-Mar-07		N/A		1.0			1.00
8-Mar-07		N/A		0.0	-1.0		-0.50
9-Mar-07		N/A	2.0	2.0	0.0		1.33
10-Mar-07		N/A	N/A	0.0	0.0		0.00
11-Mar-07		-1.0	2.0	5.0	0.0		1.50
12-Mar-07		2.0	1.0	N/A	3.0		2.00
13-Mar-07		7.0	N/A	N/A	0.0		3.50
14-Mar-07		N/A	0.0	0.0	N/A		0.00
15-Mar-07		N/A	N/A	7.0	N/A		7.00
16-Mar-07		N/A	N/A	N/A	N/A		N/A
17-Mar-07		N/A	N/A	N/A	N/A		N/A
18-Mar-07	N/A	N/A	2.0	N/A	N/A		2.00
19-Mar-07	N/A	N/A	-1.0	9.0	N/A		4.00
20-Mar-07	N/A	0.0	N/A	N/A	N/A		0.00
21-Mar-07	N/A	N/A	4.0	9.0	2.0		5.00
22-Mar-07	N/A	3.0	N/A	N/A	N/A		3.00
23-Mar-07	N/A	N/A	7.0	N/A	N/A	N/A	7.00
24-Mar-07	1.0	8.0	4.0	9.0	N/A	N/A	5.50
25-Mar-07	N/A	N/A	0.0	N/A	N/A	0.0	0.00
26-Mar-07	N/A	N/A	N/A	9.0	N/A	N/A	9.00
27-Mar-07	N/A	N/A	1.0	0.0	1.0	N/A	0.67
28-Mar-07	N/A	N/A	4.0	N/A	5.0	N/A	4.50
29-Mar-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30-Mar-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
31-Mar-07	N/A	N/A	-1.0	N/A	N/A	-6.0	-1.00
1-Apr-07	N/A	N/A	1.0	N/A	-1.0	N/A	0.00
2-Apr-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3-Apr-07	N/A	N/A	-1.0	N/A	N/A	0.0	-0.50
4-Apr-07	1.0	N/A	1.0	N/A	N/A	0.0	0.67
5-Apr-07	2.0	N/A	N/A	N/A	N/A	N/A	2.00
6-Apr-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7-Apr-07	N/A	N/A	N/A	N/A	-1.0	N/A	-1.00
8-Apr-07	N/A	10.0	N/A	1.0	0.0	2.0	3.25
9-Apr-07	N/A	2.0	N/A	1.0	1.0	3.0	1.75
10-Apr-07	-1.0	N/A	N/A	N/A	-1.0	0.0	-0.67
11-Apr-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12-Apr-07	N/A	N/A	N/A	N/A	-1.0	0.0	-0.50
13-Apr-07	N/A	N/A	N/A	N/A	-1.0	0.0	-0.50
14-Apr-07	N/A	N/A	N/A	0.0	N/A	N/A	0.00
15-Apr-07	0.0	N/A	-1.0	0.0	N/A	0.0	-0.25

Date	Deep percolation						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	Average
	mm	mm	mm	mm	mm	mm	mm
16-Apr-07	0.0	N/A	N/A	1.0	N/A	N/A	0.50
17-Apr-07	2.0	N/A	N/A	1.0	N/A	N/A	1.50
18-Apr-07	3.0	N/A	0.0	N/A	4.0	N/A	2.33
19-Apr-07	1.0	N/A	N/A	N/A	N/A	N/A	1.00
20-Apr-07	5.0	N/A	N/A	N/A	N/A	-2.0	5.00
21-Apr-07	6.0	N/A	9.0	10.0	N/A	5.0	7.50
22-Apr-07	3.0	N/A	N/A	N/A	N/A	2.0	2.50
23-Apr-07	2.0	5.0	N/A	N/A	N/A	5.0	4.00
24-Apr-07	-1.0	9.0	N/A	N/A	N/A	5.0	2.00
25-Apr-07	-1.0	10.0	N/A	2.0	5.0	5.0	4.20
26-Apr-07	1.0	0.0	N/A	N/A	N/A	5.0	2.00
27-Apr-07	N/A	N/A	1.0	N/A	2.0	0.0	1.00
28-Apr-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29-Apr-07	N/A	N/A	N/A	2.0	N/A	N/A	2.00
30-Apr-07	N/A	N/A	2.0	-2.0	N/A	N/A	2.00
1-May-07	2.0	N/A	N/A	72.0	N/A	5.0	3.50
2-May-07	N/A	N/A	N/A	10.0	2.0	N/A	6.00
3-May-07	6.0	N/A	N/A	N/A	N/A	N/A	6.00
4-May-07	N/A	N/A	N/A	-1.0	N/A	N/A	-1.00
5-May-07	N/A	N/A	N/A	N/A	N/A	5.0	5.00
6-May-07	10.0	N/A	1.0	0.0	N/A	5.0	4.00
7-May-07	N/A	N/A	N/A	2.0	3.0	5.0	3.33
8-May-07	N/A	N/A	N/A	N/A	1.0	0.0	0.50
9-May-07	8.0	N/A	N/A	N/A	3.0	N/A	5.50
10-May-07	8.0	N/A	2.0	2.0	9.0	N/A	5.25
11-May-07	3.0	N/A	0.0	N/A	N/A	N/A	1.50
12-May-07	N/A	N/A	N/A	N/A	1.0	4.0	2.50
13-May-07	6.0	1.0	1.0	N/A	-1.0	0.0	1.40
14-May-07	5.0	N/A	6.0	N/A	3.0	8.0	5.50
15-May-07	8.0	N/A	N/A	7.0	N/A	N/A	7.50
16-May-07	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17-May-07	N/A	N/A	N/A	N/A	7.0	3.0	5.00
18-May-07	N/A	N/A	N/A	1.0	N/A	N/A	1.00
19-May-07	N/A	N/A	N/A	4.0	N/A	7.0	5.50
20-May-07	-1.0	N/A	N/A	5.0	3.0	3.0	2.50
21-May-07	N/A	N/A	N/A	N/A	N/A	5.0	5.00
22-May-07	1.0	N/A	N/A	N/A	N/A	5.0	3.00
23-May-07	0.0	N/A	N/A	N/A	N/A	5.0	2.50
24-May-07	-1.0	N/A	N/A	5.0	5.0	N/A	3.00
25-May-07	2.0	N/A	N/A	N/A	7.0		4.50
26-May-07	-1.0	N/A	N/A	1.0	8.0		2.67
27-May-07	1.0	N/A	N/A	10.0	-1.0		3.33
28-May-07	-1.0	N/A	N/A	N/A	2.0		0.50
29-May-07	2.0	N/A	0.0	6.0	6.0		3.50
30-May-07	2.0	0.0	5.0	N/A	N/A		2.33
31-May-07	1.0		N/A	N/A	N/A		1.00
1-Jun-07	1.0			N/A			1.00
2-Jun-07	0.0			N/A			0.00
3-Jun-07	N/A			4.0			4.00
4-Jun-07	0.0			N/A			0.00

Date	**Deep percolation**						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	Average
	mm	mm	mm	mm	mm	mm	mm
5-Jun-07	-1.0			N/A			-1.00
6-Jun-07	N/A			N/A			N/A
7-Jun-07	N/A						N/A
Average	2.13mm/d	3.95mm/d	1.86mm/d	3.53mm/d	2.14mm/d	3.07mm/d	**2.62mm/d**
Total Perc							**3.90 MCM**

Deep Percolation (Wet Season 2007)

Date	Deep percolation						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	Average
	mm	mm	mm	mm	mm	mm	mm
5-Aug-07					N/A		N/A
6-Aug-07					-1.0		-1.00
7-Aug-07					-1.0		-1.00
8-Aug-07					-1.0		-1.00
9-Aug-07					-1.0		-1.00
10-Aug-07	-1.0				0.0		-0.50
11-Aug-07	N/A				0.0		0.00
12-Aug-07	9.0				N/A		9.00
13-Aug-07	8.0				0.0		4.00
14-Aug-07	1.0				0.0		0.50
15-Aug-07	3.0				N/A		3.00
16-Aug-07	6.0				-1.0		2.50
17-Aug-07	N/A				1.0		-1.50
18-Aug-07	3.0				0.0		1.50
19-Aug-07	N/A			0.0	-1.0		-0.50
20-Aug-07	2.0			-1.0	0.0		0.33
21-Aug-07	0.0			2.0	0.0		0.67
22-Aug-07	1.0			0.0	1.0		0.67
23-Aug-07	-1.0			-2.0	-1.0		-1.00
24-Aug-07	2.0			2.0	2.0		2.00
25-Aug-07	1.0			6.0	N/A		3.50
26-Aug-07	-1.0		N/A	N/A	N/A	N/A	-1.00
27-Aug-07	1.0	9.0	N/A	N/A	N/A	-1.0	3.00
28-Aug-07	-1.0	2.0	3.0	N/A	N/A	1.0	1.25
29-Aug-07	3.0	8.0	N/A	2.0	N/A	N/A	4.33
30-Aug-07	1.0	N/A	1.0	N/A	-1.0	4.0	1.25
31-Aug-07	N/A	N/A	0.0	N/A	1.0	N/A	0.50
1-Sep-07	N/A	-1.0	N/A	N/A	N/A	-1.0	-1.00
2-Sep-07	N/A	N/A	1.0	N/A	-1.0	4.0	1.33
3-Sep-07	N/A	1.0	7.0	N/A	0.0	N/A	2.67
4-Sep-07	N/A	0.0	5.0	N/A	N/A	0.0	1.67
5-Sep-07	0.0	1.0	1.0	N/A	0.0	3.0	1.00
6-Sep-07	-1.0	-1.0	0.0	N/A	N/A	1.0	-0.25
7-Sep-07	N/A	0.0	1.0	N/A	N/A	N/A	0.50
8-Sep-07	0.0	-1.0	N/A	N/A	N/A	N/A	-0.50
9-Sep-07	N/A	1.0	N/A	N/A	N/A	N/A	1.00
10-Sep-07	0.0	N/A	N/A	N/A	N/A	8.0	4.00
11-Sep-07	-1.0	2.0	-1.0	N/A	N/A	N/A	0.00
12-Sep-07	N/A	N/A	-1.0	N/A	N/A	2.0	0.50
13-Sep-07	N/A	0.0	1.0	0.0	N/A	1.0	0.50
14-Sep-07	0.0	1.0	4.0	N/A	1.0	0.0	1.20
15-Sep-07	-1.0	-1.0	-1.0	N/A	N/A	0.0	-0.75
16-Sep-07	3.0	1.0	3.0	N/A	0.0	-1.0	1.20
17-Sep-07	9.0	2.0	-1.0	N/A	N/A	0.0	2.50
18-Sep-07	8.0	1.0	3.0	-1.0	0.0	0.0	1.83
19-Sep-07	4.0	N/A	N/A	0.0	N/A	N/A	2.00
20-Sep-07	-1.0	1.0	N/A	N/A	N/A	N/A	0.67
21-Sep-07	3.0	-1.0	N/A	N/A	N/A	N/A	1.00
22-Sep-07	0.0	3.0	1.0	N/A	-1.0	N/A	0.75
23-Sep-07	0.0	0.0	0.0	N/A	-1.0	9.0	1.60
24-Sep-07	0.0	0.0	0.0	N/A	N/A	3.0	0.75
25-Sep-07	4.0	-1.0	10.0	N/A	1.0	0.0	2.80

Date	Deep percolation						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	Canal M23	Average
	mm	mm	mm	mm	mm	mm	mm
26-Sep-07	2.0	N/A	N/A	9.0	-1.0	3.0	3.25
27-Sep-07	0.0	-1.0	N/A	1.0	N/A	-1.0	-0.25
28-Sep-07	2.0	0.0	0.0	3.0	-1.0	1.0	0.83
29-Sep-07	1.0	N/A	3.0	6.0	1.0	2.0	2.60
30-Sep-07	N/A	3.0	1.0	4.0	N/A	1.0	2.25
1-Oct-07	0.0	0.0	N/A	N/A	1.0	3.0	1.00
2-Oct-07	N/A	-1.0	N/A	-1.0	5.0	2.0	1.25
3-Oct-07	0.0	3.0	N/A	0.0	N/A	4.0	1.75
4-Oct-07	0.0	0.0	2.0	N/A	N/A	-1.0	0.25
5-Oct-07	0.0	1.0	9.0	N/A	N/A	-1.0	2.25
6-Oct-07	1.0	N/A	N/A	N/A	N/A	N/A	1.00
7-Oct-07	1.0	5.0	N/A	0.0	N/A	2.0	2.00
8-Oct-07	N/A	N/A	N/A	10.0	N/A	0.0	5.00
9-Oct-07	N/A	0.0	N/A	N/A	1.0	9.0	3.33
10-Oct-07	N/A	0.0	N/A	N/A	N/A	N/A	0.00
11-Oct-07	N/A	0.0	N/A	6.0	N/A	1.0	2.33
12-Oct-07	N/A	N/A	3.0	4.0	N/A	0.0	2.33
13-Oct-07	N/A	0.0	N/A	N/A	0.0	0.0	0.00
14-Oct-07	6.0	N/A	N/A	N/A	-1.0	6.0	3.67
15-Oct-07	N/A	4.0	N/A	N/A	0.0	N/A	2.00
16-Oct-07	2.0	0.0	N/A	N/A	N/A	N/A	1.00
17-Oct-07	N/A	-1.0	N/A	N/A	N/A	N/A	-1.00
18-Oct-07	N/A	3.0	N/A	N/A	N/A	N/A	3.00
19-Oct-07	3.0	N/A	N/A	N/A	N/A	N/A	3.00
20-Oct-07	6.0	N/A	N/A	N/A	N/A	7.0	6.50
21-Oct-07	N/A	1.0	N/A	N/A	N/A	2.0	1.50
22-Oct-07	-1.0	-1.0	N/A	N/A	N/A	2.0	0.00
23-Oct-07	0.0	1.0	N/A	N/A	N/A	N/A	0.50
24-Oct-07	-1.0	3.0	N/A	N/A	N/A	N/A	1.00
25-Oct-07	0.0	1.0	N/A	6.0	N/A	0.0	1.75
26-Oct-07	2.0	N/A	N/A	N/A	4.0	-1.0	1.67
27-Oct-07	N/A	-1.0	N/A	N/A	2.0	3.0	1.33
28-Oct-07	N/A	4.0	N/A	N/A	2.0	2.0	2.67
29-Oct-07	N/A	2.0	N/A	N/A	-1.0	1.0	0.67
30-Oct-07	N/A	N/A	N/A	N/A	0.0	5.0	2.50
31-Oct-07	0.0	N/A	N/A	9.0	N/A	1.0	3.33
1-Nov-07	3.0	0.0	N/A	3.0	0.0	2.0	1.60
2-Nov-07	3.0	1.0		N/A	N/A	8.0	4.00
3-Nov-07	1.0	2.0		N/A	N/A	-1.0	0.67
4-Nov-07	N/A	-1.0			N/A	N/A	-1.00
5-Nov-07	10.0	N/A			N/A	4.0	10.00
6-Nov-07	N/A	N/A			N/A	5.0	5.00
7-Nov-07	N/A	N/A			-1.0	0.0	-0.50
8-Nov-07	1.0	N/A			0.0	6.0	2.33
9-Nov-07	N/A	N/A			0.0	1.0	0.50
10-Nov-07	0.0	N/A			3.0	0.0	1.00
11-Nov-07	-1.0	N/A			0.0		-0.50
12-Nov-07	0.0	N/A			6.0		3.00
13-Nov-07	2.0	N/A			4.0		3.00
14-Nov-07	7.0	N/A			N/A		7.00
15-Nov-07	2.0	0.0			10.0		4.00

Date	Deep percolation						
	Canal A-C	Canal M9-2	Canal M19-1	Canal N2-3-2	Canal N2-5-1	CanalM23	Average
	mm	mm	mm	mm	mm	mm	mm
16-Nov-07	-1.0				8.0		3.50
17-Nov-07	0.0				N/A		0.00
18-Nov-07	3.0				N/A		3.00
19-Nov-07	10.0				N/A		10.00
20-Nov-07	N/A				3.0		3.00
21-Nov-07	0.0				3.0		1.50
22-Nov-07	N/A				4.0		3.00
23-Nov-07	N/A				3.0		7.00
24-Nov-07	N/A				N/A		N/A
25-Nov-07	4.0				1.0		2.50
26-Nov-07	-1.0				N/A		-1.00
27-Nov-07	3.0				0.0		1.50
28-Nov-07	-1.0				0.0		-0.50
29-Nov-07	1.0				N/A		1.00
30-Nov-07	3.0				N/A		3.00
1-Dec-07	3.0				0.0		1.50
2-Dec-07	4.0				N/A		4.00
3-Dec-07	0.0				1.0		0.50
4-Dec-07	N/A				N/A		N/A
5-Dec-07					-1.0		-1.00
6-Dec-07					N/A		N/A
7-Dec-07					N/A		N/A
8-Dec-07					5.0		5.00
9-Dec-07					N/A		N/A
10-Dec-07					2.0		2.00
11-Dec-07					N/A		N/A
12-Dec-07					-1.0		-1.00
13-Dec-07					N/A		N/A
Average	1.80 mm/d	1.02 mm/d	2.04 mm/d	2.92 mm/d	0.89 mm/d	2.02mm/d	**1.72mm/d**
Total Perc							**5.78 MCM**

Annex 8. Water Requirement **Dry Season 2007**

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
1-Feb-07	5.60	6.88	2.62	15.10	1452.5	0	81,340
2-Feb-07	5.60	6.88	2.62	15.10	1429.8	23	82,224
3-Feb-07	5.60	6.88	2.62	15.10	1407.1	45	83,108
4-Feb-07	5.60	6.88	2.62	15.10	1384.4	68	83,993
5-Feb-07	5.60	6.88	2.62	15.10	1361.7	91	84,877
6-Feb-07	5.60	6.88	2.62	15.10	1339	114	85,761
7-Feb-07	5.60	6.88	2.62	15.10	1316.3	136	86,645
8-Feb-07	5.60	6.88	2.62	15.10	1293.6	159	87,529
9-Feb-07	5.60	6.88	2.62	15.10	1270.9	182	88,414
10-Feb-07	5.60	6.88	2.62	15.10	1225.5	227	90,182
11-Feb-07	5.60	6.88	2.62	15.10	1183.1	269	91,833
12-Feb-07	5.60	6.88	2.62	15.10	1140.7	312	93,485
13-Feb-07	5.60	6.88	2.62	15.10	1098.3	354	95,137
14-Feb-07	5.60	6.88	2.62	15.10	1055.9	397	96,788
15-Feb-07	5.60	6.88	2.62	15.10	1013.5	439	98,440
16-Feb-07	5.60	6.88	2.62	15.10	971.1	481	100,091
17-Feb-07	5.60	6.88	2.62	15.10	928.7	524	101,743
18-Feb-07	5.60	6.88	2.62	15.10	886.3	566	103,394
19-Feb-07	5.60	6.88	2.62	15.10	843.9	609	105,046
20-Feb-07	5.60	6.88	2.62	15.10	801.5	651	106,697
21-Feb-07	5.60	6.88	2.62	15.10	771	682	107,885
22-Feb-07	5.60	6.88	2.62	15.10	740.5	712	109,073
23-Feb-07	5.60	6.88	2.62	15.10	710	743	110,261
24-Feb-07	5.60	6.88	9.00	21.48	679.5	773	160,774
25-Feb-07	5.60	6.00	2.62	14.22	649	804	105,598
26-Feb-07	5.60	0.00	10.00	15.60	618.5	834	118,036
27-Feb-07	5.60	6.88	2.00	14.48	588	865	109,661
28-Feb-07	5.60	10.00	0.00	15.60	557.5	895	120,720
1-Mar-07	5.60	2.00	3.00	10.60	529.8	923	75,804
2-Mar-07	5.60	3.00	4.00	12.60	502.1	950	94,646
3-Mar-07	5.60	2.00	2.62	10.22	474.4	978	71,746
4-Mar-07	5.60	6.00	2.62	14.22	446.7	1006	111,706
5-Mar-07	5.60	6.88	2.62	15.10	419	1034	121,596
6-Mar-07	5.60	3.00	2.00	10.60	391.3	1061	74,973
7-Mar-07	5.60	5.50	1.00	12.10	363.6	1089	91,140
8-Mar-07	5.60	6.67	-0.50	11.77	335.9	1117	87,667
9-Mar-07	5.60	3.00	1.33	9.93	308.2	1144	66,846
10-Mar-07	5.60	5.00	0.00	10.60	280.5	1172	74,308
11-Mar-07	5.60	4.75	1.50	11.85	265.8	1187	89,054
12-Mar-07	5.60	5.67	2.00	13.27	251.1	1201	106,169
13-Mar-07	5.60	6.75	3.50	15.85	236.4	1216	137,889
14-Mar-07	5.60	7.50	0.00	13.10	221.7	1231	104,725
15-Mar-07	5.60	7.50	7.00	20.10	207	1246	192,190
16-Mar-07	5.60	9.00	2.62	17.22	192.3	1260	157,193
17-Mar-07	5.60	10.00	2.62	18.22	177.6	1275	170,827
18-Mar-07	5.60	6.00	2.00	13.60	162.9	1290	112,290
19-Mar-07	5.60	1.50	4.00	11.10	148.2	1304	80,036
20-Mar-07	5.60	11.00	0.00	16.60	133.5	1319	152,566
21-Mar-07	5.60	4.33	5.00	14.93	121.41	1331	131,034
22-Mar-07	5.60	6.80	3.00	15.40	109.32	1343	137,754
23-Mar-07	5.60	4.25	7.00	16.85	97.23	1355	157,913
24-Mar-07	5.60	6.40	5.50	17.50	85.14	1367	167,484
25-Mar-07	5.60	6.40	0.00	12.00	73.05	1379	92,376
26-Mar-07	5.60	6.75	9.00	21.35	60.95	1392	222,582
27-Mar-07	5.60	6.50	0.67	12.77	48.86	1404	103,330

Water Requirement

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
28-Mar-07	5.60	7.60	4.50	17.70	36.77	1416	173,362
29-Mar-07	5.60	6.00	2.62	14.22	24.68	1428	124,447
30-Mar-07	5.60	8.50	2.62	16.72	12.59	1440	160,810
31-Mar-07	5.60	8.80	-1.00	13.40	0.50	1452	113,284
1-Apr-07		7.25	0.00	7.25		1452.5	105,306
2-Apr-07		10.25	2.62	12.87		1452.5	186,924
3-Apr-07		7.80	-0.50	7.30		1452.5	106,033
4-Apr-07		8.50	0.67	9.17		1452.5	133,146
5-Apr-07		9.50	2.00	11.50		1452.5	167,038
6-Apr-07		6.60	2.62	9.22		1452.5	133,907
7-Apr-07		6.40	2.62	9.02		1452.5	131,002
8-Apr-07		7.33	3.25	10.58		1452.5	153,723
9-Apr-07		4.67	1.75	6.42		1452.5	93,202
10-Apr-07		4.83	-0.67	4.17		1452.5	60,521
11-Apr-07		2.00	2.62	4.62		1452.5	67,092
12-Apr-07		2.25	-0.50	1.75		1452.5	25,419
13-Apr-07		6.75	-0.50	6.25		1452.5	90,781
14-Apr-07		4.60	0.00	4.60		1452.5	66,815
15-Apr-07		3.00	-0.25	2.75		1452.5	39,944
16-Apr-07		8.50	0.50	9.00		1452.5	130,725
17-Apr-07		5.00	1.50	6.50		1452.5	94,413
18-Apr-07		7.75	2.33	10.08		1452.5	146,460
19-Apr-07		7.20	1.00	8.20		1452.5	119,105
20-Apr-07		5.33	5.00	10.33		1452.5	150,092
21-Apr-07		7.83	7.50	15.33		1452.5	222,717
22-Apr-07		7.67	2.50	10.17		1452.5	147,671
23-Apr-07		11.00	4.00	15.00		1452.5	217,875
24-Apr-07		3.67	2.00	5.67		1452.5	82,308
25-Apr-07		9.83	4.20	14.03		1452.5	203,834
26-Apr-07		8.17	2.00	10.17		1452.5	147,671
27-Apr-07		5.80	1.00	6.80		1452.5	98,770
28-Apr-07		10.67	2.62	13.29		1452.5	192,976
29-Apr-07		8.00	2.00	10.00		1452.5	145,250
30-Apr-07		10.00	2.00	12.00		1452.5	174,300
1-May-07		5.00	3.50	8.50		1452.5	123,463
2-May-07		6.88	6.00	12.88		1452.5	187,024
3-May-07		4.00	6.00	10.00		1452.5	145,250
4-May-07		7.20	-1.00	6.20		1452.5	90,055
5-May-07		7.67	5.00	12.67		1452.5	183,983
6-May-07		3.67	4.00	7.67		1452.5	111,358
7-May-07		4.67	3.33	8.00		1452.5	116,200
8-May-07		5.00	0.50	5.50		1452.5	79,887
9-May-07		5.17	5.50	10.67		1452.5	154,933
10-May-07		6.67	5.25	11.92		1452.5	173,090
11-May-07		7.00	1.50	8.50		1452.5	123,463
12-May-07		6.88	2.50	9.38		1452.5	136,187
13-May-07		2.67	1.40	4.07		1452.5	59,068

Water Requirement

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
14-May-07		5.33	5.50	10.83		1452.5	157,354
15-May-07		11.50	7.50	19.00		1452.5	275,975
16-May-07		13.00	2.62	15.62		1452.5	226,867
17-May-07		15.50	5.00	20.50		1452.5	297,763
18-May-07		8.20	1.00	9.20		1452.5	133,630
19-May-07		5.25	5.50	10.75		1452.5	156,144
20-May-07		6.00	2.50	8.50		1452.5	123,463
21-May-07		4.60	5.00	9.60		1452.5	139,440
22-May-07		7.00	3.00	10.00		1452.5	145,250
23-May-07		11.00	2.50	13.50		1452.5	196,088
24-May-07		13.60	3.00	16.60		1452.5	241,115
25-May-07		9.00	4.50	13.50		1452.5	196,088
26-May-07		11.20	2.67	13.87		1452.5	201,413
27-May-07		7.40	3.33	10.73		1452.5	155,902
28-May-07		7.00	0.50	7.50		1452.5	108,938
29-May-07		3.00	3.50	6.50		1452.5	94,413
30-May-07		6.75	2.33	9.08		1452.5	131,935
31-May-07		10.00	1.00	11.00		1452.5	159,775
1-Jun-07		7.00	1.00	8.00		1452.5	116,200
2-Jun-07		10.00	0.00	10.00		1452.5	145,250
3-Jun-07		9.00	4.00	13.00		1452.5	188,825
4-Jun-07		7.00	0.00	7.00		1452.5	101,675
5-Jun-07		6.88	-1.00	5.88		1452.5	85,349
6-Jun-07		6.88	2.62	9.50		1452.5	137,917
7-Jun-07		6.88	2.62	9.50		1452.5	137,917
average	5.60	6.79	2.65				
Total MCM	1.98	10.24	3.90				16.12

Water Requirement Wet Season 2007

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
1-Jun-07	5.60	5.11	1.72	12.43	2518.37	0.00	141,029
2-Jun-07	5.60	5.11	1.72	12.43	2494.48	23.89	141,322
3-Jun-07	5.60	5.11	1.72	12.43	2470.59	47.78	141,616
4-Jun-07	5.60	5.11	1.72	12.43	2446.70	71.67	141,910
5-Jun-07	5.60	5.11	1.72	12.43	2422.81	95.56	142,203
6-Jun-07	5.60	5.11	1.72	12.43	2398.93	119.44	142,497
7-Jun-07	5.60	5.11	1.72	12.43	2375.04	143.33	142,790
8-Jun-07	5.60	5.11	1.72	12.43	2351.15	167.22	143,084
9-Jun-07	5.60	5.11	1.72	12.43	2327.26	191.11	143,378
10-Jun-07	5.60	5.11	1.72	12.43	2303.37	215.00	143,671
11-Jun-07	5.60	5.11	1.72	12.43	2300.37	218.00	143,708
12-Jun-07	5.60	5.11	1.72	12.43	2297.37	221.00	143,745
13-Jun-07	5.60	5.11	1.72	12.43	2294.37	224.00	143,782
14-Jun-07	5.60	5.11	1.72	12.43	2291.37	227.00	143,819
15-Jun-07	5.60	5.11	1.72	12.43	2288.37	230.00	143,856
16-Jun-07	5.60	5.11	1.72	12.43	2285.37	233.00	143,892
17-Jun-07	5.60	5.11	1.72	12.43	2282.37	236.00	143,929
18-Jun-07	5.60	5.11	1.72	12.43	2279.37	239.00	143,966
19-Jun-07	5.60	5.11	1.72	12.43	2276.37	242.00	144,003
20-Jun-07	5.60	5.11	1.72	12.43	2273.37	245.00	144,040
21-Jun-07	5.60	5.11	1.72	12.43	2270.67	247.70	144,073
22-Jun-07	5.60	5.11	1.72	12.43	2267.97	250.40	144,106
23-Jun-07	5.60	5.11	1.72	12.43	2265.27	253.10	144,139
24-Jun-07	5.60	5.11	1.72	12.43	2262.57	255.80	144,173
25-Jun-07	5.60	5.11	1.72	12.43	2259.87	258.50	144,206
26-Jun-07	5.60	5.11	1.72	12.43	2257.17	261.20	144,239
27-Jun-07	5.60	5.11	1.72	12.43	2254.47	263.90	144,272
28-Jun-07	5.60	5.11	1.72	12.43	2251.77	266.60	144,305
29-Jun-07	5.60	5.11	1.72	12.43	2249.07	269.30	144,339
30-Jun-07	5.60	5.11	1.72	12.43	2246.37	272.00	144,372
1-Jul-07	5.60	5.11	1.72	12.43	2239.52	278.85	144,456
2-Jul-07	5.60	5.11	1.72	12.43	2232.67	285.70	144,540
3-Jul-07	5.60	5.11	1.72	12.43	2225.82	292.55	144,624
4-Jul-07	5.60	5.11	1.72	12.43	2218.97	299.40	144,708
5-Jul-07	5.60	5.11	1.72	12.43	2212.12	306.25	144,793
6-Jul-07	5.60	5.11	1.72	12.43	2205.27	313.10	144,877
7-Jul-07	5.60	5.11	1.72	12.43	2198.42	319.95	144,961
8-Jul-07	5.60	5.11	1.72	12.43	2191.57	326.80	145,045
9-Jul-07	5.60	5.11	1.72	12.43	2184.72	333.65	145,129
10-Jul-07	5.60	5.11	1.72	12.43	2177.87	340.50	145,214
11-Jul-07	5.60	5.11	1.72	12.43	2109.51	408.86	146,054
12-Jul-07	5.60	5.11	1.72	12.43	2041.14	477.23	146,894
13-Jul-07	5.60	5.11	1.72	12.43	1972.78	545.59	147,734
14-Jul-07	5.60	5.11	1.72	12.43	1904.41	613.96	148,575
15-Jul-07	5.60	5.11	1.72	12.43	1836.05	682.32	149,415
16-Jul-07	5.60	5.11	1.72	12.43	1767.69	750.68	150,255
17-Jul-07	5.60	5.11	1.72	12.43	1699.32	819.05	151,095
18-Jul-07	5.60	5.11	1.72	12.43	1630.96	887.41	151,935
19-Jul-07	5.60	5.11	1.72	12.43	1562.59	955.78	152,776
20-Jul-07	5.60	5.11	1.72	12.43	1494.23	1024.14	153,616
21-Jul-07	5.60	5.11	1.72	12.43	1425.96	1092.41	154,455
22-Jul-07	5.60	5.11	1.72	12.43	1357.69	1160.68	155,294
23-Jul-07	5.60	5.11	1.72	12.43	1289.42	1228.95	156,133
24-Jul-07	5.60	5.11	1.72	12.43	1221.15	1297.22	156,972
25-Jul-07	5.60	5.11	1.72	12.43	1152.88	1365.49	157,811

Water Requirement

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
26-Jul-07	5.60	5.11	1.72	12.43	1084.61	1433.76	158,650
27-Jul-07	5.60	5.11	1.72	12.43	1016.34	1502.03	159,489
28-Jul-07	5.60	5.11	1.72	12.43	948.07	1570.30	160,328
29-Jul-07	5.60	5.11	1.72	12.43	879.80	1638.57	161,168
30-Jul-07	5.60	5.11	1.72	12.43	811.53	1706.84	162,007
31-Jul-07	5.60	5.11	1.72	12.43	743.23	1775.14	162,846
1-Aug-07	5.60	5.11	1.72	12.43	693.76	1824.61	163,454
2-Aug-07	5.60	5.11	1.72	12.43	644.28	1874.09	164,062
3-Aug-07	5.60	5.11	1.72	12.43	594.81	1923.56	164,670
4-Aug-07	5.60	5.11	1.72	12.43	545.34	1973.03	165,278
5-Aug-07	5.60	6.00	1.72	13.32	495.87	2022.51	183,869
6-Aug-07	5.60	1.00	-1.00	5.60	446.39	2071.98	24,998
7-Aug-07	5.60	0.00	-1.00	4.60	396.92	2121.45	1,013
8-Aug-07	5.60	3.00	-1.00	7.60	347.45	2170.92	62,875
9-Aug-07	5.60	5.00	-1.00	9.60	297.97	2220.40	105,502
10-Aug-07	5.60	1.00	-0.50	6.10	248.50	2269.87	25,265
11-Aug-07	5.60	5.00	0.00	10.60	231.47	2286.90	127,307
12-Aug-07	5.60	3.50	9.00	18.10	214.43	2303.94	300,000
13-Aug-07	5.60	3.50	4.00	13.10	197.40	2320.97	185,127
14-Aug-07	5.60	5.00	0.50	11.10	180.37	2338.00	138,691
15-Aug-07	5.60	5.50	3.00	14.10	163.34	2355.04	209,325
16-Aug-07	5.60	5.11	2.50	13.21	146.30	2372.07	188,728
17-Aug-07	5.60	5.50	-1.50	9.60	129.27	2389.10	102,803
18-Aug-07	5.60	6.50	1.50	13.60	112.24	2406.13	198,776
19-Aug-07	5.60	6.33	-0.50	11.43	95.20	2423.17	146,683
20-Aug-07	5.60	3.67	0.33	9.60	78.17	2440.20	101,986
21-Aug-07	5.60	5.00	0.67	11.27	71.07	2447.30	142,660
22-Aug-07	5.60	4.67	0.67	10.93	63.97	2454.40	134,484
23-Aug-07	5.60	6.33	-1.00	10.93	56.87	2461.50	134,465
24-Aug-07	5.60	7.33	2.00	14.93	49.77	2468.60	233,190
25-Aug-07	5.60	7.50	3.50	16.60	42.67	2475.70	274,717
26-Aug-07	5.60	10.00	-1.00	14.60	35.57	2482.80	225,444
27-Aug-07	5.60	7.00	3.00	15.60	28.47	2489.90	250,584
28-Aug-07	5.60	5.67	1.25	12.52	21.37	2497.00	173,906
29-Aug-07	5.60	8.50	4.33	18.43	14.27	2504.10	322,159
30-Aug-07	5.60	3.75	1.25	10.60	7.17	2511.20	125,962
31-Aug-07	5.60	3.00	0.50	9.10	0.00	2518.37	88,143
1-Sep-07		9.00	-1.00	8.00		2518.37	201,470
2-Sep-07		5.33	1.33	6.67		2518.37	167,891
3-Sep-07		4.50	2.67	7.17		2518.37	180,483
4-Sep-07		4.83	1.67	6.50		2518.37	163,694
5-Sep-07		3.60	1.00	4.60		2518.37	115,845
6-Sep-07		5.83	-0.25	5.58		2518.37	140,609
7-Sep-07		6.50	0.50	7.00		2518.37	176,286
8-Sep-07		5.50	-0.50	5.00		2518.37	125,919
9-Sep-07		5.50	1.00	6.50		2518.37	163,694
10-Sep-07		11.75	4.00	15.75		2518.37	396,643
11-Sep-07		5.00	0.00	5.00		2518.37	125,919
12-Sep-07		5.11	0.50	5.61		2518.37	141,303
13-Sep-07		3.67	0.50	4.17		2518.37	104,932

Water Requirement

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
14-Sep-07		5.20	1.20	6.40		2518.37	161,176
15-Sep-07		5.67	-0.75	4.92		2518.37	123,820
16-Sep-07		3.50	1.20	4.70		2518.37	118,363
17-Sep-07		5.00	2.50	7.50		2518.37	188,878
18-Sep-07		4.25	1.83	6.08		2518.37	153,201
19-Sep-07		3.33	2.00	5.33		2518.37	134,313
20-Sep-07		3.67	0.67	4.33		2518.37	109,129
21-Sep-07		2.00	1.00	3.00		2518.37	75,551
22-Sep-07		5.40	0.75	6.15		2518.37	154,880
23-Sep-07		5.33	1.60	6.93		2518.37	174,607
24-Sep-07		5.33	0.75	6.08		2518.37	153,201
25-Sep-07		5.83	2.80	8.63		2518.37	217,419
26-Sep-07		5.83	3.25	9.08		2518.37	228,752
27-Sep-07		5.25	-0.25	5.00		2518.37	125,919
28-Sep-07		3.00	0.83	3.83		2518.37	96,538
29-Sep-07		3.33	2.60	5.93		2518.37	149,423
30-Sep-07		6.00	2.25	8.25		2518.37	207,766
1-Oct-07		4.67	1.00	5.67		2518.37	142,708
2-Oct-07		5.25	1.25	6.50		2518.37	163,694
3-Oct-07		6.60	1.75	8.35		2518.37	210,284
4-Oct-07		2.33	0.25	2.58		2518.37	65,058
5-Oct-07		4.33	2.25	6.58		2518.37	165,793
6-Oct-07		3.00	1.00	4.00		2518.37	100,735
7-Oct-07		5.00	2.00	7.00		2518.37	176,286
8-Oct-07		3.67	5.00	8.67		2518.37	218,259
9-Oct-07		2.80	3.33	6.13		2518.37	154,460
10-Oct-07		10.40	0.00	10.40		2518.37	261,910
11-Oct-07		5.00	2.33	7.33		2518.37	184,680
12-Oct-07		4.80	2.33	7.13		2518.37	179,644
13-Oct-07		2.50	0.00	2.50		2518.37	62,959
14-Oct-07		2.20	3.67	5.87		2518.37	147,744
15-Oct-07		4.33	2.00	6.33		2518.37	159,497
16-Oct-07		12.33	1.00	13.33		2518.37	335,783
17-Oct-07		4.33	-1.00	3.33		2518.37	83,946
18-Oct-07		3.50	3.00	6.50		2518.37	163,694
19-Oct-07		5.67	3.00	8.67		2518.37	218,259
20-Oct-07		4.20	6.50	10.70		2518.37	269,466
21-Oct-07		4.00	1.50	5.50		2518.37	138,510
22-Oct-07		7.00	0.00	7.00		2518.37	176,286
23-Oct-07		4.00	0.50	4.50		2518.37	113,327
24-Oct-07		4.33	1.00	5.33		2518.37	134,313
25-Oct-07		4.33	1.75	6.08		2518.37	153,201
26-Oct-07		4.33	1.67	6.00		2518.37	151,102
27-Oct-07		4.33	1.33	5.67		2518.37	142,708
28-Oct-07		8.50	2.67	11.17		2518.37	281,218
29-Oct-07		3.83	0.67	4.50		2518.37	113,327
30-Oct-07		9.67	2.50	12.17		2518.37	306,402
31-Oct-07		1.00	3.33	4.33		2518.37	109,129
1-Nov-07		2.50	1.60	4.10		2518.37	103,253

Water Requirement

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
2-Nov-07		3.50	4.00	7.50		2518.37	188,878
3-Nov-07		6.80	0.67	7.47		2518.37	188,038
4-Nov-07		8.50	-1.00	7.50		2518.37	188,878
5-Nov-07		6.50	10.00	16.50		2518.37	415,531
6-Nov-07		9.50	5.00	14.50		2518.37	365,164
7-Nov-07		6.33	-0.50	5.83		2518.37	146,905
8-Nov-07		4.00	2.33	6.33		2518.37	159,497
9-Nov-07		6.00	0.50	6.50		2518.37	163,694
10-Nov-07		5.67	1.00	6.67		2518.37	167,891
11-Nov-07		4.50	-0.50	4.00		2518.37	100,735
12-Nov-07		2.00	3.00	5.00		2518.37	125,919
13-Nov-07		4.00	3.00	7.00		2518.37	176,286
14-Nov-07		9.33	7.00	16.33		2518.37	411,334
15-Nov-07		3.50	4.00	7.50		2518.37	188,878
16-Nov-07		4.50	3.50	8.00		2518.37	201,470
17-Nov-07		5.50	0.00	5.50		2518.37	138,510
18-Nov-07		6.50	3.00	9.50		2518.37	239,245
19-Nov-07		5.11	10.00	15.11		2518.37	380,548
20-Nov-07		5.11	3.00	8.11		2518.37	204,262
21-Nov-07		8.50	1.50	10.00		2518.37	251,837
22-Nov-07		9.00	3.00	12.00		2518.37	302,204
23-Nov-07		4.00	7.00	11.00		2518.37	277,021
24-Nov-07		5.50	1.72	7.22		2518.37	181,780
25-Nov-07		5.50	2.50	8.00		2518.37	201,470
26-Nov-07		7.00	-1.00	6.00		2518.37	151,102
27-Nov-07		4.00	1.50	5.50		2518.37	138,510
28-Nov-07		6.50	-0.50	6.00		2518.37	151,102
29-Nov-07		4.50	1.00	5.50		2518.37	138,510
30-Nov-07		4.00	3.00	7.00		2518.37	176,286
average	5.60	5.14	1.72				
Total MCM	7.18	17.19	5.78				**30.15**

Annex 9. Rainfall and Effective Rainfall

Dry Season 2007

Date	Rainfall	Planted Area	Effective Rainfall
	mm/d	ha	m3
3-Feb-07		1452.5	0.00
4-Feb-07		1452.5	0.00
5-Feb-07		1452.5	0.00
6-Feb-07		1452.5	0.00
7-Feb-07		1452.5	0.00
8-Feb-07		1452.5	0.00
9-Feb-07		1452.5	0.00
10-Feb-07		1452.5	0.00
11-Feb-07		1452.5	0.00
12-Feb-07		1452.5	0.00
13-Feb-07		1452.5	0.00
14-Feb-07		1452.5	0.00
15-Feb-07		1452.5	0.00
16-Feb-07		1452.5	0.00
17-Feb-07		1452.5	0.00
18-Feb-07		1452.5	0.00
19-Feb-07		1452.5	0.00
20-Feb-07		1452.5	0.00
21-Feb-07	39.00	1452.5	433919.85
22-Feb-07	44.00	1452.5	470377.60
23-Feb-07	19.00	1452.5	244513.85
24-Feb-07		1452.5	0.00
25-Feb-07		1452.5	0.00
26-Feb-07		1452.5	0.00
27-Feb-07	13.00	1452.5	174096.65
28-Feb-07		1452.5	0.00
1-Mar-07		1452.5	0.00
2-Mar-07		1452.5	0.00
3-Mar-07		1452.5	0.00
4-Mar-07		1452.5	0.00
5-Mar-07		1452.5	0.00
6-Mar-07		1452.5	0.00
7-Mar-07		1452.5	0.00
8-Mar-07		1452.5	0.00
9-Mar-07		1452.5	0.00
10-Mar-07		1452.5	0.00
11-Mar-07		1452.5	0.00
12-Mar-07		1452.5	0.00
13-Mar-07		1452.5	0.00
14-Mar-07		1452.5	0.00
15-Mar-07		1452.5	0.00
16-Mar-07		1452.5	0.00
17-Mar-07	5.00	1452.5	70446.25
18-Mar-07		1452.5	0.00
19-Mar-07		1452.5	0.00
20-Mar-07	23.00	1452.5	287972.65
21-Mar-07	4.00	1452.5	56705.60
22-Mar-07		1452.5	0.00
23-Mar-07		1452.5	0.00
24-Mar-07	2.00	1452.5	28701.40
25-Mar-07		1452.5	0.00

Dry Season 2007

Date	Rainfall	Planted Area	Effective Rainfall
	mm/d	ha	m3
26-Mar-07		1452.5	0.00
27-Mar-07		1452.5	0.00
28-Mar-07		1452.5	0.00
29-Mar-07		1452.5	0.00
30-Mar-07		1452.5	0.00
31-Mar-07		1452.5	0.00
1-Apr-07		1452.5	0.00
2-Apr-07		1452.5	0.00
3-Apr-07		1452.5	0.00
4-Apr-07		1452.5	0.00
5-Apr-07		1452.5	0.00
6-Apr-07		1452.5	0.00
7-Apr-07		1452.5	0.00
8-Apr-07		1452.5	0.00
9-Apr-07		1452.5	0.00
10-Apr-07	27.00	1452.5	0.00
11-Apr-07		1452.5	0.00
12-Apr-07	7.00	1452.5	0.00
13-Apr-07		1452.5	0.00
14-Apr-07		1452.5	0.00
15-Apr-07		1452.5	0.00
16-Apr-07		1452.5	0.00
17-Apr-07		1452.5	0.00
18-Apr-07		1452.5	0.00
19-Apr-07		1452.5	0.00
20-Apr-07		1452.5	0.00
21-Apr-07		1452.5	0.00
22-Apr-07	10.00	1452.5	0.00
23-Apr-07		1452.5	0.00
24-Apr-07	2.00	1452.5	0.00
25-Apr-07		1452.5	0.00
26-Apr-07		1452.5	0.00
27-Apr-07	9.00	1452.5	0.00
28-Apr-07	9.00	1452.5	0.00
29-Apr-07	26.00	1452.5	0.00
30-Apr-07	12.00	1452.5	0.00
1-May-07	68.00	1452.5	0.00
2-May-07		1452.5	0.00
3-May-07		1452.5	0.00
4-May-07	6.00	1452.5	0.00
5-May-07	2.00	1452.5	0.00
6-May-07		1452.5	0.00
7-May-07	8.00	1452.5	0.00
8-May-07		1452.5	0.00
9-May-07	6.00	1452.5	0.00
10-May-07	13.00	1452.5	0.00
11-May-07	34.00	1452.5	0.00
12-May-07		1452.5	0.00
13-May-07	4.00	1452.5	0.00
14-May-07	12.00	1452.5	1524.57
15-May-07	14.00	1452.5	96695.32

Rainfall and Effective Rainfall **(Dry Season 2007)**

Date	Rainfall	Planted Area	Effective Rainfall
	mm/d	ha	m3
16-May-07	17.00	1452.5	221738.65
17-May-07	1.00	1452.5	14437.85
18-May-07		1452.5	0.00
19-May-07	2.00	1452.5	28701.40
20-May-07	1.00	1452.5	14437.85
21-May-07		1452.5	0.00
22-May-07		1452.5	0.00
23-May-07		1452.5	0.00
24-May-07	2.00	1452.5	28701.40
25-May-07		1452.5	0.00
26-May-07		1452.5	0.00
27-May-07		1452.5	0.00
28-May-07	21.00	1452.5	266591.85
29-May-07	2.00	1452.5	28701.40
30-May-07		1452.5	0.00
31-May-07	14.00	1452.5	186268.60
1-Jun-07		1452.5	0.00
2-Jun-07		1452.5	0.00
3-Jun-07	8.00	1452.5	110622.40
4-Jun-07	18.00	1452.5	233213.40
5-Jun-07	1.00	1452.5	14437.85
6-Jun-07		1452.5	0.00
7-Jun-07		1452.5	0.00
8-Jun-07		1452.5	0.00
9-Jun-07		1452.5	0.00
10-Jun-07		1452.5	0.00
11-Jun-07		1452.5	0.00
12-Jun-07		1452.5	0.00
13-Jun-07		1452.5	0.00
14-Jun-07		1452.5	0.00
15-Jun-07		1452.5	0.00
16-Jun-07		1452.5	0.00
17-Jun-07		1452.5	0.00
18-Jun-07	11	1452.5	149229.85
19-Jun-07	3	1452.5	42790.65
20-Jun-07	25	1452.5	308656.25
21-Jun-07		1452.5	0.00
22-Jun-07	48	1452.5	496406.40
23-Jun-07	34	1452.5	393104.60
24-Jun-07	26	1452.5	318736.60
25-Jun-07	3	1452.5	42790.65
26-Jun-07		1452.5	0.00
27-Jun-07	5	1452.5	70446.25
28-Jun-07	3	1452.5	42790.65
29-Jun-07		1452.5	0.00
30-Jun-07	6	1452.5	84012.60
Average	13.65mm/d		
Total	505 mm	1,452.50	0.048 MCM
	0.15 MCM		

Rainfall and Effective Rainfall (Wet Season 2007)

Date	Rainfall	Planted Area	Effective Rainfall	Date	Rainfall	Planted Area	Effective Rainfall
	mm/d	ha	m3		mm/d	ha	m3
1-Jun-07		2518.37	0.00	22-Jul-07		2518.37	0.00
2-Jun-07		2518.37	0.00	23-Jul-07		2518.37	0.00
3-Jun-07	8.00	2518.37	191799.06	24-Jul-07	11.00	2518.37	258737.33
4-Jun-07		2518.37	0.00	25-Jul-07		2518.37	0.00
5-Jun-07	18.00	2518.37	404349.49	26-Jul-07		2518.37	0.00
6-Jun-07	1.00	2518.37	25032.60	27-Jul-07		2518.37	0.00
7-Jun-07		2518.37	0.00	28-Jul-07		2518.37	0.00
8-Jun-07		2518.37	0.00	29-Jul-07		2518.37	0.00
9-Jun-07		2518.37	0.00	30-Jul-07		2518.37	0.00
10-Jun-07		2518.37	0.00	31-Jul-07		2518.37	0.00
11-Jun-07		2518.37	0.00	1-Aug-07		2518.37	0.00
12-Jun-07		2518.37	0.00	2-Aug-07		2518.37	0.00
13-Jun-07		2518.37	0.00	3-Aug-07	10.00	2518.37	236726.78
14-Jun-07		2518.37	0.00	4-Aug-07		2518.37	0.00
15-Jun-07		2518.37	0.00	5-Aug-07		2518.37	0.00
16-Jun-07		2518.37	0.00	6-Aug-07		2518.37	0.00
17-Jun-07		2518.37	0.00	7-Aug-07		2518.37	0.00
18-Jun-07	11.00	2518.37	258737.33	8-Aug-07		2518.37	0.00
19-Jun-07	3.00	2518.37	74191.18	9-Aug-07		2518.37	0.00
20-Jun-07	25.00	2518.37	535153.63	10-Aug-07	12.00	2518.37	280445.68
21-Jun-07		2518.37	0.00	11-Aug-07		2518.37	0.00
22-Jun-07	48.00	2518.37	860678.13	12-Aug-07		2518.37	0.00
23-Jun-07	34.00	2518.37	681571.66	13-Aug-07		2518.37	0.00
24-Jun-07	26.00	2518.37	552631.11	14-Aug-07		2518.37	0.00
25-Jun-07	3.00	2518.37	74191.18	15-Aug-07	15.00	2518.37	343757.51
26-Jun-07		2518.37	0.00	16-Aug-07		2518.37	0.00
27-Jun-07	5.00	2518.37	122140.95	17-Aug-07		2518.37	0.00
28-Jun-07	3.00	2518.37	74191.18	18-Aug-07		2518.37	0.00
29-Jun-07	0.00	2518.37	0.00	19-Aug-07	2.00	2518.37	49762.99
30-Jun-07	6.00	2518.37	145662.52	20-Aug-07	7.00	2518.37	168881.89
1-Jul-07		2518.37	0.00	21-Aug-07	5.00	2518.37	122140.95
2-Jul-07		2518.37	0.00	22-Aug-07		2518.37	0.00
3-Jul-07	3.00	2518.37	74191.18	23-Aug-07	7.00	2518.37	168881.89
4-Jul-07		2518.37	0.00	24-Aug-07	2.00	2518.37	49762.99
5-Jul-07	8.00	2518.37	191799.06	25-Aug-07	4.00	2518.37	98317.16
6-Jul-07	21.00	2518.37	462221.63	26-Aug-07		2518.37	0.00
7-Jul-07		2518.37	0.00	27-Aug-07		2518.37	0.00
8-Jul-07		2518.37	0.00	28-Aug-07	27.00	2518.37	569806.40
9-Jul-07		2518.37	0.00	29-Aug-07		2518.37	0.00
10-Jul-07		2518.37	0.00	30-Aug-07		2518.37	0.00
11-Jul-07		2518.37	0.00	31-Aug-07	21.00	2518.37	462221.63
12-Jul-07	23.00	2518.37	499292.04	1-Sep-07		2518.37	0.00
13-Jul-07		2518.37	0.00	2-Sep-07		2518.37	0.00
14-Jul-07		2518.37	0.00	3-Sep-07	6.00	2518.37	145662.52
15-Jul-07	8.00	2518.37	191799.06	4-Sep-07	1.00	2518.37	25032.60
16-Jul-07		2518.37	0.00	5-Sep-07		2518.37	0.00
17-Jul-07	10.00	2518.37	236726.78	6-Sep-07		2518.37	0.00
18-Jul-07		2518.37	0.00	7-Sep-07		2518.37	0.00
19-Jul-07		2518.37	0.00	8-Sep-07		2518.37	0.00
20-Jul-07		2518.37	0.00	9-Sep-07	14.00	2518.37	322955.77
21-Jul-07		2518.37	0.00	10-Sep-07	10.00	2518.37	236726.78

Rainfall and Effective Rainfall

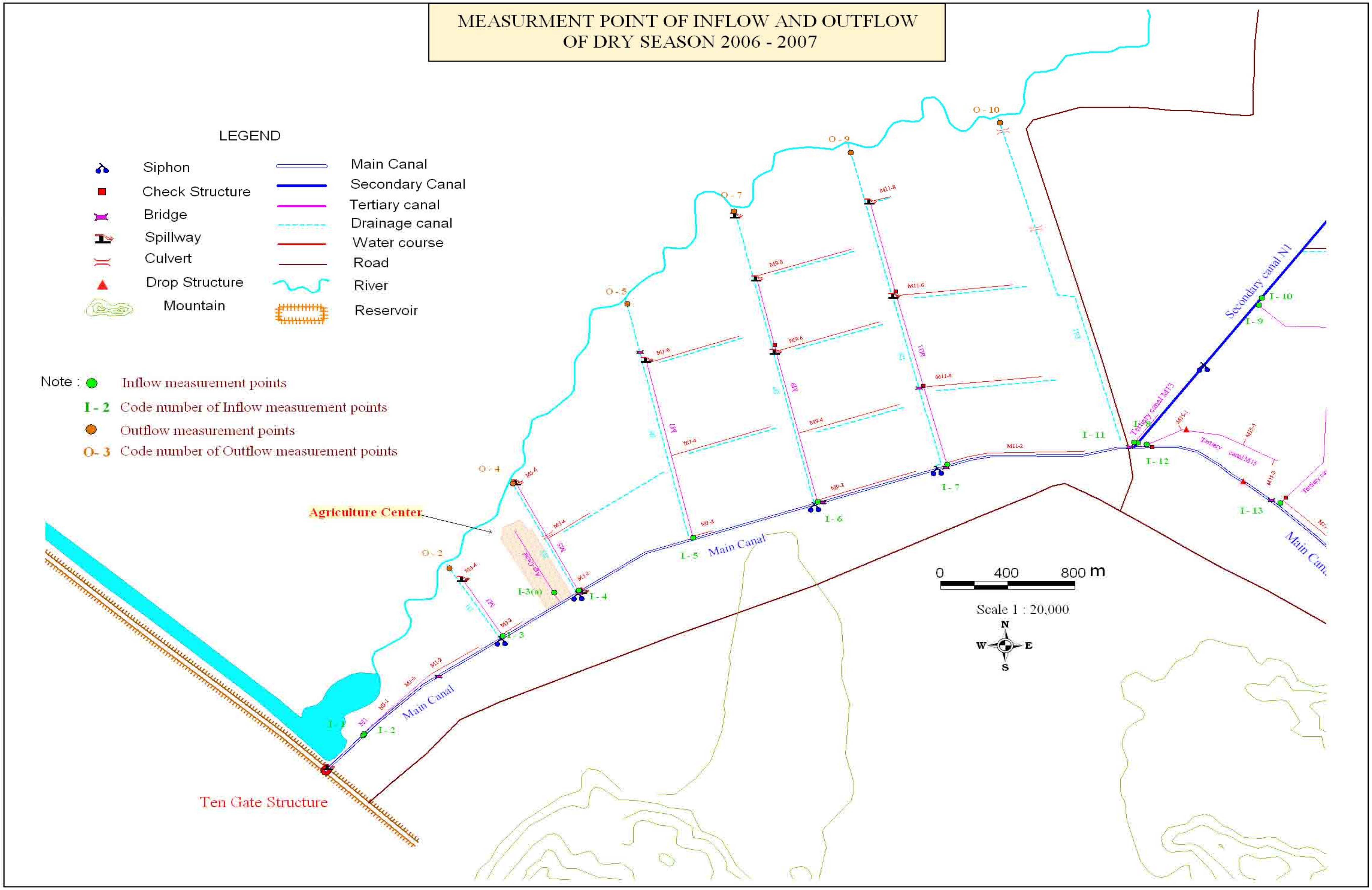
Wet Season 2007 Dry Season 2007

Date	Rainfall	Planted Area	Effective Rainfall	Date	Rainfall	Planted Area	Effective Rainfall
	mm/d	ha	m3		mm/d	ha	m3
11-Sep-07	37.00	2518.37	724937.99	22-Oct-07	14.00	2518.37	322955.77
12-Sep-07		2518.37	0.00	23-Oct-07		2518.37	0.00
13-Sep-07		2518.37	0.00	24-Oct-07		2518.37	0.00
14-Sep-07		2518.37	0.00	25-Oct-07		2518.37	0.00
15-Sep-07		2518.37	0.00	26-Oct-07	3.00	2518.37	74191.18
16-Sep-07	21.00	2518.37	462221.63	27-Oct-07	10.00	2518.37	236726.78
17-Sep-07		2518.37	0.00	28-Oct-07		2518.37	0.00
18-Sep-07		2518.37	0.00	29-Oct-07		2518.37	0.00
19-Sep-07		2518.37	0.00	30-Oct-07	5.00	2518.37	122140.95
20-Sep-07	53.00	2518.37	910290.02	31-Oct-07		2518.37	0.00
21-Sep-07		2518.37	0.00	1-Nov-07		2518.37	0.00
22-Sep-07		2518.37	0.00	2-Nov-07		2518.37	0.00
23-Sep-07		2518.37	0.00	3-Nov-07		2518.37	0.00
24-Sep-07		2518.37	0.00	4-Nov-07		2518.37	0.00
25-Sep-07		2518.37	0.00	5-Nov-07		2518.37	0.00
26-Sep-07	15.00	2518.37	343757.51	6-Nov-07		2518.37	0.00
27-Sep-07	19.00	2518.37	423942.41	7-Nov-07		2518.37	0.00
28-Sep-07		2518.37	0.00	8-Nov-07		2518.37	0.00
29-Sep-07	3.00	2518.37	74191.18	9-Nov-07		2518.37	0.00
30-Sep-07	13.00	2518.37	301851.83	10-Nov-07		2518.37	0.00
1-Oct-07		2518.37	0.00	11-Nov-07	15.00	2518.37	343757.51
2-Oct-07		2518.37	0.00	12-Nov-07		2518.37	0.00
3-Oct-07		2518.37	0.00	13-Nov-07	18.00	2518.37	404349.49
4-Oct-07	3.00	2518.37	74191.18	14-Nov-07	8.00	2518.37	191799.06
5-Oct-07		2518.37	0.00	15-Nov-07	1.00	2518.37	25032.60
6-Oct-07		2518.37	0.00	16-Nov-07		2518.37	0.00
7-Oct-07	3.00	2518.37	74191.18	17-Nov-07		2518.37	0.00
8-Oct-07		2518.37	0.00	18-Nov-07	35.00	2518.37	696329.31
9-Oct-07	12.00	2518.37	280445.68	19-Nov-07	12.00	2518.37	280445.68
10-Oct-07	55.00	2518.37	928019.35	20-Nov-07		2518.37	0.00
11-Oct-07		2518.37	0.00	21-Nov-07		2518.37	0.00
12-Oct-07	3.00	2518.37	74191.18	22-Nov-07		2518.37	0.00
13-Oct-07		2518.37	0.00	23-Nov-07		2518.37	0.00
14-Oct-07	18.00	2518.37	404349.49	24-Nov-07		2518.37	0.00
15-Oct-07	12.00	2518.37	280445.68	25-Nov-07		2518.37	0.00
16-Oct-07	8.00	2518.37	191799.06	26-Nov-07		2518.37	0.00
17-Oct-07	4.00	2518.37	98317.16	27-Nov-07		2518.37	0.00
18-Oct-07		2518.37	0.00	28-Nov-07		2518.37	0.00
19-Oct-07		2518.37	0.00	29-Nov-07		2518.37	0.00
20-Oct-07		2518.37	0.00	30-Nov-07		2518.37	0.00
21-Oct-07		2518.37	0.00				
				Average	13.19mm/d		
				Total	818 mm 0.15 MCM	2,518.37	

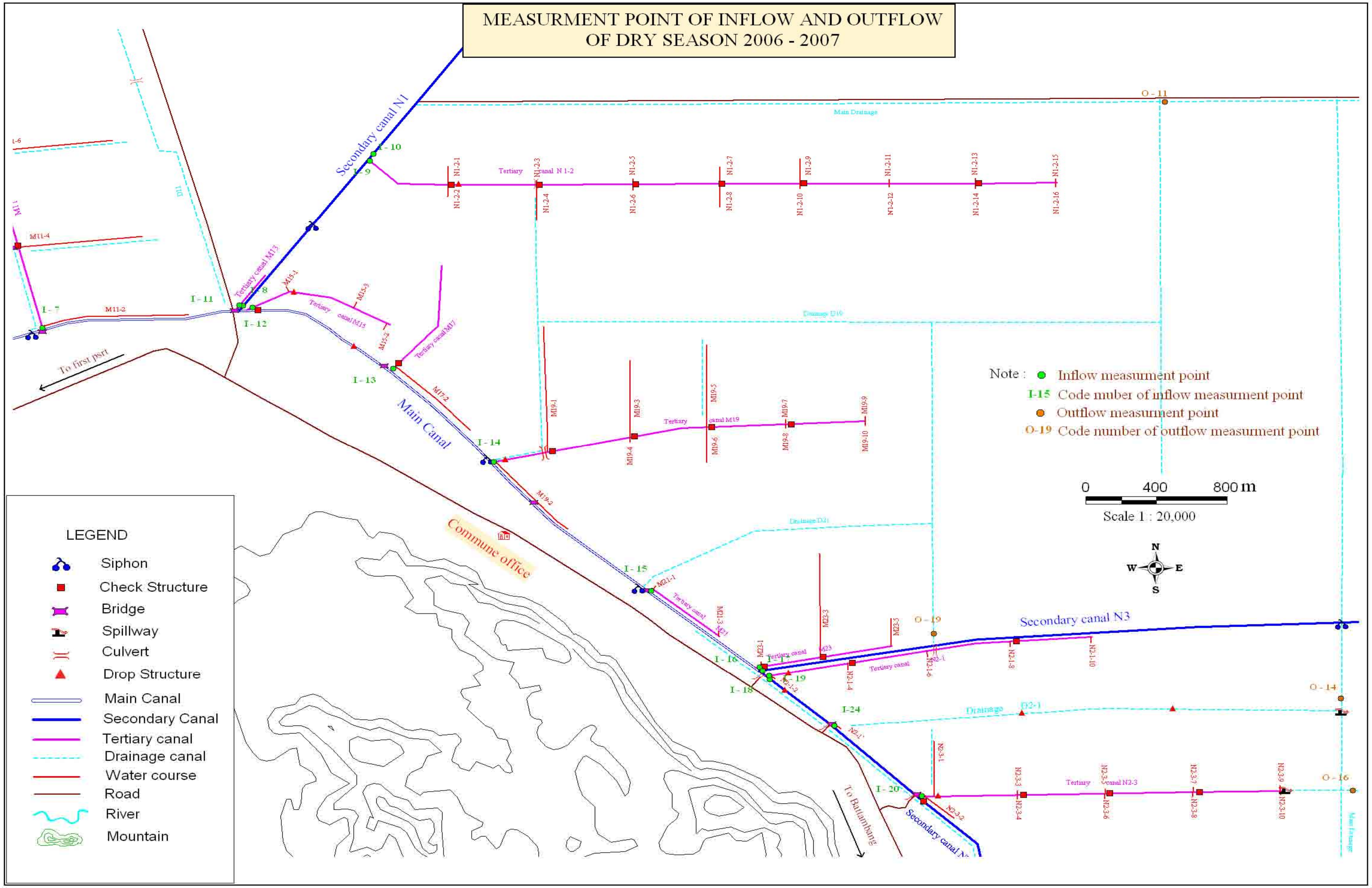
RAINFALL DATA 2007

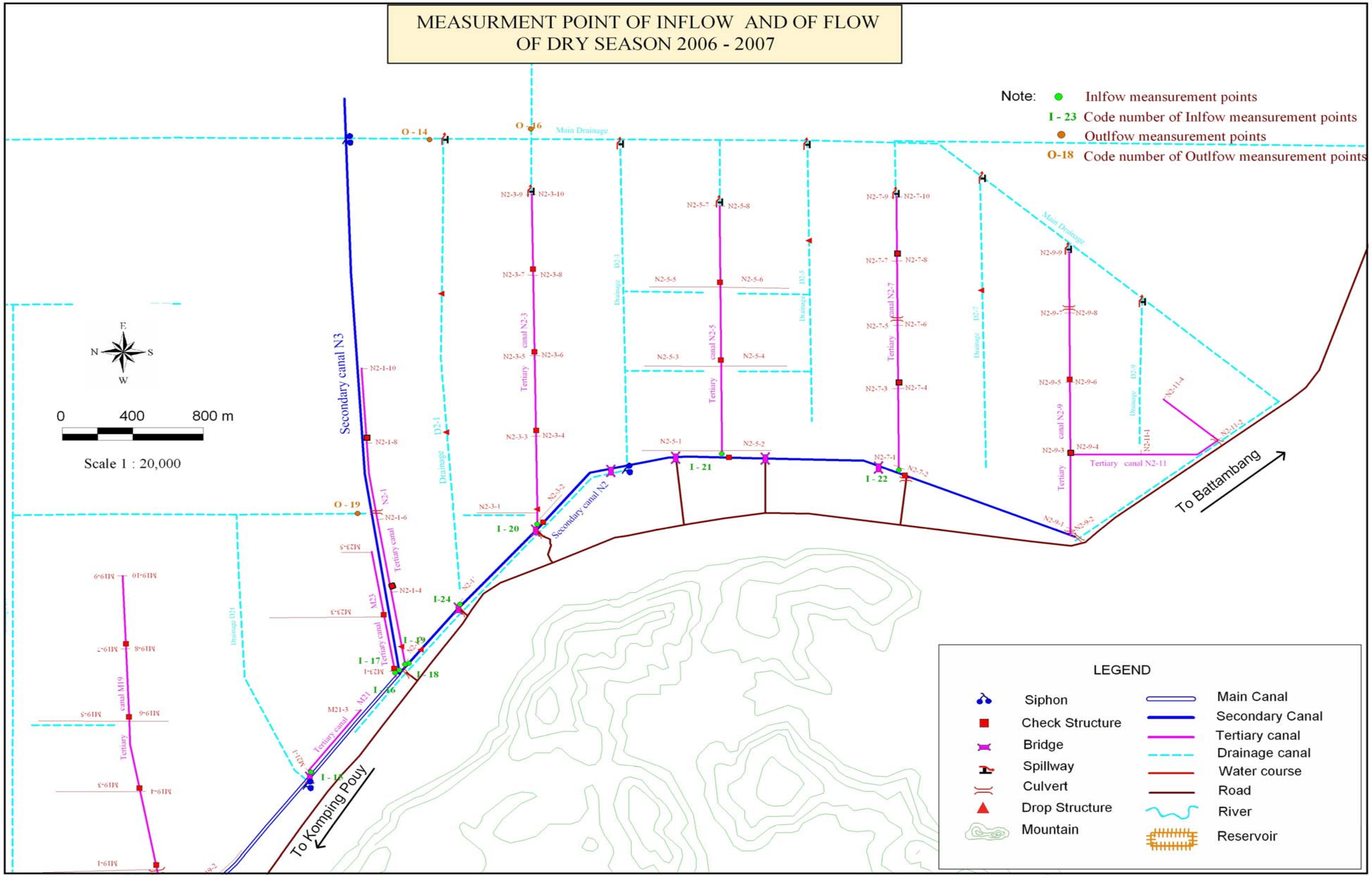
Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1					68							
2												
3						8	3	10	6			
4					6				1	3		
5					2	18	8					
6	2					1	21					
7					8					3		
8												
9					6				14	12		
10				27	13			12	10	55		
11					34				37		15	
12				7			23			3		
13					4						18	
14					12					18	8	
15					14		8	15		12	1	
16					17				21	8		
17			5		1		10			4		
18						11					35	
19					2	3		2			12	
20			23		1	25		7	53			
21		39	4					5				
22	38	44		10		48				14		
23		19				34		7				
24			2	2	2	26	11	2				
25						3		4				
26		13							15	3		
27				9		5			19	10		
28				9	21	3		27				
29				26	2				3			
30				12		6			13	5		
31					14			21				
Total	**40**	**115**	**34**	**102**	**227**	**191**	**84**	**112**	**192**	**150**	**89**	**0**
No of days	**2**	**4**	**4**	**8**	**18**	**13**	**7**	**11**	**11**	**13**	**6**	**0**
Total										1336 mm/year		

Annex 10. Location map of Inflow and Outflow measurement

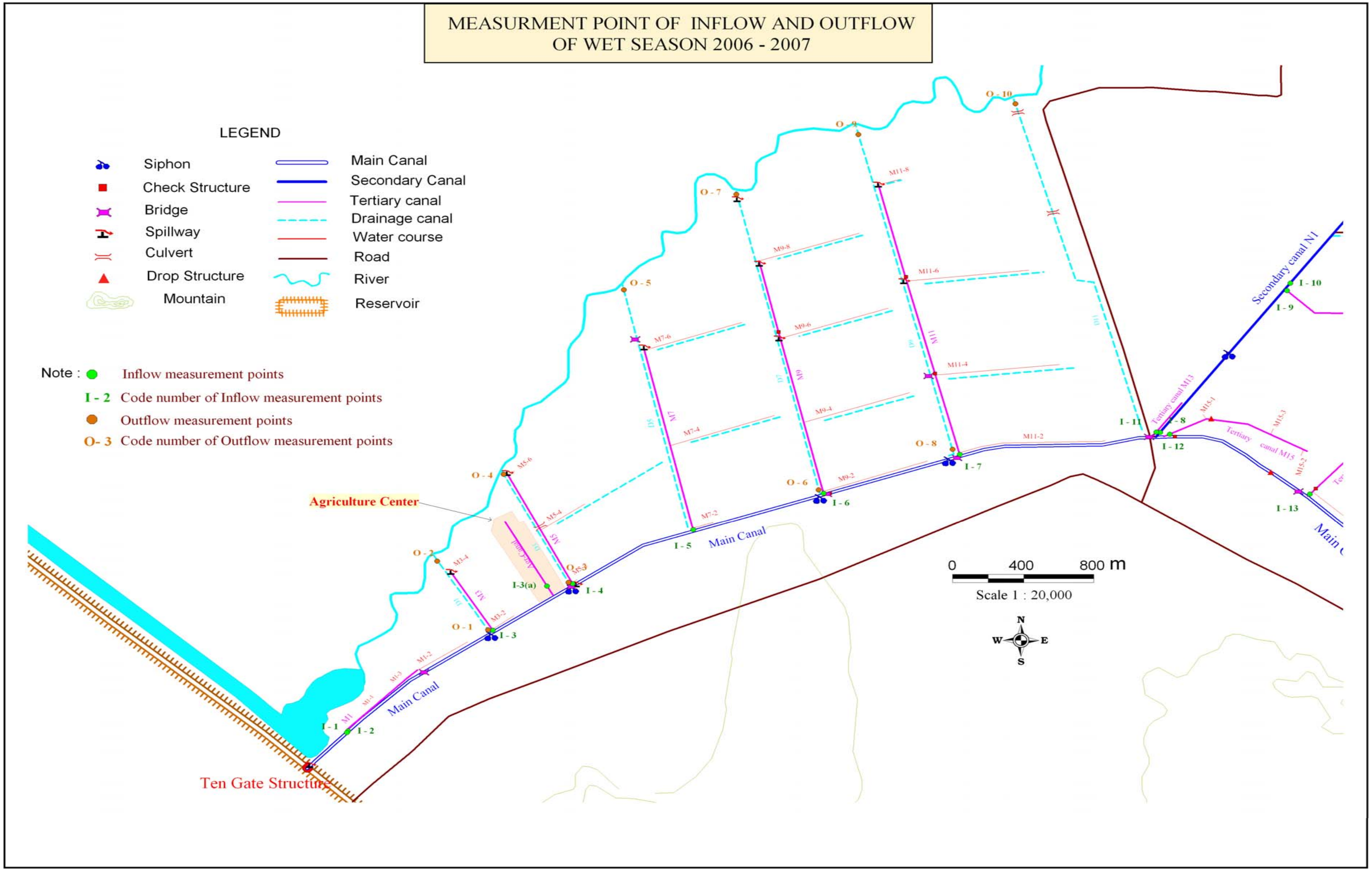


MEASURMENT POINT OF INFLOW AND OUTFLOW OF DRY SEASON 2006 - 2007



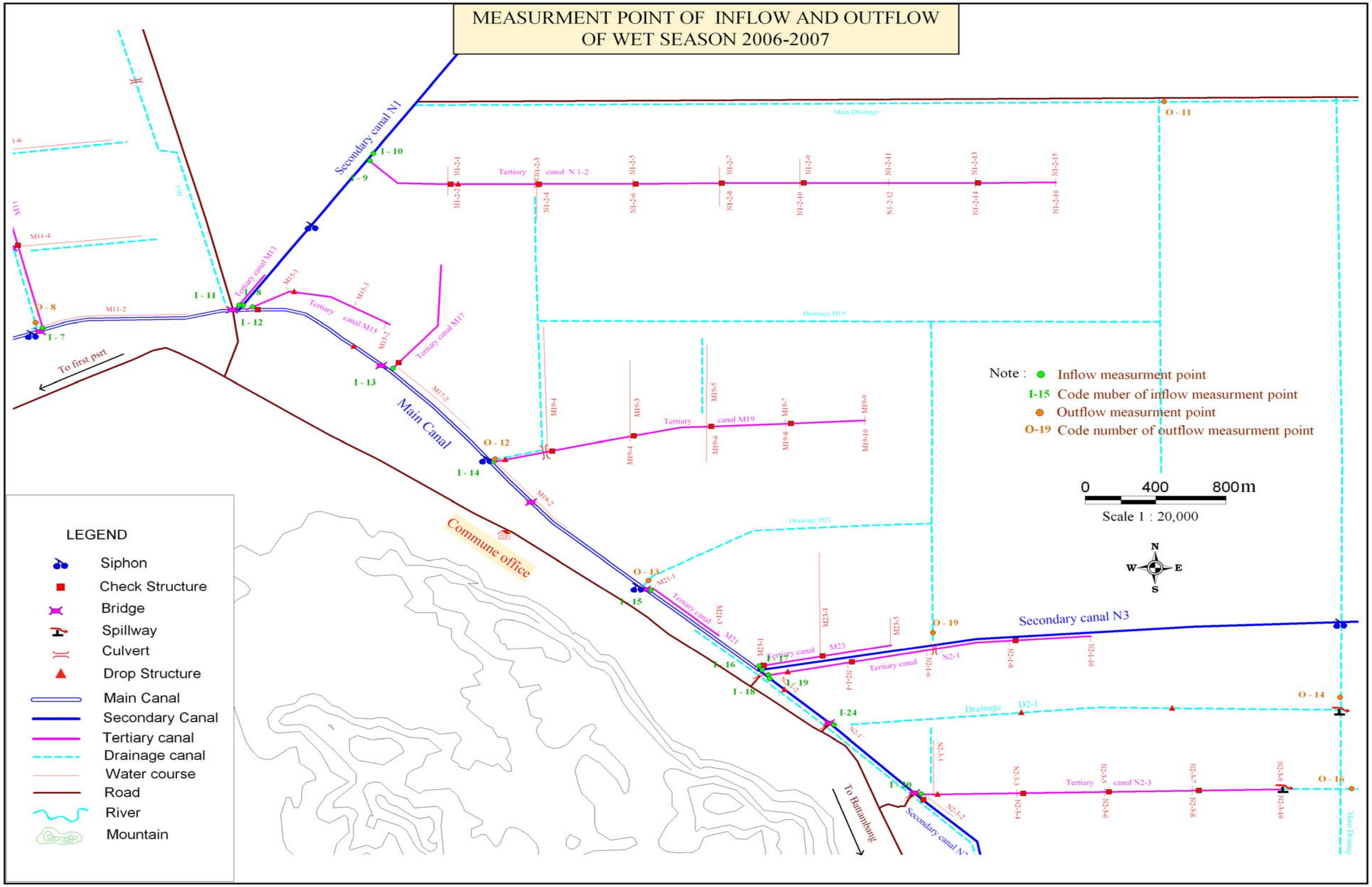


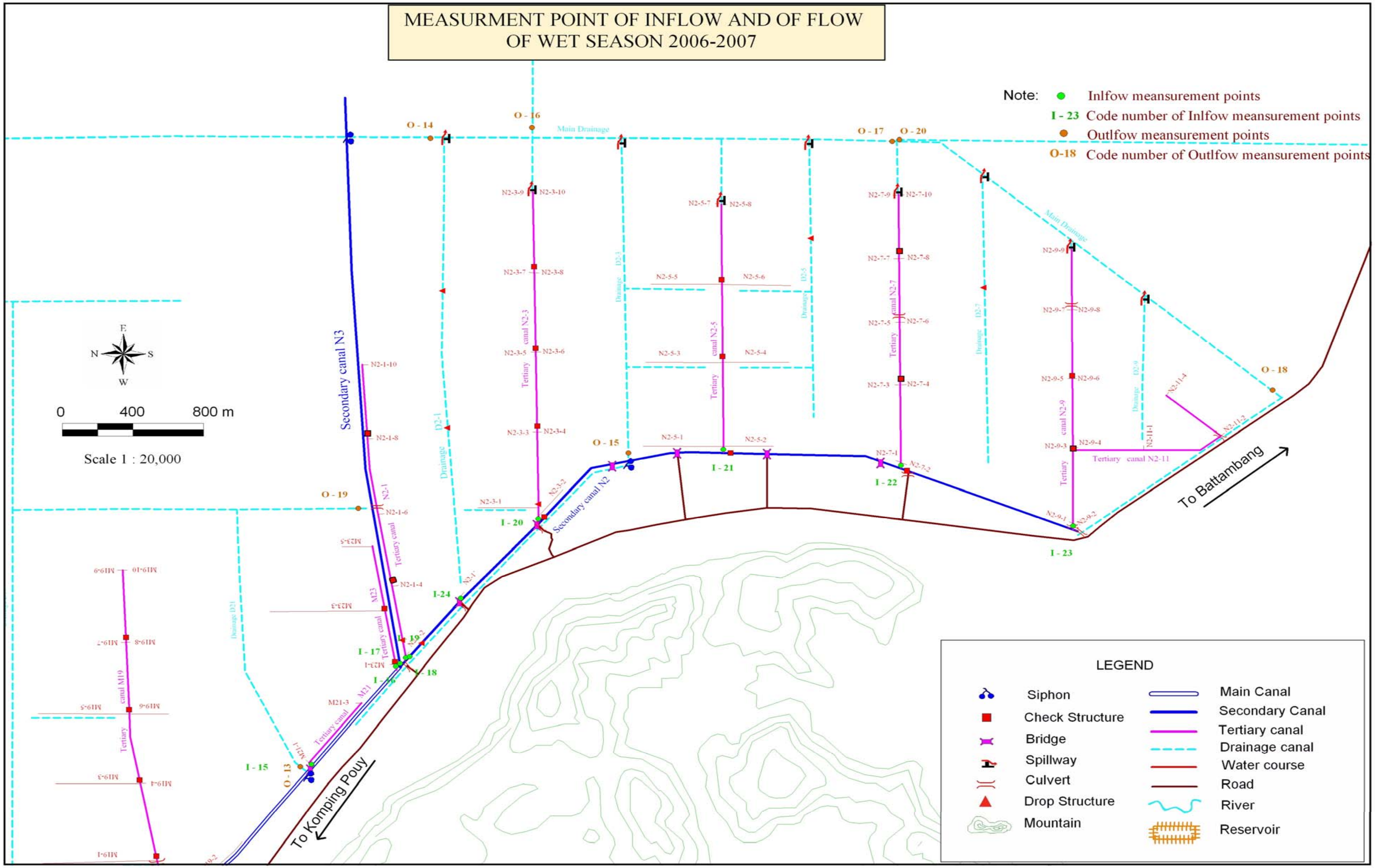
MEASURMENT POINT OF INFLOW AND OF FLOW OF DRY SEASON 2006 - 2007



MEASURMENT POINT OF INFLOW AND OUTFLOW OF WET SEASON 2006 - 2007

MEASURMENT POINT OF INFLOW AND OUTFLOW OF WET SEASON 2006-2007





MEASURMENT POINT OF INFLOW AND OF FLOW OF WET SEASON 2006-2007

Surface inflow and outflow

Dry season 2007

Date				Surface Inflows														Surface Outflow	
				Ten Gate Operation												Reservoir Operation		Outflows Operation	
Open		Close		Num gate	H gate	W gate	Water Level in reservoir		Area (m^2)	μ	g	Z (m)	Q	Time (s)	Quantity (m^3)	Leakage (m^3)	Reservoir Estimation(m^3)	Percentage Outflows	Volume Outflows(m^3)
Date	Time	Date	Time				Open	Close											
27-Jan-07	4 h 33 mn	28-Jan-07	4 h 30 mn	3	0.18	2	2.30	2.30	1.08	0.7	9.81	2.30	4.88	86400	421,231		642,935	20.72%	[illegible]
28-Jan-07	4 h 30 mn	29-Jan-07	4 h 30 mn	3	0.20	2	2.29	2.29	1.20	0.7	9.81	2.29	5.41	86400	467,016		712,818	20.72%	147670
29-Jan-07	7 h 46 mn	30-Jan-07	7 h 46 mn	3	0.23	2	2.28	2.28	1.38	0.7	9.81	2.28	6.20	86400	535,894		817,949	20.72%	169449
30-Jan-07	7 h 38 mn	31-Jan-07	7 h 38 mn	3	0.25	2	2.25	2.25	1.50	0.7	9.81	2.25	6.70	86400	578,649		883,206	20.72%	182968
31-Jan-07		1-Feb-07																	
1-Feb-07		2-Feb-07																	
2-Feb-07		3-Feb-07																	
3-Feb-07	3 h 50 mn	4-Feb-07	3 h 50 mn	3	0.20	2	2.18	2.18	1.20	0.7	9.81	2.18	5.27	86400	455,661		695,487	20.72%	144080
4-Feb-07	8 h 10 mn	5-Feb-07	8 h 50 mn	3	0.20	2	2.15	2.15	1.20	0.7	9.81	2.15	5.24	88800	465,085		709,871	20.72%	147059
5-Feb-07	7 h 20 mn	6-Feb-07	7 h 20 mn	3	0.20	2	2.14	2.14	1.20	0.7	9.81	2.14	5.23	86400	451,461		689,077	20.72%	142752
6-Feb-07	3 h 40 mn	7-Feb-07	3 h 40 mn	1	0.10	2	2.14	2.14	0.20	0.7	9.81	2.14	0.87	86400	75,244		114,846	20.72%	23792
7-Feb-07		8-Feb-07																	
8-Feb-07		9-Feb-07																	
9-Feb-07		10-Feb-07																	
10-Feb-07		11-Feb-07																	
11-Feb-07	6 h 50 mn	12-Feb-07	6 h 50 mn	1	0.10	2	2.10	2.10	0.20	0.7	9.81	2.10	0.86	86400	74,537		113,768	20.72%	23569
12-Feb-07		13-Feb-07														21,600	21,600	20.72%	
13-Feb-07		14-Feb-07														21,600	21,600	20.72%	
14-Feb-07		15-Feb-07														21,600	21,600	20.72%	
15-Feb-07		16-Feb-07														21,600	21,600	20.72%	
16-Feb-07		17-Feb-07														21,600	21,600	20.72%	
17-Feb-07		18-Feb-07														21,600	21,600	20.72%	
18-Feb-07	7 h 48 mn	18-Feb-07	13h 35 mn	3	0.10	2	2.05	2.05	0.60	0.7	9.81	2.05	2.56	20820	53,239				
18-Feb-07	13h 35 mn	19-Feb-07	10 h 15 mn	3	0.2	2	2.05	2.05	0.90	0.7	9.81	2.05	3.84	74400	285,372		369,068	13.78%	50871
19-Feb-07	10 h 15 mn	20-Feb-07	9 h 15 mn	3	0.10	2	2.04	2.04	0.60	0.7	9.81	2.04	2.55	82800	211,210		273,156	13.78%	37651
20-Feb-07	9 h 15 mn	21-Feb-07	15 h 45 mn	3	0.1	2	2.03	2.03	0.48	0.7	9.81	2.03	2.04	1E+05	230,845		298,549	13.78%	41151
21-Feb-07	15h 45mn	22-Feb-07	13h 28mn	3	0.10	2	2.02	2.02	0.60	0.7	9.81	2.02	2.54	78180	198,446		256,647	13.78%	35375
22-Feb-07		23-Feb-07															68,853	13.78%	9490
23-Feb-07	13h 40mn	24-Feb-07	10h 45mn	1	0.1	2	2.01	2.15	0.20	0.7	9.81	2.01	0.84	75900	64,060		82,848	13.78%	11419
24-Feb-07		25-Feb-07																	
25-Feb-07	10h 45mn	26-Feb-07	8h 30mn	2	0.10	2	2.13	2.13	0.40	0.7	9.81	2.13	1.74	78300	136,060		175,965	13.78%	24254

surface inflow and outflow

Dry season 2007

Date				Surface Inflows														Surface Outflow	
				Ten Gate Operation												Reservoir Operation		Outflows Operation	
Open		Close		Num gate	H gate	W gate	Water Level in reservoir		Area (m^2)	μ	g	Z (m)	Q	Time (s)	Quantity (m^3)	Leakage (m^3)	Reservoir Estimation (m^3)	Percentage Outflows	Volume Outflows(m^3)
Date	Time	Date	Time				Open	Close											
26-Feb-07		27-Feb-07														21,600			
27-Feb-07		28-Feb-07														21,600			
28-Feb-07		1-Mar-07														21,600			
1-Mar-07		2-Mar-07														21,600			
2-Mar-07	17h 30mn	3-Mar-07	8h 12mn	3	0.08	2	2.11	2.08	0.48	0.67	9.81	2.11	2.08	52920	109,830		142,042	17.62%	25026
3-Mar-07	8h 12mn	4-Mar-07	8h 12mn	3	0.08	2	2.11	2.08	0.48	0.67	9.81	2.11	2.08	86400	179,314		231,905	17.62%	40859
4-Mar-07	8h 12mn	5-Mar-07	8h 12mn	3	0.08	2	2.11	2.08	0.48	0.67	9.81	2.11	2.08	86400	179,314		231,905	17.62%	40859
5-Mar-07	8h 12mn	6-Mar-07	8h 12mn	3	0.15	2	2.05	2.02	0.90	0.67	9.81	2.05	3.84	86400	331,400		428,595	17.62%	75514
6-Mar-07	8h 12mn	7-Mar-07	8h 12mn	3	0.15	2	2.05	2.02	0.90	0.67	9.81	2.05	3.84	86400	331,400		428,595	17.62%	75514
7-Mar-07	8h 12mn	8-Mar-07	8h 12mn	3	0.15	2	2.05	2.02	0.90	0.67	9.81	2.05	3.84	86400	331,400		428,595	17.62%	75514
8-Mar-07	8h 12mn	9-Mar-07	8h 12mn	3	0.15	2	2.05	2.02	0.90	0.67	9.81	2.05	3.84	86400	331,400		428,595	17.62%	75514
9-Mar-07	8h 12mn	10-Mar-07	7h 10mn	3	0.15	2	2.05	2.02	0.90	0.67	9.81	2.05	3.84	82680	317,131		410,141	17.62%	72263
10-Mar-07		11-Mar-07														21,600			
11-Mar-07		12-Mar-07														21,600			
12-Mar-07		13-Mar-07														21,600			
13-Mar-07		14-Mar-07														21,600			
14-Mar-07	17h 26mn	15-Mar-07	16h 00mn	3	0.08	2	2.01	1.96	0.48	0.67	9.81	2.01	2.03	81240	164,561		200,957	11.71%	23524
15-Mar-07	16h 00mn	16-Mar-07	16h 00mn	3	0.08	2	2.01	1.96	0.48	0.67	9.81	2.01	2.03	86400	175,014		213,721	11.71%	25019
16-Mar-07	16h 00mn	17-Mar-07	16h 00mn	3	0.15	2	1.96	1.94	0.90	0.67	9.81	1.96	3.75	86400	324,043		395,711	11.71%	46323
17-Mar-07	16h 00mn	18-Mar-07	16h 00mn	3	0.15	2	1.96	1.94	0.90	0.67	9.81	1.96	3.75	86400	324,043		395,711	11.71%	46323
18-Mar-07	16h 00mn	19-Mar-07	16h 00mn	3	0.15	2	1.96	1.94	0.90	0.67	9.81	1.96	3.75	86400	324,043		395,711	11.71%	46323
19-Mar-07	16h 00mn	20-Mar-07	17h 00mn	3	0.15	2	1.96	1.94	0.90	0.67	9.81	1.96	3.75	90000	337,545		412,199	11.71%	48253
20-Mar-07		21-Mar-07														21,600			
21-Mar-07		22-Mar-07														21,600			
22-Mar-07		23-Mar-07														21,600			
23-Mar-07		24-Mar-07														21,600			
24-Mar-07		25-Mar-07														21,600			
25-Mar-07		26-Mar-07														21,600			
26-Mar-07	17h 20mn	27-Mar-07	17h 20mn	3	0.15	2	1.89	1.86	0.90	0.67	9.81	1.89	3.68	86400	318,204		411,529	7.22%	29700
27-Mar-07	17h 20mn	28-Mar-07	17h 20mn	3	0.15	2	1.89	1.86	0.90	0.67	9.81	1.89	3.68	86400	318,204		411,529	7.22%	29700
28-Mar-07	17h 20mn	29-Mar-07	16h 48mn	3	0.15	2	1.89	1.86	0.90	0.67	9.81	1.89	3.68	84480	311,133		402,384	7.22%	29040
29-Mar-07	16h 48mn	30-Mar-07	16h 48mn	3	0.17	2	1.86	1.82	1.02	0.67	9.81	1.86	4.14	86400	357,758		462,684	7.22%	33392
30-Mar-07	16h 48mn	31-Mar-07	16h 48mn	3	0.17	2	1.86	1.82	1.02	0.67	9.81	1.86	4.14	86400	357,758		462,684	7.22%	33392

surface inflow and outflow

Dry season 2007

Date				Surface Inflows														Surface Outflow	
				Ten Gate Operation												Reservoir Operation		Outflows Operation	
Open		Close		Num	H	W	Water Level in reservoir		Area	μ	g	Z	Q	Time	Quantity	Leakage	Reservoir	Percentage Outflows	Volume Outflows(m^3)
Date	Time	Date	Time	gate	gate	gate	Open	Close	(m^2			(m		(s)	(m^3)	(m^3)	Estimation (m^3)		
31-Mar-07	16h 48mn	1-Apr-07	16h 48mn	3	0.17	2	1.86	1.82	1.02	0.67	9.81	1.86	4.14	86400	357,758		462,684	7.22%	33392
1-Apr-07	16h 48mn	2-Apr-07	6h 40mn	3	0.17	2	1.86	1.82	1.02	0.67	9.81	1.86	4.14	49920	206,705		267,328	7.22%	19293
2-Apr-07	6h 40mn	3-Apr-07	6h 40mn	1	0.10	2	1.82	1.77	0.20	0.67	9.81	1.82	0.80	86400	69,390		89,741	7.22%	6477
3-Apr-07	6h 40mn	4-Apr-07	6h 40mn	1	0.10	2	1.82	1.77	0.20	0.67	9.81	1.82	0.80	86400	69,390		89,741	7.22%	6477
4-Apr-07	6h 40mn	5-Apr-07	6h 40mn	1	0.10	2	1.82	1.77	0.20	0.67	9.81	1.82	0.80	86400	69,390		89,741	7.22%	6477
5-Apr-07	6h 40mn	6-Apr-07	6h 40mn	1	0.10	2	1.82	1.77	0.20	0.67	9.81	1.82	0.80	86400	69,390		89,741	7.22%	6477
6-Apr-07	6h 40mn	7-Apr-07	8h 35mn	1	0.10	2	1.82	1.77	0.20	0.67	9.81	1.82	0.80	93300	74,932		96,908	7.22%	6994
7-Apr-07		8-Apr-07														21,600			
8-Apr-07		9-Apr-07														21,600			
9-Apr-07		10-Apr-07														21,600			
10-Apr-07	7h 15mn	11-Apr-07	7h 15mn	3	0.20	2	1.75	1.71	1.20	0.67	9.81	1.75	4.73	86400	408,256		527,993	12.63%	66670
11-Apr-07	7h 15mn	12-Apr-07	7h 15mn	3	0.20	2	1.75	1.71	1.20	0.67	9.81	1.75	4.73	86400	408,256		527,993	12.63%	66670
12-Apr-07	7h 15mn	13-Apr-07	7h 15mn	3	0.20	2	1.75	1.71	1.20	0.67	9.81	1.75	4.73	86400	408,256		527,993	12.63%	66670
13-Apr-07	7h 15mn	14-Apr-07	11h 02mn	3	0.20	2	1.75	1.71	1.20	0.67	9.81	1.75	4.73	100020	472,613		611,225	12.63%	77180
14-Apr-07	11h 02mn	15-Apr-07	11h 02mn	3	0.17	2	1.71	1.68	1.02	0.67	9.81	1.71	3.97	86400	343,029		443,635	12.63%	56018
15-Apr-07	11h 02mn	16-Apr-07	6h 20mn	3	0.17	2	1.71	1.68	1.02	0.67	9.81	1.71	3.97	69480	275,852		356,756	12.63%	45048
16-Apr-07	6h 20mn	17-Apr-07	17h 00mn	3	0.1	2	1.68	1.66	0.60	0.67	9.81	1.68	2.31	124800	288,894		373,624	12.63%	47178
17-Apr-07		18-Apr-07														21,600			
18-Apr-07		19-Apr-07														21,600			
19-Apr-07		20-Apr-07														21,600			
20-Apr-07		21-Apr-07														21,600			
21-Apr-07		22-Apr-07														21,600			
22-Apr-07		23-Apr-07														21,600			
23-Apr-07		24-Apr-07														21,600			
24-Apr-07		25-Apr-07														21,600			
25-Apr-07	16h 00mn	26-Apr-07	14h 55mn	3	0.18	2	1.64	1.63	1.08	0.67	9.81	1.64	4.12	82500	339,640		525,692	5.20%	27332
26-Apr-07	14h 55mn	27-Apr-07	14h 55mn	3	0.2	2	1.63	1.6	1.20	0.67	9.81	1.63	4.56	86400	394,010		609,847	5.20%	31707
27-Apr-07	14h 55mn	28-Apr-07	14h 55mn	3	0.2	2	1.63	1.6	1.20	0.67	9.81	1.63	4.56	86400	394,010		609,847	5.20%	31707
28-Apr-07	14h 55mn	29-Apr-07	14h 55mn	3	0.2	2	1.63	1.6	1.20	0.67	9.81	1.63	4.56	86400	394,010		609,847	5.20%	31707
29-Apr-07	14h 55mn	30-Apr-07	10h 50mn	3	0.2	2	1.63	1.6	1.20	0.67	9.81	1.63	4.56	71700	326,974		506,088	5.20%	26313
30-Apr-07	10h 50mn	1-May-07	10h 50mn	3	0.15	2	1.6	1.66	0.90	0.67	9.81	1.6	3.39	86400	292,776		453,156	5.20%	23561
1-May-07		2-May-07														21,600			

surface inflow and outflow

Dry season 2007

Date				Surface Inflows														Surface Outflow	
				Ten Gate Operation												Reservoir Operation		Outflows Operation	
Open		Close		Num	H	W	Water Level in reservoir		Area	μ	g	Z	Q	Time	Quantity	Leakage	Reservoir	Percentage	Volume
Date	Time	Date	Time	gate	gate	gate	Open	Close	(m^2)			(m)		(s)	(m^3)	(m^3)	Estimation (m^3)	Outflows	Outflows(m^3)
2-May-07		3-May-07														21,600			
3-May-07		4-May-07														21,600			
4-May-07		5-May-07														21,600			
5-May-07		6-May-07														21,600			
6-May-07		7-May-07														21,600			
7-May-07		8-May-07														21,600			
8-May-07		9-May-07														21,600			
9-May-07		10-May-07														21,600			
10-May-07		11-May-07														21,600			
11-May-07		12-May-07														21,600			
12-May-07		13-May-07														21,600			
13-May-07		14-May-07														21,600			
14-May-07		15-May-07														21,600			
15-May-07		16-May-07														21,600			
16-May-07		17-May-07														21,600			
17-May-07		18-May-07														21,600			
18-May-07		19-May-07														21,600			
19-May-07		20-May-07														21,600			
20-May-07		21-May-07														21,600			
21-May-07		22-May-07														21,600			
22-May-07		23-May-07														21,600			
23-May-07		24-May-07														21,600			
24-May-07		25-May-07														21,600			
25-May-07		26-May-07														21,600			
26-May-07	19 h 00 mn	27-May-07	19 h 00 mn	2	0.1	2	1.8	1.83	0.40	0.67	9.81	1.8	1.60	86400	138,016		178,494	51.66%	92217
27-May-07	19 h 00 mn	28-May-07	19 h 00 mn	2	0.1	2	1.8	1.83	0.40	0.67	9.81	1.8	1.60	86400	138,016		178,494	51.66%	92217
28-May-07	19 h 00 mn	29-May-07	19 h 00 mn	2	0.1	2	1.8	1.83	0.40	0.67	9.81	1.8	1.60	86400	138,016		178,494	51.66%	92217
29-May-07	19 h 00 mn	30-May-07	6 h 30 mn	2	0.1	2	1.8	1.83	0.40	0.67	9.81	1.8	1.60	41400	66,133		85,528	51.66%	44188
															Total (MCM)	**1.21**	**22.29**		**3.20**

surface inflow and outflow

Wet season 2007

Date				Surface Inflows														Surface Outflow	
				Ten Gate Operation												Reservoir Operation		Outflows Operation	
Open		Close		Num gate	H gate	W gate	Water Level in reservoir		Area (m²)	µ	g	Z (m)	Q	Time (s)	Quantity (m³)	Leakage (m³)	Reservoir Estimation (m³)	Percentage Outflows	Volum Outflows(m³)
Date	Time	Date	Time				Open	Close											
10-Jul-07	18 h 45mn	11-Jul-07	18 h 30mn	2	0.08	2	1.88	1.88	0.32	0.67	9.81	1.88	1.306	85500	111,664		160,533	2.45%	3932
11-Jul-07	18 h 30mn	12-Jul-07	18 h 30mn	2	0.08	2	1.88	1.88	0.32	0.67	9.81	1.88	1.306	86400	112,840		162,222	2.45%	3973
12-Jul-07		13-Jul-07														21,600			
13-Jul-07		14-Jul-07														21,600			
14-Jul-07		15-Jul-07														21,600			
15-Jul-07		16-Jul-07														21,600			
16-Jul-07		17-Jul-07														21,600			
17-Jul-07		18-Jul-07														21,600			
18-Jul-07		19-Jul-07														21,600			
19-Jul-07		20-Jul-07														21,600			
20-Jul-07		21-Jul-07														21,600			
21-Jul-07		22-Jul-07														21,600			
22-Jul-07	18h40mn	23-Jul-07	9h20mn	1	0.10	2	1.90	1.89	0.20	0.67	9.81	1.9	0.821	52800	43,327		50,955	2.45%	1248
23-Jul-07	9h20mn	24-Jul-07	9h20mn	1	0.10	2	1.90	1.89	0.20	0.67	9.81	1.9	0.821	86400	70,899		83,380	2.45%	2042
24-Jul-07	9h20mn	25-Jul-07	6h30mn	1	0.15	2	1.89	1.88	0.30	0.67	9.81	1.89	1.228	76200	93,546		110,015	2.45%	2695
25-Jul-07	6h30mn	26-Jul-07	16h45mn	2	0.10	2	1.88	1.86	0.40	0.67	9.81	1.88	1.633	123300	201,289		236,726	2.45%	5798
26-Jul-07	16h45mn	27-Jul-07	16h45mn	2	0.10	2	1.88	1.86	0.40	0.67	9.81	1.88	1.633	86400	141,049		165,881	2.45%	4063
27-Jul-07	16h45mn	28-Jul-07	15h30mn	2	0.18	2	1.86	1.83	0.72	0.67	9.81	1.86	2.923	81900	239,382		281,524	2.45%	6895
28-Jul-07	15h30mn	29-Jul-07	15h30mn	2	0.18	2	1.86	1.83	0.72	0.67	9.81	1.86	2.923	86400	252,535		296,993	2.45%	7274
29-Jul-07	15h30mn	30-Jul-07	15h30mn	2	0.18	2	1.86	1.83	0.72	0.67	9.81	1.86	2.923	86400	252,535		296,993	2.45%	7274
30-Jul-07	15h30mn	31-Jul-07	15h30mn	2	0.18	2	1.86	1.83	0.72	0.67	9.81	1.86	2.923	86400	252,535		296,993	2.45%	7274
31-Jul-07	15h30mn	1-Aug-07	9h30mn	2	0.20	2	1.83	1.8	0.80	0.67	9.81	1.83	3.221	64800	208,742		245,490	2.45%	6013
1-Aug-07	9h30mn	2-Aug-07	9h30mn	2	0.20	2	1.83	1.8	0.80	0.67	9.81	1.83	3.221	86400	278,322		327,320	2.45%	8017
2-Aug-07	9h30mn	3-Aug-07	11h45mn	2	0.25	2	1.80	1.75	1.00	0.67	9.81	1.8	3.994	80100	319,880		376,194	2.45%	9214
3-Aug-07	11h45mn	4-Aug-07	11h45mn	2	0.25	2	1.80	1.75	1.00	0.67	9.81	1.8	3.994	86400	345,039		405,782	2.45%	9939
4-Aug-07	11h45mn	5-Aug-07	11h45mn	2	0.25	2	1.80	1.75	1.00	0.67	9.81	1.8	3.994	86400	345,039		405,782	2.45%	9939
5-Aug-07	11h45mn	6-Aug-07	11h45mn	2	0.25	2	1.80	1.75	1.00	0.67	9.81	1.8	3.994	86400	345,039		405,782	2.45%	9939
6-Aug-07	11h45mn	7-Aug-07	11h45mn	2	0.25	2	1.80	1.75	1.00	0.67	9.81	1.8	3.994	86400	345,039		405,782	2.45%	9939
7-Aug-07	11h45mn	8-Aug-07	16h30mn	1	0.20	2	1.75	1.74	0.40	0.67	9.81	1.75	1.575	103500	163,019		191,718	2.45%	4696
8-Aug-07	16h30mn	9-Aug-07	9h15mn	1	0.20	2	1.74	1.71	0.40	0.67	9.81	1.74	1.571	60300	94,705		111,377	2.45%	2728
9-Aug-07	9h15mn	10-Aug-07	9h15mn	1	0.20	2	1.74	1.71	0.40	0.67	9.81	1.74	1.571	86400	135,696		159,585	2.45%	3909

surface inflow and outflow (Wet season 2007)

Date				Surface Inflows														Surface Outflow	
				Ten Gate Operation												Reservoir Operation		Outflows Operation	
Open		Close		Num	H	W	Water Level in reservoir		Area	μ	g	Z	Q	Time	Quantity	Leakage	Reservoir	Percentage Outflows	Volume Outflows(m^3)
Date	Time	Date	Time	gate	gate	gate	Open	Close	(m^2)			(m)		(s)	(m^3)	(m^3)	Estimation (m^3)		
10-Aug-07	9h15mn	11-Aug-07	9h15mn	1	0.20	2	1.74	1.71	0.40	0.67	9.81	1.74	1.571	86400	135,696		159,585	2.45%	3909
11-Aug-07	9h15mn	12-Aug-07	9h15mn	1	0.20	2	1.74	1.71	0.40	0.67	9.81	1.74	1.571	86400	135,696		159,585	2.45%	3909
12-Aug-07	9h15mn	13-Aug-07	9h15mn	1	0.20	2	1.74	1.71	0.40	0.67	9.81	1.74	1.571	86400	135,696		159,585	2.45%	3909
13-Aug-07	9h15mn	14-Aug-07	9h15mn	1	0.20	2	1.74	1.71	0.40	0.67	9.81	1.74	1.571	86400	135,696		159,585	2.45%	3909
14-Aug-07		15-Aug-07														21,600			
15-Aug-07		16-Aug-07														21,600			
16-Aug-07		17-Aug-07														21,600			
17-Aug-07		18-Aug-07														21,600			
18-Aug-07		19-Aug-07														21,600			
19-Aug-07		20-Aug-07														21,600			
20-Aug-07	16h45mn	21-Aug-07	7h15mn	2	0.25	2	1.70	1.67	1.00	0.67	9.81	1.7	3.881	52200	202,588		305,721	14.37%	43945
21-Aug-07	7h15mn	22-Aug-07	7h15mn	2	0.25	2	1.70	1.67	1.00	0.67	9.81	1.7	3.881	86400	335,318		506,021	14.37%	72736
22-Aug-07	7h15mn	23-Aug-07	7h15mn	2	0.25	2	1.70	1.67	1.00	0.67	9.81	1.7	3.881	86400	335,318		506,021	14.37%	72736
23-Aug-07	7h15mn	24-Aug-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	95100	438,974		662,446	14.37%	95221
24-Aug-07	9h30mn	25-Aug-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
25-Aug-07	9h30mn	26-Aug-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
26-Aug-07	9h30mn	27-Aug-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
27-Aug-07	9h30mn	28-Aug-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
28-Aug-07	9h30mn	29-Aug-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
29-Aug-07	9h30mn	30-Aug-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
30-Aug-07	9h30mn	31-Aug-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
31-Aug-07	9h30mn	1-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
1-Sep-07	9h30mn	2-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
2-Sep-07	9h30mn	3-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
3-Sep-07	9h30mn	4-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
4-Sep-07	9h30mn	5-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
5-Sep-07	9h30mn	6-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
6-Sep-07	9h30mn	7-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
7-Sep-07	9h30mn	8-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
8-Sep-07	9h30mn	9-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
9-Sep-07	9h30mn	10-Sep-07	9h30mn	2	0.30	2	1.67	1.38	1.20	0.67	9.81	1.67	4.616	86400	398,815		601,843	14.37%	86510
10-Sep-07		11-Sep-07														21,600			
11-Sep-07		12-Sep-07														21,600			

surface inflow and outflow

Wet season 2007

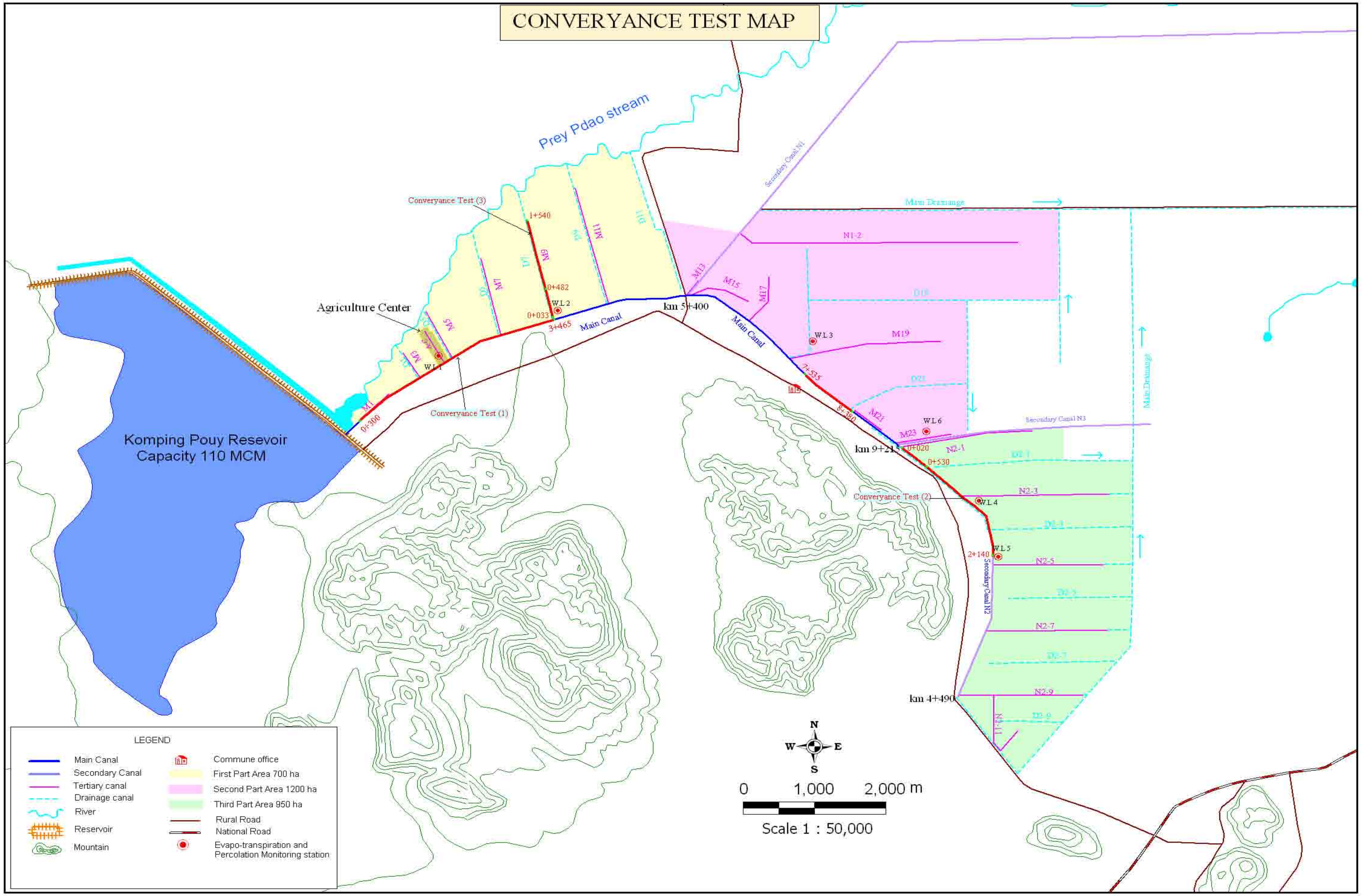
Date				Surface Inflows														Surface Outflow	
				Ten Gate Operation												Reservoir Operation		Outflows Operation	
Open		Close		Num	H	W	Water Level in reservoir		Area	µ	g	Z	Q	Time	Quantity	Leakage	Reservoir	Percentage	Volume
Date	Time	Date	Time	gate	gate	gate	Open	Close	(m^2)			(m)		(s)	(m^3)	(m^3)	Estimation (m^3)	Outflows	Outflows(m^3)
12-Sep-07		13-Sep-07														21,600			
13-Sep-07		14-Sep-07														21,600			
14-Sep-07		15-Sep-07														21,600			
15-Sep-07		16-Sep-07														21,600			
16-Sep-07		17-Sep-07														21,600			
17-Sep-07	11h30mn	18-Sep-07	9h51mn	2	0.35	2	1.38	1.36	1.40	0.67	9.81	1.38	4.895	81060	396,819		570,483	18.07%	103062
18-Sep-07	9h51mn	19-Sep-07	9h51mn	2	0.35	2	1.38	1.36	1.40	0.67	9.81	1.38	4.895	86400	422,961		608,064	18.07%	109851
19-Sep-07	9h51mn	20-Sep-07	11h40mn	2	0.40	2	1.36	1.55	1.60	0.67	9.81	1.36	5.554	96540	536,186		770,841	18.07%	139258
20-Sep-07	11h40mn	21-Sep-07	11h40mn	2	0.40	2	1.36	1.55	1.60	0.67	9.81	1.36	5.554	86400	479,868		689,877	18.07%	124631
21-Sep-07	11h40mn	22-Sep-07	11h40mn	2	0.40	2	1.36	1.55	1.60	0.67	9.81	1.36	5.554	86400	479,868		689,877	18.07%	124631
22-Sep-07		23-Sep-07														21,600			
23-Sep-07		24-Sep-07														21,600			
24-Sep-07		25-Sep-07														21,600			
25-Sep-07		26-Sep-07														21,600			
26-Sep-07		27-Sep-07														21,600			
27-Sep-07		28-Sep-07														21,600			
28-Sep-07		29-Sep-07														21,600			
29-Sep-07		30-Sep-07														21,600			
30-Sep-07		1-Oct-07														21,600			
1-Oct-07		2-Oct-07														21,600			
2-Oct-07		3-Oct-07														21,600			
3-Oct-07		4-Oct-07														21,600			
4-Oct-07		5-Oct-07														21,600			
5-Oct-07		6-Oct-07														21,600			
6-Oct-07		7-Oct-07														21,600			
7-Oct-07	10h30mn	8-Oct-07	10h22mn	2	0.25	2	1.76	1.89	1.00	0.67	9.81	1.76	3.949	85920	339,289		487,774	42.70%	208286
8-Oct-07	10h22mn	9-Oct-07	10h22mn	2	0.25	2	1.76	1.89	1.00	0.67	9.81	1.76	3.949	86400	341,184		490,499	42.70%	209450
9-Oct-07	10h22mn	10-Oct-07	10h22mn	2	0.25	2	1.76	1.89	1.00	0.67	9.81	1.76	3.949	86400	341,184		490,499	42.70%	209450
10-Oct-07	10h22mn	11-Oct-07	10h22mn	2	0.25	2	1.76	1.89	1.00	0.67	9.81	1.76	3.949	86400	341,184		490,499	42.70%	209450
11-Oct-07	10h22mn	12-Oct-07	10h22mn	2	0.25	2	1.76	1.89	1.00	0.67	9.81	1.76	3.949	86400	341,184		490,499	42.70%	209450
12-Oct-07	10h22mn	13-Oct-07	16h30mn	2	0.10	2	1.89	1.9	0.40	0.67	9.81	1.89	1.637	108480	177,566		255,275	42.70%	109006
13-Oct-07		14-Oct-07														21,600			

surface inflow and outflow

Wet season 2007

Date				Surface Inflows														Surface Outflow	
				Ten Gate Operation												Reservoir Operation		Outflows Operation	
Open		Close		Num gate	H gate	W gate	Water Level in reservoir		Area (m²)	µ	g	Z (m)	Q	Time (s)	Quantity (m³)	Leakage (m³)	Reservoir Estimation (m³)	Percentage Outflows	Volume Outflows(m³)
Date	Time	Date	Time				Open	Close											
14-Oct-07		15-Oct-07														21,600			
15-Oct-07		16-Oct-07														21,600			
16-Oct-07		17-Oct-07														21,600			
17-Oct-07		18-Oct-07														21,600			
18-Oct-07		19-Oct-07														21,600			
19-Oct-07		20-Oct-07														21,600			
20-Oct-07		21-Oct-07														21,600			
21-Oct-07		22-Oct-07														21,600			
22-Oct-07		23-Oct-07														21,600			
23-Oct-07		24-Oct-07														21,600			
24-Oct-07	13h15mn	25-Oct-07	6h20mn	2	0.20	2	2.15	2.13	0.80	0.67	9.81	2.15	3.492	47100	164,456		236,428	89.39%	211350
25-Oct-07	6h20mn	26-Oct-07	6h20mn	2	0.20	2	2.15	2.13	0.80	0.67	9.81	2.15	3.492	86400	301,677		433,702	89.39%	387700
26-Oct-07	6h20mn	27-Oct-07	6h20mn	2	0.20	2	2.15	2.13	0.80	0.67	9.81	2.15	3.492	86400	301,677		433,702	89.39%	387700
27-Oct-07	6h20mn	28-Oct-07	6h20mn	2	0.20	2	2.15	2.13	0.80	0.67	9.81	2.15	3.492	86400	301,677		433,702	89.39%	387700
28-Oct-07	6h20mn	29-Oct-07	6h20mn	2	0.20	2	2.15	2.13	0.80	0.67	9.81	2.15	3.492	86400	301,677		433,702	89.39%	387700
29-Oct-07	6h20mn	30-Oct-07	6h20mn	2	0.20	2	2.15	2.13	0.80	0.67	9.81	2.15	3.492	86400	301,677		433,702	89.39%	387700
30-Oct-07		31-Oct-07														21,600			
31-Oct-07		1-Nov-07														21,600			
1-Nov-07		2-Nov-07														21,600			
2-Nov-07		3-Nov-07														21,600			
3-Nov-07		4-Nov-07														21,600			
4-Nov-07		5-Nov-07														21,600			
5-Nov-07		6-Nov-07														21,600			
6-Nov-07		7-Nov-07														21,600			
7-Nov-07		8-Nov-07														21,600			
8-Nov-07		9-Nov-07														21,600			
9-Nov-07		10-Nov-07														21,600			
10-Nov-07	7h15mn	11-Nov-07	12h15mn	2	0.05	2	2.16	2.15	0.20	0.67	9.81	2.16	0.875	104400	91,343		524,590	89.39%	468947
11-Nov-07	12h15mn	12-Nov-07	12h15mn	2	0.05	2	2.16	2.15	0.20	0.67	9.81	2.16	0.875	86400	75,594		434,143	89.39%	388094
12-Nov-07	12h15mn	13-Nov-07	12h15mn	2	0.05	2	2.16	2.15	0.20	0.67	9.81	2.16	0.875	86400	75,594		434,143	89.39%	388094
13-Nov-07	12h15mn	14-Nov-07	12h15mn	2	0.05	2	2.16	2.15	0.20	0.67	9.81	2.16	0.875	86400	75,594		434,143	89.39%	388094
															Total (MCM)	**1.30**	**28.29**		**7.44**

Annex 11. Conveyance test along the canals map



Conveyance test at selected point along the canals

Nº	Name Canal	Station	Discharge (m³ /s)	Lose (m³ /s)	Length (Km)	Lose/km (m³ /s)	Remake	Condition
1- Conveyance test at selected point along the main canal								
1	M.C	I-1 Pk 0+300	4.508	0.574	3.165	0.181	Have 5 Structure	Structure
2	M.C	Br-M9 Pk 3+465	3.934					
3	M.C	Br-M19 Pk 7+535	0.957	0.108	0.845	0.128		Non Structure
4	M.C	Br-M21 Pk 8+380	0.849					
2- Conveyance test at selected point along the secondary canal								
8	N2	I-18 Pk 0+020	0.576	0.039	0.510	0.077		Non Structure
9	N2	Br N2-1` Pk 0+530	0.537					
10	N2	Br N2-5 Pk 2+140	0.371	0.205	2.120	0.097	Have 2 Structure	Structure
3- Conveyance test at selected point along the tertiary canal								
5	M-9	I -6 Pk = 33	0.353	0.032	0.449	0.071		Non Structure
6	M-9	Pk = 4 82	0.321					
7	M-9	Pk = 1+540	0.049	0.304	1.507	0.202	Have 5 Structure	Structure

System Conveyance Efficiency

Dry Season 2007

Canal level	Name	Efficiency (%)	Ave. (%)
Main Canal	MC	81.29	81.29
Secondary Canal	N1	82.80	82.80
	N14	53.40	53.40
Tertiary Canal	MCV	72.67	72.67
System Conveyance Efficiency			**72.54**

Conveyance Efficiency of Main Canal

Dry Season 2007

Code	Canal	Measurement Date								Q average(m^3/s)	Remark
		2-Feb-07 (m^3/s)	20-Feb-07 (m^3/s)	6-Mar-07 (m^3/s)	19-Mar-07 (m^3/s)	28-Mar-07 (m^3/s)	11-Apr-07 (m^3/s)	27-Apr-07 (m^3/s)	29-May-07 (m^3/s)		
I-1	MC	6.70	1.94	3.83	3.91	3.60	4.32	4.43	1.13	3.73	Intake
I-2	M 1	0.05	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.01	Intake
I-3	M 3	0.06	0.01	0.01	0.03	0.00	0.03	0.04	0.01	0.02	Intake
I-3 (a)	A -C	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Intake
I-4	M 5	0.20	0.06	0.09	0.07	0.11	0.19	0.07	0.00	0.10	Intake
I-5	M 7	0.33	0.27	0.12	0.13	0.20	0.07	0.27	0.13	0.19	Intake
I-6	M 9	0.36	0.35	0.32	0.34	0.35	0.36	0.38	0.28	0.34	Intake
I-7	M 11	0.28	0.07	0.20	0.36	0.22	0.44	0.53	0.00	0.26	Intake
I-8	N1	1.19	0.33	0.91	0.99	0.55	0.57	0.35	0.00	0.61	Intake
I-11	M 13	0.25	0.15	0.00	0.01	0.20	0.17	0.17	0.00	0.12	Intake
I-12	M 15	0.19	0.11	0.19	0.17	0.15	0.19	0.18	0.00	0.15	Intake
I-13	M 17	0.22	0.00	0.09	0.06	0.06	0.13	0.13	0.05	0.09	Intake
I-14	M 19	0.93	0.00	0.64	0.57	0.36	0.50	0.32	0.00	0.41	Intake
I-15	M 21	0.08	0.01	0.07	0.03	0.04	0.07	0.04	0.00	0.04	Intake
I-16	M 23	0.13	0.00	0.11	0.17	0.15	0.09	0.10	0.00	0.09	Intake
I-17	N3	0.00	0.04	0.06	0.02	0.03	0.06	0.05	0.00	0.03	Intake
I-18	N2	1.39	0.03	0.43	0.36	0.31	0.58	0.41	0.00	0.44	Intake
I-19	N2-1	0.26	0.07	0.17	0.10	0.10	0.12	0.11	0.00	0.12	Off take
Conveyance Efficiency.(%)		88.48	77.07	88.75	87.31	78.48	82.90	71.37	41.47	81.29	

Conveyance Efficiency of Secondary Canal N1

Dry Season 2007

Code	Canal	Measurement Date								Q average(m^3/s)	Remark
		2-Feb-07	20-Feb-07	6-Mar-07	19-Mar-07	28-Mar-07	11-Apr-07	27-Apr-07	29-May-07		
		(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)		
I-8	N1	1.19	0.33	*0.91*	0.99	0.55	*0.57*	*0.35*	0.00	0.76	Intake
I-9	N1-2	0.83	0.20	*0.94*	0.82	0.35	*0.64*	*0.40*	0.00	0.55	Off take
I-10	N12+50m	0.00	0.09	*0.49*	0.15	0.08	*0.06*	*-0.05*	0.00	0.08	Off take
Conveyance Efficiency.(%)		70.40	90.13	*158.26*	97.15	79.23	*123.97*	*101.77*	0.00	82.80	

Conveyance Efficiency of Secondary Canal N2

Dry Season 2007

Code	Canal	Measurement Date								Q average(m^3/s)	Remark
		2-Feb-07	20-Feb-07	6-Mar-07	19-Mar-07	28-Mar-07	11-Apr-07	27-Apr-07	29-May-07		
		(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)		
I-18	N2	1.39	0.03	0.43	0.36	0.31	0.58	0.41	0.00	0.439	Intake
I-20	N2-3	0.23	0.00	0.18	0.09	0.01	0.12	0.00	0.00	0.079	Off take
I-21	N2-5	0.16	0.00	0.04	0.25	0.03	0.03	0.08	0.00	0.072	Off take
I-22	N2-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	Off take
I-24	N2-1`	0.00	0.00	0.18	0.00	0.13	0.23	0.12	0.00	0.083	Off take
Conveyance Efficiency (%)		N.A	7.41	92.10	93.90	56.94	66.04	47.62	0.00	53.40	

Conveyance Efficiency of Tertiary Canal M-9

Dry Season 2007

Code	Canal	Length	Q start	Q end	Conveyance Efficiency
		km	m^3/s	m^3/s	%
Tertiary canal	MCV	2.12	0.415	0.302	**72.67**

System Conveyance Efficiency

Wet Season 2007

Canal level	Name	Efficiency (%)	Ave. (%)
Main Canal	MC	72.38	72.38
Secondary Canal	N1	130.60	130.60
	N14	60.95	60.95
Tertiary Canal	MCV	72.67	72.67
System Conveyance Efficiency			**84.15**

Conveyance Efficiency of Main Canal

Wet Season 2007

		Measurement Date						
		28-Jul-07	26-Aug-07	20-Sep-07	26-Oct-07	9-Oct-07		
Code	Canal	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	Q average(m^3/s)	Remark
I-1	MC	2.54	5.15	5.31	5.47	4.24	4.54	Intake
I-2	M 1	0.01	0.03	0.00	0.02	0.05	0.02	Intake
I-3	M 3	0.00	0.02	0.02	0.02	0.02	0.01	Intake
I-3 (a)	A -C	0.00	0.00	0.00	0.00	0.00	0.00	Intake
I-4	M 5	0.05	0.13	0.18	0.08	0.26	0.14	Intake
I-5	M 7	0.08	0.23	0.23	0.27	0.79	0.32	Intake
I-6	M 9	0.14	0.16	0.27	0.24	0.32	0.23	Intake
I-7	M 11	0.00	0.30	0.28	0.29	0.61	0.30	Intake
I-8	N1	0.23	0.59	0.44	0.54	0.84	0.53	Intake
I-11	M 13	0.00	0.17	0.00	0.15	0.23	0.11	Intake
I-12	M 15	0.13	0.15	0.21	0.18	0.16	0.17	Intake
I-13	M 17	0.09	0.09	0.08	0.19	0.12	0.11	Intake
I-14	M 19	0.45	0.45	0.50	0.32	0.26	0.40	Intake
I-15	M 21	0.08	0.04	0.00	0.05	0.03	0.04	Intake
I-16	M 23	0.04	0.17	0.19	0.38	0.13	0.18	Intake
I-17	N3	0.02	0.39	1.07	0.00	0.00	0.30	Intake
I-18	N2	0.73	0.76	0.36	0.11	0.11	0.42	Intake
I-19	N2-1	0.00	0.00	0.00	0.06	0.06	0.02	Intake
Conveyance Efficiency.(%)		81.05	71.40	72.11	52.68	94.12	72.38	

Conveyance Efficiency of Secondary Canal N1

Wet Season 2007

Code	Canal	Measurement Date					Q average(m^3/s)	Remark
		25-Nov-06	16-Dec-06	1-Jan-07	16-Jan-07	1-Feb-07		
		(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)		
I-8	N1	0.23	0.59	0.44	0.54	0.84	0.53	Intake
I-9	N1-2	0.15	0.37	0.12	0.15	0.28	0.21	Off take
I-10	N1-2+50m	-0.07	0.33	0.67	0.23	1.22	0.48	Off take
Conveyance Efficiency.(%)		33.94	119.60	179.32	70.34	178.36	130.60	

Conveyance Efficiency of Secondary Canal N2

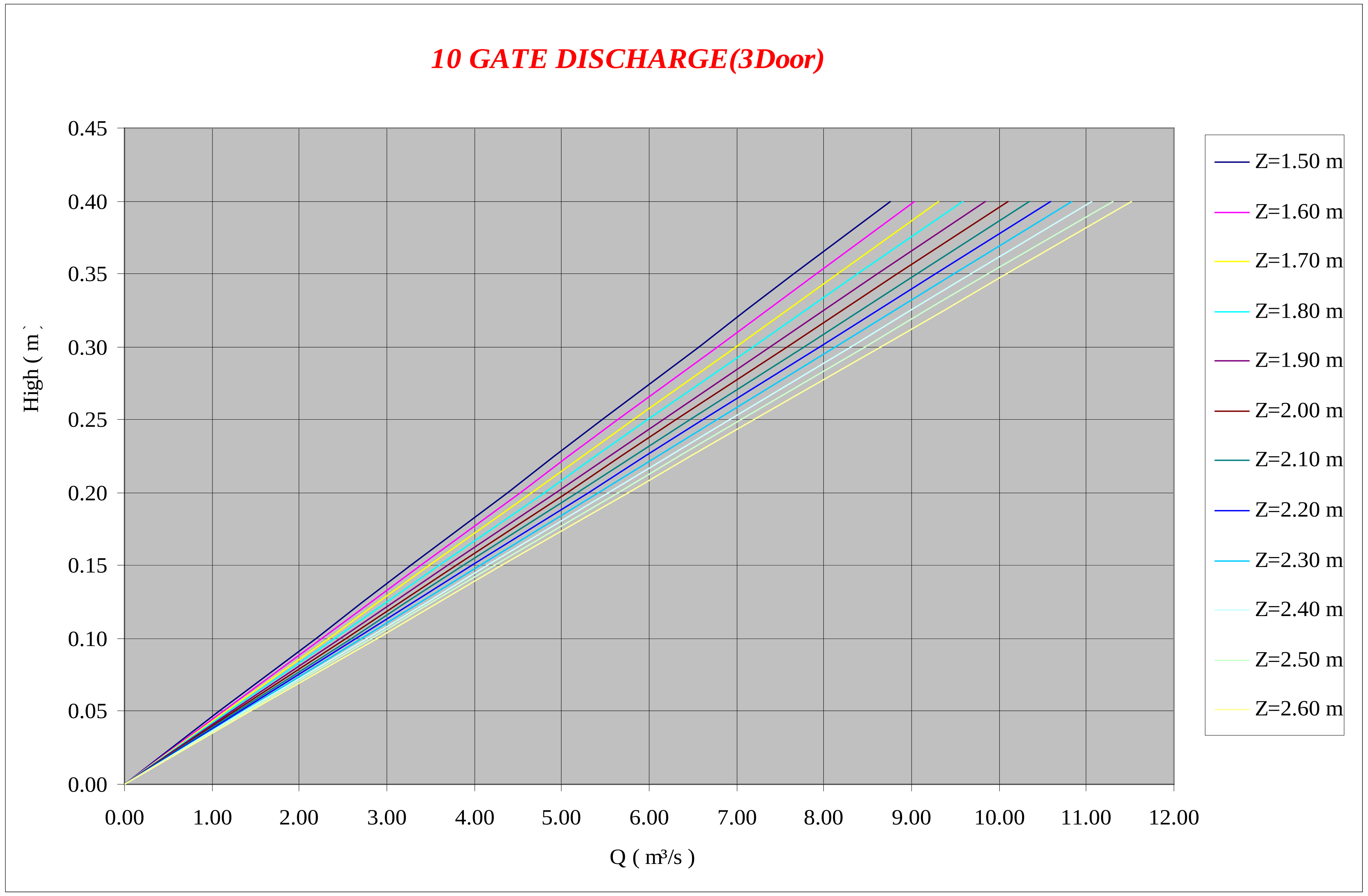
Wet Season 2007

Code	Canal	Measurement Date					Q average(m^3/s)	Remark
		25-Nov-06	16-Dec-06	1-Jan-07	16-Jan-07	1-Feb-07		
		(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)		
I-18	N2	0.73	0.76	0.36	0.11	0.11	0.415	Intake
I-20	N2-3	0.06	0.17	0.22	0.04	0.00	0.099	Off take
I-21	N2-5	0.04	0.00	0.18	0.00	0.00	0.044	Off take
I-22	N2-7	0.00	0.07	0.04	0.00	0.01	0.024	Off take
I-23	N2-9	0.00	0.01	0.03	-0.01	-0.02	0.000	Off take
I-24	N2-1`	0.24	0.00	0.00	0.08	0.11	0.086	Off take
Conveyance Efficiency. (%)		45.62	32.16	130.59	98.48	95.07	60.95	

Annex 12. H-Q curve of 10 Gates Structure

DISCHARGE TABLE OF 10 GATE STRUCTURE

W Gate	H Gate	Nº Gate	S	μ	g	Z	Q	Z 1.600	Z 1.700	Z 1.800	Z 1.900	Z 2.000	Z 2.100	Z 2.200	Z 2.300	Z 2.400	Z 2.500	Z 2.600
2	0.00	3	0.000	0.672	9.81	1.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.05	3	0.300	0.672	9.81	1.50	1.094	1.130	1.164	1.198	1.231	1.263	1.294	1.324	1.354	1.383	1.412	1.440
2	0.10	3	0.600	0.672	9.81	1.50	2.187	2.259	2.329	2.396	2.462	2.526	2.588	2.649	2.709	2.767	2.824	2.880
2	0.15	3	0.900	0.672	9.81	1.50	3.281	3.389	3.493	3.594	3.693	3.789	3.882	3.973	4.063	4.150	4.236	4.320
2	0.20	3	1.200	0.672	9.81	1.50	4.375	4.518	4.657	4.792	4.924	5.051	5.176	5.298	5.417	5.534	5.648	5.760
2	0.25	3	1.500	0.672	9.81	1.50	5.468	5.648	5.821	5.990	6.154	6.314	6.470	6.622	6.771	6.917	7.060	7.199
2	0.30	3	1.800	0.672	9.81	1.50	6.562	6.777	6.986	7.188	7.385	7.577	7.764	7.947	8.126	8.300	8.472	8.639
2	0.35	3	2.100	0.672	9.81	1.50	7.656	7.907	8.150	8.386	8.616	8.840	9.058	9.271	9.480	9.684	9.883	10.079
2	0.40	3	2.400	0.672	9.81	1.50	8.749	9.036	9.314	9.584	9.847	10.103	10.352	10.596	10.834	11.067	11.295	11.519


10 GATE DISCHARGE(3Door)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
High (m)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
Q (m³/s)
Z=1.50 m
Z=1.60 m
Z=1.70 m
Z=1.80 m
Z=1.90 m
Z=2.00 m
Z=2.10 m
Z=2.20 m
Z=2.30 m
Z=2.40 m
Z=2.50 m
Z=2.60 m

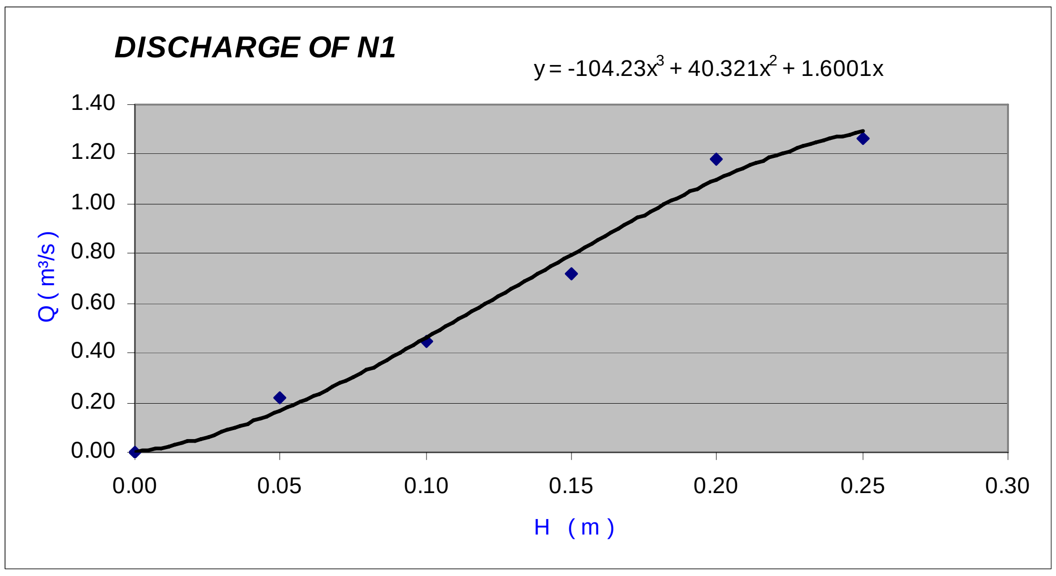
H-Q Curves of Secondary canal N1 and canal N2

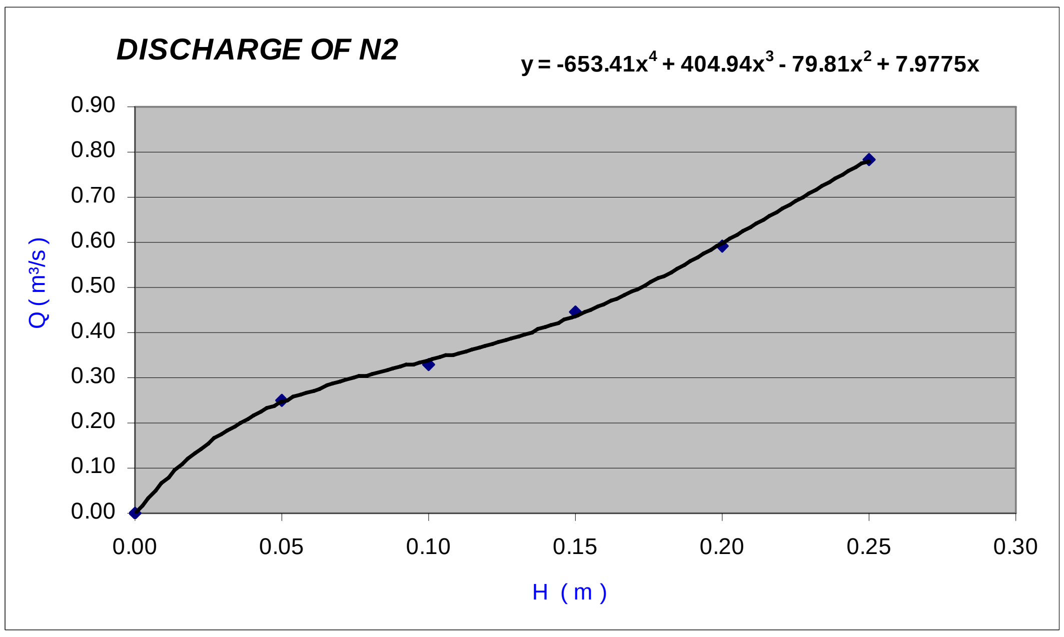
DISCHARGE OF N1

Nº	High Gate to open (m)	High water in front of structure (m)	High water Behind of structure (m)	Velocity average (m /s)	Area of canal (m²)	Discharge (m³/s)
1	0.00	0.00	0.00	0.000	0.000	0.000
2	0.05	1.96	0.78	0.029	7.222	0.219
3	0.10	1.96	0.79	0.059	7.312	0.446
4	0.15	1.94	0.83	0.094	7.488	0.719
5	0.20	1.92	0.86	0.146	7.939	1.182
6	0.25	1.89	0.94	0.146	8.494	1.266

DISCHARGE OF N2

Nº	High Gate to open (m)	High water in front of structure (m)	High water behind of structure (m)	Velocity average (m /s)	Area of canal (m²)	Discharge (m³/s)
1	0.00	0.00	0.00	0.000	0.000	0.000
2	0.05	1.66	0.18	0.118	1.810	0.251
3	0.10	1.67	0.21	0.151	1.904	0.329
4	0.15	1.67	0.22	0.185	2.194	0.447
5	0.20	1.66	0.23	0.218	2.558	0.592
6	0.25	1.65	0.25	0.263	2.828	0.782


DISCHARGE OF N1
y = -104.23x3 + 40.321x2 + 1.6001x
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Q (m³/s)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
H (m)


DISCHARGE OF N2
y = -653.41x4 + 404.94x3 - 79.81x2 + 7.9775x
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Q (m³/s)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
H (m)

Annex 13. Overall Command Area Efficiency

Overall Command Area Efficiency

Dry Season 2007

Items	Unit	Values
System water requirement (SWR)	MCM	16.120
Effective Rainfall (ER)	MCM	6.098
Total diverted water	MCM	23.500
Total drain water	MCM	3.201
Conveyance efficiency	%	72.540
Water delivered to the fields(WDF)	MCM	13.846
Overall command area efficiency	%	**72.38**

Overall Command Area Efficiency

Wet Season 2007

Items	Unit	Values
System water requirement (SWR)	MCM	30.149
Effective Rainfall (ER)	MCM	17.541
Total diverted water	MCM	29.589
Total drain water	MCM	10.285
Conveyance efficiency	%	84.150
Water delivered to the fields(WDF)	MCM	14.614
Overall command area efficiency	%	**86.28**

System Water Balance

Dry Season 2007

Flows	Water Balance Components	Value (MCM)
Inflow	Effective Rainfall	6.10
	Irrigation from main canal	23.50
Total Inflows		*29.60*
Outflow	Evapo-transpriration of paddy	10.24
	Percolation	3.90
	Drainage	3.20
Total Outflows		*17.34*
Available Water Supply (AWS)		**12.26**

System Water Balance

Wet Season 2007

Flows	Water Balance Components	Value (MCM)
Inflow	Effective Rainfall	17.54
	Irrigation from main canal	29.59
Total Inflows		*47.13*
Outflow	Evapo-transpriration of paddy	17.19
	Percolation	5.78
	Drainage	10.29
Total Outflows		*33.25*
Available Water Supply (AWS)		**13.88**

Annex 14. Water productivity

Calculation of productivity

No	Station Code	Canal Name	Rice Name	Rice Type	Cultivation type	Yield (kg)		Plot size	Yield Average
						Wet	Dry	(m^2)	(kg/m^2)
1	W.L 1	A-C	Sen Pidor	Early	Transplanting	720	612	1920	0.319
2	W.L 2	M9-2	Somaly Hun Sen	Medium	Direct Seedling		503	1130	0.445
3	W.L 3	M19-1	Sen Kro Ob	Early	Transplanting	967	822	2022	0.407
4	W.L 4	N2-3-1	Phka Sla	Early	Transplanting		365	1067	0.342
5	W.L 5	N2-5-2	Phka Khngey	Early	Direct Seedling		194	756	0.257
6	W.L 6	M23-3	Sen Kro Ob	Early	Transplanting	200	170	554	0.307
Average									0.346
Total							2054	5529	0.371

Calculation of water productivity in total scheme

Productivity	Total area	Total production	Total water diverted	Water productivity	
T/ha	ha	T	MCM	kg/m^3	USD/m^3
3.715	**1452.5**	**5,395.84**	**23.50**	**0.230**	**0.048**

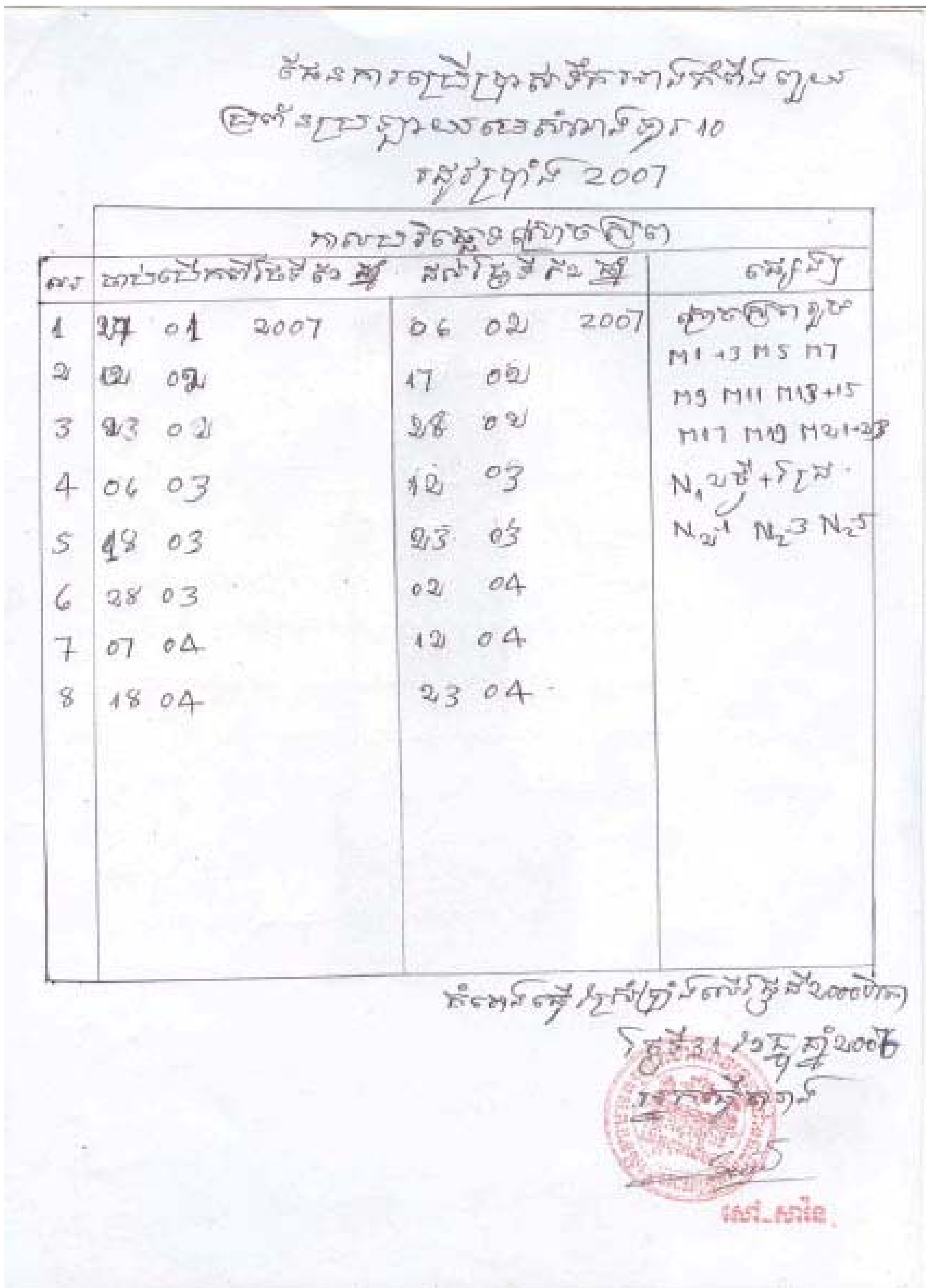
Calculation of productivity

No	Station Code	Canal Name	Rice Name	Rice Type	Cultivation type	Yield (kg)		Plot size	Yield Average
						Wet	Dry	(m^2)	(kg/m^2)
1	W.L 1	A-C	Reang Chey	Late	Transplanting	1560	1485	4275	0.347
2	W.L 2	M9-2	Sen Kro Ob	Early	Transplanting		295	798	0.370
3	W.L 3	M19-1	Sen Kro Ob	Early	Transplanting		570	2022	0.282
4	W.L 4	N2-3-1	Phkar Slar	Early	Transplanting		289	1067	0.271
5	W.L 5	N2-5-2	Reang Chey	Late	Transplanting		290	756	0.384
6	W.L 6	M23-3	Phkar Romdoul	Medium	Transplanting		191	520	0.367
Average									0.337
Total							3120	9438	0.331

Calculation of water productivity in total scheme

Productivity	Total area	Total production	Total water diverted	Water productivity	
T/ha	ha	T	MCM	kg/m^3	USD/m^3
3.306	**2518.37**	**8,325.19**	**29.59**	**0.281**	**0.059**

Annex 15. Water Distribution Plan By FWUC



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រដូវប្រាំង 2007

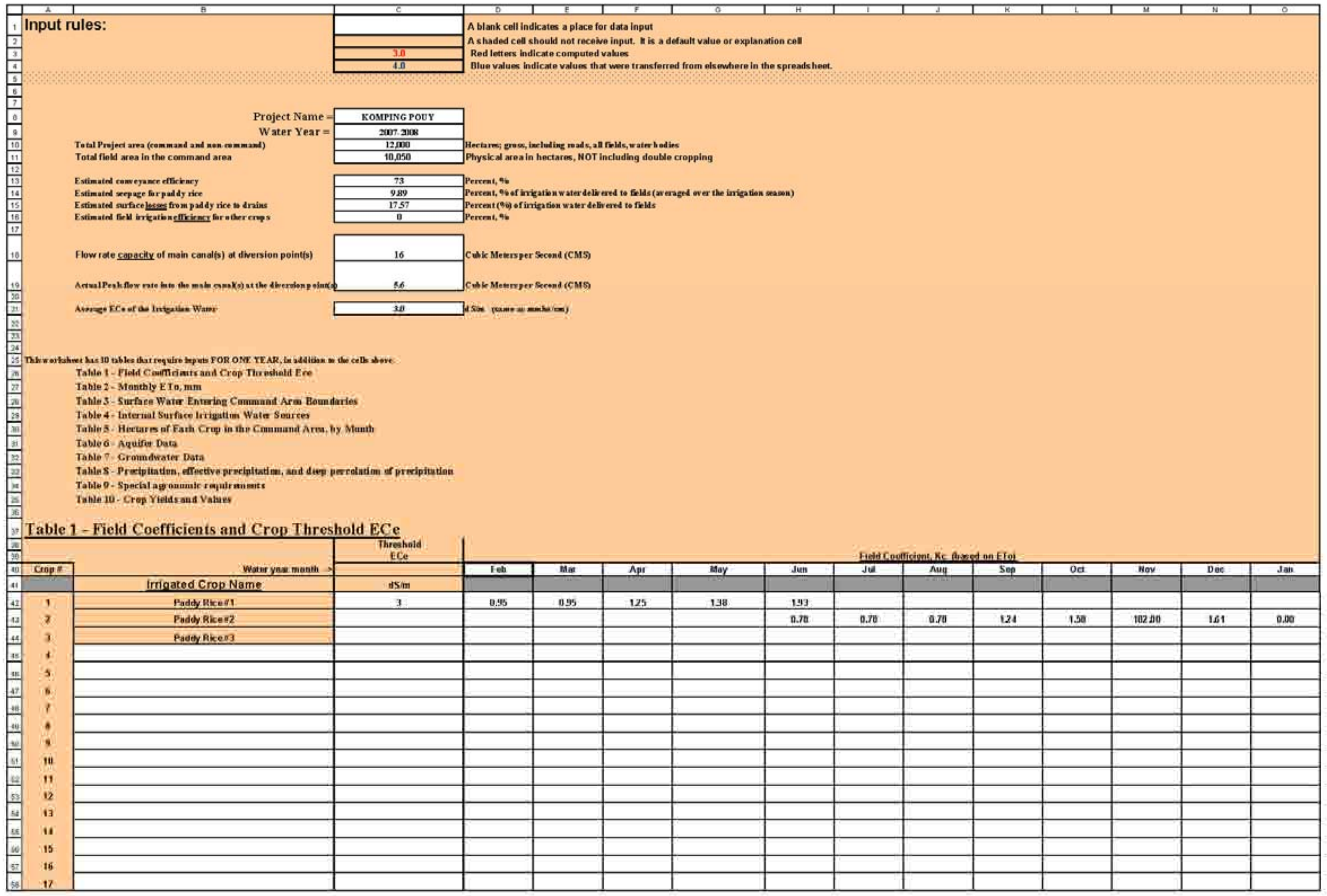
	[illegible]		
ល.រ	[illegible]	[illegible]	[illegible]
1	២7 01 ២007	06 0២ 2007	[illegible] M1+3 M5 M7
២	១២ 0២	17 0២	M9 M11 M13+15
3	២3 0២	២8 0២	M17 M19 M21+23
4	06 03	1២ 03	N1 [illegible]
5	18 03	២3 03	N២-1 N2-3 N2-5
6	២8 03	0២ 04	
7	07 04	1២ 04	
8	18 04	២3 04	

[illegible]

[illegible] ២០០6

Annex 16. RAPs

1. Input – Year 1



Input rules:

A blank cell indicates a place for data input

A shaded cell should not receive input. It is a default value or explanation cell

3.0 Red letters indicate computed values

4.0 Blue values indicate values that were transferred from elsewhere in the spreadsheet.

Project Name = KOMPING POUY

Water Year = 2007-2008

Total Project area (command and non-command)	12,000	Hectares; gross, including roads, all fields, water bodies
Total field area in the command area	10,050	Physical area in hectares, NOT including double cropping
Estimated conveyance efficiency	73	Percent, %
Estimated seepage for paddy rice	9.89	Percent, % of irrigation water delivered to fields (averaged over the irrigation season)
Estimated surface losses from paddy rice to drains	17.57	Percent (%) of irrigation water delivered to fields
Estimated field irrigation efficiency for other crops	0	Percent, %
Flow rate capacity of main canal(s) at diversion point(s)	16	Cubic Meters per Second (CMS)
Actual Peak flow rate into the main canal(s) at the diversion point(s)	5.6	Cubic Meters per Second (CMS)
Average ECe of the Irrigation Water	3.0	dS/m (same as mmho/cm)

This worksheet has 10 tables that require inputs FOR ONE YEAR, in addition to the cells above:

Table 1 - Field Coefficients and Crop Threshold Ece
Table 2 - Monthly ETo, mm
Table 3 - Surface Water Entering Command Area Boundaries
Table 4 - Internal Surface Irrigation Water Sources
Table 5 - Hectares of Each Crop in the Command Area, by Month
Table 6 - Aquifer Data
Table 7 - Groundwater Data
Table 8 - Precipitation, effective precipitation, and deep percolation of precipitation
Table 9 - Special agronomic requirements
Table 10 - Crop Yields and Values

Table 1 - Field Coefficients and Crop Threshold ECe

		Threshold ECe	Field Coefficient, Kc (based on ETo)											
Crop #	Water year month ->		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	Irrigated Crop Name	dS/m												
1	Paddy Rice#1	3	0.95	0.95	1.25	1.38	1.93							
2	Paddy Rice#2						0.78	0.78	0.78	1.24	1.58	102.00	1.61	0.00
3	Paddy Rice#3													
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														

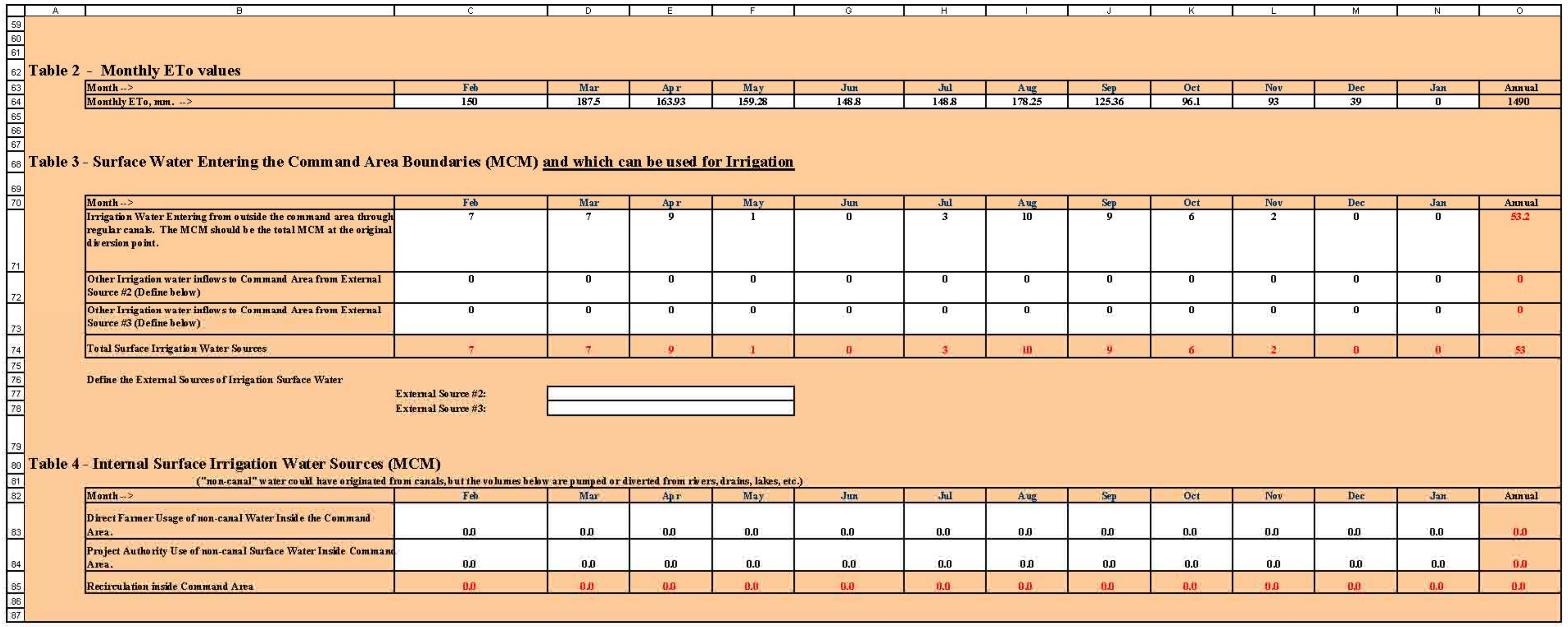


Table 2 - Monthly ETo values

Month -->	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Annual
Monthly ETo, mm. -->	150	187.5	163.93	159.28	148.8	148.8	178.25	125.36	96.1	93	39	0	1490

Table 3 - Surface Water Entering the Command Area Boundaries (MCM) <u>and which can be used for Irrigation</u>

Month -->	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Annual
Irrigation Water Entering from outside the command area through regular canals. The MCM should be the total MCM at the original diversion point.	7	7	9	1	0	3	10	9	6	2	0	0	53.2
Other Irrigation water inflows to Command Area from External Source #2 (Define below)	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Irrigation water inflows to Command Area from External Source #3 (Define below)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Surface Irrigation Water Sources	7	7	9	1	0	3	10	9	6	2	0	0	53

Define the External Sources of Irrigation Surface Water

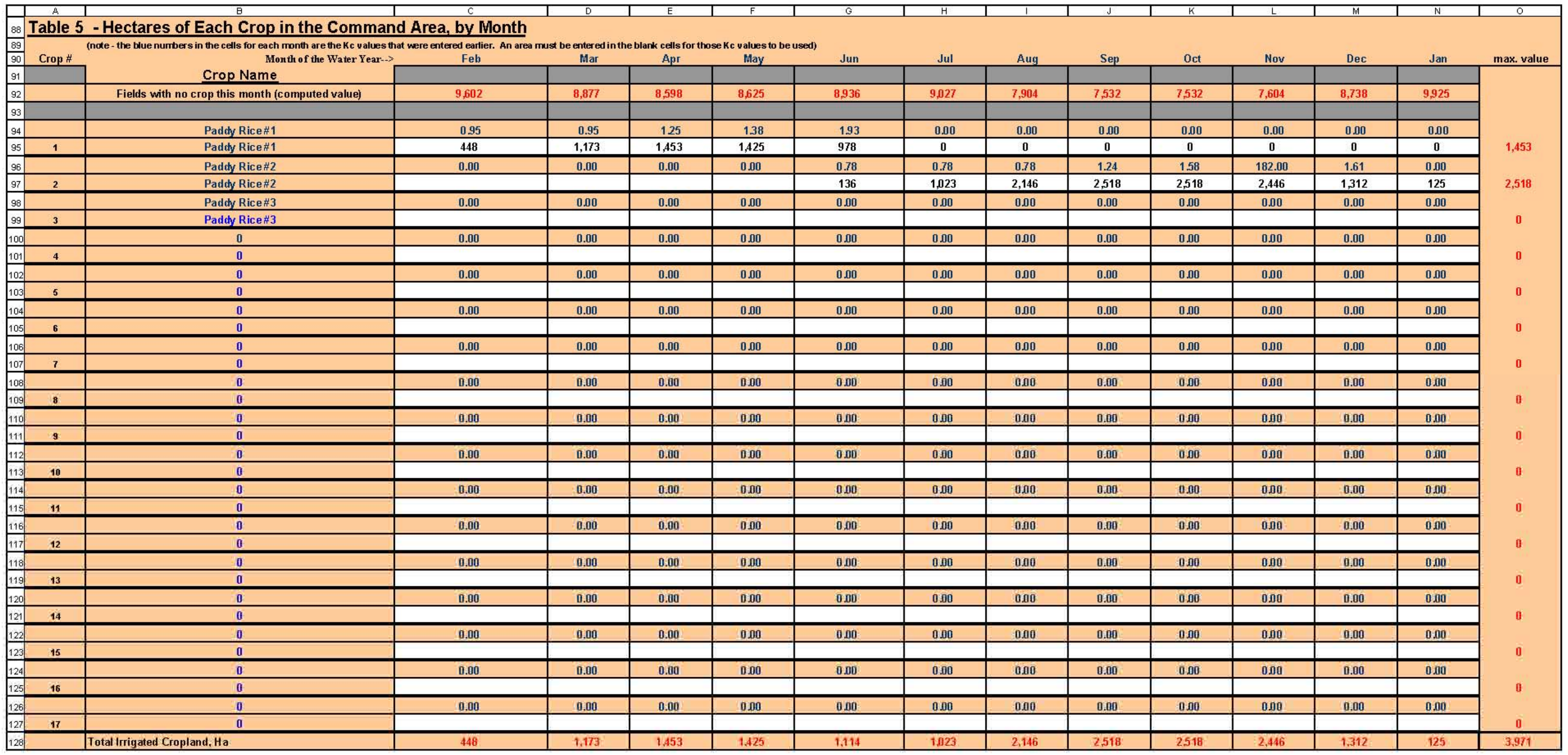
External Source #2:

External Source #3:

Table 4 - Internal Surface Irrigation Water Sources (MCM)

("non-canal" water could have originated from canals, but the volumes below are pumped or diverted from rivers, drains, lakes, etc.)

Month -->	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Annual
Direct Farmer Usage of non-canal Water Inside the Command Area.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Authority Use of non-canal Surface Water Inside Command Area.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recirculation inside Command Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
88	**Table 5 - Hectares of Each Crop in the Command Area, by Month**														
89		(note - the blue numbers in the cells for each month are the Kc values that were entered earlier. An area must be entered in the blank cells for those Kc values to be used)													
90	Crop #	Month of the Water Year-->	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	max. value
91		Crop Name													
92		Fields with no crop this month (computed value)	9,602	8,877	8,598	8,625	8,936	9,027	7,904	7,532	7,532	7,604	8,738	9,925	
93															
94		Paddy Rice#1	0.95	0.95	1.25	1.38	1.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
95	1	Paddy Rice#1	448	1,173	1,453	1,425	978	0	0	0	0	0	0	0	1,453
96		Paddy Rice#2	0.00	0.00	0.00	0.00	0.78	0.78	0.78	1.24	1.58	182.00	1.61	0.00	
97	2	Paddy Rice#2					136	1,023	2,146	2,518	2,518	2,446	1,312	125	2,518
98		Paddy Rice#3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
99	3	Paddy Rice#3													0
100		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
101	4	0													0
102		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
103	5	0													0
104		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
105	6	0													0
106		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
107	7	0													0
108		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
109	8	0													0
110		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
111	9	0													0
112		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
113	10	0													0
114		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
115	11	0													0
116		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
117	12	0													0
118		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
119	13	0													0
120		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
121	14	0													0
122		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
123	15	0													0
124		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
125	16	0													0
126		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
127	17	0													0
128		Total Irrigated Cropland, Ha	448	1,173	1,453	1,425	1,114	1,023	2,146	2,518	2,518	2,446	1,312	125	3,971

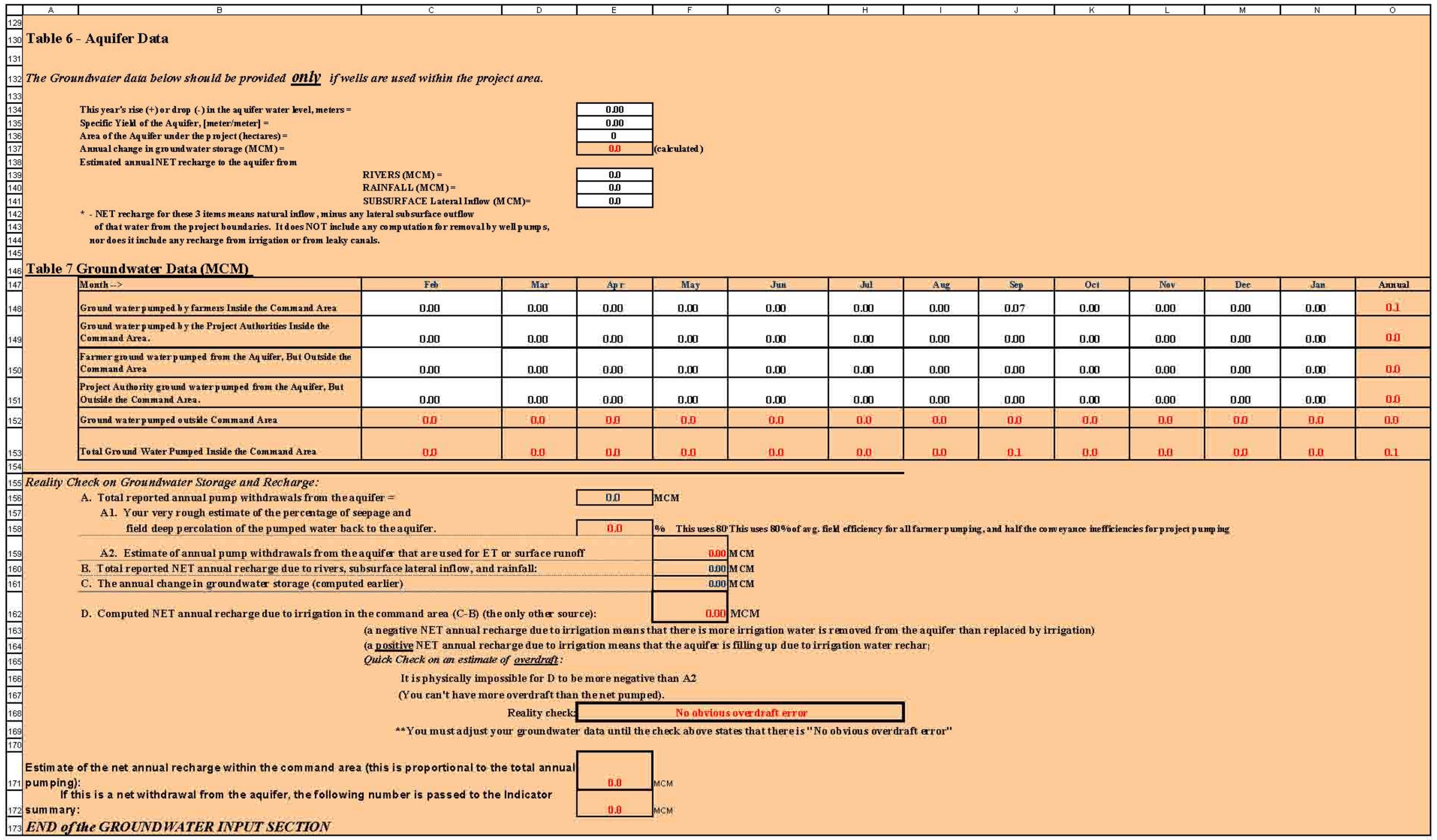


Table 6 - Aquifer Data

*The Groundwater data below should be provided **only** if wells are used within the project area.*

This year's rise (+) or drop (-) in the aquifer water level, meters =	0.00
Specific Yield of the Aquifer, [meter/meter] =	0.00
Area of the Aquifer under the project (hectares) =	0
Annual change in groundwater storage (MCM) =	0.0 (calculated)
Estimated annual NET recharge to the aquifer from	
RIVERS (MCM) =	0.0
RAINFALL (MCM) =	0.0
SUBSURFACE Lateral Inflow (MCM)=	0.0

* - NET recharge for these 3 items means natural inflow, minus any lateral subsurface outflow of that water from the project boundaries. It does NOT include any computation for removal by well pumps, nor does it include any recharge from irrigation or from leaky canals.

Table 7 Groundwater Data (MCM)

Month -->	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Annual
Ground water pumped by farmers Inside the Command Area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.1
Ground water pumped by the Project Authorities Inside the Command Area.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Farmer ground water pumped from the Aquifer, But Outside the Command Area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Project Authority ground water pumped from the Aquifer, But Outside the Command Area.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Ground water pumped outside Command Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Ground Water Pumped Inside the Command Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1

Reality Check on Groundwater Storage and Recharge:

A. Total reported annual pump withdrawals from the aquifer = 0.0 MCM

A1. Your very rough estimate of the percentage of seepage and field deep percolation of the pumped water back to the aquifer. 0.0 % This uses 80' This uses 80% of avg. field efficiency for all farmer pumping, and half the conveyance inefficiencies for project pumping

A2. Estimate of annual pump withdrawals from the aquifer that are used for ET or surface runoff 0.00 MCM

B. Total reported NET annual recharge due to rivers, subsurface lateral inflow, and rainfall: 0.00 MCM

C. The annual change in groundwater storage (computed earlier) 0.00 MCM

D. Computed NET annual recharge due to irrigation in the command area (C-B) (the only other source): 0.00 MCM

(a negative NET annual recharge due to irrigation means that there is more irrigation water is removed from the aquifer than replaced by irrigation)

(a positive NET annual recharge due to irrigation means that the aquifer is filling up due to irrigation water rechar;

Quick Check on an estimate of overdraft:

It is physically impossible for D to be more negative than A2

(You can't have more overdraft than the net pumped).

Reality check: No obvious overdraft error

**You must adjust your groundwater data until the check above states that there is "No obvious overdraft error"

Estimate of the net annual recharge within the command area (this is proportional to the total annual pumping): 0.0 MCM

If this is a net withdrawal from the aquifer, the following number is passed to the Indicator summary: 0.0 MCM

END of the GROUNDWATER INPUT SECTION

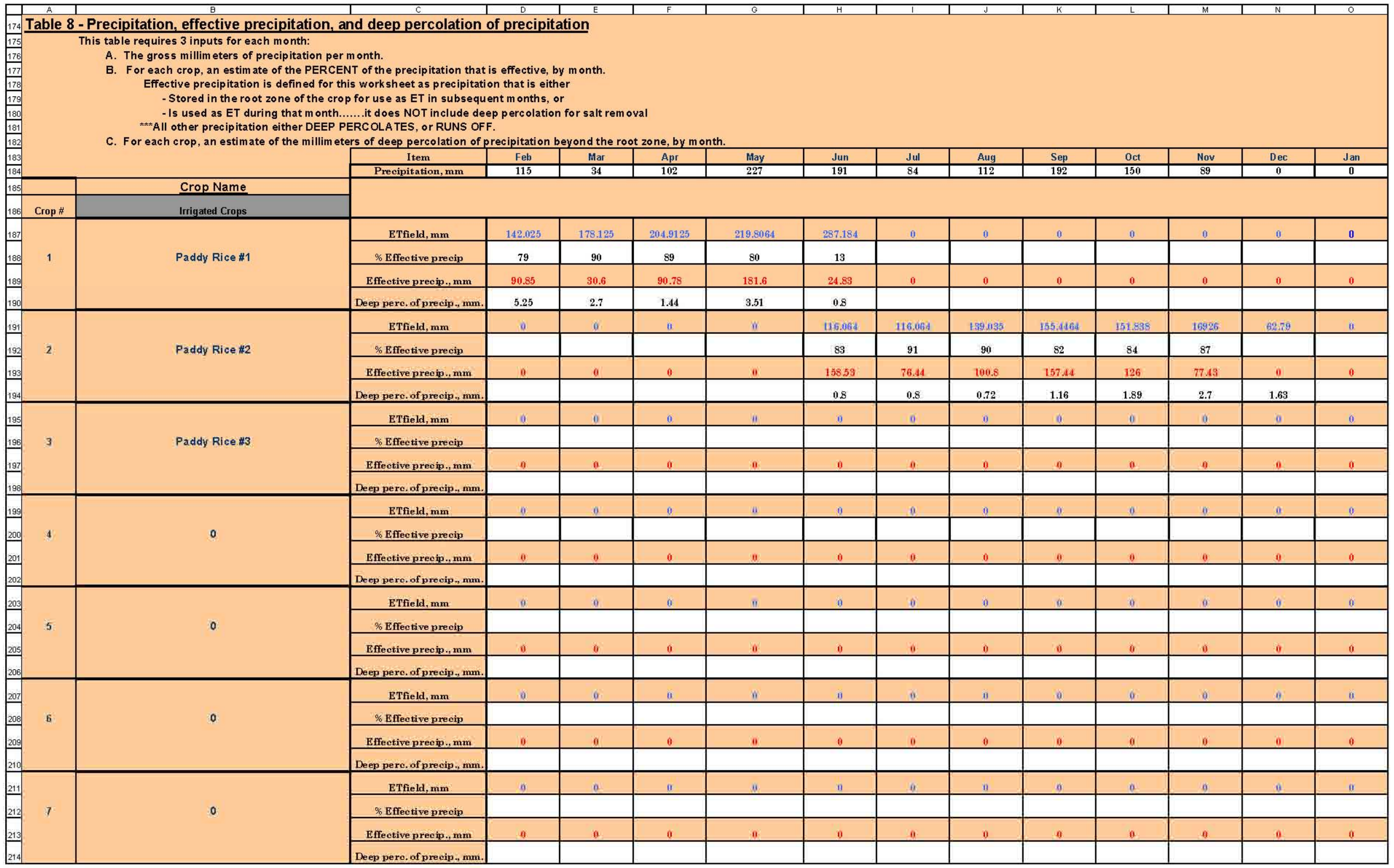


Table 8 - Precipitation, effective precipitation, and deep percolation of precipitation

This table requires 3 inputs for each month:

A. The gross millimeters of precipitation per month.

B. For each crop, an estimate of the PERCENT of the precipitation that is effective, by month.

Effective precipitation is defined for this worksheet as precipitation that is either

- Stored in the root zone of the crop for use as ET in subsequent months, or
- Is used as ET during that month.......it does NOT include deep percolation for salt removal

***All other precipitation either DEEP PERCOLATES, or RUNS OFF.

C. For each crop, an estimate of the millimeters of deep percolation of precipitation beyond the root zone, by month.

Crop #	Crop Name Irrigated Crops	Item	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
		Precipitation, mm	115	34	102	227	191	84	112	192	150	89	0	0
1	Paddy Rice #1	ETfield, mm	142.025	178.125	204.9125	219.8064	287.184	0	0	0	0	0	0	0
		% Effective precip	79	90	89	80	13							
		Effective precip., mm	90.85	30.6	90.78	181.6	24.83	0	0	0	0	0	0	0
		Deep perc. of precip., mm.	5.25	2.7	1.44	3.51	0.8							
2	Paddy Rice #2	ETfield, mm	0	0	0	0	116.064	116.064	139.035	155.4464	151.838	16926	62.79	0
		% Effective precip					83	91	90	82	84	87		
		Effective precip., mm	0	0	0	0	158.53	76.44	100.8	157.44	126	77.43	0	0
		Deep perc. of precip., mm.					0.8	0.8	0.72	1.16	1.89	2.7	1.63	
3	Paddy Rice #3	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
4	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
5	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
6	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
7	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
215	8	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
216			% Effective precip												
217			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
218			Deep perc. of precip., mm.												
219	9	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
220			% Effective precip												
221			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
222			Deep perc. of precip., mm.												
223	10	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
224			% Effective precip												
225			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
226			Deep perc. of precip., mm.												
227	11	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
228			% Effective precip												
229			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
230			Deep perc. of precip., mm.												
231	12	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
232			% Effective precip												
233			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
234			Deep perc. of precip., mm.												
235	13	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
236			% Effective precip												
237			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
238			Deep perc. of precip., mm.												
239	14	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
240			% Effective precip												
241			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
242			Deep perc. of precip., mm.												
243	15	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
244			% Effective precip												
245			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
246			Deep perc. of precip., mm.												
247	16	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
248			% Effective precip												
249			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
250			Deep perc. of precip., mm.												
251	17	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
252			% Effective precip												
253			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
254			Deep perc. of precip., mm.												

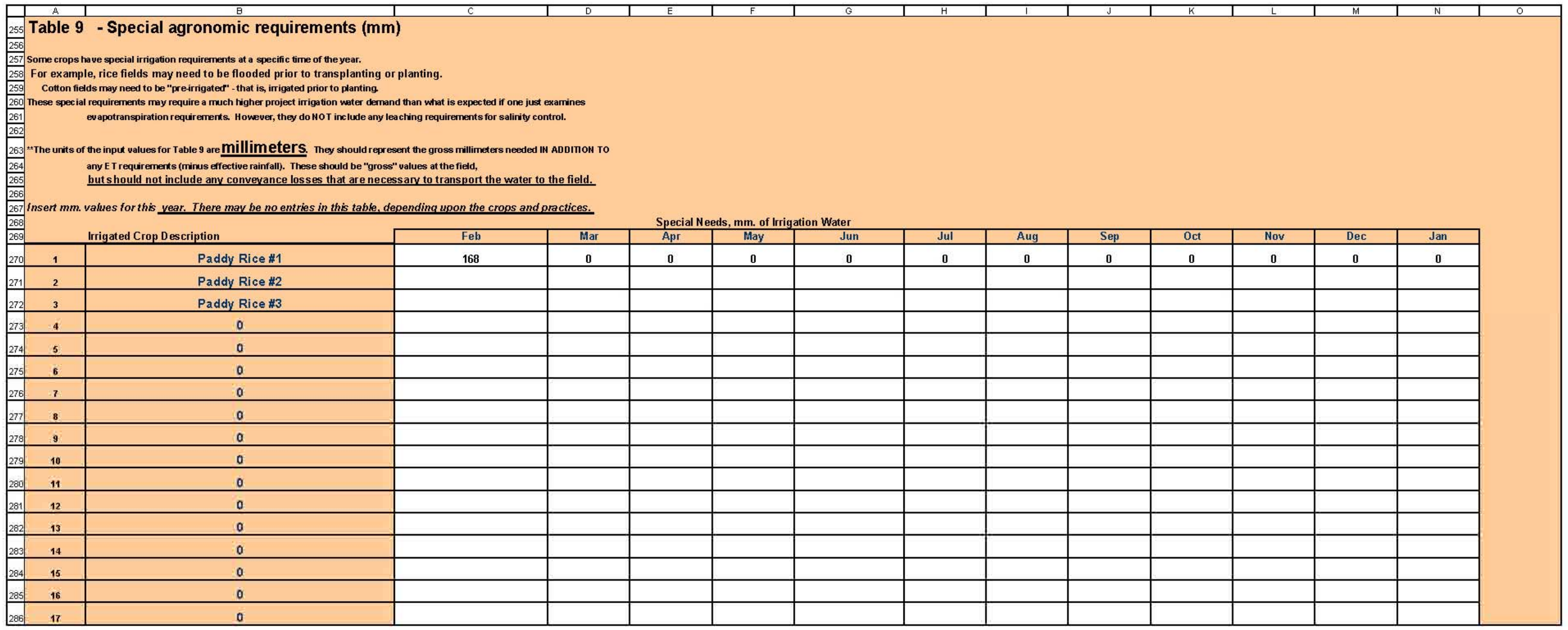


Table 9 - Special agronomic requirements (mm)

Some crops have special irrigation requirements at a specific time of the year.
For example, rice fields may need to be flooded prior to transplanting or planting.
Cotton fields may need to be "pre-irrigated" - that is, irrigated prior to planting.
These special requirements may require a much higher project irrigation water demand than what is expected if one just examines evapotranspiration requirements. However, they do NOT include any leaching requirements for salinity control.

The units of the input values for Table 9 are **millimeters. They should represent the gross millimeters needed IN ADDITION TO any E T requirements (minus effective rainfall). These should be "gross" values at the field, but should not include any conveyance losses that are necessary to transport the water to the field.

Insert mm. values for this year. There may be no entries in this table, depending upon the crops and practices.

Special Needs, mm. of Irrigation Water

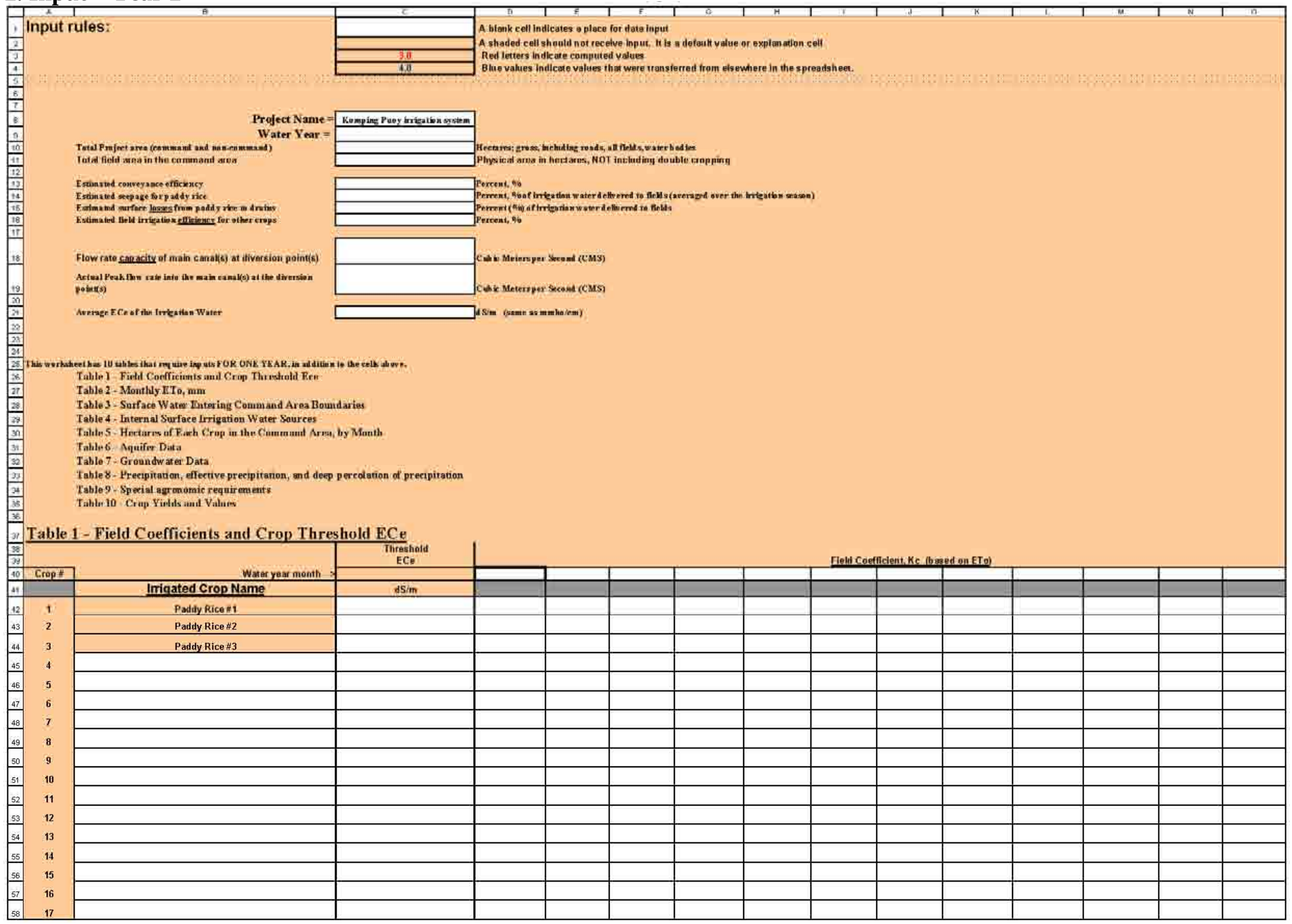
	Irrigated Crop Description	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
1	Paddy Rice #1	168	0	0	0	0	0	0	0	0	0	0	0
2	Paddy Rice #2												
3	Paddy Rice #3												
4	0												
5	0												
6	0												
7	0												
8	0												
9	0												
10	0												
11	0												
12	0												
13	0												
14	0												
15	0												
16	0												
17	0												

Table 10 - Crop Yields and Values

Exchange rate - $US/(local currency) : 2.50E-04

	Irrigated Crop Name	Typical yield, metric tons/ha	Farmgate selling price, Local currency/ metric ton	hectares		Value of agricultural production, $US/yr
1	Paddy Rice #1	3.71	800,000	1,453	5,389	1,077,755
2	Paddy Rice #2	3.36	800,000	2,518	8,460	1,692,096
3	Paddy Rice #3			0	0	0
4	0			0	0	0
5	0			0	0	0
6	0			0	0	0
7	0			0	0	0
8	0			0	0	0
9	0			0	0	0
10	0			0	0	0
11	0			0	0	0
12	0			0	0	0
13	0			0	0	0
14	0			0	0	0
15	0			0	0	0
16	0			0	0	0
17	0			0	0	0
				Total annual value ($US)		2,769,851

2. Input – Year 2



Input rules:

A blank cell indicates a place for data input

A shaded cell should not receive input. It is a default value or explanation cell

3.0 Red letters indicate computed values

4.0 Blue values indicate values that were transferred from elsewhere in the spreadsheet.

Project Name = Komping Puoy irrigation system

Water Year =

Total Project area (command and non-command) — Hectares; gross, including roads, all fields, water bodies

Total field area in the command area — Physical area in hectares, NOT including double cropping

Estimated conveyance efficiency — Percent, %

Estimated seepage for paddy rice — Percent, % of irrigation water delivered to fields (averaged over the irrigation season)

Estimated surface losses from paddy rice in drains — Percent (%) of irrigation water delivered to fields

Estimated field irrigation efficiency for other crops — Percent, %

Flow rate capacity of main canal(s) at diversion point(s) — Cubic Meters per Second (CMS)

Actual Peak flow rate into the main canal(s) at the diversion point(s) — Cubic Meters per Second (CMS)

Average ECe of the Irrigation Water — dS/m (same as mmho/cm)

This worksheet has 10 tables that require inputs FOR ONE YEAR, in addition to the cells above.

Table 1 - Field Coefficients and Crop Threshold Ece
Table 2 - Monthly ETo, mm
Table 3 - Surface Water Entering Command Area Boundaries
Table 4 - Internal Surface Irrigation Water Sources
Table 5 - Hectares of Each Crop in the Command Area, by Month
Table 6 - Aquifer Data
Table 7 - Groundwater Data
Table 8 - Precipitation, effective precipitation, and deep percolation of precipitation
Table 9 - Special agronomic requirements
Table 10 - Crop Yields and Values

Table 1 - Field Coefficients and Crop Threshold ECe

		Threshold ECe	Field Coefficient, Kc (based on ETo)											
Crop #	Water year month ->													
	Irrigated Crop Name	dS/m												
1	Paddy Rice #1													
2	Paddy Rice #2													
3	Paddy Rice #3													
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														

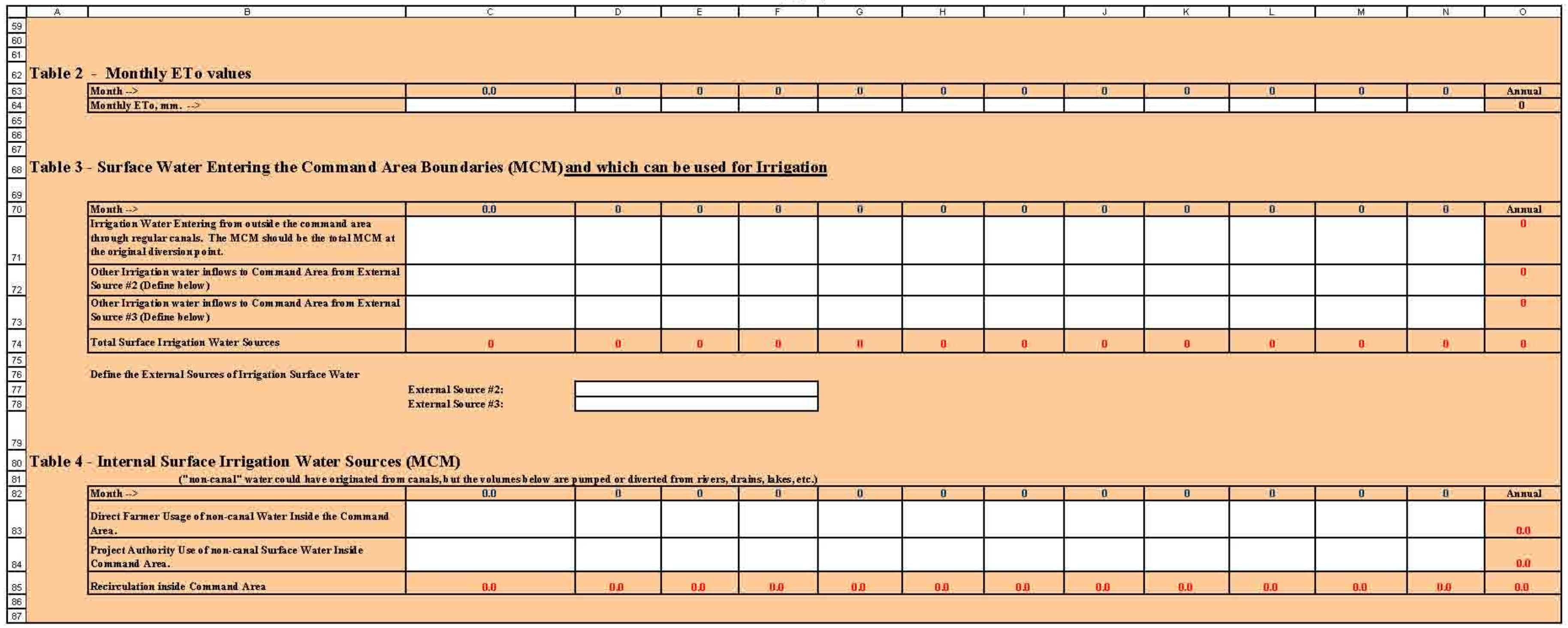


Table 2 - Monthly ETo values

Month -->	0.0	0	0	0	0	0	0	0	0	0	0	0	Annual
Monthly ETo, mm. -->													0

Table 3 - Surface Water Entering the Command Area Boundaries (MCM) <u>and which can be used for Irrigation</u>

Month -->	0.0	0	0	0	0	0	0	0	0	0	0	0	Annual
Irrigation Water Entering from outside the command area through regular canals. The MCM should be the total MCM at the original diversion point.													0
Other Irrigation water inflows to Command Area from External Source #2 (Define below)													0
Other Irrigation water inflows to Command Area from External Source #3 (Define below)													0
Total Surface Irrigation Water Sources	0	0	0	0	0	0	0	0	0	0	0	0	0

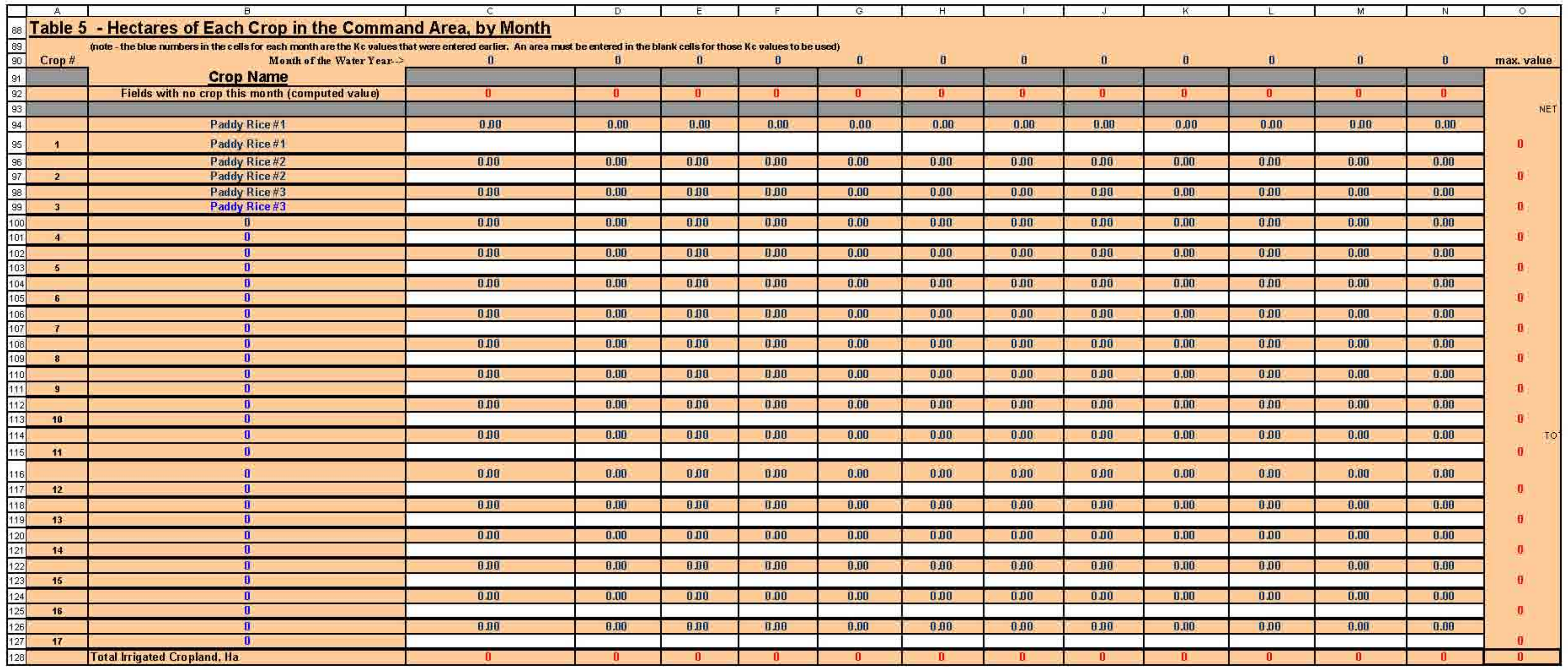
Define the External Sources of Irrigation Surface Water

External Source #2:
External Source #3:

Table 4 - Internal Surface Irrigation Water Sources (MCM)

("non-canal" water could have originated from canals, but the volumes below are pumped or diverted from rivers, drains, lakes, etc.)

Month -->	0.0	0	0	0	0	0	0	0	0	0	0	0	Annual
Direct Farmer Usage of non-canal Water Inside the Command Area.													0.0
Project Authority Use of non-canal Surface Water Inside Command Area.													0.0
Recirculation inside Command Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
88	**Table 5 - Hectares of Each Crop in the Command Area, by Month**														
89		(note - the blue numbers in the cells for each month are the Kc values that were entered earlier. An area must be entered in the blank cells for those Kc values to be used)													
90	Crop #	Month of the Water Year-->	0	0	0	0	0	0	0	0	0	0	0	0	max. value
91		**Crop Name**													
92		Fields with no crop this month (computed value)	0	0	0	0	0	0	0	0	0	0	0	0	
93															NET
94		Paddy Rice #1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
95	1	Paddy Rice #1													0
96		Paddy Rice #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
97	2	Paddy Rice #2													0
98		Paddy Rice #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
99	3	Paddy Rice #3													0
100		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
101	4	0													0
102		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
103	5	0													0
104		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
105	6	0													0
106		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
107	7	0													0
108		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
109	8	0													0
110		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
111	9	0													0
112		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
113	10	0													0
114		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TO
115	11	0													0
116		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
117	12	0													0
118		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
119	13	0													0
120		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
121	14	0													0
122		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
123	15	0													0
124		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
125	16	0													0
126		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
127	17	0													0
128		Total Irrigated Cropland, Ha	0	0	0	0	0	0	0	0	0	0	0	0	0

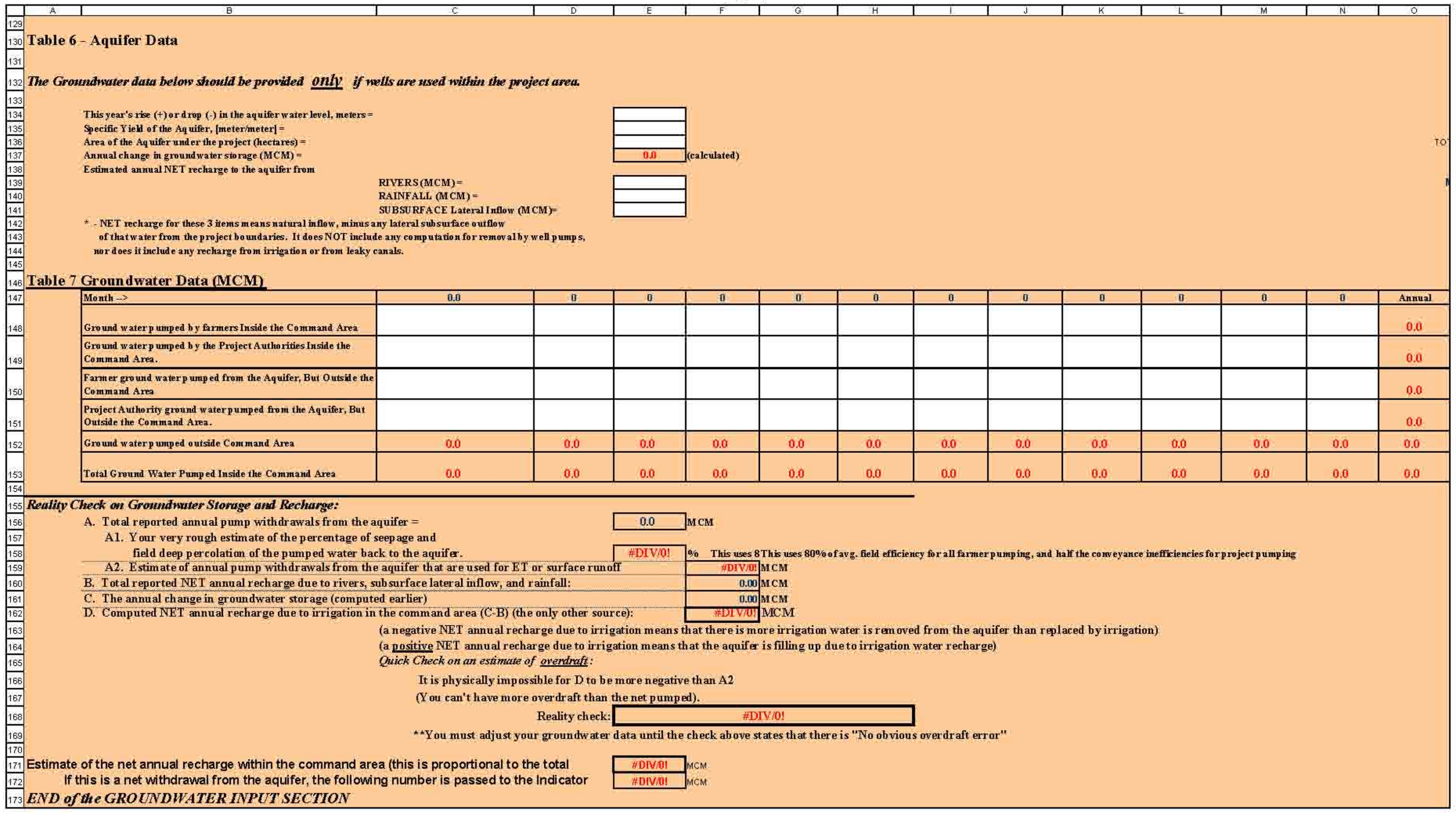


Table 6 - Aquifer Data

The Groundwater data below should be provided <u>only</u> if wells are used within the project area.

This year's rise (+) or drop (-) in the aquifer water level, meters =
Specific Yield of the Aquifer, [meter/meter] =
Area of the Aquifer under the project (hectares) =
Annual change in groundwater storage (MCM) = 0.0 (calculated)
Estimated annual NET recharge to the aquifer from
RIVERS (MCM) =
RAINFALL (MCM) =
SUBSURFACE Lateral Inflow (MCM)=

* - NET recharge for these 3 items means natural inflow, minus any lateral subsurface outflow of that water from the project boundaries. It does NOT include any computation for removal by well pumps, nor does it include any recharge from irrigation or from leaky canals.

Table 7 Groundwater Data (MCM)

Month -->	0.0	0	0	0	0	0	0	0	0	0	0	0	Annual
Ground water pumped by farmers Inside the Command Area													0.0
Ground water pumped by the Project Authorities Inside the Command Area.													0.0
Farmer ground water pumped from the Aquifer, But Outside the Command Area													0.0
Project Authority ground water pumped from the Aquifer, But Outside the Command Area.													0.0
Ground water pumped outside Command Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Ground Water Pumped Inside the Command Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Reality Check on Groundwater Storage and Recharge:

A. Total reported annual pump withdrawals from the aquifer = 0.0 MCM
A1. Your very rough estimate of the percentage of seepage and field deep percolation of the pumped water back to the aquifer. #DIV/0! % This uses 8 This uses 80% of avg. field efficiency for all farmer pumping, and half the conveyance inefficiencies for project pumping
A2. Estimate of annual pump withdrawals from the aquifer that are used for ET or surface runoff #DIV/0! MCM
B. Total reported NET annual recharge due to rivers, subsurface lateral inflow, and rainfall: 0.00 MCM
C. The annual change in groundwater storage (computed earlier) 0.00 MCM
D. Computed NET annual recharge due to irrigation in the command area (C-B) (the only other source): #DIV/0! MCM

(a negative NET annual recharge due to irrigation means that there is more irrigation water is removed from the aquifer than replaced by irrigation)
(a <u>positive</u> NET annual recharge due to irrigation means that the aquifer is filling up due to irrigation water recharge)
Quick Check on an estimate of <u>overdraft</u>:

It is physically impossible for D to be more negative than A2
(You can't have more overdraft than the net pumped).

Reality check: #DIV/0!

**You must adjust your groundwater data until the check above states that there is "No obvious overdraft error"

Estimate of the net annual recharge within the command area (this is proportional to the total #DIV/0! MCM
If this is a net withdrawal from the aquifer, the following number is passed to the Indicator #DIV/0! MCM

END of the GROUNDWATER INPUT SECTION

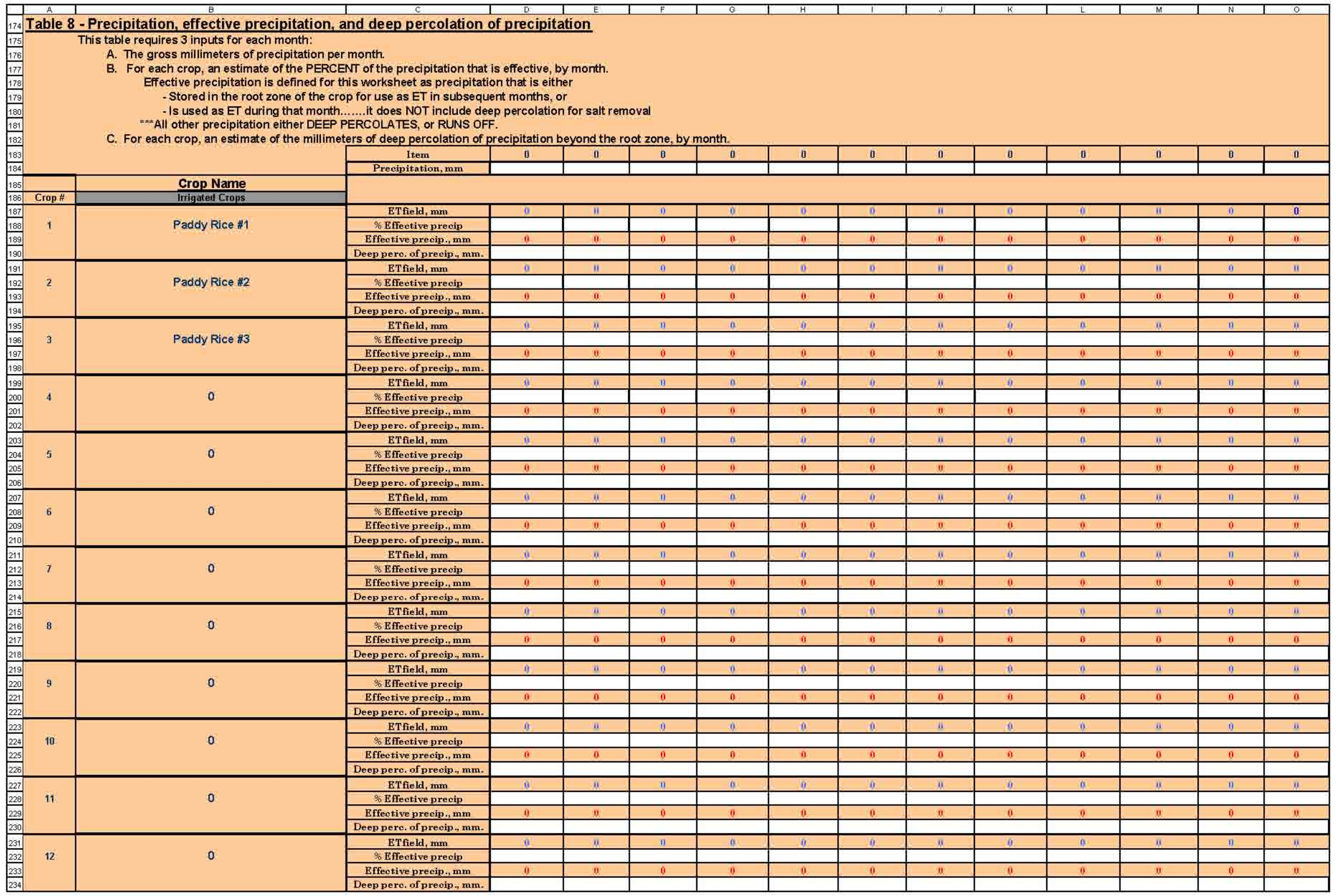


Table 8 - Precipitation, effective precipitation, and deep percolation of precipitation

This table requires 3 inputs for each month:

A. The gross millimeters of precipitation per month.

B. For each crop, an estimate of the PERCENT of the precipitation that is effective, by month.

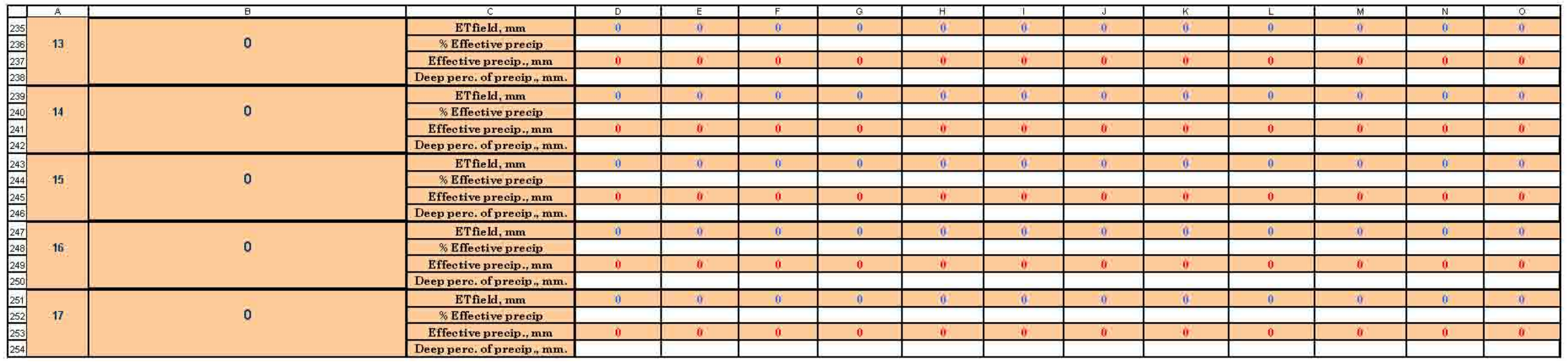
Effective precipitation is defined for this worksheet as precipitation that is either

- Stored in the root zone of the crop for use as ET in subsequent months, or
- Is used as ET during that month.......it does NOT include deep percolation for salt removal

***All other precipitation either DEEP PERCOLATES, or RUNS OFF.

C. For each crop, an estimate of the millimeters of deep percolation of precipitation beyond the root zone, by month.

		Item	0	0	0	0	0	0	0	0	0	0	0	0
		Precipitation, mm												
	Crop Name													
Crop #	Irrigated Crops													
1	Paddy Rice #1	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
2	Paddy Rice #2	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
3	Paddy Rice #3	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
4	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
5	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
6	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
7	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
8	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
9	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
10	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
11	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
12	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
235	13	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
236			% Effective precip												
237			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
238			Deep perc. of precip., mm.												
239	14	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
240			% Effective precip												
241			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
242			Deep perc. of precip., mm.												
243	15	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
244			% Effective precip												
245			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
246			Deep perc. of precip., mm.												
247	16	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
248			% Effective precip												
249			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
250			Deep perc. of precip., mm.												
251	17	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
252			% Effective precip												
253			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
254			Deep perc. of precip., mm.												

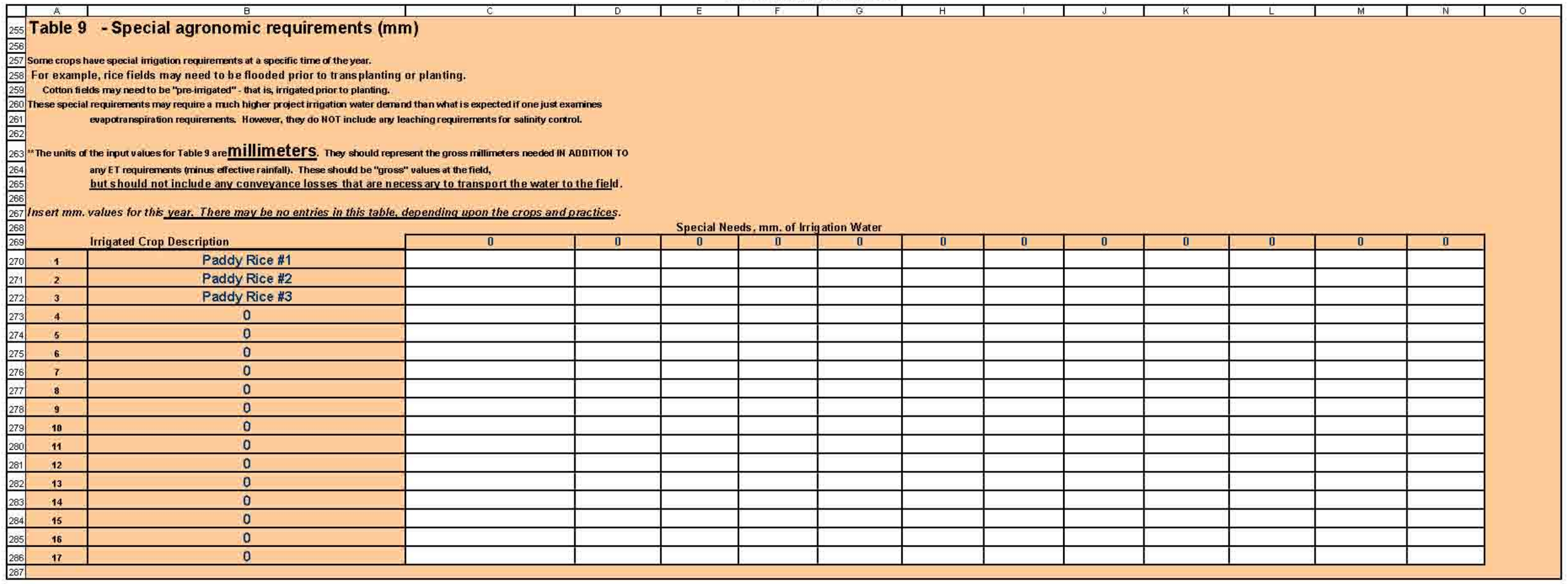


Table 9 - Special agronomic requirements (mm)

Some crops have special irrigation requirements at a specific time of the year.

For example, rice fields may need to be flooded prior to transplanting or planting.

Cotton fields may need to be "pre-irrigated" - that is, irrigated prior to planting.

These special requirements may require a much higher project irrigation water demand than what is expected if one just examines evapotranspiration requirements. However, they do NOT include any leaching requirements for salinity control.

** The units of the input values for Table 9 are **millimeters**. They should represent the gross millimeters needed IN ADDITION TO any ET requirements (minus effective rainfall). These should be "gross" values at the field, but should not include any conveyance losses that are necessary to transport the water to the field.

Insert mm. values for this year. There may be no entries in this table, depending upon the crops and practices.

		Special Needs, mm. of Irrigation Water											
	Irrigated Crop Description	0	0	0	0	0	0	0	0	0	0	0	0
1	Paddy Rice #1												
2	Paddy Rice #2												
3	Paddy Rice #3												
4	0												
5	0												
6	0												
7	0												
8	0												
9	0												
10	0												
11	0												
12	0												
13	0												
14	0												
15	0												
16	0												
17	0												

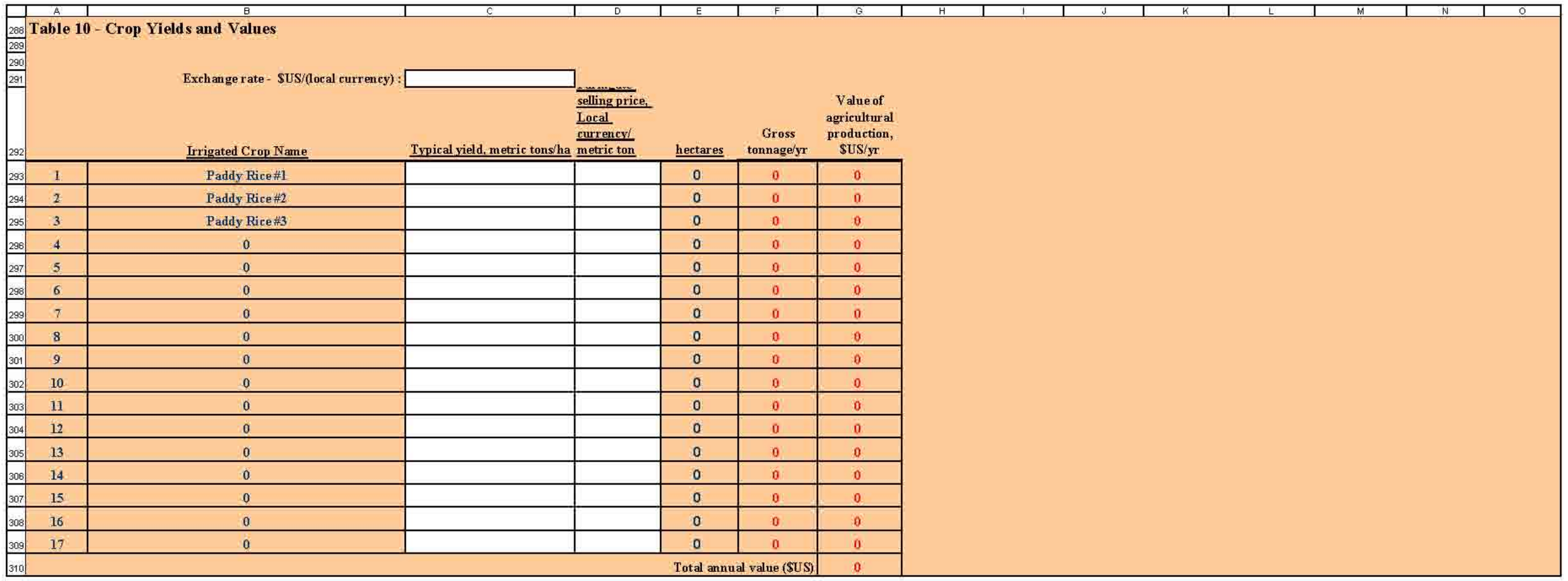
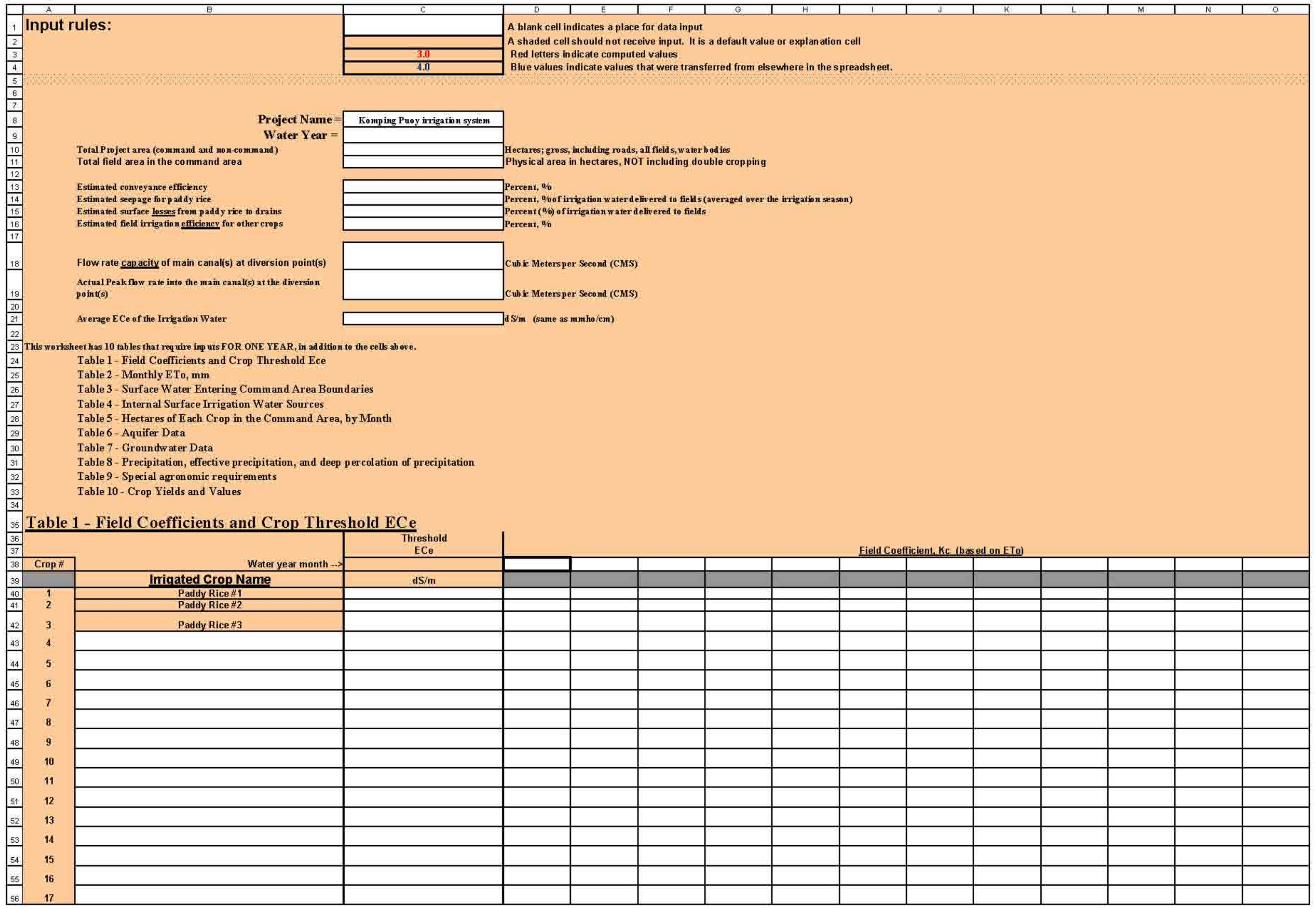


Table 10 - Crop Yields and Values

Exchange rate - $US/(local currency) :

		Irrigated Crop Name	Typical yield, metric tons/ha	selling price, Local currency/ metric ton	hectares	Gross tonnage/yr	Value of agricultural production, $US/yr
293	1	Paddy Rice#1			0	0	0
294	2	Paddy Rice#2			0	0	0
295	3	Paddy Rice#3			0	0	0
296	4	0			0	0	0
297	5	0			0	0	0
298	6	0			0	0	0
299	7	0			0	0	0
300	8	0			0	0	0
301	9	0			0	0	0
302	10	0			0	0	0
303	11	0			0	0	0
304	12	0			0	0	0
305	13	0			0	0	0
306	14	0			0	0	0
307	15	0			0	0	0
308	16	0			0	0	0
309	17	0			0	0	0
310					Total annual value ($US)		0

3. Input – Year 3



Input rules:

A blank cell indicates a place for data input
A shaded cell should not receive input. It is a default value or explanation cell
3.0 Red letters indicate computed values
4.0 Blue values indicate values that were transferred from elsewhere in the spreadsheet.

Project Name = Komping Puoy irrigation system
Water Year =

Total Project area (command and non-command) — Hectares; gross, including roads, all fields, water bodies
Total field area in the command area — Physical area in hectares, NOT including double cropping

Estimated conveyance efficiency — Percent, %
Estimated seepage for paddy rice — Percent, % of irrigation water delivered to fields (averaged over the irrigation season)
Estimated surface losses from paddy rice to drains — Percent (%) of irrigation water delivered to fields
Estimated field irrigation efficiency for other crops — Percent, %

Flow rate capacity of main canal(s) at diversion point(s) — Cubic Meters per Second (CMS)
Actual Peak flow rate into the main canal(s) at the diversion point(s) — Cubic Meters per Second (CMS)

Average ECe of the Irrigation Water — dS/m (same as mmho/cm)

This worksheet has 10 tables that require inputs FOR ONE YEAR, in addition to the cells above.

Table 1 - Field Coefficients and Crop Threshold Ece
Table 2 - Monthly ETo, mm
Table 3 - Surface Water Entering Command Area Boundaries
Table 4 - Internal Surface Irrigation Water Sources
Table 5 - Hectares of Each Crop in the Command Area, by Month
Table 6 - Aquifer Data
Table 7 - Groundwater Data
Table 8 - Precipitation, effective precipitation, and deep percolation of precipitation
Table 9 - Special agronomic requirements
Table 10 - Crop Yields and Values

Table 1 - Field Coefficients and Crop Threshold ECe

		Threshold ECe	Field Coefficient, Kc (based on ETo)											
Crop #	Water year month -->													
	Irrigated Crop Name	dS/m												
1	Paddy Rice #1													
2	Paddy Rice #2													
3	Paddy Rice #3													
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														

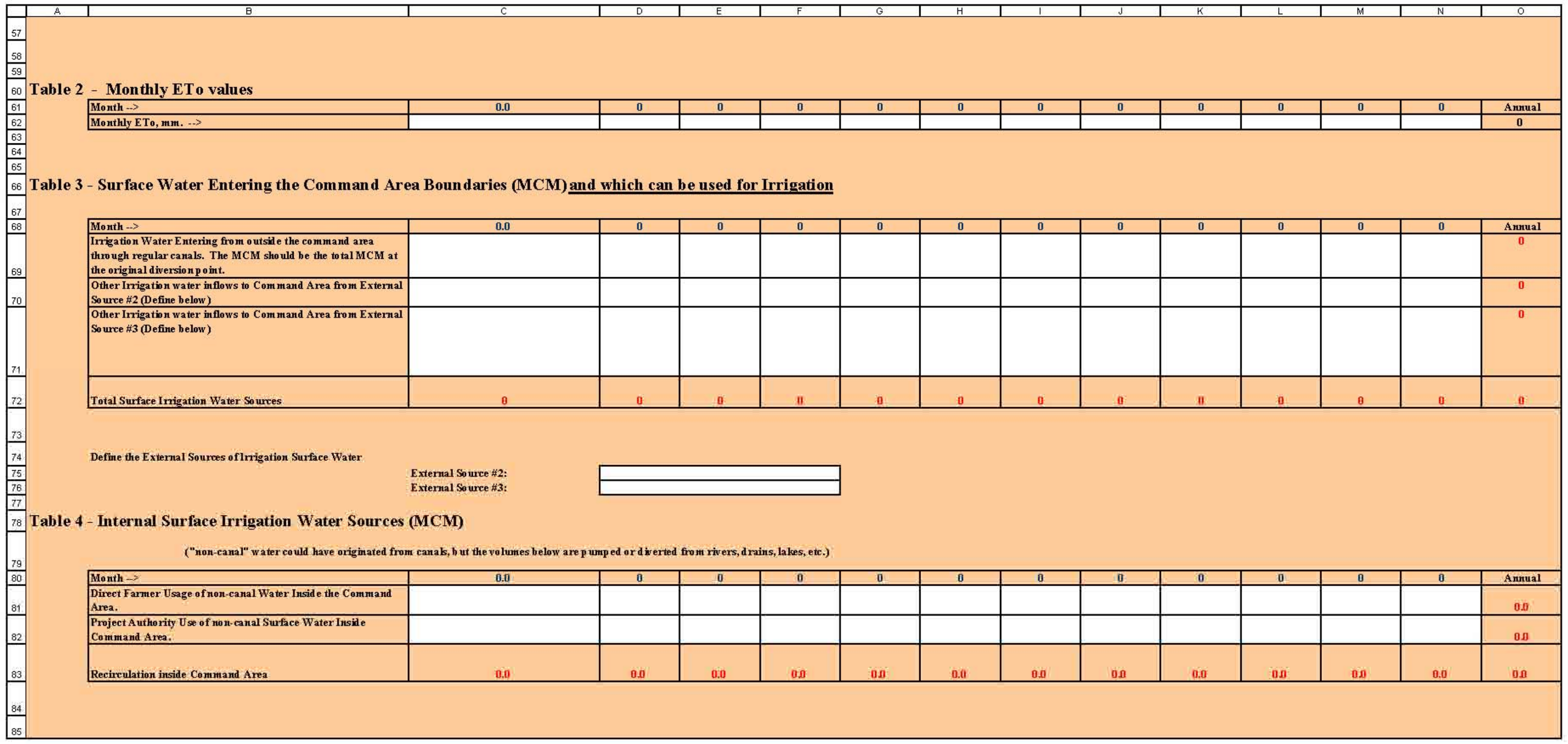


Table 2 - Monthly ETo values

Month -->	0.0	0	0	0	0	0	0	0	0	0	0	0	**Annual**
Monthly ETo, mm. -->													0

Table 3 - Surface Water Entering the Command Area Boundaries (MCM) and which can be used for Irrigation

Month -->	0.0	0	0	0	0	0	0	0	0	0	0	0	**Annual**
Irrigation Water Entering from outside the command area through regular canals. The MCM should be the total MCM at the original diversion point.													0
Other Irrigation water inflows to Command Area from External Source #2 (Define below)													0
Other Irrigation water inflows to Command Area from External Source #3 (Define below)													0
Total Surface Irrigation Water Sources	0	0	0	0	0	0	0	0	0	0	0	0	0

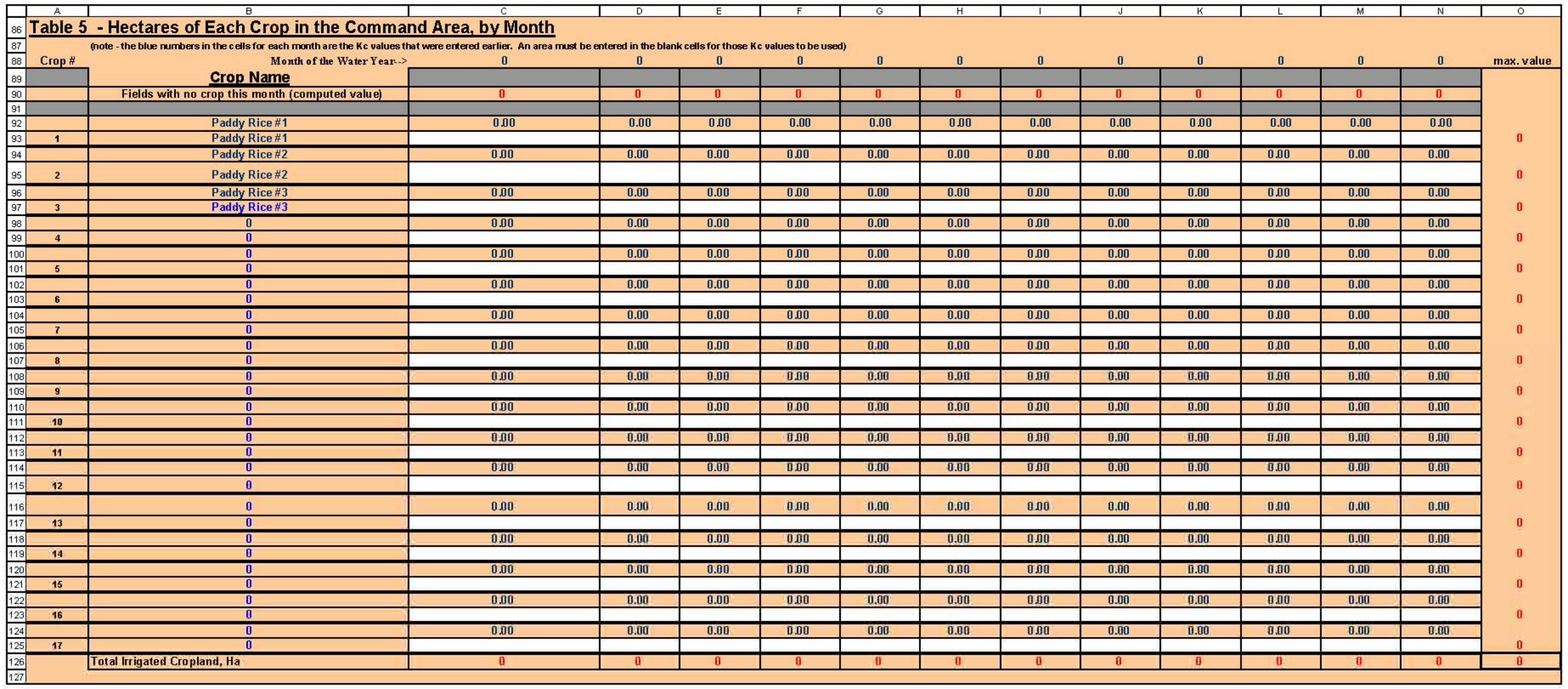
Define the External Sources of Irrigation Surface Water

External Source #2:
External Source #3:

Table 4 - Internal Surface Irrigation Water Sources (MCM)

("non-canal" water could have originated from canals, but the volumes below are pumped or diverted from rivers, drains, lakes, etc.)

Month -->	0.0	0	0	0	0	0	0	0	0	0	0	0	**Annual**
Direct Farmer Usage of non-canal Water Inside the Command Area.													0.0
Project Authority Use of non-canal Surface Water Inside Command Area.													0.0
Recirculation inside Command Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
86	**Table 5 - Hectares of Each Crop in the Command Area, by Month**														
87		(note - the blue numbers in the cells for each month are the Kc values that were entered earlier. An area must be entered in the blank cells for those Kc values to be used)													
88	Crop #	Month of the Water Year-->	0	0	0	0	0	0	0	0	0	0	0	0	max. value
89		**Crop Name**													
90		Fields with no crop this month (computed value)	0	0	0	0	0	0	0	0	0	0	0	0	
91															
92		Paddy Rice #1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
93	1	Paddy Rice #1													0
94		Paddy Rice #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
95	2	Paddy Rice #2													0
96		Paddy Rice #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
97	3	Paddy Rice #3													0
98		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
99	4	0													0
100		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
101	5	0													0
102		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
103	6	0													0
104		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
105	7	0													0
106		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
107	8	0													0
108		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
109	9	0													0
110		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
111	10	0													0
112		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
113	11	0													0
114		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
115	12	0													0
116		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
117	13	0													0
118		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
119	14	0													0
120		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
121	15	0													0
122		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
123	16	0													0
124		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
125	17	0													0
126		Total Irrigated Cropland, Ha	0	0	0	0	0	0	0	0	0	0	0	0	0
127															

Table 6 - Aquifer Data

The Groundwater data below should be provided <u>only</u> if wells are used within the project area.

This year's rise (+) or drop (-) in the aquifer water level, meters =
Specific Yield of the Aquifer, [meter/meter] =
Area of the Aquifer under the project (hectares) =
Annual change in groundwater storage (MCM) = 0.0 (calculated)
Estimated annual NET recharge to the aquifer from
RIVERS (MCM) =
RAINFALL (MCM) =
SUBSURFACE Lateral Inflow (MCM)=

*** - NET recharge for these 3 items means natural inflow, minus any lateral subsurface outflow of that water from the project boundaries. It does NOT include any computation for removal by well pumps, nor does it include any recharge from irrigation or from leaky canals.**

Table 7 Groundwater Data (MCM)

Month -->	**0.0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Annual**
Ground water pumped by farmers Inside the Command Area													0.0
Ground water pumped by the Project Authorities Inside the Command Area.													0.0
Farmer ground water pumped from the Aquifer, But Outside the Command Area													0.0
Project Authority ground water pumped from the Aquifer, But Outside the Command Area.													0.0
Ground water pumped outside Command Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Ground Water Pumped Inside the Command Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Reality Check on Groundwater Storage and Recharge:

A. Total reported annual pump withdrawals from the aquifer = 0.0 MCM
A1. Your very rough estimate of the percentage of seepage and field deep percolation of the pumped water back to the aquifer. #DIV/0! % **This uses 8This uses 80% of avg. field efficiency for all farmer pumping, and half the conveyance inefficiencies for project pumping**
A2. Estimate of annual pump withdrawals from the aquifer that are used for ET or surface runoff #DIV/0! MCM
B. Total reported NET annual recharge due to rivers, subsurface lateral inflow, and rainfall: 0.00 MCM
C. The annual change in groundwater storage (computed earlier) 0.00 MCM
D. Computed NET annual recharge due to irrigation in the command area (C-B) (the only other source): #DIV/0! MCM

(a negative NET annual recharge due to irrigation means that there is more irrigation water is removed from the aquifer than replaced by irrigation)
(a <u>positive</u> NET annual recharge due to irrigation means that the aquifer is filling up due to irrigation water recharge)

Quick Check on an estimate of <u>overdraft</u>:

It is physically impossible for D to be more negative than A2
(You can't have more overdraft than the net pumped).

Reality check: #DIV/0!

**You must adjust your groundwater data until the check above states that there is "No obvious overdraft error"

pumping): #DIV/0! MCM
If this is a net withdrawal from the aquifer, the following number is passed to the Indicator #DIV/0! MCM

END of the GROUNDWATER INPUT SECTION

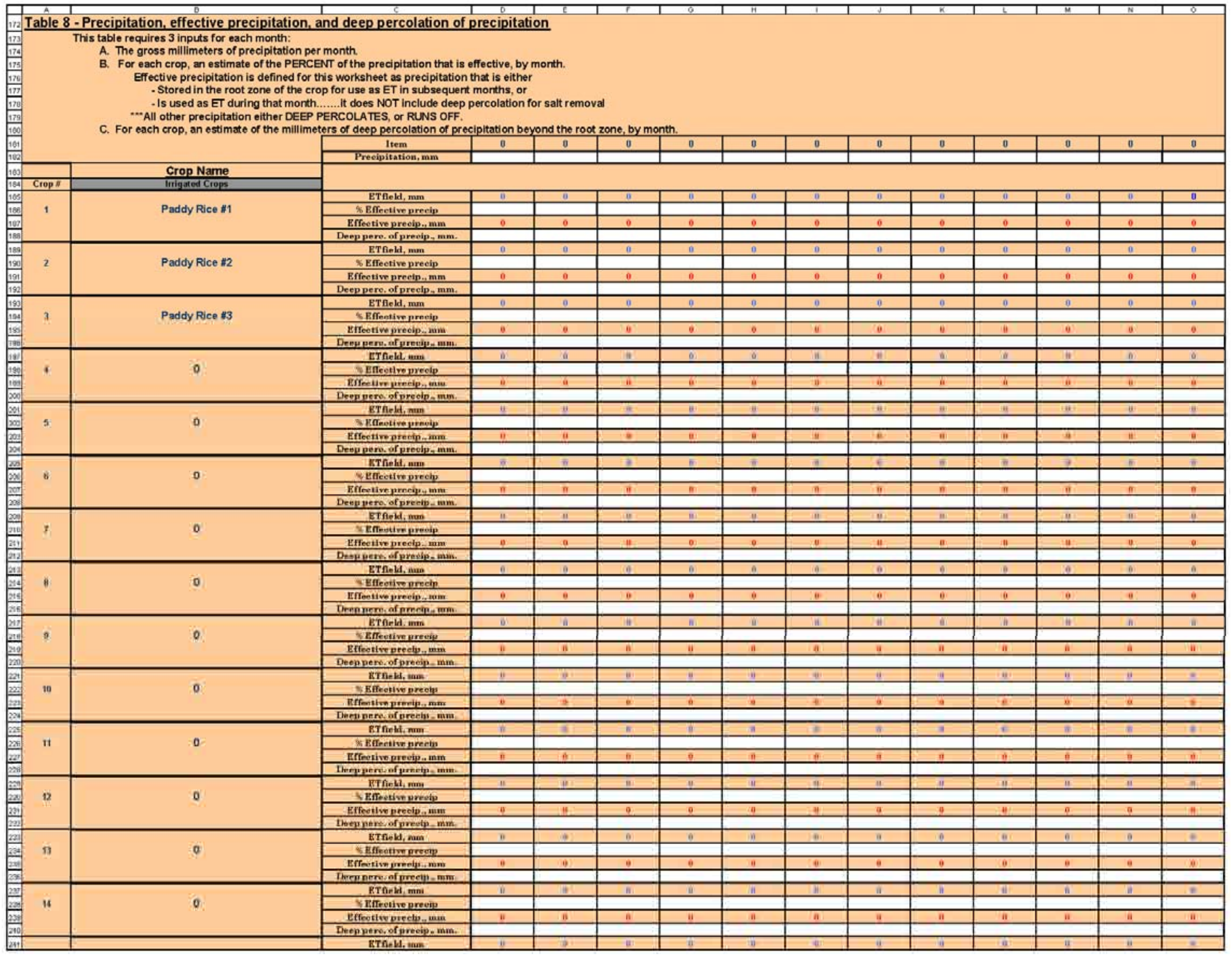


Table 8 - Precipitation, effective precipitation, and deep percolation of precipitation

This table requires 3 inputs for each month:

A. The gross millimeters of precipitation per month.

B. For each crop, an estimate of the PERCENT of the precipitation that is effective, by month.

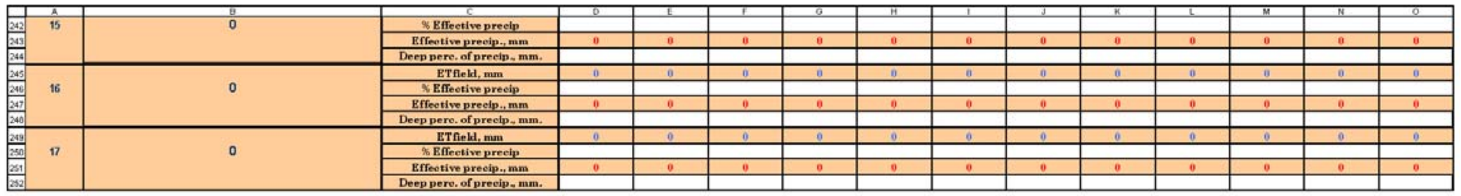
Effective precipitation is defined for this worksheet as precipitation that is either

- Stored in the root zone of the crop for use as ET in subsequent months, or
- Is used as ET during that month…….it does NOT include deep percolation for salt removal

***All other precipitation either DEEP PERCOLATES, or RUNS OFF.

C. For each crop, an estimate of the millimeters of deep percolation of precipitation beyond the root zone, by month.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
		Item	0	0	0	0	0	0	0	0	0	0	0	0
		Precipitation, mm												
	Crop Name													
Crop #	Irrigated Crops													
1	Paddy Rice #1	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
2	Paddy Rice #2	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
3	Paddy Rice #3	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
4	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
5	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
6	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
7	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
8	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
9	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
10	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
11	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
12	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
13	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
14	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
		% Effective precip												
		Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
		Deep perc. of precip., mm.												
		ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
242	15	0	% Effective precip												
243			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
244			Deep perc. of precip., mm.												
245	16	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
246			% Effective precip												
247			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
248			Deep perc. of precip., mm.												
249	17	0	ETfield, mm	0	0	0	0	0	0	0	0	0	0	0	0
250			% Effective precip												
251			Effective precip., mm	0	0	0	0	0	0	0	0	0	0	0	0
252			Deep perc. of precip., mm.												

Table 9 - Special agronomic requirements (mm)

Some crops have special irrigation requirements at a specific time of the year.

For example, rice fields may need to be flooded prior to transplanting or planting.

Cotton fields may need to be "pre-irrigated" - that is, irrigated prior to planting.

These special requirements may require a much higher project irrigation water demand than what is expected if one just examines evapotranspiration requirements. However, they do NOT include any leaching requirements for salinity control.

** The units of the input values for Table 9 are **millimeters**. They should represent the gross millimeters needed IN ADDITION TO any ET requirements (minus effective rainfall). These should be "gross" values at the field, but should not include any conveyance losses that are necessary to transport the water to the field.

Insert mm. values for this year. There may be no entries in this table, depending upon the crops and practices.

		Special Needs, mm. of Irrigation Water											
	Irrigated Crop Description	0	0	0	0	0	0	0	0	0	0	0	0
1	Paddy Rice #1												
2	Paddy Rice #2												
3	Paddy Rice #3												
4	0												
5	0												
6	0												
7	0												
8	0												
9	0												
10	0												
11	0												
12	0												
13	0												
14	0												
15	0												
16	0												
17	0												

Table 10 - Crop Yields and Values

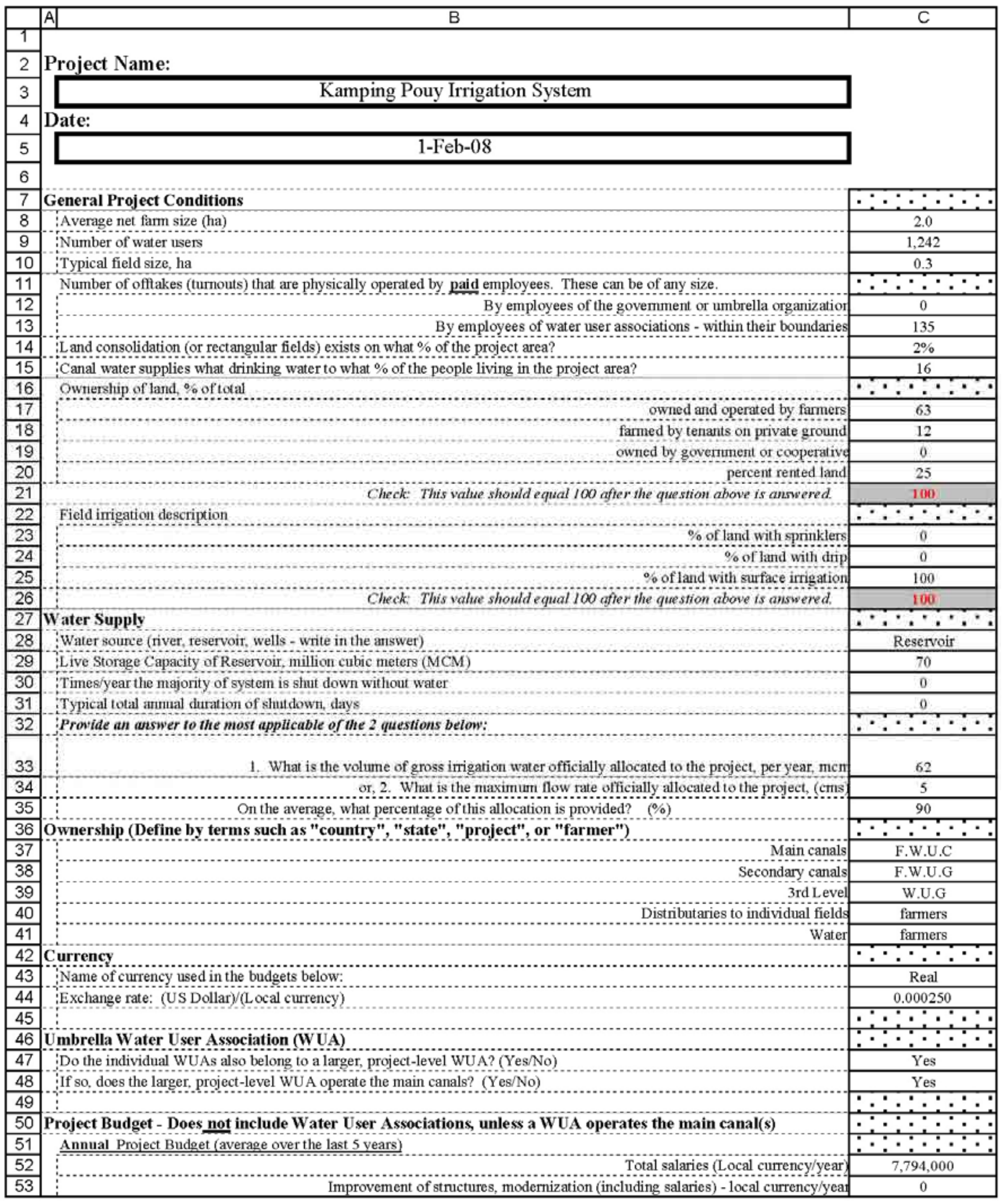
Exchange rate - $US/(local currency) :

	Irrigated Crop Name	Typical yield, metric tons/ha	Farmgate selling price, Local currency/ metric ton	hectares	Gross tonnage/yr	Value of agricultural production, $US/yr
1	Paddy Rice #1			0	0	0
2	Paddy Rice #2			0	0	0
3	Paddy Rice #3			0	0	0
4	0			0	0	0
5	0			0	0	0
6	0			0	0	0
7	0			0	0	0
8	0			0	0	0
9	0			0	0	0
10	0			0	0	0
11	0			0	0	0
12	0			0	0	0
13	0			0	0	0
14	0			0	0	0
15	0			0	0	0
16	0			0	0	0
17	0			0	0	0
					Total annual value ($US)	0

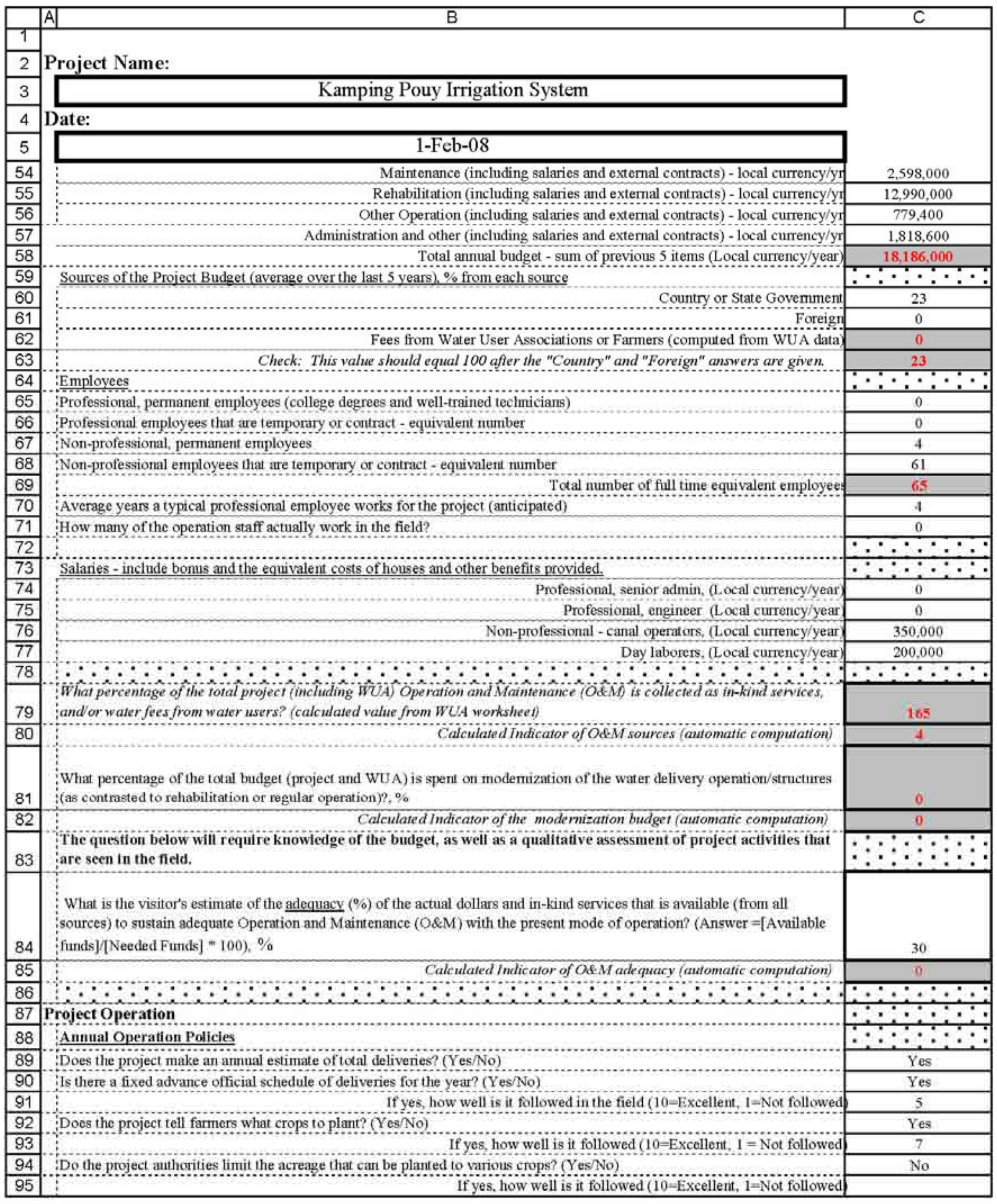
4. External Indicators

"DI 12" refers to "Data Item No. 12" of the IPTRID Guidelines	Indicator No. for RAP Documentation	Item Description	Units	KOMPING POUY				Est.
				2007-2008	0	0	2007-2008	CI
		Stated Efficiencies						%/100
	1	Stated conveyance efficiency (seepage and spills)	%	73	0	0	73	
	2	Weighted field irrigation efficiency from stated efficiencies	%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
		Areas						
DI 3	3	Physical area of cropland in the command area (not including double cropping)	Ha	10,050	0	0	10,050	
DI 4	4	Irrigated crop area in the command area	Ha	3,971	0	0	3,971	
	5	Cropping intensity in the command area including double cropping	none	0.40	#DIV/0!	#DIV/0!	0.40	0.00
		External sources of water for the command area						
DI 2	6	Surface irrigation water inflow from outside the command area (gross at diversion and entry points)	MCM	53	0	0	31	
	7	Gross precipitation in the command area	MCM	130	0	0	105	
	8	Effective precipitation to irrigated fields (not including salinity removal)	MCM	24	0	0	21	0.00
	9	Net aquifer withdrawl due to irrigation in the command area	MCM	0	#DIV/0!	#DIV/0!	0	0.00
DI 5	10	Total external water supply - including gross ppt. and net aquifer withdrawl, but excluding internal recirculation	MCM	184	#DIV/0!	#DIV/0!	136	0.00
		Water sources inside the command area						
	11	Internal surface water recirculation/pumping by farmer or project in command area	MCM	0	0	0	0	
	12	Gross groundwater pumped by farmers within command area	MCM	0.07	0	0	0.07	
	13	Gross groundwater pumped by Project Authorities within command area	MCM	0	0	0	0	
	14	Estimated total internal source water	MCM	0.07	0	0	0.07	0.00
		Irrigation water delivered to users						
	15	*Internal water sources are assumed to have a conveyance efficiency of:*	%	91	67	67	91	
DI 1	16	Delivery of external surface irrigation water to users - using stated conveyance efficiency	MCM	38.787138	0	0	22.356828	0.00
	17	Delivery of internal source water to users (surface recirculation plus pumping, with assumed conveyance efficiency)	MCM	0	0	0	0	0.00
	18	Total irrigation water deliveries to users (external surface irrigation water + internal diversions and pumping water sources), reduced for conveyance efficiencies	MCM	39	0	0	22	0.00
		Net Field Irrigation requirements						
DI 20	19	ET of irrigated crops in the command area	MCM	439	0	0	433	
	20	ET of irrigation water in the command area (ET - effective precipitation)	MCM	415	0	0	412	0.00
	21	Irrigation water needed for salinity control (net)	MCM	2	0	0	2	0.00
	22	Irrigation water needed for special practices	MCM	2	0	0	0	
	23	Total NET irrigation water requirements (ET - eff ppt + salt control + special practices)	MCM	419	0	0	414	0.00
		Other Key Values						
DI 8	24	Flow rate capacity of main canal(s) at diversion point(s)	cms	16	0	0	16	
	25	Actual peak flow rate of the main canal(s) at diversion point(s) this year	cms	5.6	0	0	5.6	
	26	Peak NET irrigation requirement for field, including any special requirements	cms	159.7	#DIV/0!	#DIV/0!	1.9	0.00
DI 9	27	Peak GROSS irrigation requirement, including all inefficiencies	cms	20.4	#DIV/0!	#DIV/0!	4.7	0.00
		ANNUAL or One-Time External INDICATORS for the Command Area						
	28	Peak liters/sec/ha of surface irrigation inflows to canal(s) this year	LPS/Ha	0.56	#DIV/0!	#DIV/0!	0.56	0.00
	29	**RWS** Relative water supply for the irrigated part of the command area (Total external water supply)/(Field ET during growing seasons + water for salt control - Effective precipitation)	none	0.44	#DIV/0!	#DIV/0!	9.76	0.00
	30	Annual **Command Area Irrigation Efficiency** [100 x (Crop ET + Leaching needs - Effective ppt)/(Surface irrigation diversions + Net groundwater)]	%	784	#DIV/0!	#DIV/0!	40	0.00
	31	**Field Irrigation Efficiency** (computed) = [Crop ET-Effective ppt + LR water]/[Total Water Delivered to Users] x 100	%	1079	#DIV/0!	#DIV/0!	61	0.00
	32	**RGCC** - Relative Gross Canal Capacity - (Peak Monthly Net Irrigation Requirement)/(Main Canal Capacity)	none	9.98	#DIV/0!	#DIV/0!	0.12	0.00
	33	**RACF** - Relative Actual Canal Flow - (Peak Monthly Net Irrigation Requirement)/(Peak Main Canal Flow Rate)	none	28.52	#DIV/0!	#DIV/0!	0.33	0.00
DI 18	34	Gross annual tonnage of agricultural production by crop type	m Tons	see Table 10 on each INPUT worksheet (1-3)			see Table 10 on each INPUT worksh	
DI 19	35	Total annual value of agricultural production	$ US	2,769,851	0	0	1,208,375	

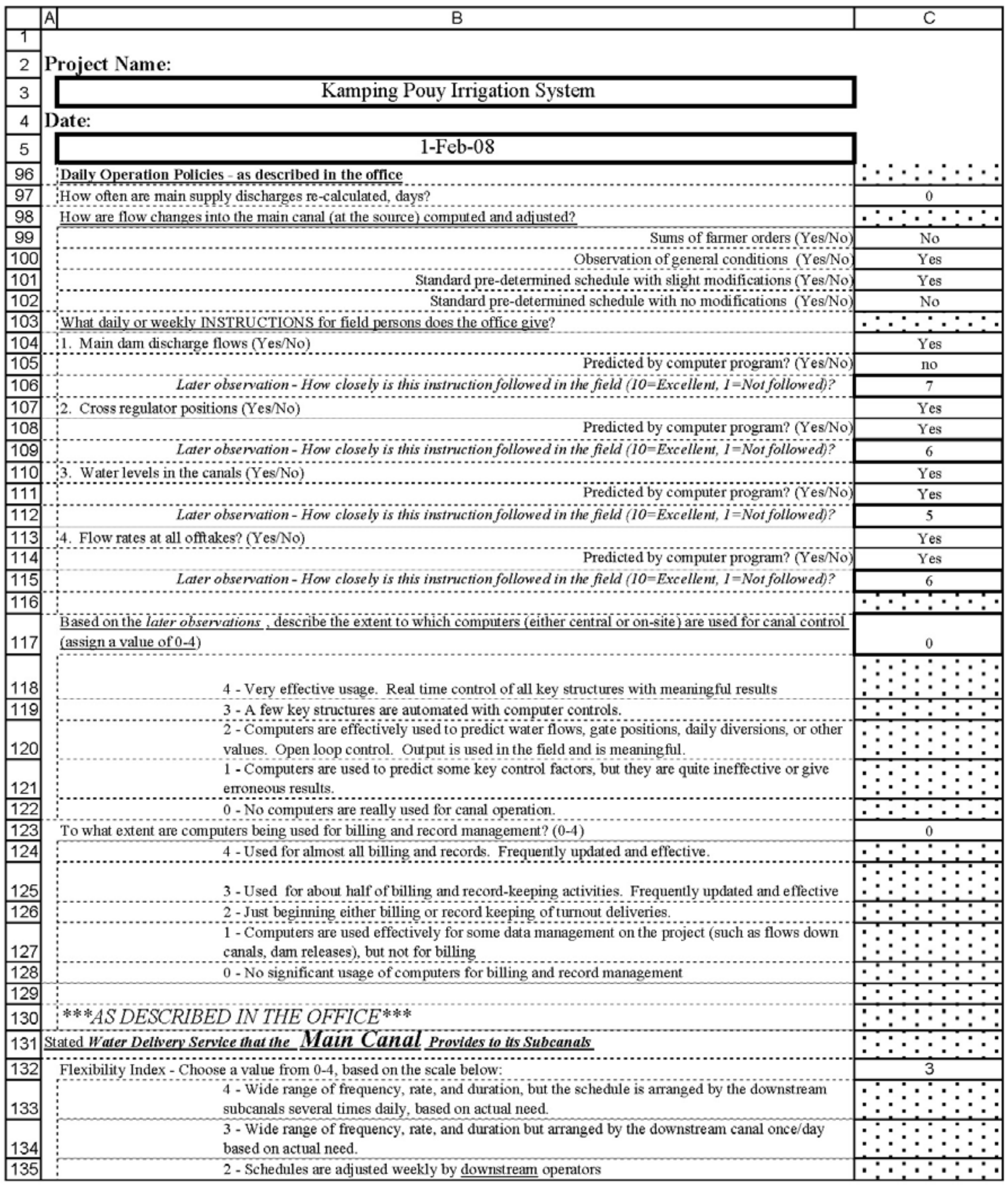
5. Project Office Questions



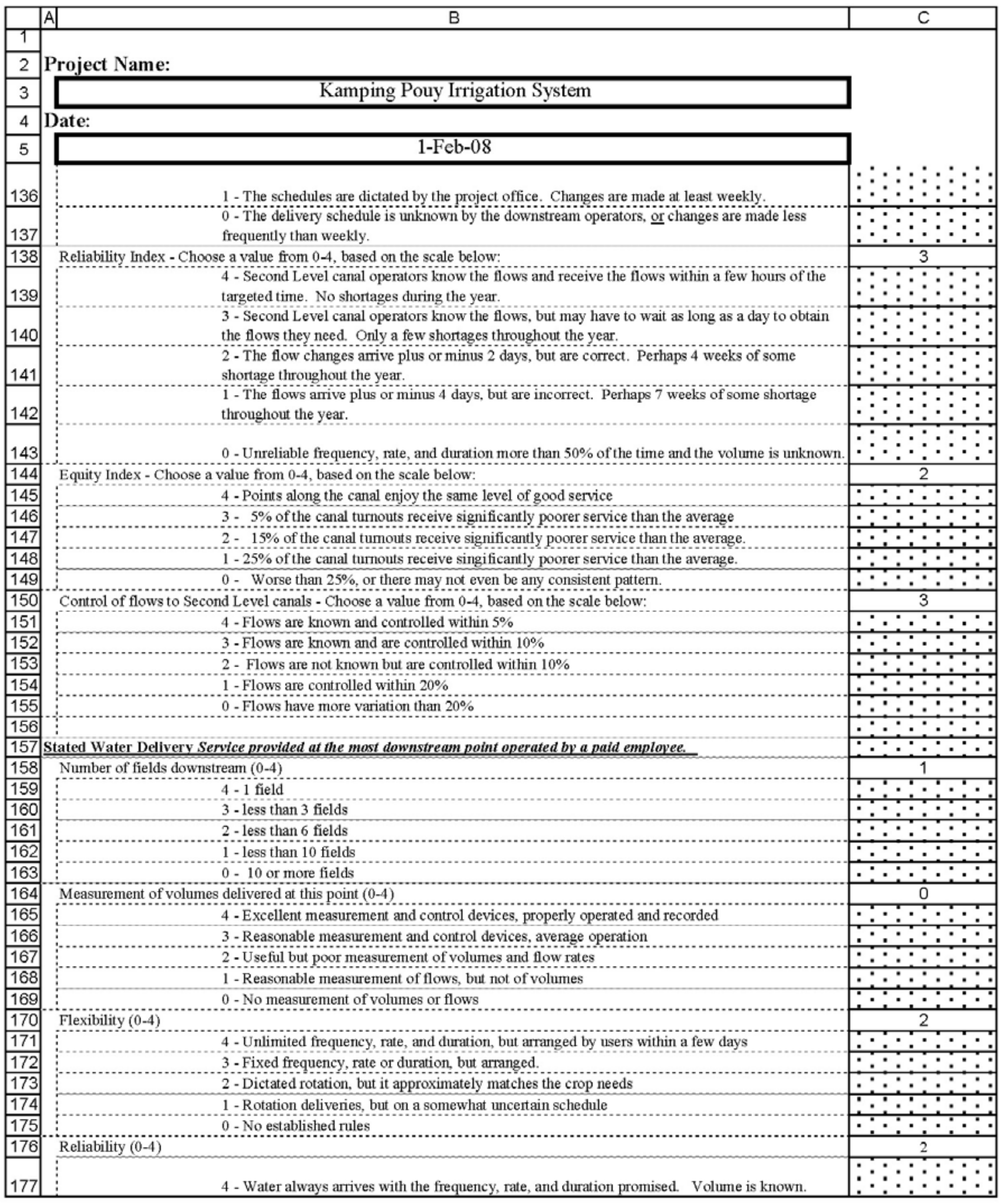
	A	B	C
1			
2		**Project Name:**	
3		Kamping Pouy Irrigation System	
4		**Date:**	
5		1-Feb-08	
6			
7		**General Project Conditions**	
8		Average net farm size (ha)	2.0
9		Number of water users	1,242
10		Typical field size, ha	0.3
11		Number of offtakes (turnouts) that are physically operated by **paid** employees. These can be of any size.	
12		By employees of the government or umbrella organizatio	0
13		By employees of water user associations - within their boundaries	135
14		Land consolidation (or rectangular fields) exists on what % of the project area?	2%
15		Canal water supplies what drinking water to what % of the people living in the project area?	16
16		Ownership of land, % of total	
17		owned and operated by farmers	63
18		farmed by tenants on private ground	12
19		owned by government or cooperative	0
20		percent rented land	25
21		*Check: This value should equal 100 after the question above is answered.*	100
22		Field irrigation description	
23		% of land with sprinklers	0
24		% of land with drip	0
25		% of land with surface irrigation	100
26		*Check: This value should equal 100 after the question above is answered.*	100
27		**Water Supply**	
28		Water source (river, reservoir, wells - write in the answer)	Reservoir
29		Live Storage Capacity of Reservoir, million cubic meters (MCM)	70
30		Times/year the majority of system is shut down without water	0
31		Typical total annual duration of shutdown, days	0
32		***Provide an answer to the most applicable of the 2 questions below:***	
33		1. What is the volume of gross irrigation water officially allocated to the project, per year, mcm	62
34		or, 2. What is the maximum flow rate officially allocated to the project, (cms)	5
35		On the average, what percentage of this allocation is provided? (%)	90
36		**Ownership (Define by terms such as "country", "state", "project", or "farmer")**	
37		Main canals	F.W.U.C
38		Secondary canals	F.W.U.G
39		3rd Level	W.U.G
40		Distributaries to individual fields	farmers
41		Water	farmers
42		**Currency**	
43		Name of currency used in the budgets below:	Real
44		Exchange rate: (US Dollar)/(Local currency)	0.000250
45			
46		**Umbrella Water User Association (WUA)**	
47		Do the individual WUAs also belong to a larger, project-level WUA? (Yes/No)	Yes
48		If so, does the larger, project-level WUA operate the main canals? (Yes/No)	Yes
49			
50		**Project Budget - Does not include Water User Associations, unless a WUA operates the main canal(s)**	
51		**Annual** Project Budget (average over the last 5 years)	
52		Total salaries (Local currency/year)	7,794,000
53		Improvement of structures, modernization (including salaries) - local currency/year	0



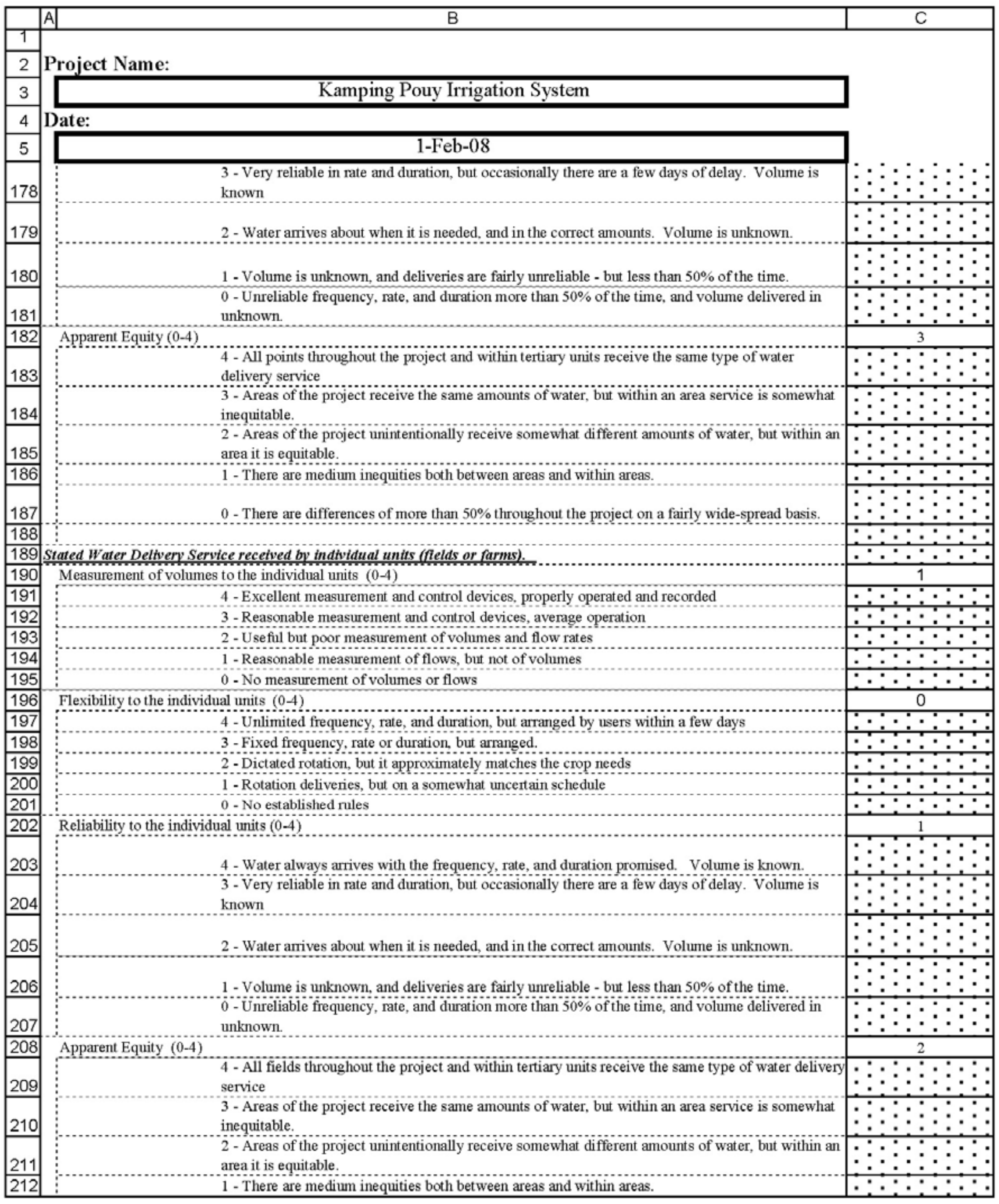
	A	B	C
1			
2	**Project Name:**		
3		Kamping Pouy Irrigation System	
4	**Date:**		
5		1-Feb-08	
54		Maintenance (including salaries and external contracts) - local currency/yr	2,598,000
55		Rehabilitation (including salaries and external contracts) - local currency/yr	12,990,000
56		Other Operation (including salaries and external contracts) - local currency/yr	779,400
57		Administration and other (including salaries and external contracts) - local currency/yr	1,818,600
58		Total annual budget - sum of previous 5 items (Local currency/year)	**18,186,000**
59		Sources of the Project Budget (average over the last 5 years), % from each source	
60		Country or State Government	23
61		Foreign	0
62		Fees from Water User Associations or Farmers (computed from WUA data)	**0**
63		*Check: This value should equal 100 after the "Country" and "Foreign" answers are given.*	**23**
64		Employees	
65		Professional, permanent employees (college degrees and well-trained technicians)	0
66		Professional employees that are temporary or contract - equivalent number	0
67		Non-professional, permanent employees	4
68		Non-professional employees that are temporary or contract - equivalent number	61
69		Total number of full time equivalent employees	**65**
70		Average years a typical professional employee works for the project (anticipated)	4
71		How many of the operation staff actually work in the field?	0
72			
73		Salaries - include bonus and the equivalent costs of houses and other benefits provided.	
74		Professional, senior admin, (Local currency/year)	0
75		Professional, engineer (Local currency/year)	0
76		Non-professional - canal operators, (Local currency/year)	350,000
77		Day laborers, (Local currency/year)	200,000
78			
79		*What percentage of the total project (including WUA) Operation and Maintenance (O&M) is collected as in-kind services, and/or water fees from water users? (calculated value from WUA worksheet)*	**165**
80		*Calculated Indicator of O&M sources (automatic computation)*	**4**
81		What percentage of the total budget (project and WUA) is spent on modernization of the water delivery operation/structures (as contrasted to rehabilitation or regular operation)?, %	0
82		*Calculated Indicator of the modernization budget (automatic computation)*	0
83		**The question below will require knowledge of the budget, as well as a qualitative assessment of project activities that are seen in the field.**	
84		What is the visitor's estimate of the adequacy (%) of the actual dollars and in-kind services that is available (from all sources) to sustain adequate Operation and Maintenance (O&M) with the present mode of operation? (Answer =[Available funds]/[Needed Funds] * 100), %	30
85		*Calculated Indicator of O&M adequacy (automatic computation)*	0
86			
87	**Project Operation**		
88		**Annual Operation Policies**	
89		Does the project make an annual estimate of total deliveries? (Yes/No)	Yes
90		Is there a fixed advance official schedule of deliveries for the year? (Yes/No)	Yes
91		If yes, how well is it followed in the field (10=Excellent, 1=Not followed)	5
92		Does the project tell farmers what crops to plant? (Yes/No)	Yes
93		If yes, how well is it followed (10=Excellent, 1 = Not followed)	7
94		Do the project authorities limit the acreage that can be planted to various crops? (Yes/No)	No
95		If yes, how well is it followed (10=Excellent, 1=Not followed)	



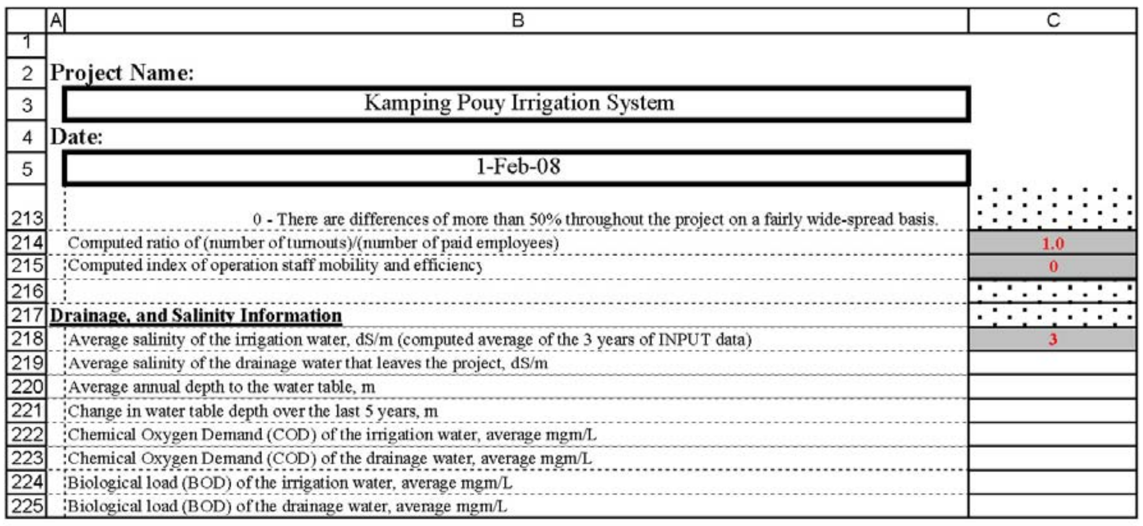
	A	B	C
1			
2	**Project Name:**		
3		Kamping Pouy Irrigation System	
4	**Date:**		
5		1-Feb-08	
96		**Daily Operation Policies - as described in the office**	░
97		How often are main supply discharges re-calculated, days?	0
98		How are flow changes into the main canal (at the source) computed and adjusted?	░
99		Sums of farmer orders (Yes/No)	No
100		Observation of general conditions (Yes/No)	Yes
101		Standard pre-determined schedule with slight modifications (Yes/No)	Yes
102		Standard pre-determined schedule with no modifications (Yes/No)	No
103		What daily or weekly INSTRUCTIONS for field persons does the office give?	░
104		1. Main dam discharge flows (Yes/No)	Yes
105		Predicted by computer program? (Yes/No)	no
106		*Later observation - How closely is this instruction followed in the field (10=Excellent, 1=Not followed)?*	7
107		2. Cross regulator positions (Yes/No)	Yes
108		Predicted by computer program? (Yes/No)	Yes
109		*Later observation - How closely is this instruction followed in the field (10=Excellent, 1=Not followed)?*	6
110		3. Water levels in the canals (Yes/No)	Yes
111		Predicted by computer program? (Yes/No)	Yes
112		*Later observation - How closely is this instruction followed in the field (10=Excellent, 1=Not followed)?*	5
113		4. Flow rates at all offtakes? (Yes/No)	Yes
114		Predicted by computer program? (Yes/No)	Yes
115		*Later observation - How closely is this instruction followed in the field (10=Excellent, 1=Not followed)?*	6
116			░
117		Based on the *later observations* , describe the extent to which computers (either central or on-site) are used for canal control (assign a value of 0-4)	0
118		4 - Very effective usage. Real time control of all key structures with meaningful results	░
119		3 - A few key structures are automated with computer controls.	░
120		2 - Computers are effectively used to predict water flows, gate positions, daily diversions, or other values. Open loop control. Output is used in the field and is meaningful.	░
121		1 - Computers are used to predict some key control factors, but they are quite ineffective or give erroneous results.	░
122		0 - No computers are really used for canal operation.	░
123		To what extent are computers being used for billing and record management? (0-4)	0
124		4 - Used for almost all billing and records. Frequently updated and effective.	░
125		3 - Used for about half of billing and record-keeping activities. Frequently updated and effective	░
126		2 - Just beginning either billing or record keeping of turnout deliveries.	░
127		1 - Computers are used effectively for some data management on the project (such as flows down canals, dam releases), but not for billing	░
128		0 - No significant usage of computers for billing and record management	░
129			░
130		****AS DESCRIBED IN THE OFFICE****	░
131	Stated ***Water Delivery Service that the* Main Canal *Provides to its Subcanals***		░
132		Flexibility Index - Choose a value from 0-4, based on the scale below:	3
133		4 - Wide range of frequency, rate, and duration, but the schedule is arranged by the downstream subcanals several times daily, based on actual need.	░
134		3 - Wide range of frequency, rate, and duration but arranged by the downstream canal once/day based on actual need.	░
135		2 - Schedules are adjusted weekly by downstream operators	░



	A	B	C
1			
2	**Project Name:**		
3		Kamping Pouy Irrigation System	
4	**Date:**		
5		1-Feb-08	
136		1 - The schedules are dictated by the project office. Changes are made at least weekly.	
137		0 - The delivery schedule is unknown by the downstream operators, <u>or</u> changes are made less frequently than weekly.	
138		Reliability Index - Choose a value from 0-4, based on the scale below:	3
139		4 - Second Level canal operators know the flows and receive the flows within a few hours of the targeted time. No shortages during the year.	
140		3 - Second Level canal operators know the flows, but may have to wait as long as a day to obtain the flows they need. Only a few shortages throughout the year.	
141		2 - The flow changes arrive plus or minus 2 days, but are correct. Perhaps 4 weeks of some shortage throughout the year.	
142		1 - The flows arrive plus or minus 4 days, but are incorrect. Perhaps 7 weeks of some shortage throughout the year.	
143		0 - Unreliable frequency, rate, and duration more than 50% of the time and the volume is unknown.	
144		Equity Index - Choose a value from 0-4, based on the scale below:	2
145		4 - Points along the canal enjoy the same level of good service	
146		3 - 5% of the canal turnouts receive significantly poorer service than the average	
147		2 - 15% of the canal turnouts receive significantly poorer service than the average.	
148		1 - 25% of the canal turnouts receive singificantly poorer service than the average.	
149		0 - Worse than 25%, or there may not even be any consistent pattern.	
150		Control of flows to Second Level canals - Choose a value from 0-4, based on the scale below:	3
151		4 - Flows are known and controlled within 5%	
152		3 - Flows are known and are controlled within 10%	
153		2 - Flows are not known but are controlled within 10%	
154		1 - Flows are controlled within 20%	
155		0 - Flows have more variation than 20%	
156			
157	**Stated Water Delivery** ***Service provided at the most downstream point operated by a paid employee.***		
158		Number of fields downstream (0-4)	1
159		4 - 1 field	
160		3 - less than 3 fields	
161		2 - less than 6 fields	
162		1 - less than 10 fields	
163		0 - 10 or more fields	
164		Measurement of volumes delivered at this point (0-4)	0
165		4 - Excellent measurement and control devices, properly operated and recorded	
166		3 - Reasonable measurement and control devices, average operation	
167		2 - Useful but poor measurement of volumes and flow rates	
168		1 - Reasonable measurement of flows, but not of volumes	
169		0 - No measurement of volumes or flows	
170		Flexibility (0-4)	2
171		4 - Unlimited frequency, rate, and duration, but arranged by users within a few days	
172		3 - Fixed frequency, rate or duration, but arranged.	
173		2 - Dictated rotation, but it approximately matches the crop needs	
174		1 - Rotation deliveries, but on a somewhat uncertain schedule	
175		0 - No established rules	
176		Reliability (0-4)	2
177		4 - Water always arrives with the frequency, rate, and duration promised. Volume is known.	



	A	B	C
1			
2	**Project Name:**		
3		Kamping Pouy Irrigation System	
4	**Date:**		
5		1-Feb-08	
178		3 - Very reliable in rate and duration, but occasionally there are a few days of delay. Volume is known	
179		2 - Water arrives about when it is needed, and in the correct amounts. Volume is unknown.	
180		1 - Volume is unknown, and deliveries are fairly unreliable - but less than 50% of the time.	
181		0 - Unreliable frequency, rate, and duration more than 50% of the time, and volume delivered in unknown.	
182		Apparent Equity (0-4)	3
183		4 - All points throughout the project and within tertiary units receive the same type of water delivery service	
184		3 - Areas of the project receive the same amounts of water, but within an area service is somewhat inequitable.	
185		2 - Areas of the project unintentionally receive somewhat different amounts of water, but within an area it is equitable.	
186		1 - There are medium inequities both between areas and within areas.	
187		0 - There are differences of more than 50% throughout the project on a fairly wide-spread basis.	
188			
189	***Stated Water Delivery Service received by individual units (fields or farms).***		
190		Measurement of volumes to the individual units (0-4)	1
191		4 - Excellent measurement and control devices, properly operated and recorded	
192		3 - Reasonable measurement and control devices, average operation	
193		2 - Useful but poor measurement of volumes and flow rates	
194		1 - Reasonable measurement of flows, but not of volumes	
195		0 - No measurement of volumes or flows	
196		Flexibility to the individual units (0-4)	0
197		4 - Unlimited frequency, rate, and duration, but arranged by users within a few days	
198		3 - Fixed frequency, rate or duration, but arranged.	
199		2 - Dictated rotation, but it approximately matches the crop needs	
200		1 - Rotation deliveries, but on a somewhat uncertain schedule	
201		0 - No established rules	
202		Reliability to the individual units (0-4)	1
203		4 - Water always arrives with the frequency, rate, and duration promised. Volume is known.	
204		3 - Very reliable in rate and duration, but occasionally there are a few days of delay. Volume is known	
205		2 - Water arrives about when it is needed, and in the correct amounts. Volume is unknown.	
206		1 - Volume is unknown, and deliveries are fairly unreliable - but less than 50% of the time.	
207		0 - Unreliable frequency, rate, and duration more than 50% of the time, and volume delivered in unknown.	
208		Apparent Equity (0-4)	2
209		4 - All fields throughout the project and within tertiary units receive the same type of water delivery service	
210		3 - Areas of the project receive the same amounts of water, but within an area service is somewhat inequitable.	
211		2 - Areas of the project unintentionally receive somewhat different amounts of water, but within an area it is equitable.	
212		1 - There are medium inequities both between areas and within areas.	

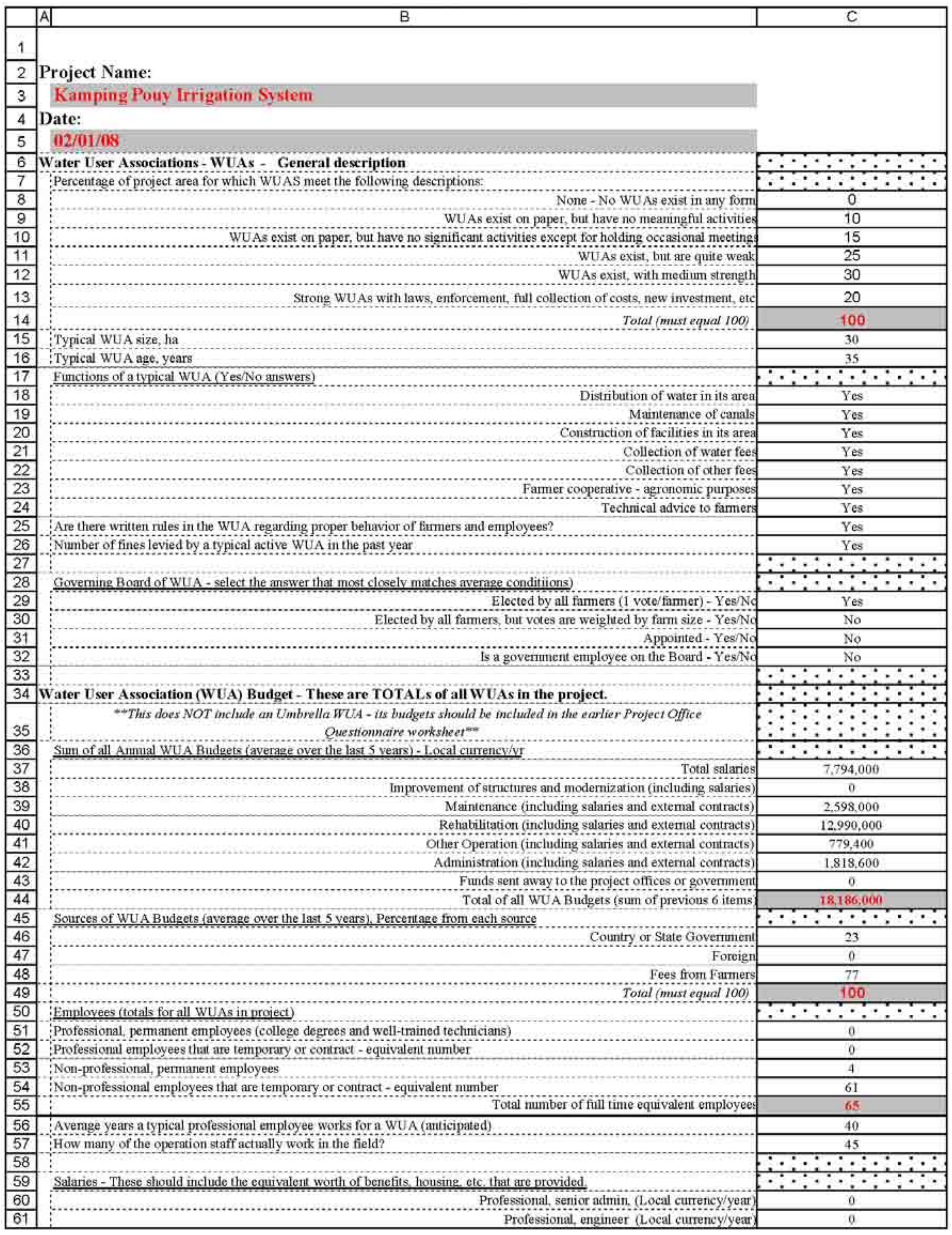


	A	B	C
1			
2	**Project Name:**		
3		Kamping Pouy Irrigation System	
4	**Date:**		
5		1-Feb-08	
213		0 - There are differences of more than 50% throughout the project on a fairly wide-spread basis.	
214		Computed ratio of (number of turnouts)/(number of paid employees)	1.0
215		Computed index of operation staff mobility and efficiency	0
216			
217	**Drainage, and Salinity Information**		
218		Average salinity of the irrigation water, dS/m (computed average of the 3 years of INPUT data)	3
219		Average salinity of the drainage water that leaves the project, dS/m	
220		Average annual depth to the water table, m	
221		Change in water table depth over the last 5 years, m	
222		Chemical Oxygen Demand (COD) of the irrigation water, average mgm/L	
223		Chemical Oxygen Demand (COD) of the drainage water, average mgm/L	
224		Biological load (BOD) of the irrigation water, average mgm/L	
225		Biological load (BOD) of the drainage water, average mgm/L	

6. Project Employees

	A	B	C
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**2/1/08**	
6		This sheet must be completed after visiting all levels of the project. The answers only refer t **paid** employees.	
7			
8			
9	**Various Indicators Regarding Project Employees**		
10		Frequency and adequacy of training of operators and middle managers (not secretaries and drivers). This should include employees at all levels of the distribution system, not only those who work in the office.	2
11		4 - Adequate training at all levels. Employees are very aware of the capabilities of themselves and of their equipment. Employees clearly have a service mentality. Employees are hired with good backgrounds or are trained at the time of employment, and afterwards.	
12		3 - Managers appear to have excellent training, both upon entering employment and continuing afterwards. But some important knowledge has not been passed down to the operators.	
13		2 - Training exists at all levels as needed, but evidently training does not go deep enough, because employees at all levels seem to be missing some important ideas. Many employees have never had adequate training - including poor pre-employment backgrounds.	
14		1 - Only minimal training exists. There is inattention to qualifications upon hiring.	
15		0 - Virtually no training exists before or after hiring.	
16		Availability of written performance rules	1
17		4 - Each employee has a written job description that spells out his/her job and specifies how he/she will be evaluated. Evaluations are annual, and results are discussed with the employee.	
18		3 - There is a general written job description in the office. There is an annual evaluation of performance, but it is not rigorous.	
19		2 - There is an evaluation, but no detailed job description, nor is there a description of evaluation procedures.	
20		1 - There is a written job description, but no meaningful evaluation procedure.	
21		0 - No written job description, and no formal evaluation procedure.	
22		Power of employees to make decisions	2
23		4 - Employees are oficially encouraged to think and act on their own, and they do it in a positive manner.	
24		3 - Employees are not officially encouraged to think and act on their own, but they do it anyway in positive manner.	
25		2 - Employees are encouraged to think and act on their own, but they do not seem to have much initiative.	
26		1 - Employees are not supposed to do any significant tasks without prior authorization. However, if they do take the initiative they are not punished.	
27		0 - Employees are not supposed to do any signficant tasks without prior authorization. They think they will be reprimande if they do something on their own initiative.	
28		Ability of the project to dismiss employees with cause.	2
29		4 - it is easy to fire or lay off employees. There is a short process. Employees are aware of this an know of other employees being fired or laid off when it was necessary.	
30		3 - Employees can be fired if the case is well documented. It is a long process. Employees are aware of other employees being fired when it was necessary.	
31		2 - Firing only happens occasionally due to laziness or serious problems. It is not common. Employees believe that it would be very unusual unless a person was VERY lazy for a long time.	
32		1 - Firing rarely occurs, and never due to laziness. It is extremely difficult to lay off excess personnel.	
33		0 - Employees are virtually never fired, even if they should be. The system appears to be plagued with many people who are not necessary or who should be dismissed but are not.	
34		Rewards for enemplary service	3
35		4 - There is a well designed program that follows a structured process. Rewards occur at least annually to a significant number of individuals. Promotions are given for meritorious service, and bonuses or extra benefits are given to those who are at the top of their grade.	
36		3 - No program, but people who do a good job are frequently promoted. Promotion is based on merit.	
37		2 - Promotion is based on time in service, some some extra benefits are given for exemplary servic This is more than just a piece of paper.	
38		1 - There are seldom awards, but occasionally it happens. The awards are primarily paper with litt or no cash or financial benefit.	
39		0 - Nothing exists.	
40		Relative salary of the canal operators, as compared to a typical day laborer. This is a computed value.	1.8
41		Index of the relative salary of an operator compared to a day laborer (computed value)	2.0

7. WUA



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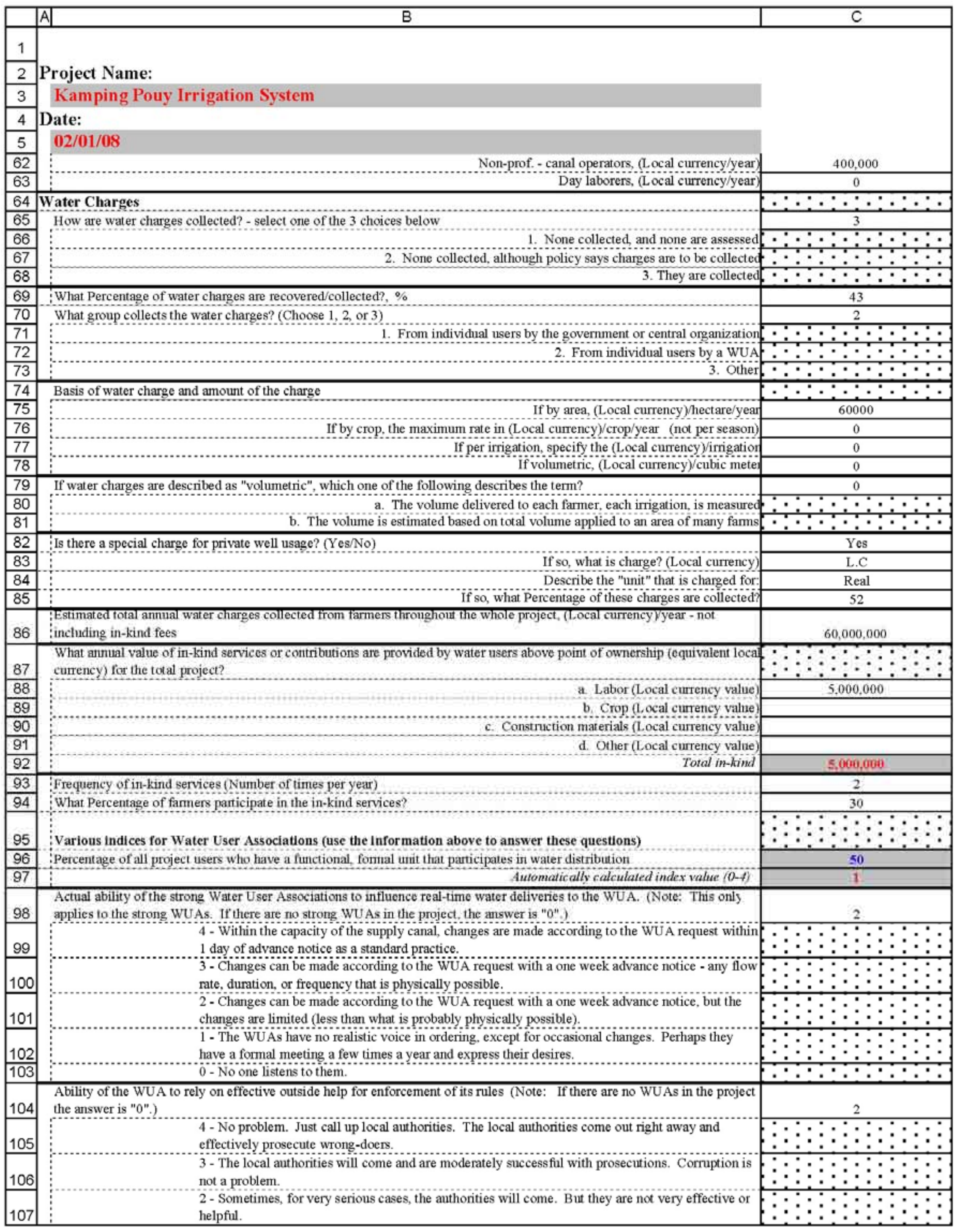
1			
2	**Project Name:**		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
6	**Water User Associations - WUAs - General description**		
7		Percentage of project area for which WUAS meet the following descriptions:	
8		None - No WUAs exist in any form	0
9		WUAs exist on paper, but have no meaningful activities	10
10		WUAs exist on paper, but have no significant activities except for holding occasional meetings	15
11		WUAs exist, but are quite weak	25
12		WUAs exist, with medium strength	30
13		Strong WUAs with laws, enforcement, full collection of costs, new investment, etc	20
14		*Total (must equal 100)*	100
15		Typical WUA size, ha	30
16		Typical WUA age, years	35
17		Functions of a typical WUA (Yes/No answers)	
18		Distribution of water in its area	Yes
19		Maintenance of canals	Yes
20		Construction of facilities in its area	Yes
21		Collection of water fees	Yes
22		Collection of other fees	Yes
23		Farmer cooperative - agronomic purposes	Yes
24		Technical advice to farmers	Yes
25		Are there written rules in the WUA regarding proper behavior of farmers and employees?	Yes
26		Number of fines levied by a typical active WUA in the past year	Yes
27			
28		Governing Board of WUA - select the answer that most closely matches average condiitions)	
29		Elected by all farmers (1 vote/farmer) - Yes/No	Yes
30		Elected by all farmers, but votes are weighted by farm size - Yes/No	No
31		Appointed - Yes/No	No
32		Is a government employee on the Board - Yes/No	No
33			
34	**Water User Association (WUA) Budget - These are TOTALs of all WUAs in the project.**		
35		***This does NOT include an Umbrella WUA - its budgets should be included in the earlier Project Office Questionnaire worksheet***	
36		Sum of all Annual WUA Budgets (average over the last 5 years) - Local currency/yr	
37		Total salaries	7,794,000
38		Improvement of structures and modernization (including salaries)	0
39		Maintenance (including salaries and external contracts)	2,598,000
40		Rehabilitation (including salaries and external contracts)	12,990,000
41		Other Operation (including salaries and external contracts)	779,400
42		Administration (including salaries and external contracts)	1,818,600
43		Funds sent away to the project offices or government	0
44		Total of all WUA Budgets (sum of previous 6 items)	18,186,000
45		Sources of WUA Budgets (average over the last 5 years), Percentage from each source	
46		Country or State Government	23
47		Foreign	0
48		Fees from Farmers	77
49		*Total (must equal 100)*	100
50		Employees (totals for all WUAs in project)	
51		Professional, permanent employees (college degrees and well-trained technicians)	0
52		Professional employees that are temporary or contract - equivalent number	0
53		Non-professional, permanent employees	4
54		Non-professional employees that are temporary or contract - equivalent number	61
55		Total number of full time equivalent employees	65
56		Average years a typical professional employee works for a WUA (anticipated)	40
57		How many of the operation staff actually work in the field?	45
58			
59		Salaries - These should include the equivalent worth of benefits, housing, etc. that are provided.	
60		Professional, senior admin, (Local currency/year)	0
61		Professional, engineer (Local currency/year)	0



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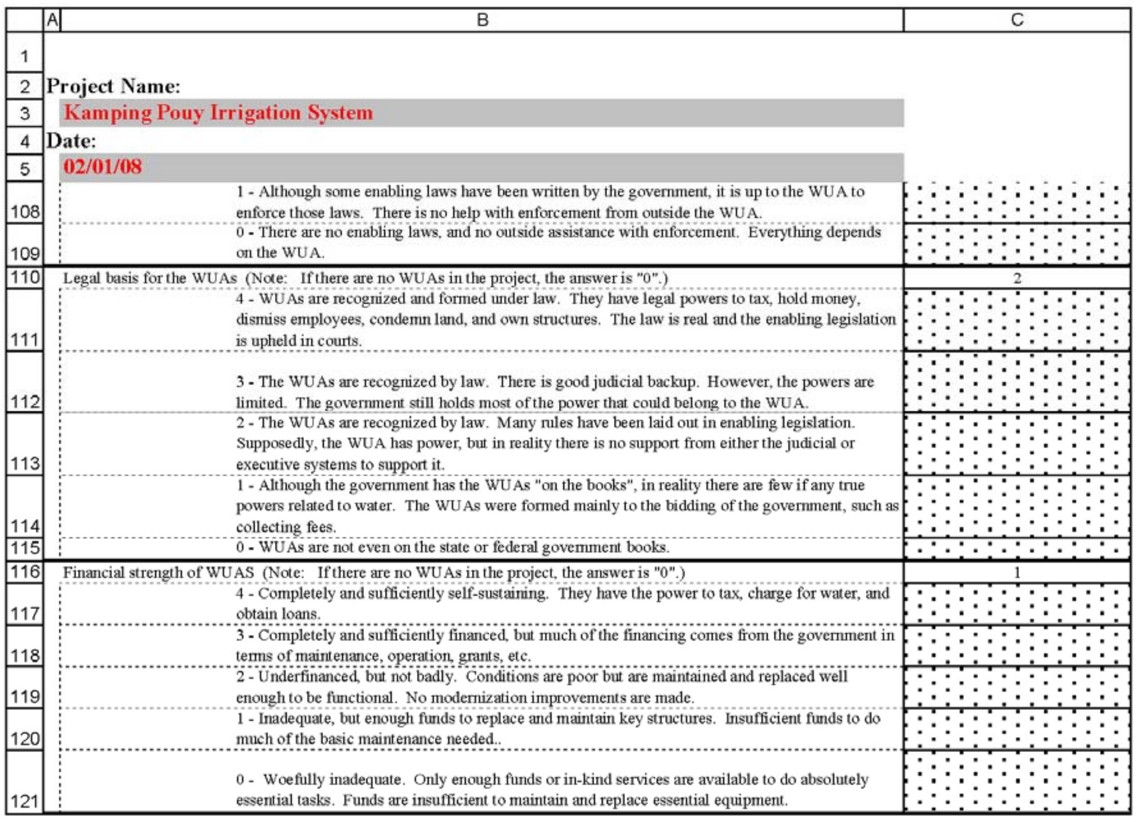
2	**Project Name:**		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
62		Non-prof. - canal operators, (Local currency/year)	400,000
63		Day laborers, (Local currency/year)	0
64	**Water Charges**		
65		How are water charges collected? - select one of the 3 choices below	3
66		1. None collected, and none are assessed	
67		2. None collected, although policy says charges are to be collected	
68		3. They are collected	
69		What Percentage of water charges are recovered/collected?, %	43
70		What group collects the water charges? (Choose 1, 2, or 3)	2
71		1. From individual users by the government or central organization	
72		2. From individual users by a WUA	
73		3. Other	
74		Basis of water charge and amount of the charge	
75		If by area, (Local currency)/hectare/year	60000
76		If by crop, the maximum rate in (Local currency)/crop/year (not per season)	0
77		If per irrigation, specify the (Local currency)/irrigation	0
78		If volumetric, (Local currency)/cubic meter	0
79		If water charges are described as "volumetric", which one of the following describes the term?	0
80		a. The volume delivered to each farmer, each irrigation, is measured	
81		b. The volume is estimated based on total volume applied to an area of many farms	
82		Is there a special charge for private well usage? (Yes/No)	Yes
83		If so, what is charge? (Local currency)	L.C
84		Describe the "unit" that is charged for:	Real
85		If so, what Percentage of these charges are collected?	52
86		Estimated total annual water charges collected from farmers throughout the whole project, (Local currency)/year - not including in-kind fees	60,000,000
87		What annual value of in-kind services or contributions are provided by water users above point of ownership (equivalent local currency) for the total project?	
88		a. Labor (Local currency value)	5,000,000
89		b. Crop (Local currency value)	
90		c. Construction materials (Local currency value)	
91		d. Other (Local currency value)	
92		*Total in-kind*	5,000,000
93		Frequency of in-kind services (Number of times per year)	2
94		What Percentage of farmers participate in the in-kind services?	30
95		**Various indices for Water User Associations (use the information above to answer these questions)**	
96		Percentage of all project users who have a functional, formal unit that participates in water distribution	**50**
97		*Automatically calculated index value (0-4)*	**1**
98		Actual ability of the strong Water User Associations to influence real-time water deliveries to the WUA. (Note: This only applies to the strong WUAs. If there are no strong WUAs in the project, the answer is "0".)	2
99		4 - Within the capacity of the supply canal, changes are made according to the WUA request within 1 day of advance notice as a standard practice.	
100		3 - Changes can be made according to the WUA request with a one week advance notice - any flow rate, duration, or frequency that is physically possible.	
101		2 - Changes can be made according to the WUA request with a one week advance notice, but the changes are limited (less than what is probably physically possible).	
102		1 - The WUAs have no realistic voice in ordering, except for occasional changes. Perhaps they have a formal meeting a few times a year and express their desires.	
103		0 - No one listens to them.	
104		Ability of the WUA to rely on effective outside help for enforcement of its rules (Note: If there are no WUAs in the project the answer is "0".)	2
105		4 - No problem. Just call up local authorities. The local authorities come out right away and effectively prosecute wrong-doers.	
106		3 - The local authorities will come and are moderately successful with prosecutions. Corruption is not a problem.	
107		2 - Sometimes, for very serious cases, the authorities will come. But they are not very effective or helpful.	



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2	**Project Name:**		
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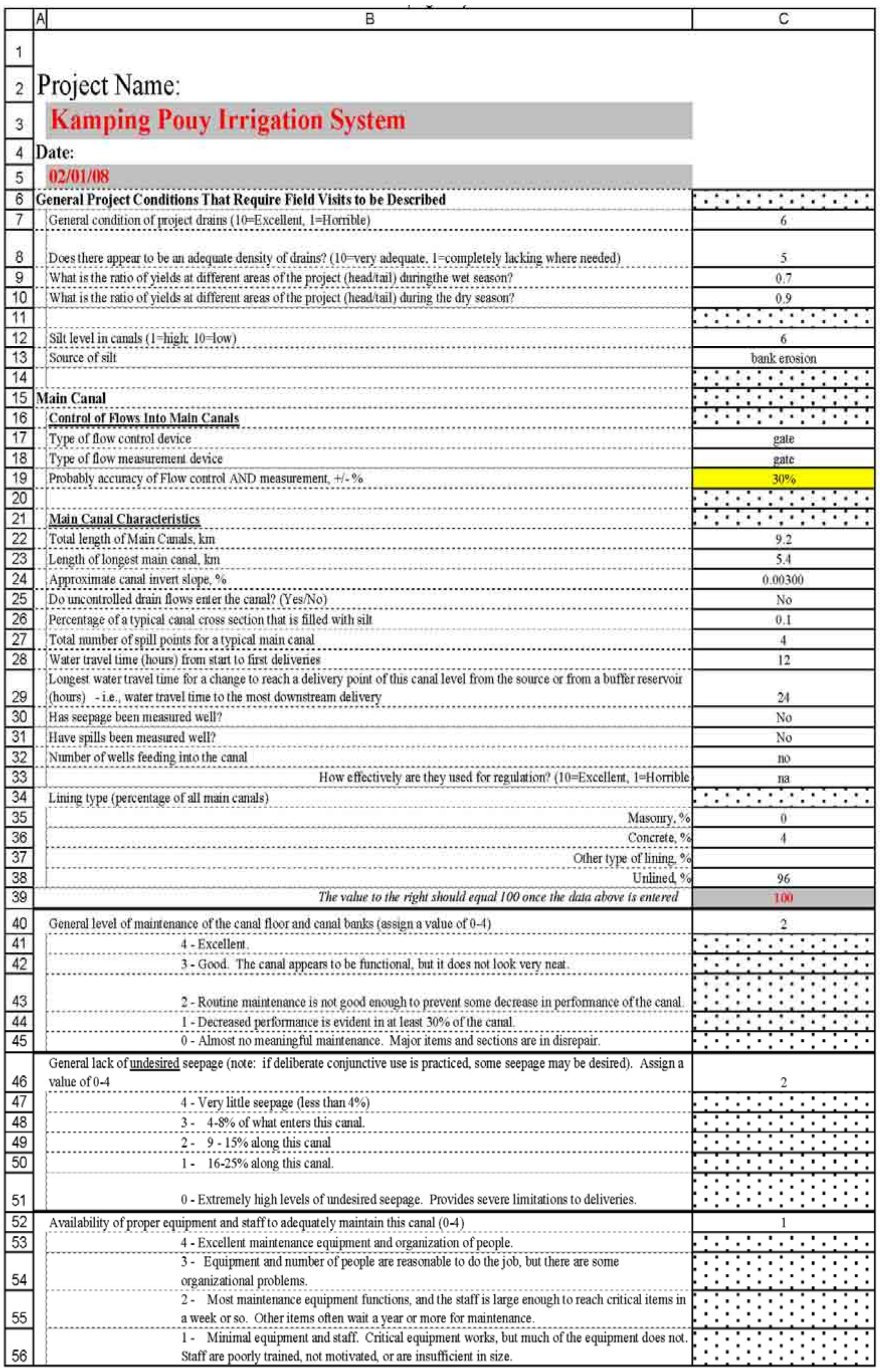
4	**Date:**		
5		**02/01/08**	
108		1 - Although some enabling laws have been written by the government, it is up to the WUA to enforce those laws. There is no help with enforcement from outside the WUA.	
109		0 - There are no enabling laws, and no outside assistance with enforcement. Everything depends on the WUA.	
110		Legal basis for the WUAs (Note: If there are no WUAs in the project, the answer is "0".)	2
111		4 - WUAs are recognized and formed under law. They have legal powers to tax, hold money, dismiss employees, condemn land, and own structures. The law is real and the enabling legislation is upheld in courts.	
112		3 - The WUAs are recognized by law. There is good judicial backup. However, the powers are limited. The government still holds most of the power that could belong to the WUA.	
113		2 - The WUAs are recognized by law. Many rules have been laid out in enabling legislation. Supposedly, the WUA has power, but in reality there is no support from either the judicial or executive systems to support it.	
114		1 - Although the government has the WUAs "on the books", in reality there are few if any true powers related to water. The WUAs were formed mainly to the bidding of the government, such as collecting fees.	
115		0 - WUAs are not even on the state or federal government books.	
116		Financial strength of WUAS (Note: If there are no WUAs in the project, the answer is "0".)	1
117		4 - Completely and sufficiently self-sustaining. They have the power to tax, charge for water, and obtain loans.	
118		3 - Completely and sufficiently financed, but much of the financing comes from the government in terms of maintenance, operation, grants, etc.	
119		2 - Underfinanced, but not badly. Conditions are poor but are maintained and replaced well enough to be functional. No modernization improvements are made.	
120		1 - Inadequate, but enough funds to replace and maintain key structures. Insufficient funds to do much of the basic maintenance needed..	
121		0 - Woefully inadequate. Only enough funds or in-kind services are available to do absolutely essential tasks. Funds are insufficient to maintain and replace essential equipment.	

8. Main Canal



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2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
6	**General Project Conditions That Require Field Visits to be Described**		
7		General condition of project drains (10=Excellent, 1=Horrible)	6
8		Does there appear to be an adequate density of drains? (10=very adequate, 1=completely lacking where needed)	5
9		What is the ratio of yields at different areas of the project (head/tail) duringthe wet season?	0.7
10		What is the ratio of yields at different areas of the project (head/tail) during the dry season?	0.9
11			
12		Silt level in canals (1=high; 10=low)	6
13		Source of silt	bank erosion
14			
15	**Main Canal**		
16		**Control of Flows Into Main Canals**	
17		Type of flow control device	gate
18		Type of flow measurement device	gate
19		Probably accuracy of Flow control AND measurement, +/- %	30%
20			
21		**Main Canal Characteristics**	
22		Total length of Main Canals, km	9.2
23		Length of longest main canal, km	5.4
24		Approximate canal invert slope, %	0.00300
25		Do uncontrolled drain flows enter the canal? (Yes/No)	No
26		Percentage of a typical canal cross section that is filled with silt	0.1
27		Total number of spill points for a typical main canal	4
28		Water travel time (hours) from start to first deliveries	12
29		Longest water travel time for a change to reach a delivery point of this canal level from the source or from a buffer reservoir (hours) - i.e., water travel time to the most downstream delivery	24
30		Has seepage been measured well?	No
31		Have spills been measured well?	No
32		Number of wells feeding into the canal	no
33		How effectively are they used for regulation? (10=Excellent, 1=Horrible	na
34		Lining type (percentage of all main canals)	
35		Masonry, %	0
36		Concrete, %	4
37		Other type of lining, %	
38		Unlined, %	96
39		*The value to the right should equal 100 once the data above is entered*	100
40		General level of maintenance of the canal floor and canal banks (assign a value of 0-4)	2
41		4 - Excellent.	
42		3 - Good. The canal appears to be functional, but it does not look very neat.	
43		2 - Routine maintenance is not good enough to prevent some decrease in performance of the canal.	
44		1 - Decreased performance is evident in at least 30% of the canal.	
45		0 - Almost no meaningful maintenance. Major items and sections are in disrepair.	
46		General lack of undesired seepage (note: if deliberate conjunctive use is practiced, some seepage may be desired). Assign a value of 0-4	2
47		4 - Very little seepage (less than 4%)	
48		3 - 4-8% of what enters this canal.	
49		2 - 9 - 15% along this canal	
50		1 - 16-25% along this canal.	
51		0 - Extremely high levels of undesired seepage. Provides severe limitations to deliveries.	
52		Availability of proper equipment and staff to adequately maintain this canal (0-4)	1
53		4 - Excellent maintenance equipment and organization of people.	
54		3 - Equipment and number of people are reasonable to do the job, but there are some organizational problems.	
55		2 - Most maintenance equipment functions, and the staff is large enough to reach critical items in a week or so. Other items often wait a year or more for maintenance.	
56		1 - Minimal equipment and staff. Critical equipment works, but much of the equipment does not. Staff are poorly trained, not motivated, or are insufficient in size.	

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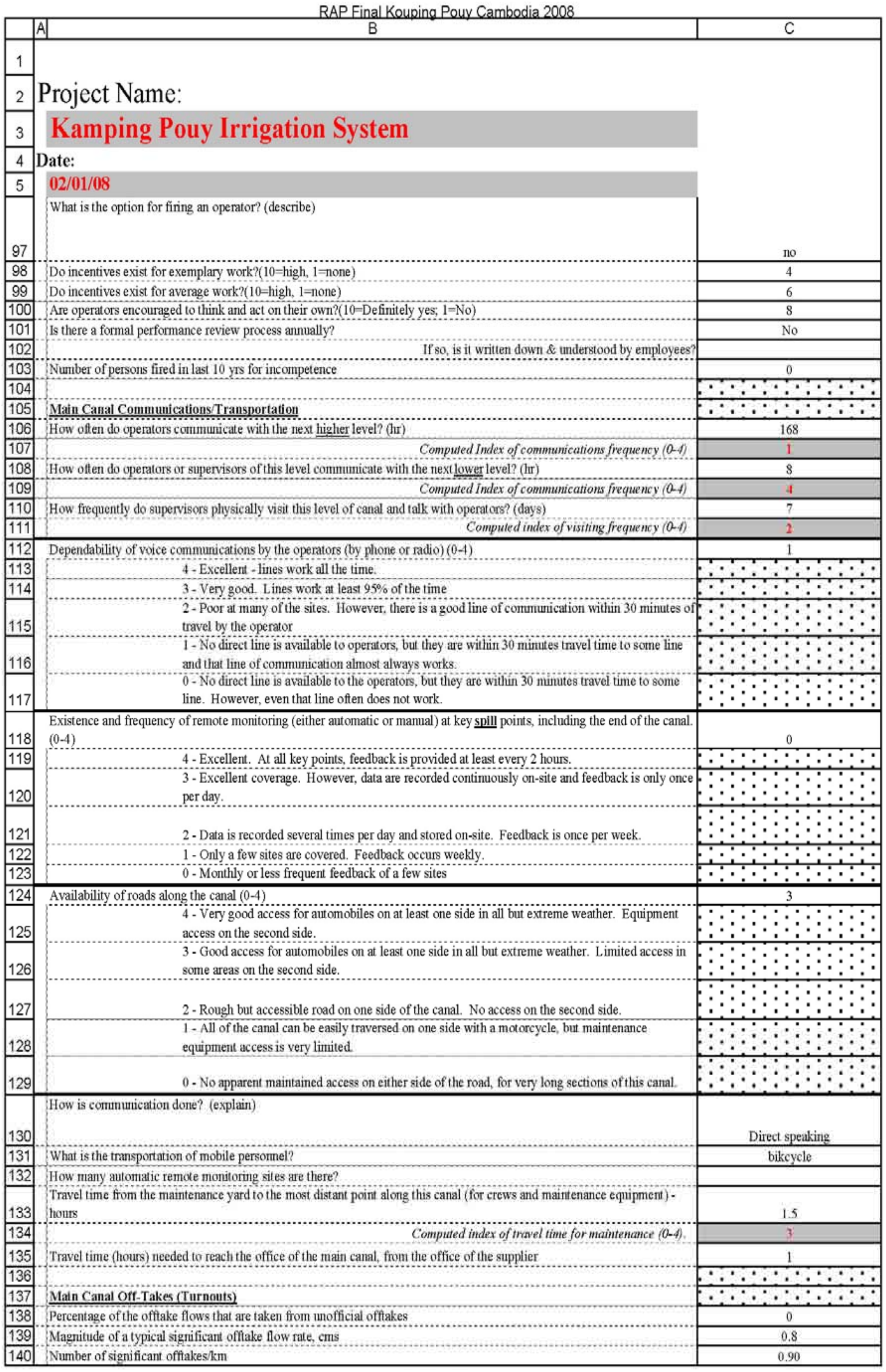
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
57		0 - Almost no adequate and working maintenance equipment is available, nor is there good mobilization of people.	
58			
59		**Main Canal Cross Regulators**	
60		Condition of cross regulators (10=Excellent, 1=Horrible)	7
61		Type of cross regulator (describe)	gate
62		Do operators live at each cross regulator site? (Yes/No)	No
63		Can the ones that exist operate as needed? (10=Excellent, 1=Horrible)	7
64		Are they operated as theoretically intended?(10=Excellent, 1=Horrible)	2
65		Number of cross regulators/km	0.5
66		Are there large overflows at cross regulator sides?	yes
67		Unintended weekly maximum controlled water surface variation in an average gate, cm	20
68		In months with water, what is the maximum number of days of no gate change?	7
69		What is the maximum time required for an operator to reach a regulator, hours?	24
70		How frequently (hrs) will an operator move a gate if required or instructed?	48
71		How frequently (days) are gates typically operated?	5
72		Officially, can the gate operator make gate adjustments without upper approval?	no
73		In reality, do gate operators make adjustments without upper approval?	yes
74		If the operators make their own decisions, how good are their decisions (10=Excellent, 1=Horrible)	7
75		Minutes required for an operator to make a significant setting change on the gate	10
76			
77		**Internal Indicators for Main Canal Cross Regulator Hardware**	
78		Ease of cross regulator operation under the current target operation. This does not mean that the current targets are being met. Rather, this rating indicates how easy or difficult it would be to move the cross regulators to meet the targets. Assign a value of 0-4 based on the descriptions below	3
79		4 - Very easy to operate. Hardware moves easily and quickly, or hardware has automatic features that work well. Water levels or flows could be controlled easily if desired. Current targets can be met with less than 2 manual changes per day.	
80		3 - Easy and quick to physically operate, but requires many manual interventions per structure per day to meet target.	
81		2 - Cumbersome to operate, but physically possible. Requires more than 5 manual changes per structure per day to meet target, but is difficult or dangerous to operate.	
82		1 - Cumbersome, difficult, or dangerous to operate. In some cases it is almost physically impossible to meet objectives.	
83		0 - Communications and hardware are very inadequate to meet the requirements. Almost impossible to operate as intended.	
84		Level of maintenance of the cross regulators. (0-4)	2
85		4 - Excellent preventative maintenance. Broken items are typically fixed within a few days, except in very unusual circumstances.	
86		3 - Decent preventative maintenance. Broken items are fixed within 2 weeks. Reasonable equipment is available for maintenance operations.	
87		2 - Routine maintenance is only done on critical items. Broken items are noticeable throughout the project, but not serious.	
88		1 - Even routine maintenance is lacking in many cases. Many broken items are noticeable, sometimes on important structures.	
89		0 - Large-scale damage has occurred due to deferred maintenance. Little or no maintenance equipment is in working order.	
90		*Maximum unintended weekly fluctuation of target water levels in the canal, expressed as a percentage of the average water level drop across a turnout. For example, if the water level in the canal varies by 40 cm (highest to lowest level at a point), and the average change in water level across a turnout is 50 cm, the percentage variation is 90%. This is calculated automatically from the other data.*	**50**
91		*Computed index regarding water level fluctuation (0-4)*	**1**
92		*Computed index regarding the travel time of a flow rate change throughout this canal level (0-4)*	**2**
93			
94		**Main Canal Cross Regulator Personnel**	
95		For whom do the operators work?	FWUC
96		Typical education level of operator (years of school)	6



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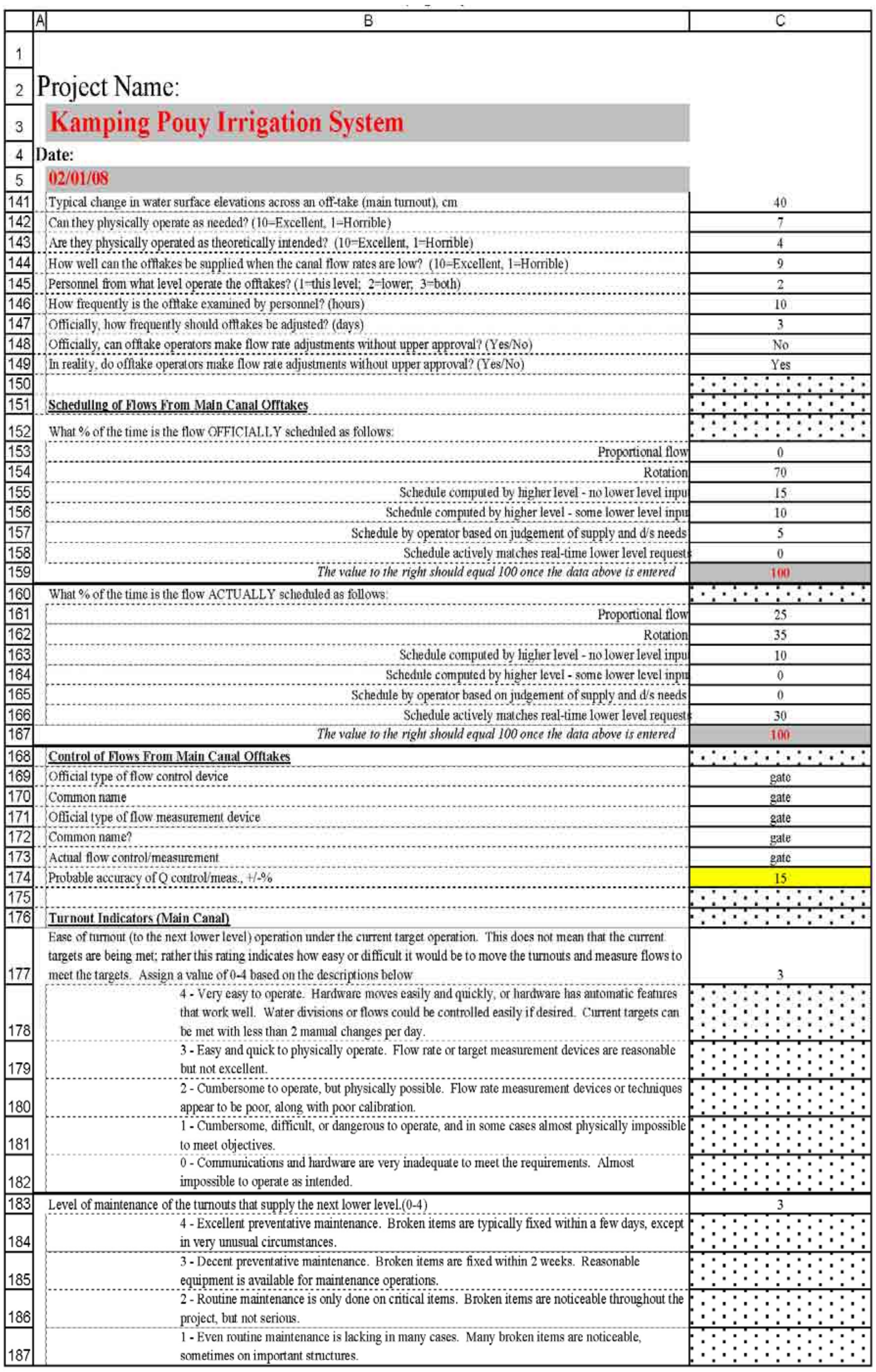
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
97		What is the option for firing an operator? (describe)	no
98		Do incentives exist for exemplary work?(10=high, 1=none)	4
99		Do incentives exist for average work?(10=high, 1=none)	6
100		Are operators encouraged to think and act on their own?(10=Definitely yes; 1=No)	8
101		Is there a formal performance review process annually?	No
102		If so, is it written down & understood by employees?	
103		Number of persons fired in last 10 yrs for incompetence	0
104			
105		**Main Canal Communications/Transportation**	
106		How often do operators communicate with the next higher level? (hr)	168
107		*Computed Index of communications frequency (0-4)*	1
108		How often do operators or supervisors of this level communicate with the next lower level? (hr)	8
109		*Computed Index of communications frequency (0-4)*	4
110		How frequently do supervisors physically visit this level of canal and talk with operators? (days)	7
111		*Computed index of visiting frequency (0-4)*	2
112		Dependability of voice communications by the operators (by phone or radio) (0-4)	1
113		4 - Excellent - lines work all the time.	
114		3 - Very good. Lines work at least 95% of the time	
115		2 - Poor at many of the sites. However, there is a good line of communication within 30 minutes of travel by the operator	
116		1 - No direct line is available to operators, but they are within 30 minutes travel time to some line and that line of communication almost always works.	
117		0 - No direct line is available to the operators, but they are within 30 minutes travel time to some line. However, even that line often does not work.	
118		Existence and frequency of remote monitoring (either automatic or manual) at key **spill** points, including the end of the canal. (0-4)	0
119		4 - Excellent. At all key points, feedback is provided at least every 2 hours.	
120		3 - Excellent coverage. However, data are recorded continuously on-site and feedback is only once per day.	
121		2 - Data is recorded several times per day and stored on-site. Feedback is once per week.	
122		1 - Only a few sites are covered. Feedback occurs weekly.	
123		0 - Monthly or less frequent feedback of a few sites	
124		Availability of roads along the canal (0-4)	3
125		4 - Very good access for automobiles on at least one side in all but extreme weather. Equipment access on the second side.	
126		3 - Good access for automobiles on at least one side in all but extreme weather. Limited access in some areas on the second side.	
127		2 - Rough but accessible road on one side of the canal. No access on the second side.	
128		1 - All of the canal can be easily traversed on one side with a motorcycle, but maintenance equipment access is very limited.	
129		0 - No apparent maintained access on either side of the road, for very long sections of this canal.	
130		How is communication done? (explain)	Direct speaking
131		What is the transportation of mobile personnel?	bikcycle
132		How many automatic remote monitoring sites are there?	
133		Travel time from the maintenance yard to the most distant point along this canal (for crews and maintenance equipment) - hours	1.5
134		*Computed index of travel time for maintenance (0-4).*	3
135		Travel time (hours) needed to reach the office of the main canal, from the office of the supplier	1
136			
137		**Main Canal Off-Takes (Turnouts)**	
138		Percentage of the offtake flows that are taken from unofficial offtakes	0
139		Magnitude of a typical significant offtake flow rate, cms	0.8
140		Number of significant offtakes/km	0.90



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4	**Date:**		
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141		Typical change in water surface elevations across an off-take (main turnout), cm	40
142		Can they physically operate as needed? (10=Excellent, 1=Horrible)	7
143		Are they physically operated as theoretically intended? (10=Excellent, 1=Horrible)	4
144		How well can the offtakes be supplied when the canal flow rates are low? (10=Excellent, 1=Horrible)	9
145		Personnel from what level operate the offtakes? (1=this level; 2=lower; 3=both)	2
146		How frequently is the offtake examined by personnel? (hours)	10
147		Officially, how frequently should offtakes be adjusted? (days)	3
148		Officially, can offtake operators make flow rate adjustments without upper approval? (Yes/No)	No
149		In reality, do offtake operators make flow rate adjustments without upper approval? (Yes/No)	Yes
150			
151		**Scheduling of Flows From Main Canal Offtakes**	
152		What % of the time is the flow OFFICIALLY scheduled as follows:	
153		Proportional flow	0
154		Rotation	70
155		Schedule computed by higher level - no lower level inpu	15
156		Schedule computed by higher level - some lower level inpu	10
157		Schedule by operator based on judgement of supply and d/s needs	5
158		Schedule actively matches real-time lower level request	0
159		*The value to the right should equal 100 once the data above is entered*	100
160		What % of the time is the flow ACTUALLY scheduled as follows:	
161		Proportional flow	25
162		Rotation	35
163		Schedule computed by higher level - no lower level inpu	10
164		Schedule computed by higher level - some lower level inpu	0
165		Schedule by operator based on judgement of supply and d/s needs	0
166		Schedule actively matches real-time lower level request	30
167		*The value to the right should equal 100 once the data above is entered*	100
168		**Control of Flows From Main Canal Offtakes**	
169		Official type of flow control device	gate
170		Common name	gate
171		Official type of flow measurement device	gate
172		Common name?	gate
173		Actual flow control/measurement	gate
174		Probable accuracy of Q control/meas., +/-%	15
175			
176		**Turnout Indicators (Main Canal)**	
177		Ease of turnout (to the next lower level) operation under the current target operation. This does not mean that the current targets are being met; rather this rating indicates how easy or difficult it would be to move the turnouts and measure flows to meet the targets. Assign a value of 0-4 based on the descriptions below	3
178		4 - Very easy to operate. Hardware moves easily and quickly, or hardware has automatic features that work well. Water divisions or flows could be controlled easily if desired. Current targets can be met with less than 2 manual changes per day.	
179		3 - Easy and quick to physically operate. Flow rate or target measurement devices are reasonable but not excellent.	
180		2 - Cumbersome to operate, but physically possible. Flow rate measurement devices or techniques appear to be poor, along with poor calibration.	
181		1 - Cumbersome, difficult, or dangerous to operate, and in some cases almost physically impossible to meet objectives.	
182		0 - Communications and hardware are very inadequate to meet the requirements. Almost impossible to operate as intended.	
183		Level of maintenance of the turnouts that supply the next lower level.(0-4)	3
184		4 - Excellent preventative maintenance. Broken items are typically fixed within a few days, except in very unusual circumstances.	
185		3 - Decent preventative maintenance. Broken items are fixed within 2 weeks. Reasonable equipment is available for maintenance operations.	
186		2 - Routine maintenance is only done on critical items. Broken items are noticeable throughout the project, but not serious.	
187		1 - Even routine maintenance is lacking in many cases. Many broken items are noticeable, sometimes on important structures.	

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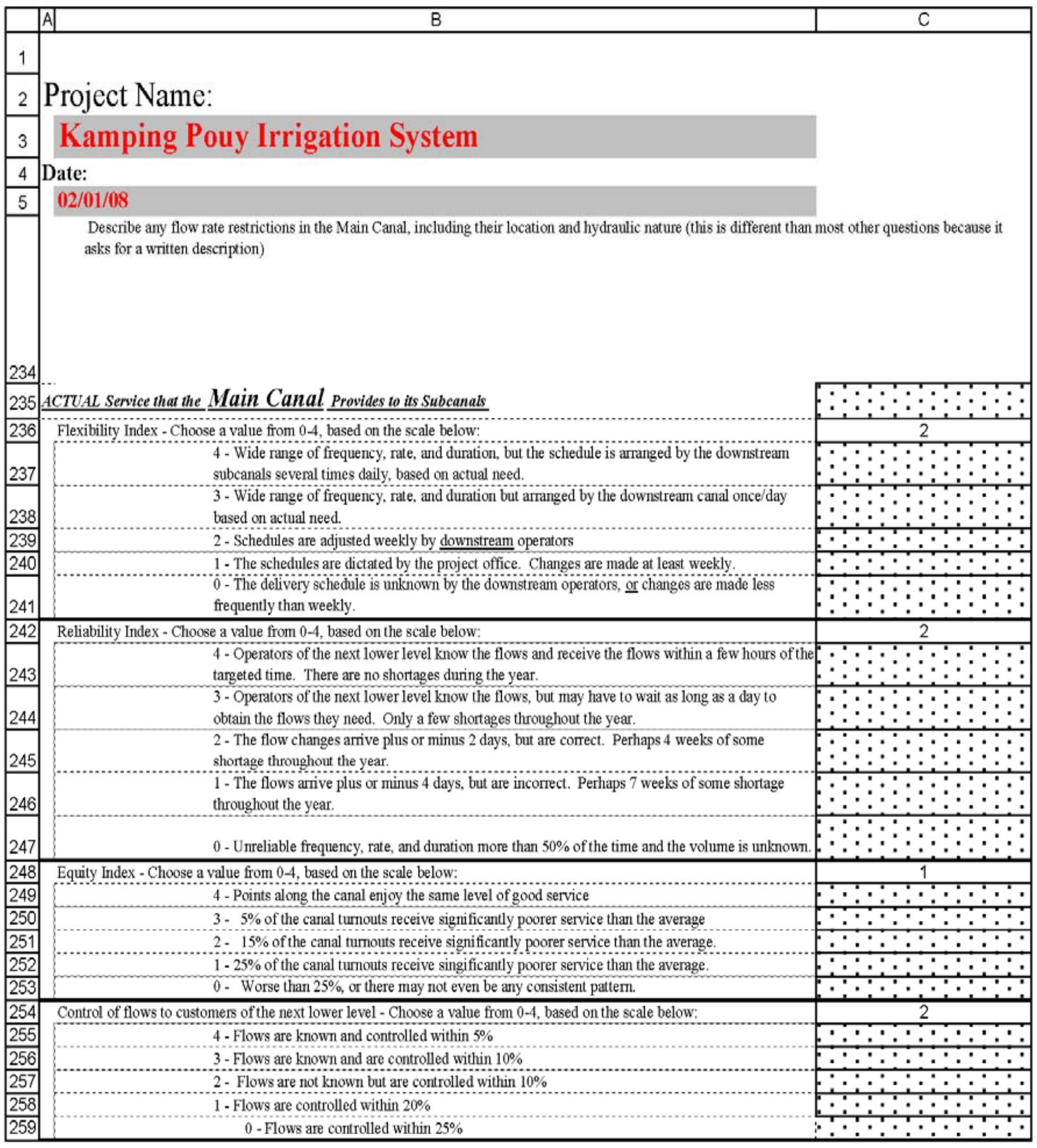
188		0 - Large-scale damage has occurred due to deferred maintenance. Little or no maintenance equipment is in working order.	
189		Flow rate capacities of the main canal turnouts (to the next lower level) (0-4)	2
190		4 - No problems passing the maximum desired flow rates.	
191		2 - Minor problems	
192		0 - Serious problems - many structures are under-designed.	
193			
194		**Regulating Reservoir Indicators (Main Canal)**	
195		Suitability of the number of location(s) (0-4)	0
196		4 - Properly located and of sufficient quantity.	
197		2 - There is 1 regulating reservoir but more are needed or the location is wrong.	
198		0 - None.	
199		Effectiveness of operation (0-4)	0
200		4 - Excellent.	
201		2 - They are used, but well below their potential.	
202		0 - There are none, they are not used, or are used incorrectly.	
203		Suitability of the storage/buffer capacities (0-4)	0
204		4 - Excellent.	
205		2 - Helpful, but not large enough.	
206		0 - There are none, or they are so small that they give almost no benefit.	
207		Maintenance (0-4)	0
208		4 - Excellent.	
209		2 - Not too good.	
210		0 - None, or very bad siltation and weed growth so that the effectiveness is reduced.	
211		**Operation (Main Canal)**	
212		How frequently does the headworks respond to realistic real time feedback from the operators/observers of this canal level? This question deals with a mismatch of orders, and problems associated with wedge storage variations and wave travel times. Assign a value of 0-4 based on the descriptions below	1.3
213		4 - If there is an excess or deficit (spill or deficit at the tail ends), the headworks responds within 12 hours.	
214		2.7 - Headworks responds to real-time feedback observations within 24 hours	
215		1.3 - Headworks responds within 3 days.	
216		0 - Headworks responds in a time of greater than 3 days.	
217		Existence and effectiveness of water ordering/delivery procedures to match actual demands. This is different than the previous question, because the previous question dealt with problems that occur AFTER a change has been made.	2.7
218		4 - Excellent. Information passes from the lower level to this level in a timely and reliable manner, and the system then responds.	
219		2.7 -Good. Reliable procedure. Updated at least once every 2 days, and the system responds.	
220		1.3 - The schedule is updated at least weekly with meaningful data. Changes are actually made based on downstream requirements.	
221		0 - Perhaps the schedule is updated weekly, but with data that is not very meaningful. Corresponding changes may not actually be made.	
222		Clarity and correctness of instructions to operators.	2.7
223		4 - Instructions are very clear and very correct.	
224		2.7 - Instructions are clear, but lacking in sufficient detail.	
225		1.3 - Instructions are unclear, but are generally correct.	
226		0 - Instructions are incorrect, whether they are clear or not.	
227		How frequently is the whole length of this canal checked for problems and reported to the office? This means one or more persons physically drive all the sections of the canal.	2.7
228		4 - Once/day	
229		2.7 - Once/2 days	
230		1.3 - Once per week	
231		0 - Once per month or less often	
232			
233		**Capacity "bottlenecks" in the Main Canal**	



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1			
2	Project Name:		
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4	**Date:**		
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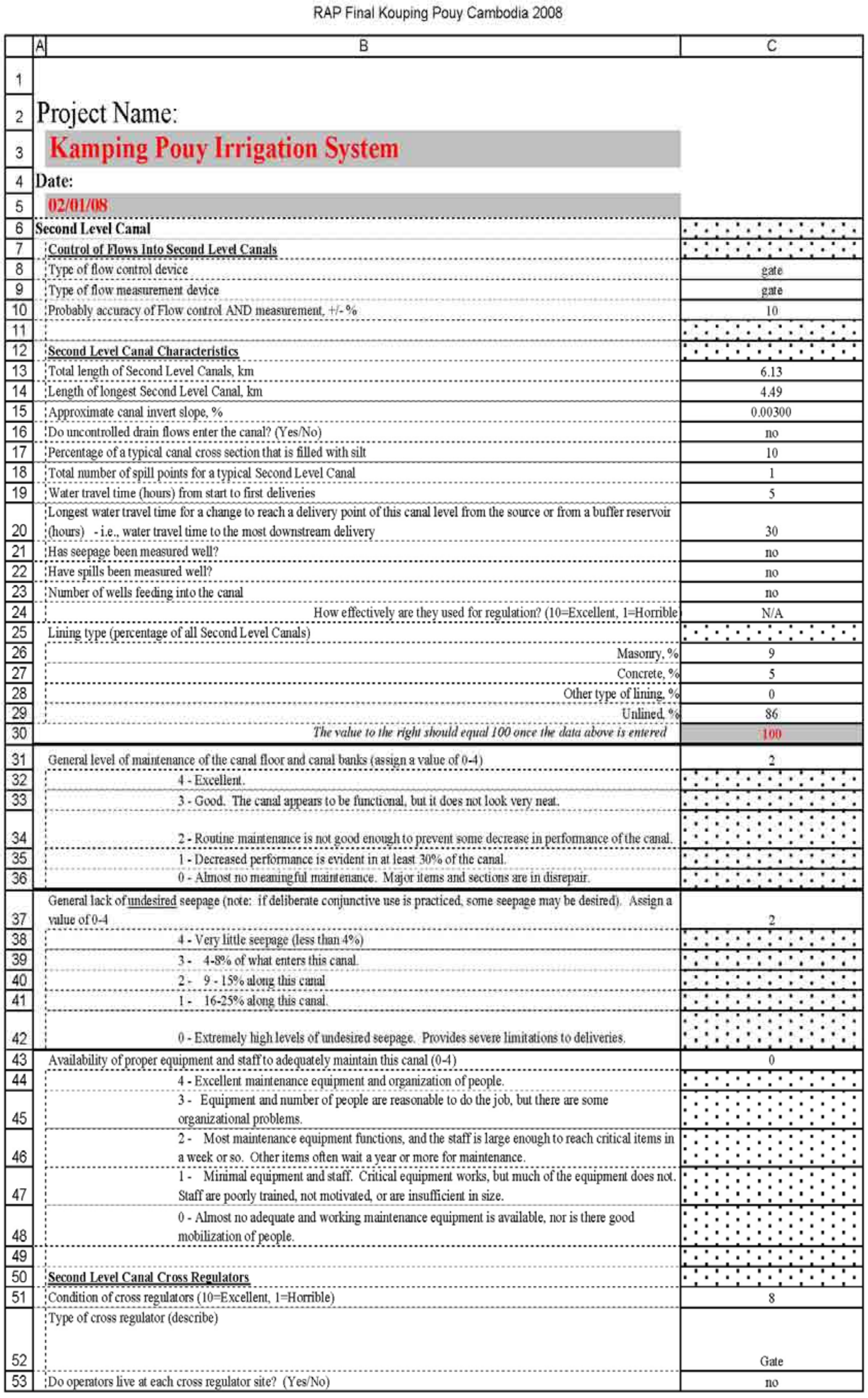
234		Describe any flow rate restrictions in the Main Canal, including their location and hydraulic nature (this is different than most other questions because it asks for a written description)	
235	***ACTUAL Service that the Main Canal Provides to its Subcanals***		
236		Flexibility Index - Choose a value from 0-4, based on the scale below:	2
237		4 - Wide range of frequency, rate, and duration, but the schedule is arranged by the downstream subcanals several times daily, based on actual need.	
238		3 - Wide range of frequency, rate, and duration but arranged by the downstream canal once/day based on actual need.	
239		2 - Schedules are adjusted weekly by downstream operators	
240		1 - The schedules are dictated by the project office. Changes are made at least weekly.	
241		0 - The delivery schedule is unknown by the downstream operators, or changes are made less frequently than weekly.	
242		Reliability Index - Choose a value from 0-4, based on the scale below:	2
243		4 - Operators of the next lower level know the flows and receive the flows within a few hours of the targeted time. There are no shortages during the year.	
244		3 - Operators of the next lower level know the flows, but may have to wait as long as a day to obtain the flows they need. Only a few shortages throughout the year.	
245		2 - The flow changes arrive plus or minus 2 days, but are correct. Perhaps 4 weeks of some shortage throughout the year.	
246		1 - The flows arrive plus or minus 4 days, but are incorrect. Perhaps 7 weeks of some shortage throughout the year.	
247		0 - Unreliable frequency, rate, and duration more than 50% of the time and the volume is unknown.	
248		Equity Index - Choose a value from 0-4, based on the scale below:	1
249		4 - Points along the canal enjoy the same level of good service	
250		3 - 5% of the canal turnouts receive significantly poorer service than the average	
251		2 - 15% of the canal turnouts receive significantly poorer service than the average.	
252		1 - 25% of the canal turnouts receive singificantly poorer service than the average.	
253		0 - Worse than 25%, or there may not even be any consistent pattern.	
254		Control of flows to customers of the next lower level - Choose a value from 0-4, based on the scale below:	2
255		4 - Flows are known and controlled within 5%	
256		3 - Flows are known and are controlled within 10%	
257		2 - Flows are not known but are controlled within 10%	
258		1 - Flows are controlled within 20%	
259		0 - Flows are controlled within 25%	

9.Second Level Canals



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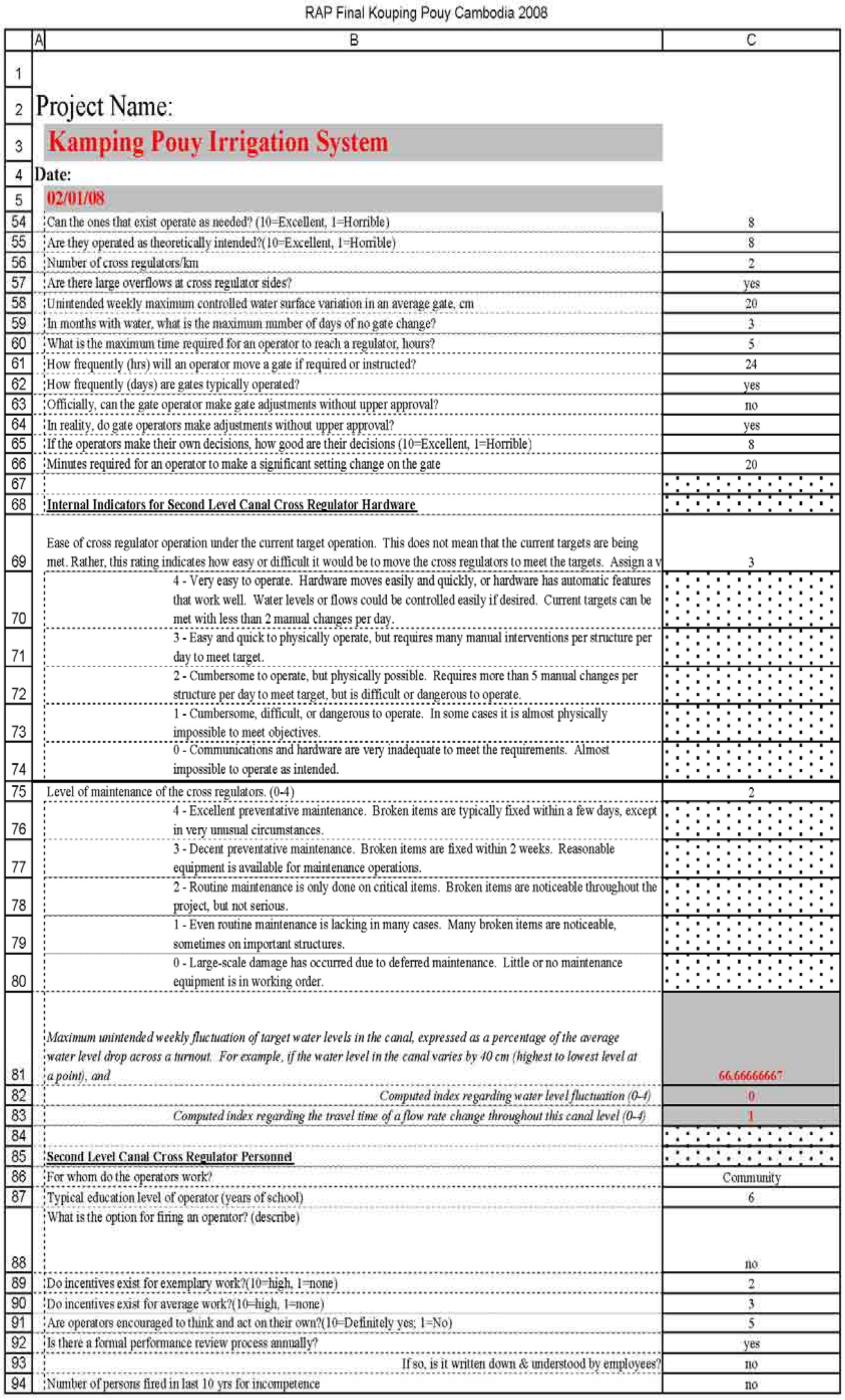
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
6	**Second Level Canal**		
7		**Control of Flows Into Second Level Canals**	
8		Type of flow control device	gate
9		Type of flow measurement device	gate
10		Probably accuracy of Flow control AND measurement, +/- %	10
11			
12		**Second Level Canal Characteristics**	
13		Total length of Second Level Canals, km	6.13
14		Length of longest Second Level Canal, km	4.49
15		Approximate canal invert slope, %	0.00300
16		Do uncontrolled drain flows enter the canal? (Yes/No)	no
17		Percentage of a typical canal cross section that is filled with silt	10
18		Total number of spill points for a typical Second Level Canal	1
19		Water travel time (hours) from start to first deliveries	5
20		Longest water travel time for a change to reach a delivery point of this canal level from the source or from a buffer reservoir (hours) - i.e., water travel time to the most downstream delivery	30
21		Has seepage been measured well?	no
22		Have spills been measured well?	no
23		Number of wells feeding into the canal	no
24		How effectively are they used for regulation? (10=Excellent, 1=Horrible	N/A
25		Lining type (percentage of all Second Level Canals)	
26		Masonry, %	9
27		Concrete, %	5
28		Other type of lining, %	0
29		Unlined, %	86
30		*The value to the right should equal 100 once the data above is entered*	100
31		General level of maintenance of the canal floor and canal banks (assign a value of 0-4)	2
32		4 - Excellent.	
33		3 - Good. The canal appears to be functional, but it does not look very neat.	
34		2 - Routine maintenance is not good enough to prevent some decrease in performance of the canal.	
35		1 - Decreased performance is evident in at least 30% of the canal.	
36		0 - Almost no meaningful maintenance. Major items and sections are in disrepair.	
37		General lack of undesired seepage (note: if deliberate conjunctive use is practiced, some seepage may be desired). Assign a value of 0-4	2
38		4 - Very little seepage (less than 4%)	
39		3 - 4-8% of what enters this canal.	
40		2 - 9 - 15% along this canal	
41		1 - 16-25% along this canal.	
42		0 - Extremely high levels of undesired seepage. Provides severe limitations to deliveries.	
43		Availability of proper equipment and staff to adequately maintain this canal (0-4)	0
44		4 - Excellent maintenance equipment and organization of people.	
45		3 - Equipment and number of people are reasonable to do the job, but there are some organizational problems.	
46		2 - Most maintenance equipment functions, and the staff is large enough to reach critical items in a week or so. Other items often wait a year or more for maintenance.	
47		1 - Minimal equipment and staff. Critical equipment works, but much of the equipment does not. Staff are poorly trained, not motivated, or are insufficient in size.	
48		0 - Almost no adequate and working maintenance equipment is available, nor is there good mobilization of people.	
49			
50		**Second Level Canal Cross Regulators**	
51		Condition of cross regulators (10=Excellent, 1=Horrible)	8
52		Type of cross regulator (describe)	Gate
53		Do operators live at each cross regulator site? (Yes/No)	no



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1			
2	Project Name:		
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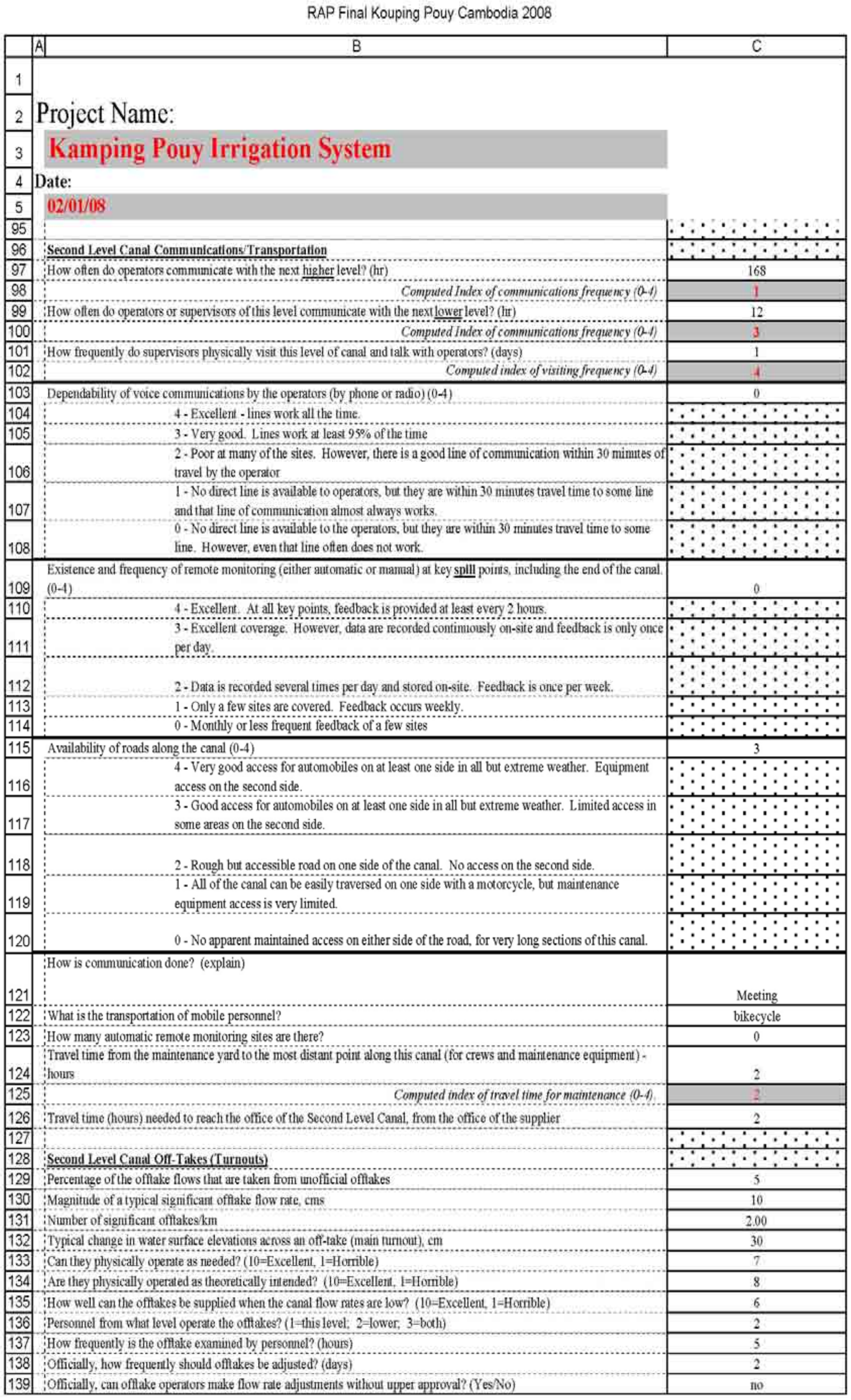
54		Can the ones that exist operate as needed? (10=Excellent, 1=Horrible)	8
55		Are they operated as theoretically intended?(10=Excellent, 1=Horrible)	8
56		Number of cross regulators/km	2
57		Are there large overflows at cross regulator sides?	yes
58		Unintended weekly maximum controlled water surface variation in an average gate, cm	20
59		In months with water, what is the maximum number of days of no gate change?	3
60		What is the maximum time required for an operator to reach a regulator, hours?	5
61		How frequently (hrs) will an operator move a gate if required or instructed?	24
62		How frequently (days) are gates typically operated?	yes
63		Officially, can the gate operator make gate adjustments without upper approval?	no
64		In reality, do gate operators make adjustments without upper approval?	yes
65		If the operators make their own decisions, how good are their decisions (10=Excellent, 1=Horrible)	8
66		Minutes required for an operator to make a significant setting change on the gate	20
67			
68		**Internal Indicators for Second Level Canal Cross Regulator Hardware**	
69		Ease of cross regulator operation under the current target operation. This does not mean that the current targets are being met. Rather, this rating indicates how easy or difficult it would be to move the cross regulators to meet the targets. Assign a v	3
70		4 - Very easy to operate. Hardware moves easily and quickly, or hardware has automatic features that work well. Water levels or flows could be controlled easily if desired. Current targets can be met with less than 2 manual changes per day.	
71		3 - Easy and quick to physically operate, but requires many manual interventions per structure per day to meet target.	
72		2 - Cumbersome to operate, but physically possible. Requires more than 5 manual changes per structure per day to meet target, but is difficult or dangerous to operate.	
73		1 - Cumbersome, difficult, or dangerous to operate. In some cases it is almost physically impossible to meet objectives.	
74		0 - Communications and hardware are very inadequate to meet the requirements. Almost impossible to operate as intended.	
75		Level of maintenance of the cross regulators. (0-4)	2
76		4 - Excellent preventative maintenance. Broken items are typically fixed within a few days, except in very unusual circumstances.	
77		3 - Decent preventative maintenance. Broken items are fixed within 2 weeks. Reasonable equipment is available for maintenance operations.	
78		2 - Routine maintenance is only done on critical items. Broken items are noticeable throughout the project, but not serious.	
79		1 - Even routine maintenance is lacking in many cases. Many broken items are noticeable, sometimes on important structures.	
80		0 - Large-scale damage has occurred due to deferred maintenance. Little or no maintenance equipment is in working order.	
81		*Maximum unintended weekly fluctuation of target water levels in the canal, expressed as a percentage of the average water level drop across a turnout. For example, if the water level in the canal varies by 40 cm (highest to lowest level at a point), and*	66.66666667
82		*Computed index regarding water level fluctuation (0-4)*	0
83		*Computed index regarding the travel time of a flow rate change throughout this canal level (0-4)*	1
84			
85		**Second Level Canal Cross Regulator Personnel**	
86		For whom do the operators work?	Community
87		Typical education level of operator (years of school)	6
88		What is the option for firing an operator? (describe)	no
89		Do incentives exist for exemplary work?(10=high, 1=none)	2
90		Do incentives exist for average work?(10=high, 1=none)	3
91		Are operators encouraged to think and act on their own?(10=Definitely yes; 1=No)	5
92		Is there a formal performance review process annually?	yes
93		If so, is it written down & understood by employees?	no
94		Number of persons fired in last 10 yrs for incompetence	no



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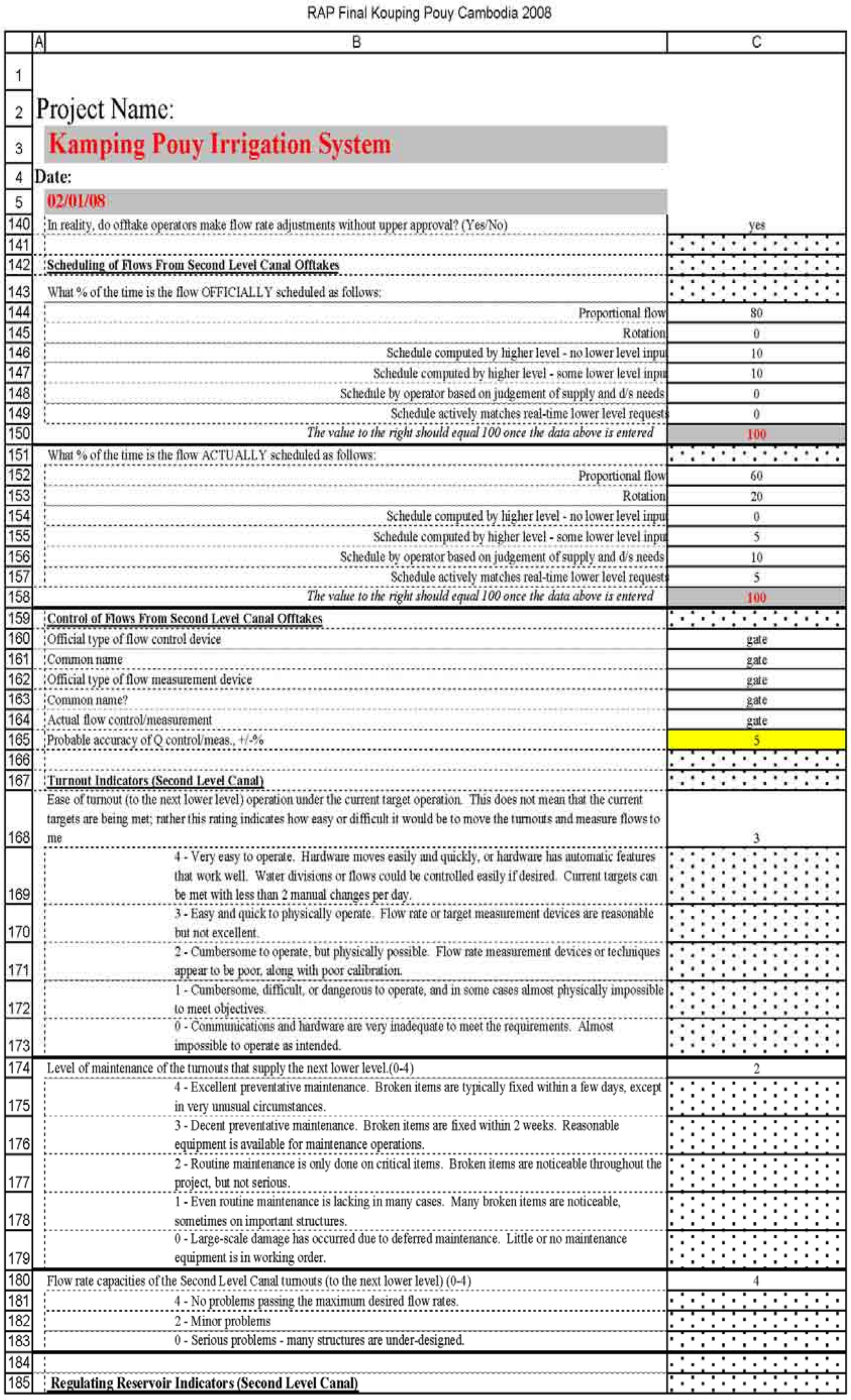
1			
2		Project Name:	
3		**Kamping Pouy Irrigation System**	
4		**Date:**	
5		**02/01/08**	
95			
96		**Second Level Canal Communications/Transportation**	
97		How often do operators communicate with the next higher level? (hr)	168
98		*Computed Index of communications frequency (0-4)*	1
99		How often do operators or supervisors of this level communicate with the next lower level? (hr)	12
100		*Computed Index of communications frequency (0-4)*	3
101		How frequently do supervisors physically visit this level of canal and talk with operators? (days)	1
102		*Computed index of visiting frequency (0-4)*	4
103		Dependability of voice communications by the operators (by phone or radio) (0-4)	0
104		4 - Excellent - lines work all the time.	
105		3 - Very good. Lines work at least 95% of the time	
106		2 - Poor at many of the sites. However, there is a good line of communication within 30 minutes of travel by the operator	
107		1 - No direct line is available to operators, but they are within 30 minutes travel time to some line and that line of communication almost always works.	
108		0 - No direct line is available to the operators, but they are within 30 minutes travel time to some line. However, even that line often does not work.	
109		Existence and frequency of remote monitoring (either automatic or manual) at key **spill** points, including the end of the canal. (0-4)	0
110		4 - Excellent. At all key points, feedback is provided at least every 2 hours.	
111		3 - Excellent coverage. However, data are recorded continuously on-site and feedback is only once per day.	
112		2 - Data is recorded several times per day and stored on-site. Feedback is once per week.	
113		1 - Only a few sites are covered. Feedback occurs weekly.	
114		0 - Monthly or less frequent feedback of a few sites	
115		Availability of roads along the canal (0-4)	3
116		4 - Very good access for automobiles on at least one side in all but extreme weather. Equipment access on the second side.	
117		3 - Good access for automobiles on at least one side in all but extreme weather. Limited access in some areas on the second side.	
118		2 - Rough but accessible road on one side of the canal. No access on the second side.	
119		1 - All of the canal can be easily traversed on one side with a motorcycle, but maintenance equipment access is very limited.	
120		0 - No apparent maintained access on either side of the road, for very long sections of this canal.	
121		How is communication done? (explain)	Meeting
122		What is the transportation of mobile personnel?	bikecycle
123		How many automatic remote monitoring sites are there?	0
124		Travel time from the maintenance yard to the most distant point along this canal (for crews and maintenance equipment) - hours	2
125		*Computed index of travel time for maintenance (0-4)*	2
126		Travel time (hours) needed to reach the office of the Second Level Canal, from the office of the supplier	2
127			
128		**Second Level Canal Off-Takes (Turnouts)**	
129		Percentage of the offtake flows that are taken from unofficial offtakes	5
130		Magnitude of a typical significant offtake flow rate, cms	10
131		Number of significant offtakes/km	2.00
132		Typical change in water surface elevations across an off-take (main turnout), cm	30
133		Can they physically operate as needed? (10=Excellent, 1=Horrible)	7
134		Are they physically operated as theoretically intended? (10=Excellent, 1=Horrible)	8
135		How well can the offtakes be supplied when the canal flow rates are low? (10=Excellent, 1=Horrible)	6
136		Personnel from what level operate the offtakes? (1=this level; 2=lower; 3=both)	2
137		How frequently is the offtake examined by personnel? (hours)	5
138		Officially, how frequently should offtakes be adjusted? (days)	2
139		Officially, can offtake operators make flow rate adjustments without upper approval? (Yes/No)	no



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1			
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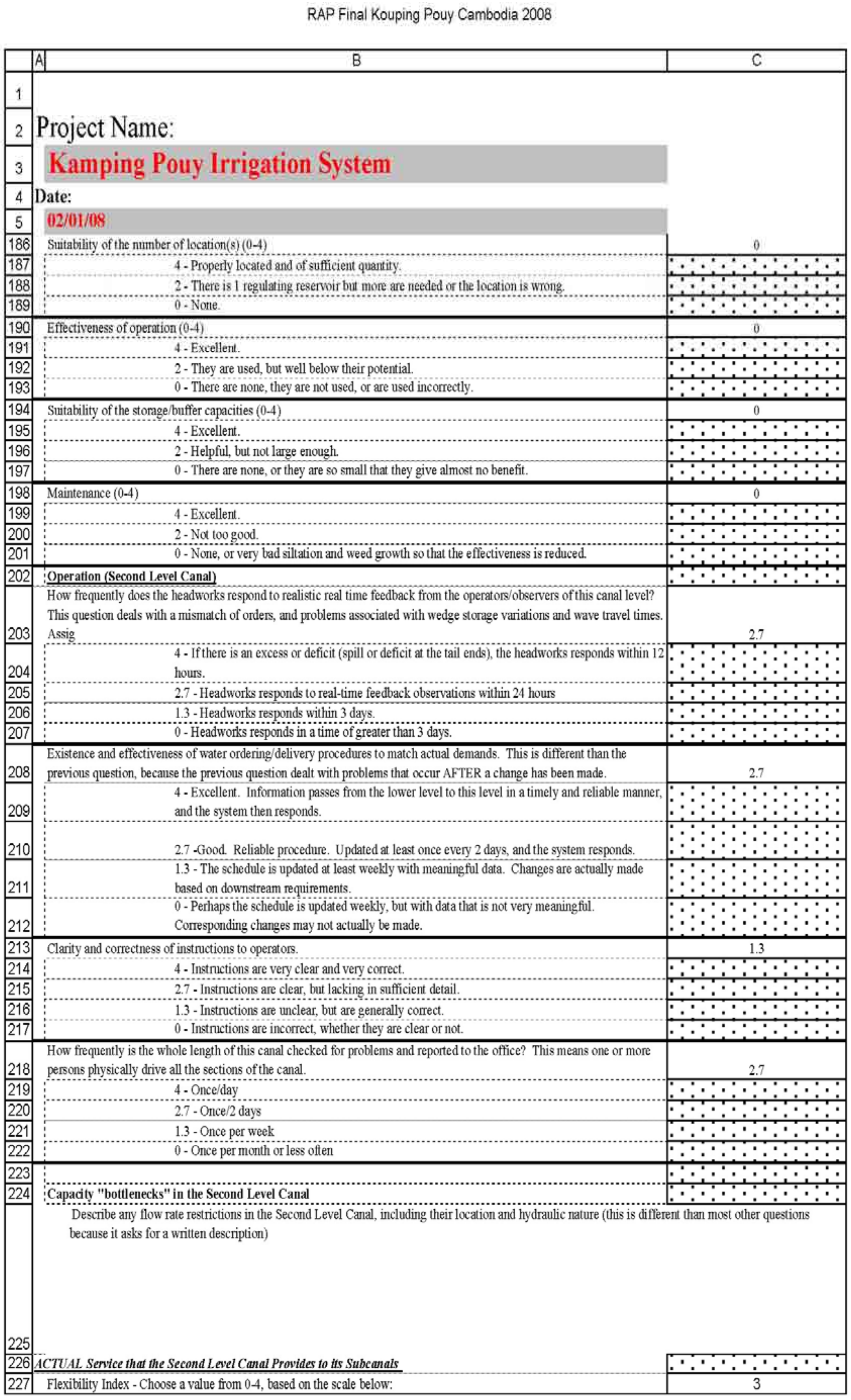
140		In reality, do offtake operators make flow rate adjustments without upper approval? (Yes/No)	yes
141			
142		**Scheduling of Flows From Second Level Canal Offtakes**	
143		What % of the time is the flow OFFICIALLY scheduled as follows:	
144		Proportional flow	80
145		Rotation	0
146		Schedule computed by higher level - no lower level inpu	10
147		Schedule computed by higher level - some lower level inpu	10
148		Schedule by operator based on judgement of supply and d/s needs	0
149		Schedule actively matches real-time lower level request	0
150		*The value to the right should equal 100 once the data above is entered*	**100**
151		What % of the time is the flow ACTUALLY scheduled as follows:	
152		Proportional flow	60
153		Rotation	20
154		Schedule computed by higher level - no lower level inpu	0
155		Schedule computed by higher level - some lower level inpu	5
156		Schedule by operator based on judgement of supply and d/s needs	10
157		Schedule actively matches real-time lower level request	5
158		*The value to the right should equal 100 once the data above is entered*	**100**
159		**Control of Flows From Second Level Canal Offtakes**	
160		Official type of flow control device	gate
161		Common name	gate
162		Official type of flow measurement device	gate
163		Common name?	gate
164		Actual flow control/measurement	gate
165		Probable accuracy of Q control/meas., +/-%	5
166			
167		**Turnout Indicators (Second Level Canal)**	
168		Ease of turnout (to the next lower level) operation under the current target operation. This does not mean that the current targets are being met; rather this rating indicates how easy or difficult it would be to move the turnouts and measure flows to me	3
169		4 - Very easy to operate. Hardware moves easily and quickly, or hardware has automatic features that work well. Water divisions or flows could be controlled easily if desired. Current targets can be met with less than 2 manual changes per day.	
170		3 - Easy and quick to physically operate. Flow rate or target measurement devices are reasonable but not excellent.	
171		2 - Cumbersome to operate, but physically possible. Flow rate measurement devices or techniques appear to be poor, along with poor calibration.	
172		1 - Cumbersome, difficult, or dangerous to operate, and in some cases almost physically impossible to meet objectives.	
173		0 - Communications and hardware are very inadequate to meet the requirements. Almost impossible to operate as intended.	
174		Level of maintenance of the turnouts that supply the next lower level.(0-4)	2
175		4 - Excellent preventative maintenance. Broken items are typically fixed within a few days, except in very unusual circumstances.	
176		3 - Decent preventative maintenance. Broken items are fixed within 2 weeks. Reasonable equipment is available for maintenance operations.	
177		2 - Routine maintenance is only done on critical items. Broken items are noticeable throughout the project, but not serious.	
178		1 - Even routine maintenance is lacking in many cases. Many broken items are noticeable, sometimes on important structures.	
179		0 - Large-scale damage has occurred due to deferred maintenance. Little or no maintenance equipment is in working order.	
180		Flow rate capacities of the Second Level Canal turnouts (to the next lower level) (0-4)	4
181		4 - No problems passing the maximum desired flow rates.	
182		2 - Minor problems	
183		0 - Serious problems - many structures are under-designed.	
184			
185		**Regulating Reservoir Indicators (Second Level Canal)**	



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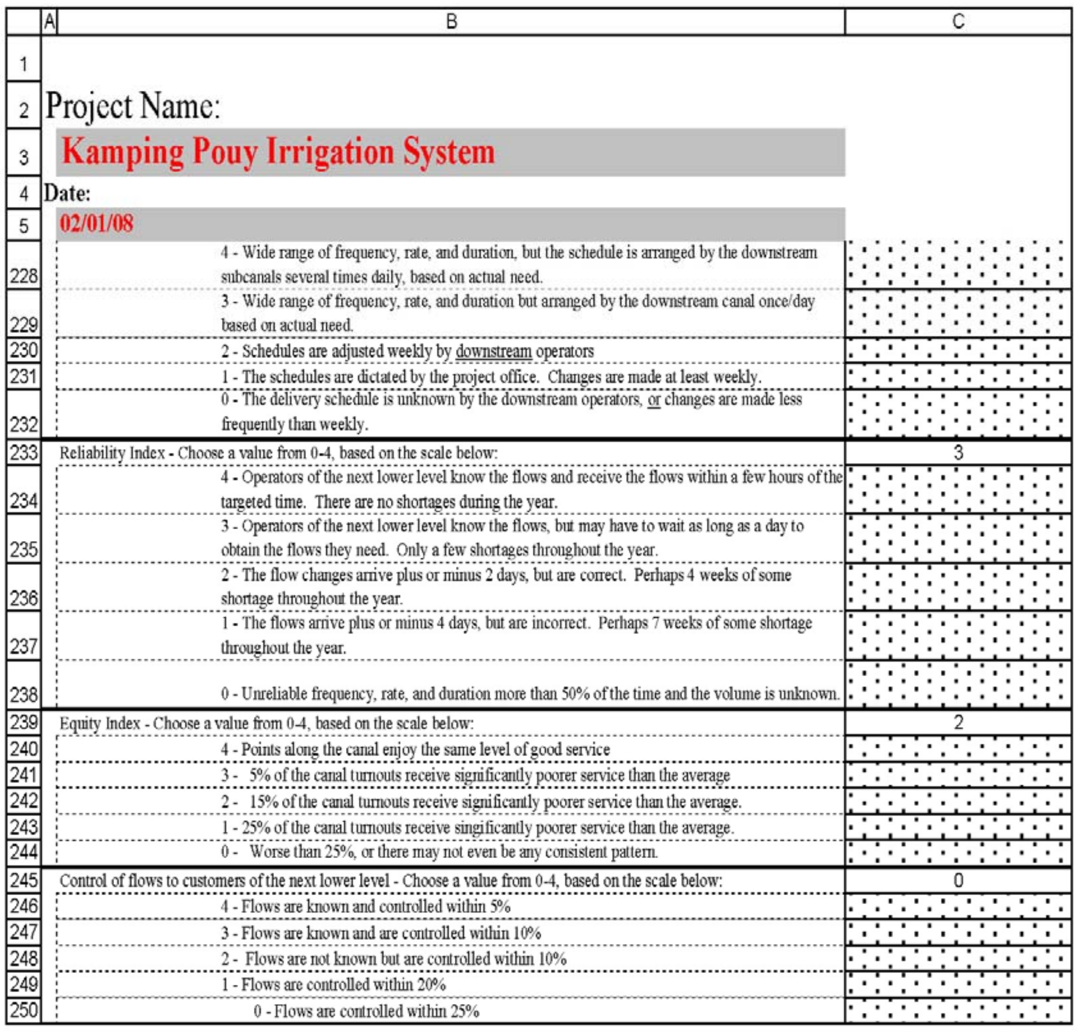
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
186		Suitability of the number of location(s) (0-4)	0
187		4 - Properly located and of sufficient quantity.	
188		2 - There is 1 regulating reservoir but more are needed or the location is wrong.	
189		0 - None.	
190		Effectiveness of operation (0-4)	0
191		4 - Excellent.	
192		2 - They are used, but well below their potential.	
193		0 - There are none, they are not used, or are used incorrectly.	
194		Suitability of the storage/buffer capacities (0-4)	0
195		4 - Excellent.	
196		2 - Helpful, but not large enough.	
197		0 - There are none, or they are so small that they give almost no benefit.	
198		Maintenance (0-4)	0
199		4 - Excellent.	
200		2 - Not too good.	
201		0 - None, or very bad siltation and weed growth so that the effectiveness is reduced.	
202		**Operation (Second Level Canal)**	
203		How frequently does the headworks respond to realistic real time feedback from the operators/observers of this canal level? This question deals with a mismatch of orders, and problems associated with wedge storage variations and wave travel times. Assig	2.7
204		4 - If there is an excess or deficit (spill or deficit at the tail ends), the headworks responds within 12 hours.	
205		2.7 - Headworks responds to real-time feedback observations within 24 hours	
206		1.3 - Headworks responds within 3 days.	
207		0 - Headworks responds in a time of greater than 3 days.	
208		Existence and effectiveness of water ordering/delivery procedures to match actual demands. This is different than the previous question, because the previous question dealt with problems that occur AFTER a change has been made.	2.7
209		4 - Excellent. Information passes from the lower level to this level in a timely and reliable manner, and the system then responds.	
210		2.7 -Good. Reliable procedure. Updated at least once every 2 days, and the system responds.	
211		1.3 - The schedule is updated at least weekly with meaningful data. Changes are actually made based on downstream requirements.	
212		0 - Perhaps the schedule is updated weekly, but with data that is not very meaningful. Corresponding changes may not actually be made.	
213		Clarity and correctness of instructions to operators.	1.3
214		4 - Instructions are very clear and very correct.	
215		2.7 - Instructions are clear, but lacking in sufficient detail.	
216		1.3 - Instructions are unclear, but are generally correct.	
217		0 - Instructions are incorrect, whether they are clear or not.	
218		How frequently is the whole length of this canal checked for problems and reported to the office? This means one or more persons physically drive all the sections of the canal.	2.7
219		4 - Once/day	
220		2.7 - Once/2 days	
221		1.3 - Once per week	
222		0 - Once per month or less often	
223			
224		**Capacity "bottlenecks" in the Second Level Canal**	
225		Describe any flow rate restrictions in the Second Level Canal, including their location and hydraulic nature (this is different than most other questions because it asks for a written description)	
226	***ACTUAL Service that the Second Level Canal Provides to its Subcanals***		
227		Flexibility Index - Choose a value from 0-4, based on the scale below:	3



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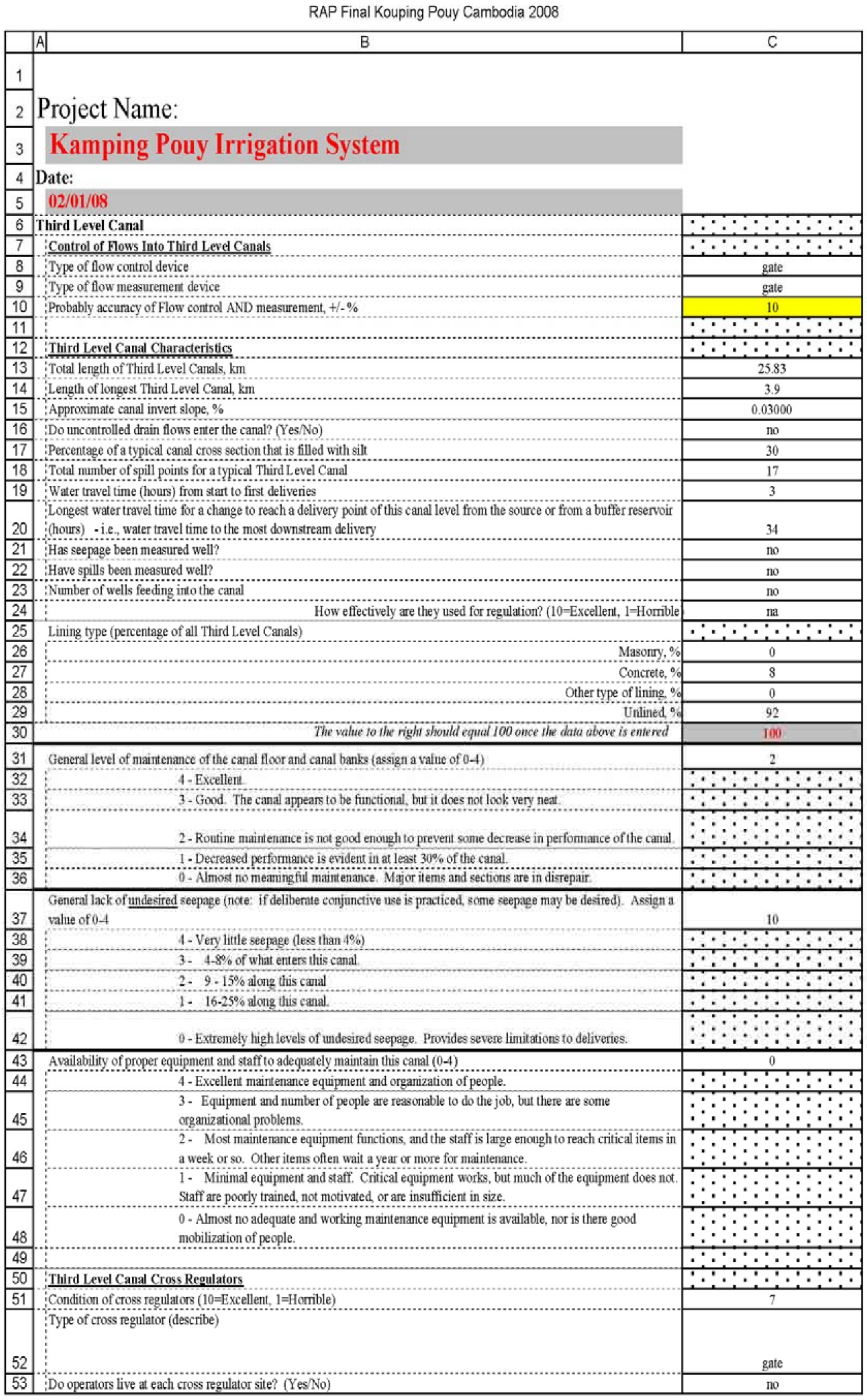
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
228		4 - Wide range of frequency, rate, and duration, but the schedule is arranged by the downstream subcanals several times daily, based on actual need.	
229		3 - Wide range of frequency, rate, and duration but arranged by the downstream canal once/day based on actual need.	
230		2 - Schedules are adjusted weekly by downstream operators	
231		1 - The schedules are dictated by the project office. Changes are made at least weekly.	
232		0 - The delivery schedule is unknown by the downstream operators, or changes are made less frequently than weekly.	
233		Reliability Index - Choose a value from 0-4, based on the scale below:	3
234		4 - Operators of the next lower level know the flows and receive the flows within a few hours of the targeted time. There are no shortages during the year.	
235		3 - Operators of the next lower level know the flows, but may have to wait as long as a day to obtain the flows they need. Only a few shortages throughout the year.	
236		2 - The flow changes arrive plus or minus 2 days, but are correct. Perhaps 4 weeks of some shortage throughout the year.	
237		1 - The flows arrive plus or minus 4 days, but are incorrect. Perhaps 7 weeks of some shortage throughout the year.	
238		0 - Unreliable frequency, rate, and duration more than 50% of the time and the volume is unknown.	
239		Equity Index - Choose a value from 0-4, based on the scale below:	2
240		4 - Points along the canal enjoy the same level of good service	
241		3 - 5% of the canal turnouts receive significantly poorer service than the average	
242		2 - 15% of the canal turnouts receive significantly poorer service than the average.	
243		1 - 25% of the canal turnouts receive singificantly poorer service than the average.	
244		0 - Worse than 25%, or there may not even be any consistent pattern.	
245		Control of flows to customers of the next lower level - Choose a value from 0-4, based on the scale below:	0
246		4 - Flows are known and controlled within 5%	
247		3 - Flows are known and are controlled within 10%	
248		2 - Flows are not known but are controlled within 10%	
249		1 - Flows are controlled within 20%	
250		0 - Flows are controlled within 25%	

10. Third Level Canals



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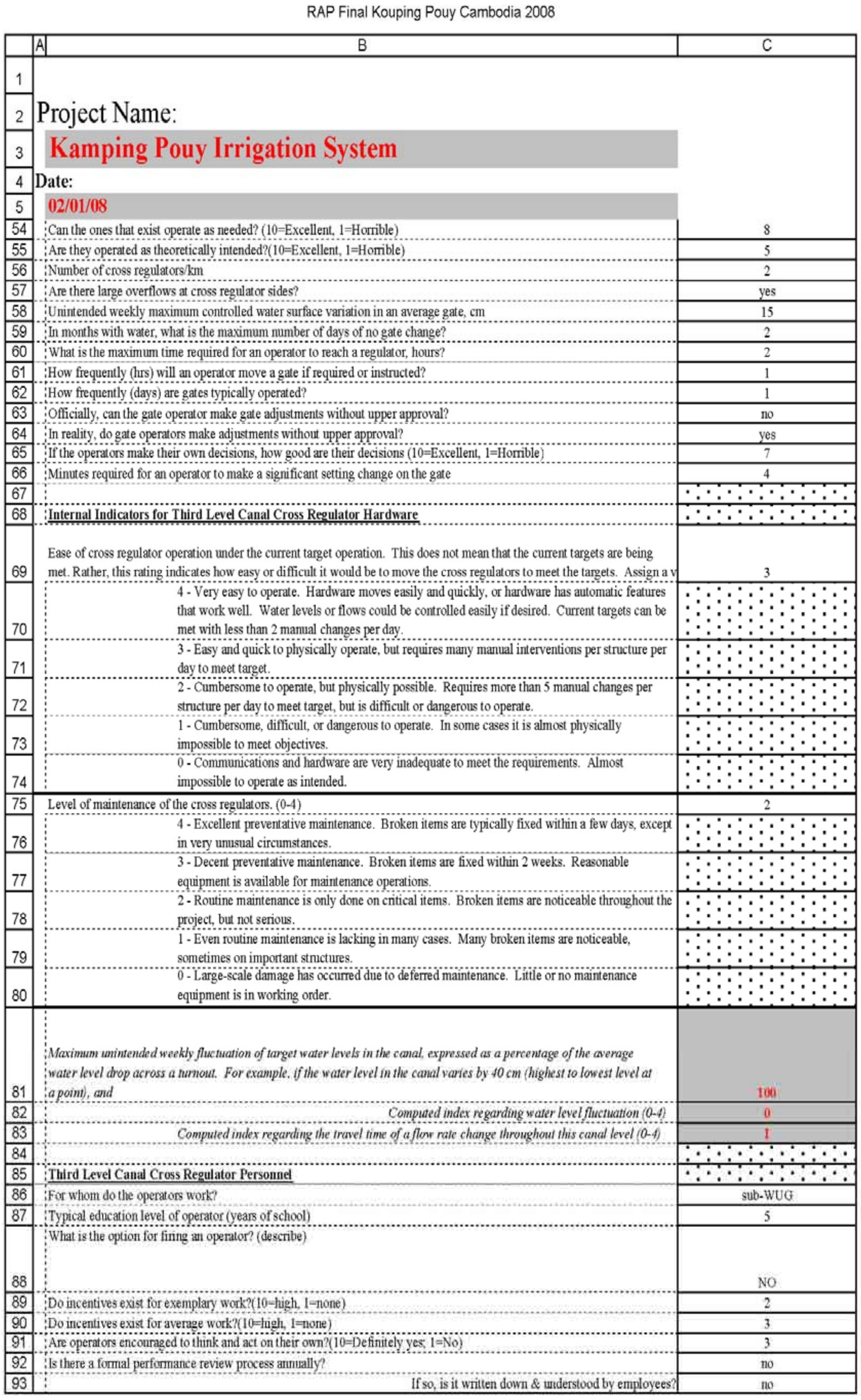
	A	B	C
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
6	**Third Level Canal**		
7		**Control of Flows Into Third Level Canals**	
8		Type of flow control device	gate
9		Type of flow measurement device	gate
10		Probably accuracy of Flow control AND measurement, +/- %	10
11			
12		**Third Level Canal Characteristics**	
13		Total length of Third Level Canals, km	25.83
14		Length of longest Third Level Canal, km	3.9
15		Approximate canal invert slope, %	0.03000
16		Do uncontrolled drain flows enter the canal? (Yes/No)	no
17		Percentage of a typical canal cross section that is filled with silt	30
18		Total number of spill points for a typical Third Level Canal	17
19		Water travel time (hours) from start to first deliveries	3
20		Longest water travel time for a change to reach a delivery point of this canal level from the source or from a buffer reservoir (hours) - i.e., water travel time to the most downstream delivery	34
21		Has seepage been measured well?	no
22		Have spills been measured well?	no
23		Number of wells feeding into the canal	no
24		How effectively are they used for regulation? (10=Excellent, 1=Horrible	na
25		Lining type (percentage of all Third Level Canals)	
26		Masonry, %	0
27		Concrete, %	8
28		Other type of lining, %	0
29		Unlined, %	92
30		*The value to the right should equal 100 once the data above is entered*	100
31		General level of maintenance of the canal floor and canal banks (assign a value of 0-4)	2
32		4 - Excellent.	
33		3 - Good. The canal appears to be functional, but it does not look very neat.	
34		2 - Routine maintenance is not good enough to prevent some decrease in performance of the canal.	
35		1 - Decreased performance is evident in at least 30% of the canal.	
36		0 - Almost no meaningful maintenance. Major items and sections are in disrepair.	
37		General lack of undesired seepage (note: if deliberate conjunctive use is practiced, some seepage may be desired). Assign a value of 0-4	10
38		4 - Very little seepage (less than 4%)	
39		3 - 4-8% of what enters this canal.	
40		2 - 9 - 15% along this canal	
41		1 - 16-25% along this canal.	
42		0 - Extremely high levels of undesired seepage. Provides severe limitations to deliveries.	
43		Availability of proper equipment and staff to adequately maintain this canal (0-4)	0
44		4 - Excellent maintenance equipment and organization of people.	
45		3 - Equipment and number of people are reasonable to do the job, but there are some organizational problems.	
46		2 - Most maintenance equipment functions, and the staff is large enough to reach critical items in a week or so. Other items often wait a year or more for maintenance.	
47		1 - Minimal equipment and staff. Critical equipment works, but much of the equipment does not. Staff are poorly trained, not motivated, or are insufficient in size.	
48		0 - Almost no adequate and working maintenance equipment is available, nor is there good mobilization of people.	
49			
50		**Third Level Canal Cross Regulators**	
51		Condition of cross regulators (10=Excellent, 1=Horrible)	7
52		Type of cross regulator (describe)	gate
53		Do operators live at each cross regulator site? (Yes/No)	no



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	A	B	C
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
54		Can the ones that exist operate as needed? (10=Excellent, 1=Horrible)	8
55		Are they operated as theoretically intended?(10=Excellent, 1=Horrible)	5
56		Number of cross regulators/km	2
57		Are there large overflows at cross regulator sides?	yes
58		Unintended weekly maximum controlled water surface variation in an average gate, cm	15
59		In months with water, what is the maximum number of days of no gate change?	2
60		What is the maximum time required for an operator to reach a regulator, hours?	2
61		How frequently (hrs) will an operator move a gate if required or instructed?	1
62		How frequently (days) are gates typically operated?	1
63		Officially, can the gate operator make gate adjustments without upper approval?	no
64		In reality, do gate operators make adjustments without upper approval?	yes
65		If the operators make their own decisions, how good are their decisions (10=Excellent, 1=Horrible)	7
66		Minutes required for an operator to make a significant setting change on the gate	4
67			
68		**Internal Indicators for Third Level Canal Cross Regulator Hardware**	
69		Ease of cross regulator operation under the current target operation. This does not mean that the current targets are being met. Rather, this rating indicates how easy or difficult it would be to move the cross regulators to meet the targets. Assign a v	3
70		4 - Very easy to operate. Hardware moves easily and quickly, or hardware has automatic features that work well. Water levels or flows could be controlled easily if desired. Current targets can be met with less than 2 manual changes per day.	
71		3 - Easy and quick to physically operate, but requires many manual interventions per structure per day to meet target.	
72		2 - Cumbersome to operate, but physically possible. Requires more than 5 manual changes per structure per day to meet target, but is difficult or dangerous to operate.	
73		1 - Cumbersome, difficult, or dangerous to operate. In some cases it is almost physically impossible to meet objectives.	
74		0 - Communications and hardware are very inadequate to meet the requirements. Almost impossible to operate as intended.	
75		Level of maintenance of the cross regulators. (0-4)	2
76		4 - Excellent preventative maintenance. Broken items are typically fixed within a few days, except in very unusual circumstances.	
77		3 - Decent preventative maintenance. Broken items are fixed within 2 weeks. Reasonable equipment is available for maintenance operations.	
78		2 - Routine maintenance is only done on critical items. Broken items are noticeable throughout the project, but not serious.	
79		1 - Even routine maintenance is lacking in many cases. Many broken items are noticeable, sometimes on important structures.	
80		0 - Large-scale damage has occurred due to deferred maintenance. Little or no maintenance equipment is in working order.	
81		*Maximum unintended weekly fluctuation of target water levels in the canal, expressed as a percentage of the average water level drop across a turnout. For example, if the water level in the canal varies by 40 cm (highest to lowest level at a point), and*	100
82		*Computed index regarding water level fluctuation (0-4)*	0
83		*Computed index regarding the travel time of a flow rate change throughout this canal level (0-4)*	1
84			
85		**Third Level Canal Cross Regulator Personnel**	
86		For whom do the operators work?	sub-WUG
87		Typical education level of operator (years of school)	5
88		What is the option for firing an operator? (describe)	NO
89		Do incentives exist for exemplary work?(10=high, 1=none)	2
90		Do incentives exist for average work?(10=high, 1=none)	3
91		Are operators encouraged to think and act on their own?(10=Definitely yes; 1=No)	3
92		Is there a formal performance review process annually?	no
93		If so, is it written down & understood by employees?	no

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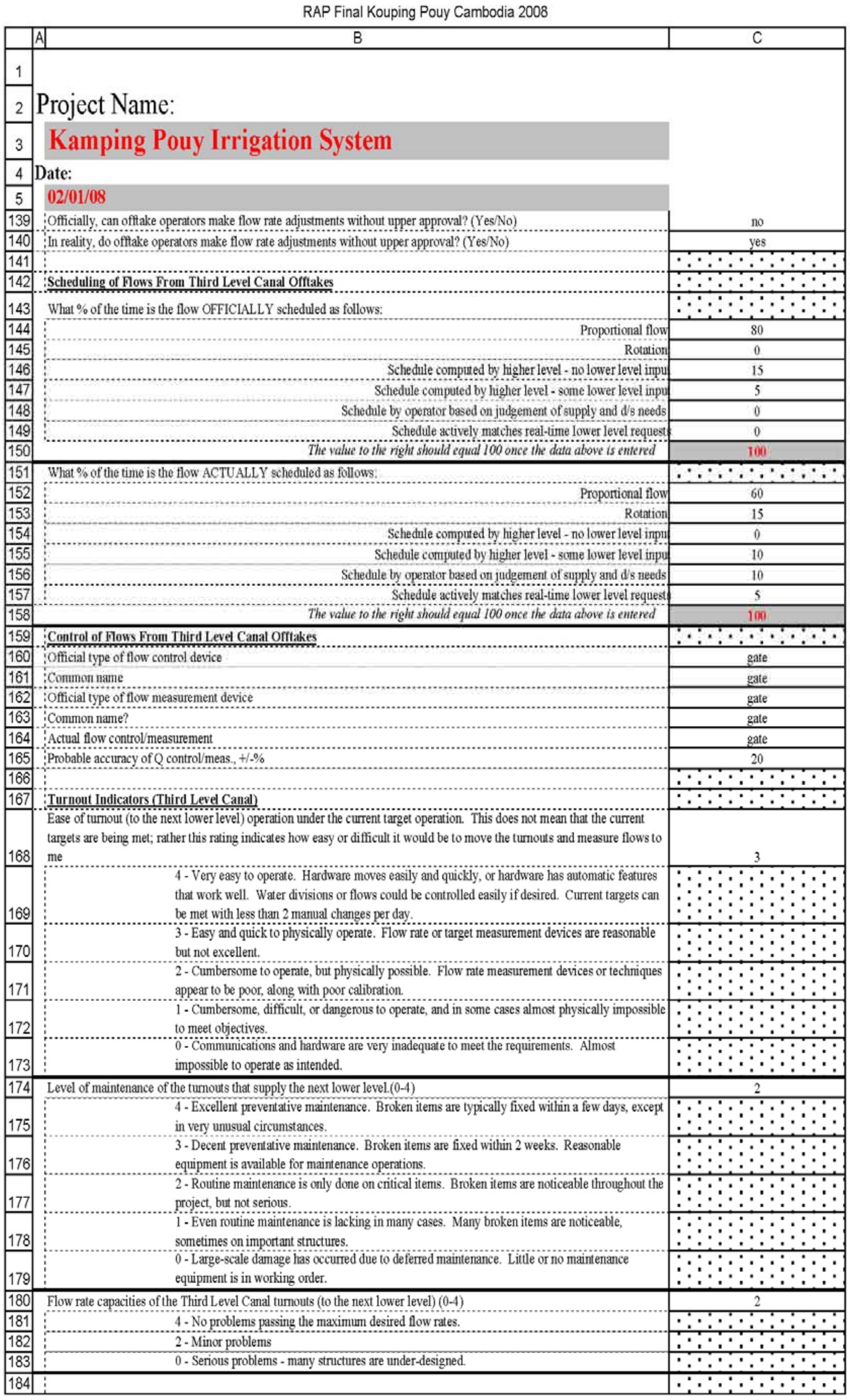
1			
2		Project Name:	
3		**Kamping Pouy Irrigation System**	
4		**Date:**	
5		**02/01/08**	
94		Number of persons fired in last 10 yrs for incompetence	no
95			
96		**Third Level Canal Communications/Transportation**	
97		How often do operators communicate with the next higher level? (hr)	12
98		*Computed Index of communications frequency (0-4)*	2
99		How often do operators or supervisors of this level communicate with the next lower level? (hr)	24
100		*Computed Index of communications frequency (0-4)*	2
101		How frequently do supervisors physically visit this level of canal and talk with operators? (days)	5
102		*Computed index of visiting frequency (0-4)*	3
103		Dependability of voice communications by the operators (by phone or radio) (0-4)	0
104		4 - Excellent - lines work all the time.	
105		3 - Very good. Lines work at least 95% of the time	
106		2 - Poor at many of the sites. However, there is a good line of communication within 30 minutes of travel by the operator	
107		1 - No direct line is available to operators, but they are within 30 minutes travel time to some line and that line of communication almost always works.	
108		0 - No direct line is available to the operators, but they are within 30 minutes travel time to some line. However, even that line often does not work.	
109		Existence and frequency of remote monitoring (either automatic or manual) at key **spill** points, including the end of the canal. (0-4)	0
110		4 - Excellent. At all key points, feedback is provided at least every 2 hours.	
111		3 - Excellent coverage. However, data are recorded continuously on-site and feedback is only once per day.	
112		2 - Data is recorded several times per day and stored on-site. Feedback is once per week.	
113		1 - Only a few sites are covered. Feedback occurs weekly.	
114		0 - Monthly or less frequent feedback of a few sites	
115		Availability of roads along the canal (0-4)	1
116		4 - Very good access for automobiles on at least one side in all but extreme weather. Equipment access on the second side.	
117		3 - Good access for automobiles on at least one side in all but extreme weather. Limited access in some areas on the second side.	
118		2 - Rough but accessible road on one side of the canal. No access on the second side.	
119		1 - All of the canal can be easily traversed on one side with a motorcycle, but maintenance equipment access is very limited.	
120		0 - No apparent maintained access on either side of the road, for very long sections of this canal.	
121		How is communication done? (explain)	meeting
122		What is the transportation of mobile personnel?	walking
123		How many automatic remote monitoring sites are there?	0
124		Travel time from the maintenance yard to the most distant point along this canal (for crews and maintenance equipment) - hours	2
125		*Computed index of travel time for maintenance (0-4).*	2
126		Travel time (hours) needed to reach the office of the Third Level Canal, from the office of the supplier	3
127			
128		**Third Level Canal Off-Takes (Turnouts)**	
129		Percentage of the offtake flows that are taken from unofficial offtakes	0
130		Magnitude of a typical significant offtake flow rate, cms	10
131		Number of significant offtakes/km	4.00
132		Typical change in water surface elevations across an off-take (main turnout), cm	15
133		Can they physically operate as needed? (10=Excellent, 1=Horrible)	7
134		Are they physically operated as theoretically intended? (10=Excellent, 1=Horrible)	5
135		How well can the offtakes be supplied when the canal flow rates are low? (10=Excellent, 1=Horrible)	3
136		Personnel from what level operate the offtakes? (1=this level; 2=lower; 3=both)	2
137		How frequently is the offtake examined by personnel? (hours)	6
138		Officially, how frequently should offtakes be adjusted? (days)	2



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1			
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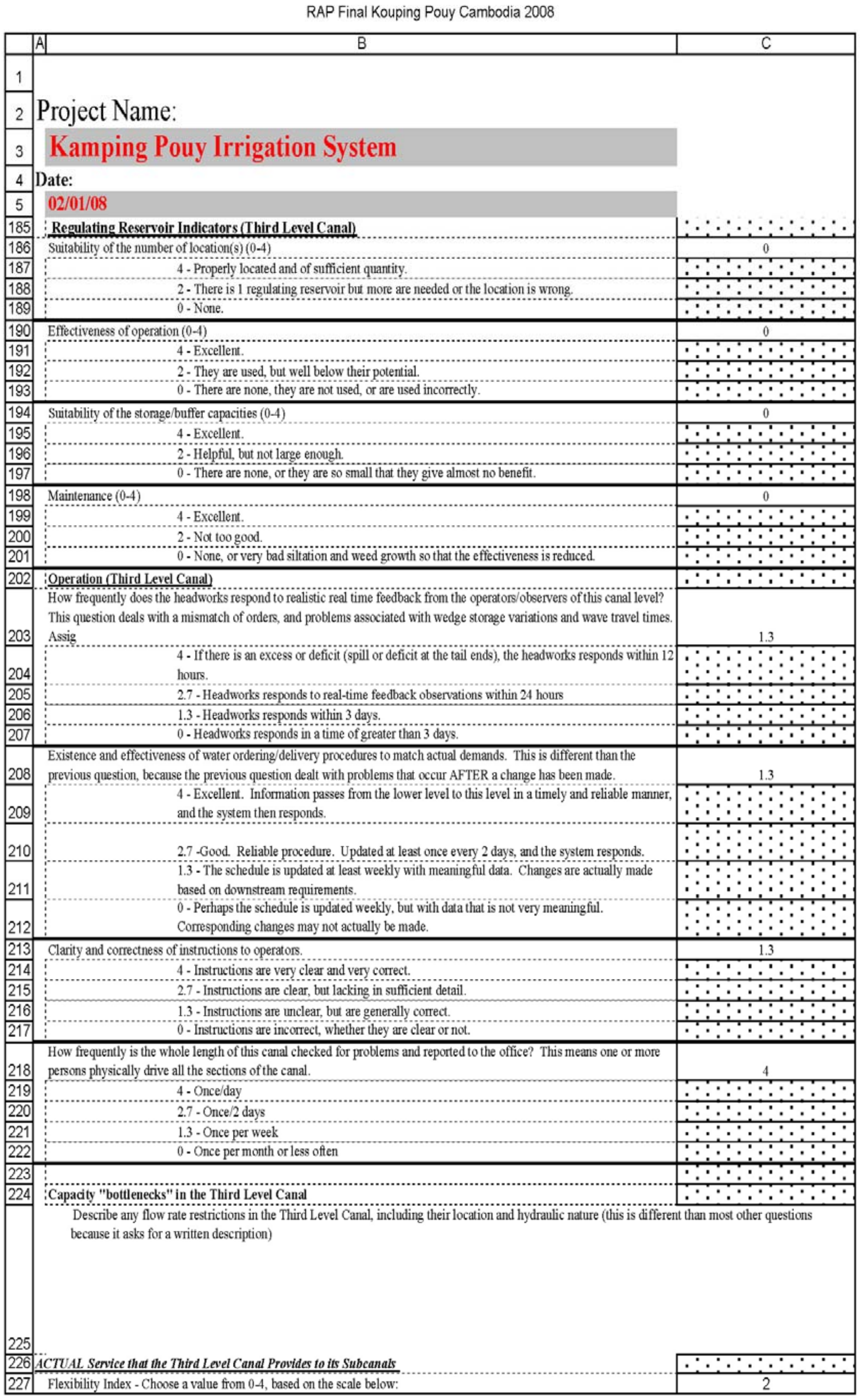
139		Officially, can offtake operators make flow rate adjustments without upper approval? (Yes/No)	no
140		In reality, do offtake operators make flow rate adjustments without upper approval? (Yes/No)	yes
141			
142		**Scheduling of Flows From Third Level Canal Offtakes**	
143		What % of the time is the flow OFFICIALLY scheduled as follows:	
144		Proportional flow	80
145		Rotation	0
146		Schedule computed by higher level - no lower level inpu	15
147		Schedule computed by higher level - some lower level inpu	5
148		Schedule by operator based on judgement of supply and d/s needs	0
149		Schedule actively matches real-time lower level request	0
150		*The value to the right should equal 100 once the data above is entered*	**100**
151		What % of the time is the flow ACTUALLY scheduled as follows:	
152		Proportional flow	60
153		Rotation	15
154		Schedule computed by higher level - no lower level inpu	0
155		Schedule computed by higher level - some lower level inpu	10
156		Schedule by operator based on judgement of supply and d/s needs	10
157		Schedule actively matches real-time lower level request	5
158		*The value to the right should equal 100 once the data above is entered*	**100**
159		**Control of Flows From Third Level Canal Offtakes**	
160		Official type of flow control device	gate
161		Common name	gate
162		Official type of flow measurement device	gate
163		Common name?	gate
164		Actual flow control/measurement	gate
165		Probable accuracy of Q control/meas., +/-%	20
166			
167		**Turnout Indicators (Third Level Canal)**	
168		Ease of turnout (to the next lower level) operation under the current target operation. This does not mean that the current targets are being met; rather this rating indicates how easy or difficult it would be to move the turnouts and measure flows to me	3
169		4 - Very easy to operate. Hardware moves easily and quickly, or hardware has automatic features that work well. Water divisions or flows could be controlled easily if desired. Current targets can be met with less than 2 manual changes per day.	
170		3 - Easy and quick to physically operate. Flow rate or target measurement devices are reasonable but not excellent.	
171		2 - Cumbersome to operate, but physically possible. Flow rate measurement devices or techniques appear to be poor, along with poor calibration.	
172		1 - Cumbersome, difficult, or dangerous to operate, and in some cases almost physically impossible to meet objectives.	
173		0 - Communications and hardware are very inadequate to meet the requirements. Almost impossible to operate as intended.	
174		Level of maintenance of the turnouts that supply the next lower level.(0-4)	2
175		4 - Excellent preventative maintenance. Broken items are typically fixed within a few days, except in very unusual circumstances.	
176		3 - Decent preventative maintenance. Broken items are fixed within 2 weeks. Reasonable equipment is available for maintenance operations.	
177		2 - Routine maintenance is only done on critical items. Broken items are noticeable throughout the project, but not serious.	
178		1 - Even routine maintenance is lacking in many cases. Many broken items are noticeable, sometimes on important structures.	
179		0 - Large-scale damage has occurred due to deferred maintenance. Little or no maintenance equipment is in working order.	
180		Flow rate capacities of the Third Level Canal turnouts (to the next lower level) (0-4)	2
181		4 - No problems passing the maximum desired flow rates.	
182		2 - Minor problems	
183		0 - Serious problems - many structures are under-designed.	
184			



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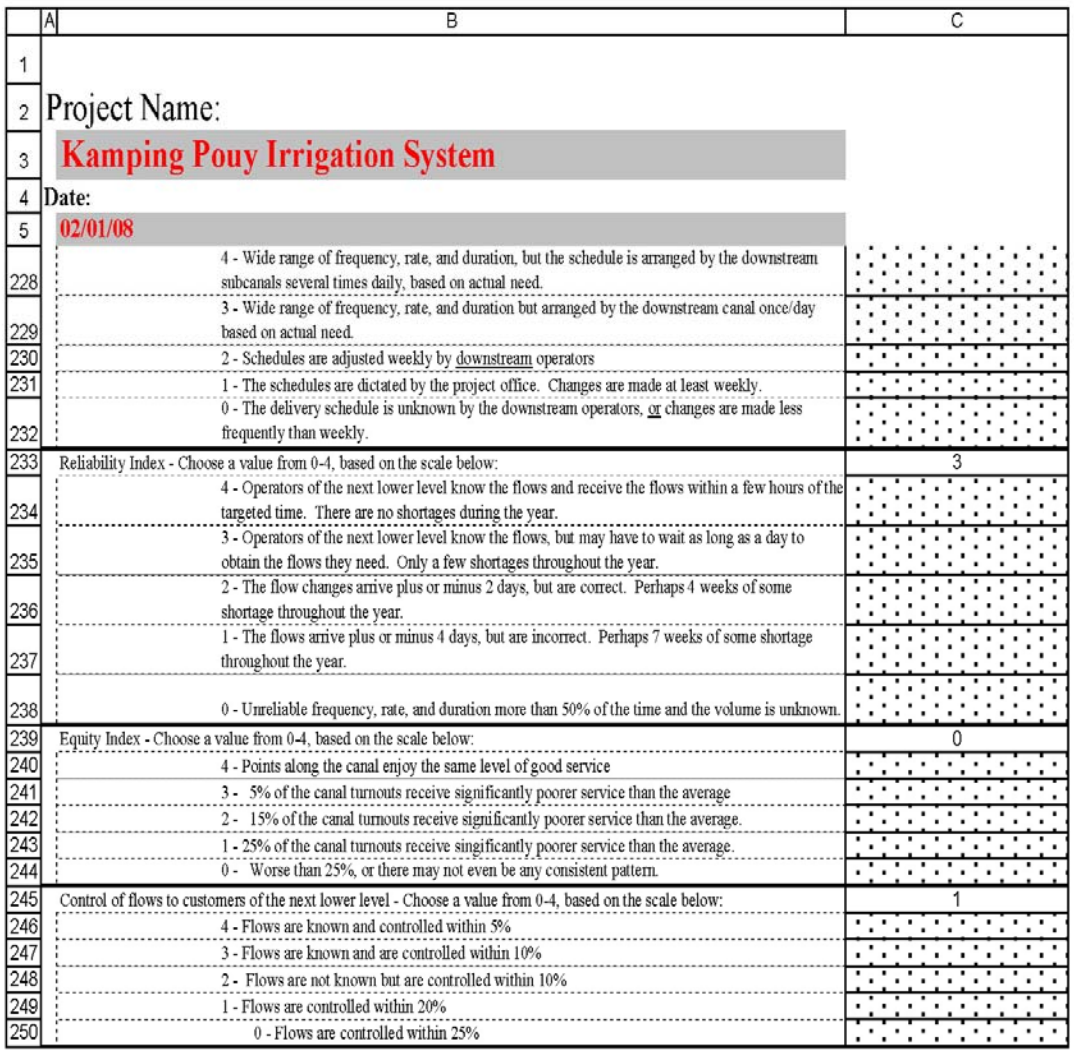
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
185		**Regulating Reservoir Indicators (Third Level Canal)**	
186		Suitability of the number of location(s) (0-4)	0
187		4 - Properly located and of sufficient quantity.	
188		2 - There is 1 regulating reservoir but more are needed or the location is wrong.	
189		0 - None.	
190		Effectiveness of operation (0-4)	0
191		4 - Excellent.	
192		2 - They are used, but well below their potential.	
193		0 - There are none, they are not used, or are used incorrectly.	
194		Suitability of the storage/buffer capacities (0-4)	0
195		4 - Excellent.	
196		2 - Helpful, but not large enough.	
197		0 - There are none, or they are so small that they give almost no benefit.	
198		Maintenance (0-4)	0
199		4 - Excellent.	
200		2 - Not too good.	
201		0 - None, or very bad siltation and weed growth so that the effectiveness is reduced.	
202		**Operation (Third Level Canal)**	
203		How frequently does the headworks respond to realistic real time feedback from the operators/observers of this canal level? This question deals with a mismatch of orders, and problems associated with wedge storage variations and wave travel times. Assig	1.3
204		4 - If there is an excess or deficit (spill or deficit at the tail ends), the headworks responds within 12 hours.	
205		2.7 - Headworks responds to real-time feedback observations within 24 hours	
206		1.3 - Headworks responds within 3 days.	
207		0 - Headworks responds in a time of greater than 3 days.	
208		Existence and effectiveness of water ordering/delivery procedures to match actual demands. This is different than the previous question, because the previous question dealt with problems that occur AFTER a change has been made.	1.3
209		4 - Excellent. Information passes from the lower level to this level in a timely and reliable manner, and the system then responds.	
210		2.7 -Good. Reliable procedure. Updated at least once every 2 days, and the system responds.	
211		1.3 - The schedule is updated at least weekly with meaningful data. Changes are actually made based on downstream requirements.	
212		0 - Perhaps the schedule is updated weekly, but with data that is not very meaningful. Corresponding changes may not actually be made.	
213		Clarity and correctness of instructions to operators.	1.3
214		4 - Instructions are very clear and very correct.	
215		2.7 - Instructions are clear, but lacking in sufficient detail.	
216		1.3 - Instructions are unclear, but are generally correct.	
217		0 - Instructions are incorrect, whether they are clear or not.	
218		How frequently is the whole length of this canal checked for problems and reported to the office? This means one or more persons physically drive all the sections of the canal.	4
219		4 - Once/day	
220		2.7 - Once/2 days	
221		1.3 - Once per week	
222		0 - Once per month or less often	
223			
224		**Capacity "bottlenecks" in the Third Level Canal**	
225		Describe any flow rate restrictions in the Third Level Canal, including their location and hydraulic nature (this is different than most other questions because it asks for a written description)	
226	***ACTUAL Service that the Third Level Canal Provides to its Subcanals***		
227		Flexibility Index - Choose a value from 0-4, based on the scale below:	2



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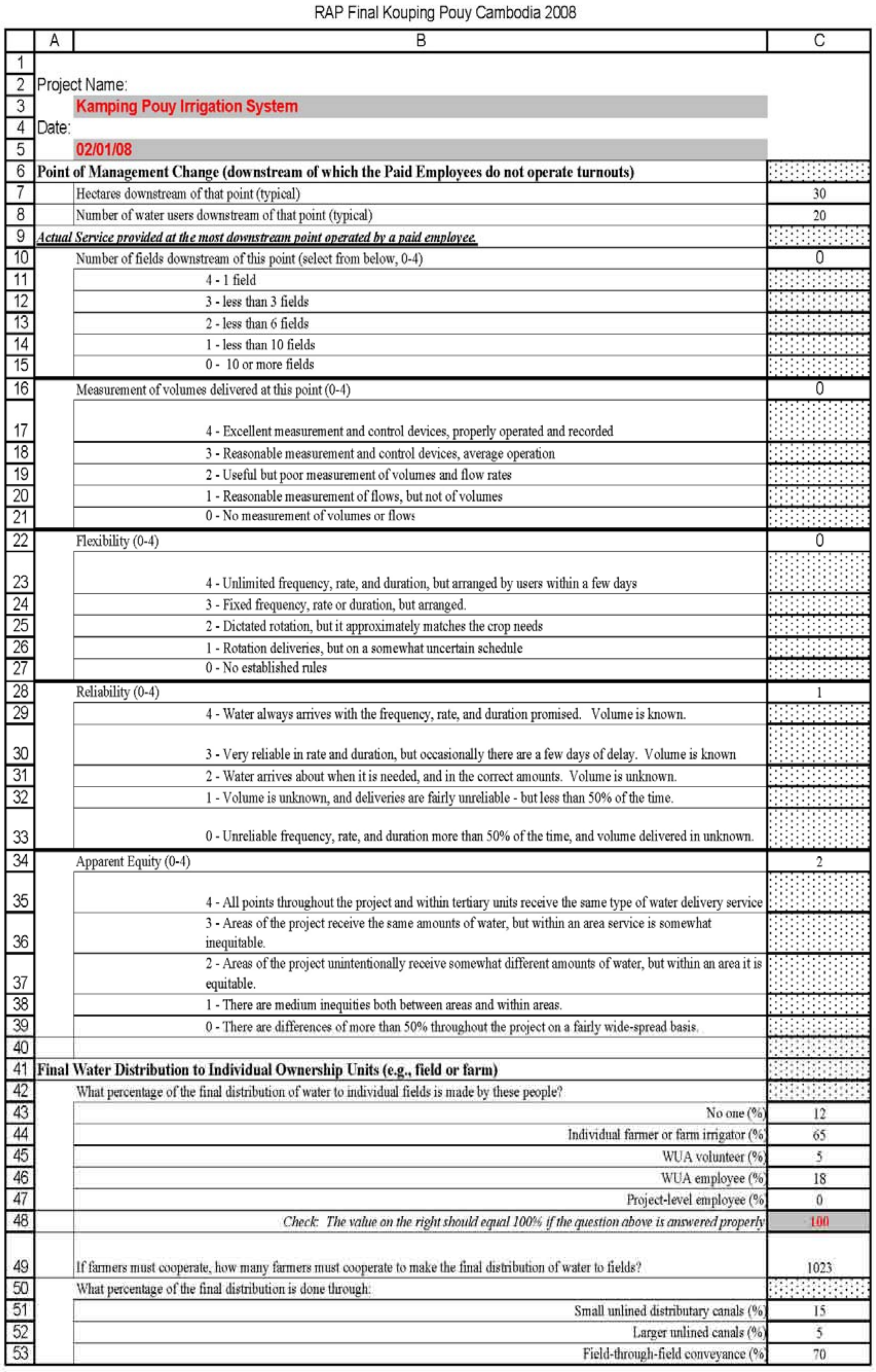
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	**Date:**		
5		**02/01/08**	
228		4 - Wide range of frequency, rate, and duration, but the schedule is arranged by the downstream subcanals several times daily, based on actual need.	
229		3 - Wide range of frequency, rate, and duration but arranged by the downstream canal once/day based on actual need.	
230		2 - Schedules are adjusted weekly by downstream operators	
231		1 - The schedules are dictated by the project office. Changes are made at least weekly.	
232		0 - The delivery schedule is unknown by the downstream operators, or changes are made less frequently than weekly.	
233		Reliability Index - Choose a value from 0-4, based on the scale below:	3
234		4 - Operators of the next lower level know the flows and receive the flows within a few hours of the targeted time. There are no shortages during the year.	
235		3 - Operators of the next lower level know the flows, but may have to wait as long as a day to obtain the flows they need. Only a few shortages throughout the year.	
236		2 - The flow changes arrive plus or minus 2 days, but are correct. Perhaps 4 weeks of some shortage throughout the year.	
237		1 - The flows arrive plus or minus 4 days, but are incorrect. Perhaps 7 weeks of some shortage throughout the year.	
238		0 - Unreliable frequency, rate, and duration more than 50% of the time and the volume is unknown.	
239		Equity Index - Choose a value from 0-4, based on the scale below:	0
240		4 - Points along the canal enjoy the same level of good service	
241		3 - 5% of the canal turnouts receive significantly poorer service than the average	
242		2 - 15% of the canal turnouts receive significantly poorer service than the average.	
243		1 - 25% of the canal turnouts receive singificantly poorer service than the average.	
244		0 - Worse than 25%, or there may not even be any consistent pattern.	
245		Control of flows to customers of the next lower level - Choose a value from 0-4, based on the scale below:	1
246		4 - Flows are known and controlled within 5%	
247		3 - Flows are known and are controlled within 10%	
248		2 - Flows are not known but are controlled within 10%	
249		1 - Flows are controlled within 20%	
250		0 - Flows are controlled within 25%	

11. Final deliveries



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1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
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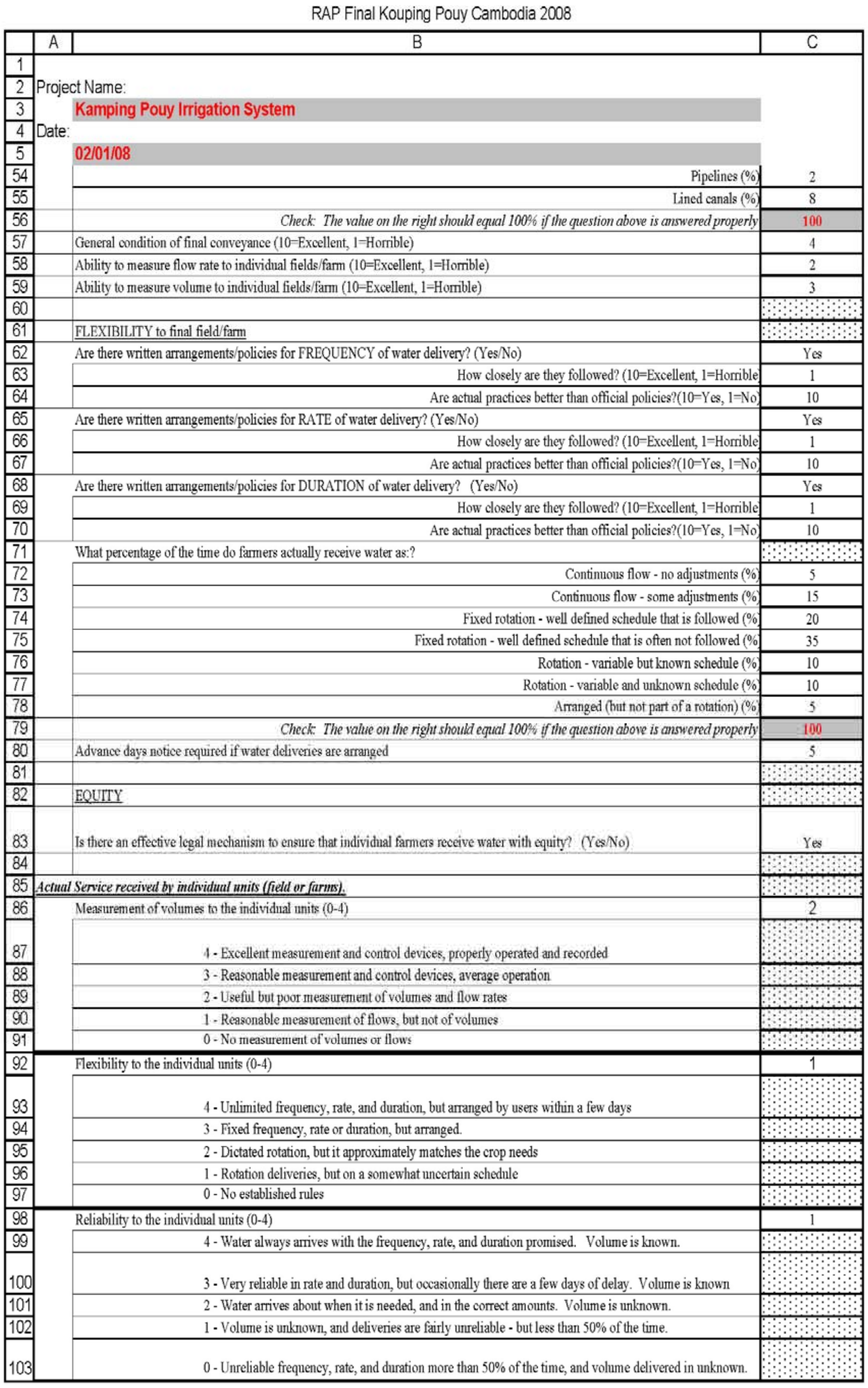
5		**02/01/08**	
6	**Point of Management Change (downstream of which the Paid Employees do not operate turnouts)**		
7		Hectares downstream of that point (typical)	30
8		Number of water users downstream of that point (typical)	20
9	***Actual Service provided at the most downstream point operated by a paid employee.***		
10		Number of fields downstream of this point (select from below, 0-4)	0
11		4 - 1 field	
12		3 - less than 3 fields	
13		2 - less than 6 fields	
14		1 - less than 10 fields	
15		0 - 10 or more fields	
16		Measurement of volumes delivered at this point (0-4)	0
17		4 - Excellent measurement and control devices, properly operated and recorded	
18		3 - Reasonable measurement and control devices, average operation	
19		2 - Useful but poor measurement of volumes and flow rates	
20		1 - Reasonable measurement of flows, but not of volumes	
21		0 - No measurement of volumes or flows	
22		Flexibility (0-4)	0
23		4 - Unlimited frequency, rate, and duration, but arranged by users within a few days	
24		3 - Fixed frequency, rate or duration, but arranged.	
25		2 - Dictated rotation, but it approximately matches the crop needs	
26		1 - Rotation deliveries, but on a somewhat uncertain schedule	
27		0 - No established rules	
28		Reliability (0-4)	1
29		4 - Water always arrives with the frequency, rate, and duration promised. Volume is known.	
30		3 - Very reliable in rate and duration, but occasionally there are a few days of delay. Volume is known	
31		2 - Water arrives about when it is needed, and in the correct amounts. Volume is unknown.	
32		1 - Volume is unknown, and deliveries are fairly unreliable - but less than 50% of the time.	
33		0 - Unreliable frequency, rate, and duration more than 50% of the time, and volume delivered in unknown.	
34		Apparent Equity (0-4)	2
35		4 - All points throughout the project and within tertiary units receive the same type of water delivery service	
36		3 - Areas of the project receive the same amounts of water, but within an area service is somewhat inequitable.	
37		2 - Areas of the project unintentionally receive somewhat different amounts of water, but within an area it is equitable.	
38		1 - There are medium inequities both between areas and within areas.	
39		0 - There are differences of more than 50% throughout the project on a fairly wide-spread basis.	
40			
41	**Final Water Distribution to Individual Ownership Units (e.g., field or farm)**		
42		What percentage of the final distribution of water to individual fields is made by these people?	
43		No one (%)	12
44		Individual farmer or farm irrigator (%)	65
45		WUA volunteer (%)	5
46		WUA employee (%)	18
47		Project-level employee (%)	0
48		*Check: The value on the right should equal 100% if the question above is answered properly*	100
49		If farmers must cooperate, how many farmers must cooperate to make the final distribution of water to fields?	1023
50		What percentage of the final distribution is done through:	
51		Small unlined distributary canals (%)	15
52		Larger unlined canals (%)	5
53		Field-through-field conveyance (%)	70



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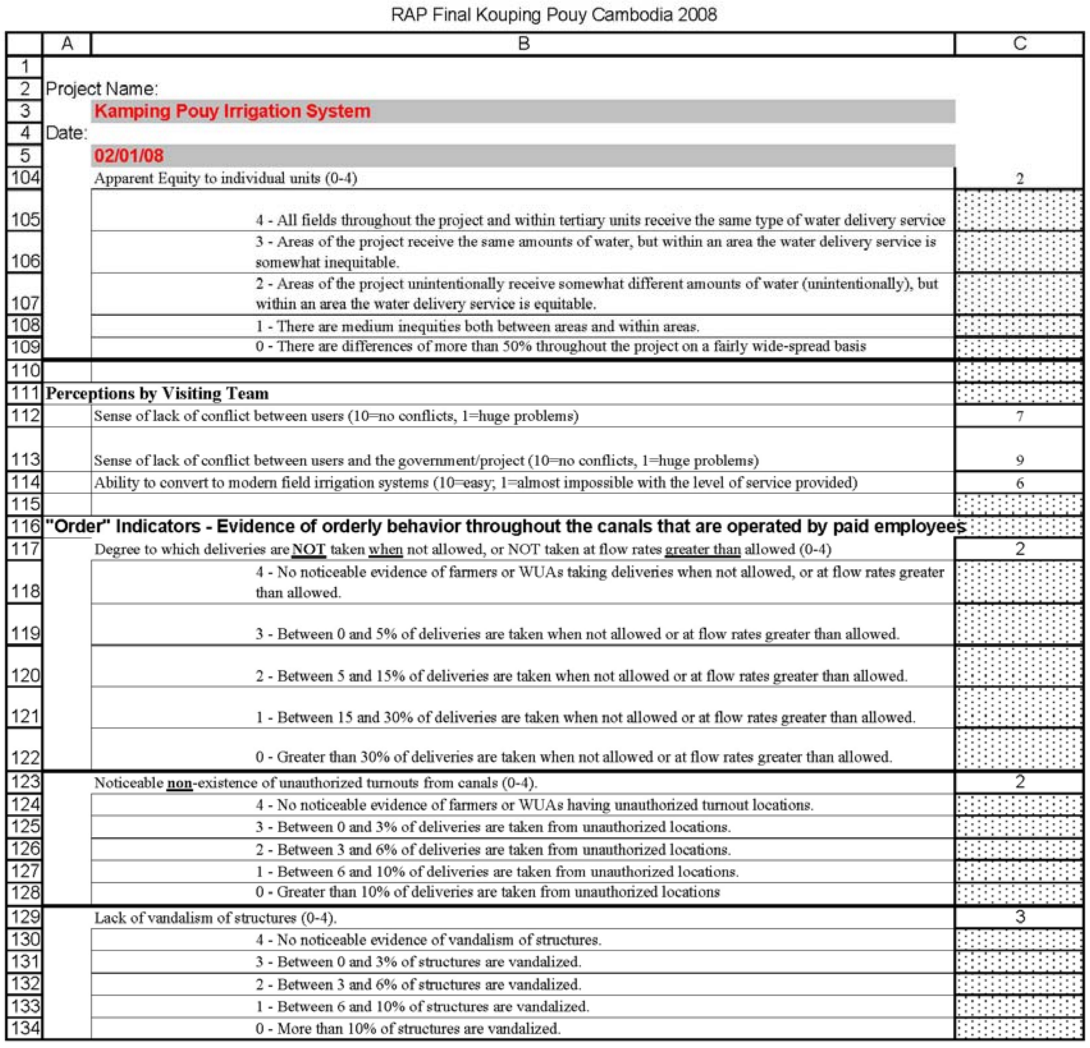
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	Date:		
5		**02/01/08**	
54		Pipelines (%)	2
55		Lined canals (%)	8
56		*Check: The value on the right should equal 100% if the question above is answered properly*	100
57		General condition of final conveyance (10=Excellent, 1=Horrible)	4
58		Ability to measure flow rate to individual fields/farm (10=Excellent, 1=Horrible)	2
59		Ability to measure volume to individual fields/farm (10=Excellent, 1=Horrible)	3
60			
61		FLEXIBILITY to final field/farm	
62		Are there written arrangements/policies for FREQUENCY of water delivery? (Yes/No)	Yes
63		How closely are they followed? (10=Excellent, 1=Horrible	1
64		Are actual practices better than official policies?(10=Yes, 1=No)	10
65		Are there written arrangements/policies for RATE of water delivery? (Yes/No)	Yes
66		How closely are they followed? (10=Excellent, 1=Horrible	1
67		Are actual practices better than official policies?(10=Yes, 1=No)	10
68		Are there written arrangements/policies for DURATION of water delivery? (Yes/No)	Yes
69		How closely are they followed? (10=Excellent, 1=Horrible	1
70		Are actual practices better than official policies?(10=Yes, 1=No)	10
71		What percentage of the time do farmers actually receive water as:?	
72		Continuous flow - no adjustments (%)	5
73		Continuous flow - some adjustments (%)	15
74		Fixed rotation - well defined schedule that is followed (%)	20
75		Fixed rotation - well defined schedule that is often not followed (%)	35
76		Rotation - variable but known schedule (%)	10
77		Rotation - variable and unknown schedule (%)	10
78		Arranged (but not part of a rotation) (%)	5
79		*Check: The value on the right should equal 100% if the question above is answered properly*	100
80		Advance days notice required if water deliveries are arranged	5
81			
82		EQUITY	
83		Is there an effective legal mechanism to ensure that individual farmers receive water with equity? (Yes/No)	Yes
84			
85	***Actual Service received by individual units (field or farms).***		
86		Measurement of volumes to the individual units (0-4)	2
87		4 - Excellent measurement and control devices, properly operated and recorded	
88		3 - Reasonable measurement and control devices, average operation	
89		2 - Useful but poor measurement of volumes and flow rates	
90		1 - Reasonable measurement of flows, but not of volumes	
91		0 - No measurement of volumes or flows	
92		Flexibility to the individual units (0-4)	1
93		4 - Unlimited frequency, rate, and duration, but arranged by users within a few days	
94		3 - Fixed frequency, rate or duration, but arranged.	
95		2 - Dictated rotation, but it approximately matches the crop needs	
96		1 - Rotation deliveries, but on a somewhat uncertain schedule	
97		0 - No established rules	
98		Reliability to the individual units (0-4)	1
99		4 - Water always arrives with the frequency, rate, and duration promised. Volume is known.	
100		3 - Very reliable in rate and duration, but occasionally there are a few days of delay. Volume is known	
101		2 - Water arrives about when it is needed, and in the correct amounts. Volume is unknown.	
102		1 - Volume is unknown, and deliveries are fairly unreliable - but less than 50% of the time.	
103		0 - Unreliable frequency, rate, and duration more than 50% of the time, and volume delivered in unknown.	



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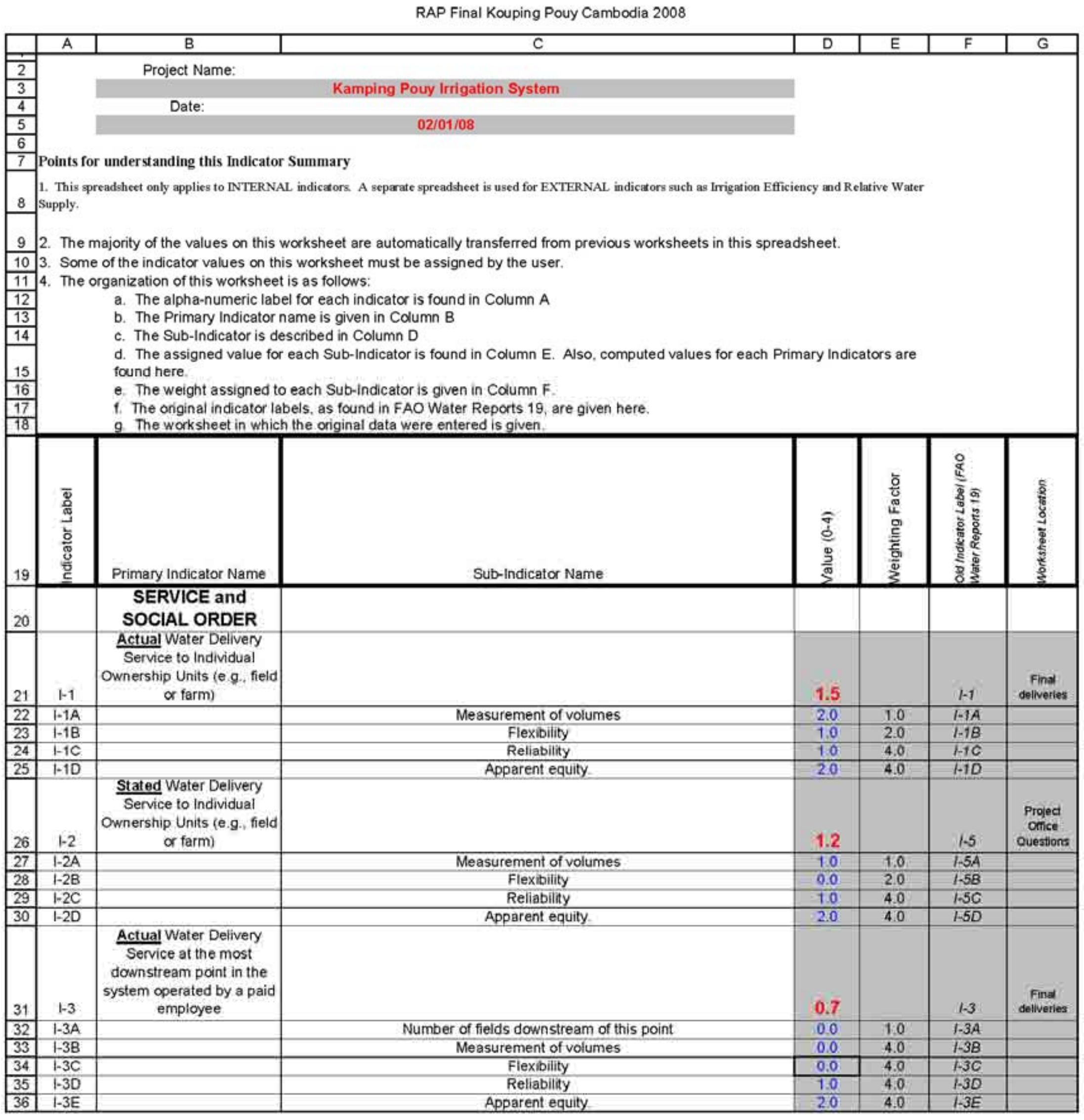
	A	B	C
1			
2	Project Name:		
3		**Kamping Pouy Irrigation System**	
4	Date:		
5		**02/01/08**	
104		Apparent Equity to individual units (0-4)	2
105		4 - All fields throughout the project and within tertiary units receive the same type of water delivery service	
106		3 - Areas of the project receive the same amounts of water, but within an area the water delivery service is somewhat inequitable.	
107		2 - Areas of the project unintentionally receive somewhat different amounts of water (unintentionally), but within an area the water delivery service is equitable.	
108		1 - There are medium inequities both between areas and within areas.	
109		0 - There are differences of more than 50% throughout the project on a fairly wide-spread basis	
110			
111	**Perceptions by Visiting Team**		
112		Sense of lack of conflict between users (10=no conflicts, 1=huge problems)	7
113		Sense of lack of conflict between users and the government/project (10=no conflicts, 1=huge problems)	9
114		Ability to convert to modern field irrigation systems (10=easy; 1=almost impossible with the level of service provided)	6
115			
116	**"Order" Indicators - Evidence of orderly behavior throughout the canals that are operated by paid employees**		
117		Degree to which deliveries are **NOT** taken when not allowed, or NOT taken at flow rates greater than allowed (0-4)	2
118		4 - No noticeable evidence of farmers or WUAs taking deliveries when not allowed, or at flow rates greater than allowed.	
119		3 - Between 0 and 5% of deliveries are taken when not allowed or at flow rates greater than allowed.	
120		2 - Between 5 and 15% of deliveries are taken when not allowed or at flow rates greater than allowed.	
121		1 - Between 15 and 30% of deliveries are taken when not allowed or at flow rates greater than allowed.	
122		0 - Greater than 30% of deliveries are taken when not allowed or at flow rates greater than allowed.	
123		Noticeable **non**-existence of unauthorized turnouts from canals (0-4).	2
124		4 - No noticeable evidence of farmers or WUAs having unauthorized turnout locations.	
125		3 - Between 0 and 3% of deliveries are taken from unauthorized locations.	
126		2 - Between 3 and 6% of deliveries are taken from unauthorized locations.	
127		1 - Between 6 and 10% of deliveries are taken from unauthorized locations.	
128		0 - Greater than 10% of deliveries are taken from unauthorized locations	
129		Lack of vandalism of structures (0-4).	3
130		4 - No noticeable evidence of vandalism of structures.	
131		3 - Between 0 and 3% of structures are vandalized.	
132		2 - Between 3 and 6% of structures are vandalized.	
133		1 - Between 6 and 10% of structures are vandalized.	
134		0 - More than 10% of structures are vandalized.	

12. Internal Indicators



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2 Project Name:

3 Kamping Pouy Irrigation System

4 Date:

5 02/01/08

6

7 **Points for understanding this Indicator Summary**

8 1. This spreadsheet only applies to INTERNAL indicators. A separate spreadsheet is used for EXTERNAL indicators such as Irrigation Efficiency and Relative Water Supply.

9 2. The majority of the values on this worksheet are automatically transferred from previous worksheets in this spreadsheet.

10 3. Some of the indicator values on this worksheet must be assigned by the user.

11 4. The organization of this worksheet is as follows:

12 a. The alpha-numeric label for each indicator is found in Column A

13 b. The Primary Indicator name is given in Column B

14 c. The Sub-Indicator is described in Column D

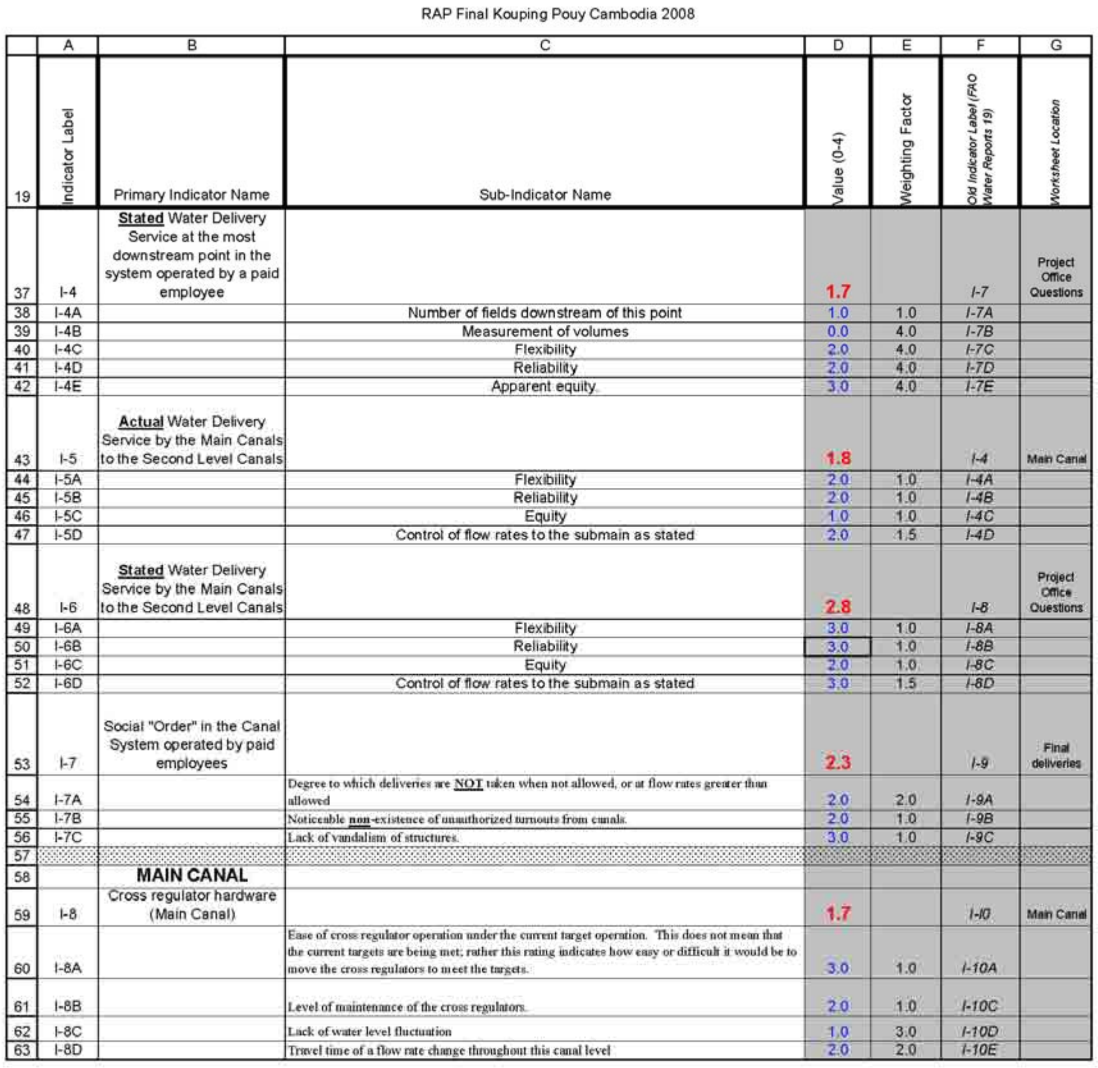
15 d. The assigned value for each Sub-Indicator is found in Column E. Also, computed values for each Primary Indicators are found here.

16 e. The weight assigned to each Sub-Indicator is given in Column F.

17 f. The original indicator labels, as found in FAO Water Reports 19, are given here.

18 g. The worksheet in which the original data were entered is given.

	A	B	C	D	E	F	G
19	Indicator Label	Primary Indicator Name	Sub-Indicator Name	Value (0-4)	Weighting Factor	Old Indicator Label (FAO Water Reports 19)	Worksheet Location
20		**SERVICE and SOCIAL ORDER**					
21	I-1	**Actual** Water Delivery Service to Individual Ownership Units (e.g., field or farm)		1.5		I-1	Final deliveries
22	I-1A		Measurement of volumes	2.0	1.0	I-1A	
23	I-1B		Flexibility	1.0	2.0	I-1B	
24	I-1C		Reliability	1.0	4.0	I-1C	
25	I-1D		Apparent equity.	2.0	4.0	I-1D	
26	I-2	**Stated** Water Delivery Service to Individual Ownership Units (e.g., field or farm)		1.2		I-5	Project Office Questions
27	I-2A		Measurement of volumes	1.0	1.0	I-5A	
28	I-2B		Flexibility	0.0	2.0	I-5B	
29	I-2C		Reliability	1.0	4.0	I-5C	
30	I-2D		Apparent equity.	2.0	4.0	I-5D	
31	I-3	**Actual** Water Delivery Service at the most downstream point in the system operated by a paid employee		0.7		I-3	Final deliveries
32	I-3A		Number of fields downstream of this point	0.0	1.0	I-3A	
33	I-3B		Measurement of volumes	0.0	4.0	I-3B	
34	I-3C		Flexibility	0.0	4.0	I-3C	
35	I-3D		Reliability	1.0	4.0	I-3D	
36	I-3E		Apparent equity.	2.0	4.0	I-3E	



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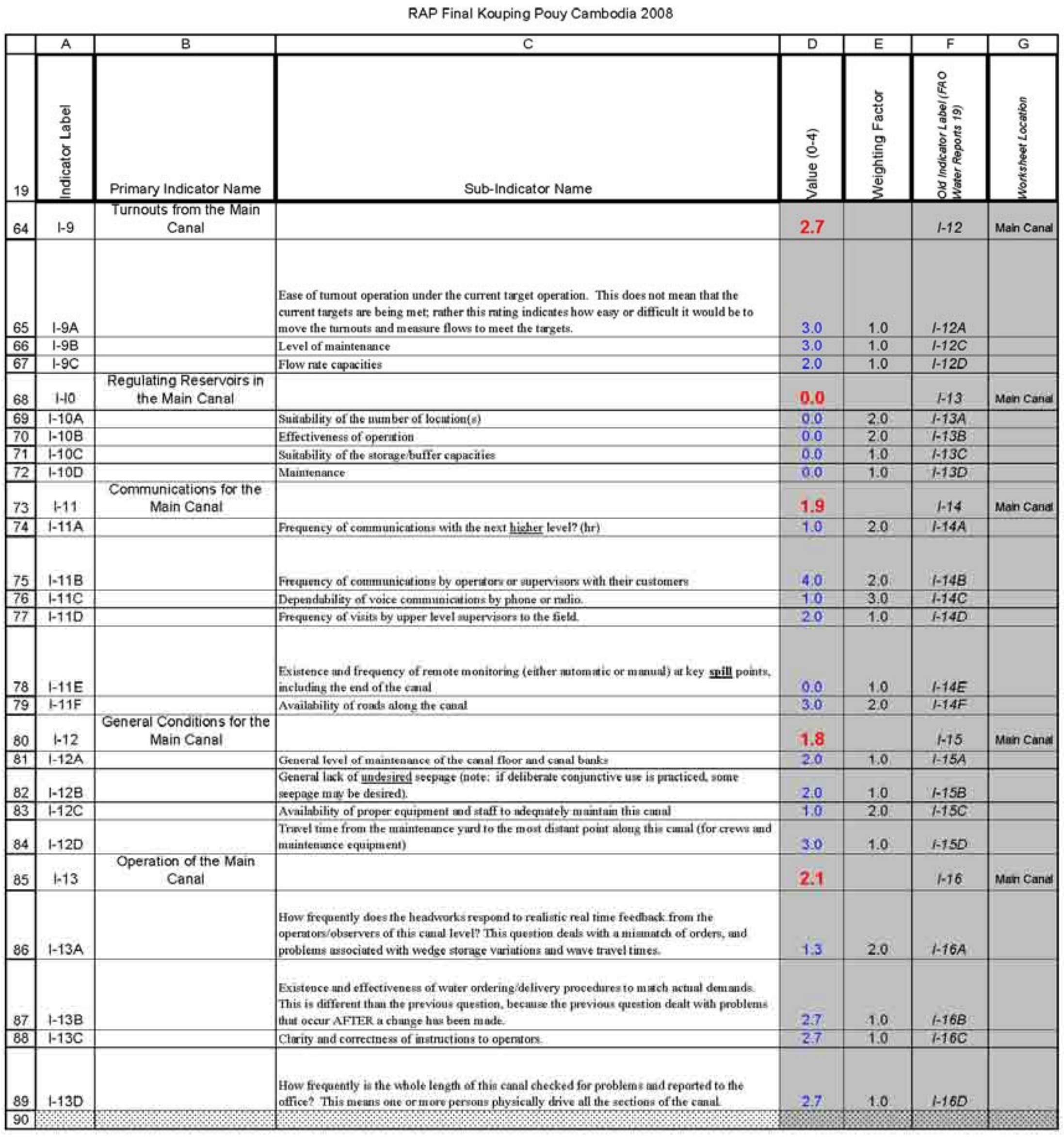
	A	B	C	D	E	F	G
19	Indicator Label	Primary Indicator Name	Sub-Indicator Name	Value (0-4)	Weighting Factor	Old Indicator Label (FAO Water Reports 19)	Worksheet Location
37	I-4	**Stated** Water Delivery Service at the most downstream point in the system operated by a paid employee		1.7		I-7	Project Office Questions
38	I-4A		Number of fields downstream of this point	1.0	1.0	I-7A	
39	I-4B		Measurement of volumes	0.0	4.0	I-7B	
40	I-4C		Flexibility	2.0	4.0	I-7C	
41	I-4D		Reliability	2.0	4.0	I-7D	
42	I-4E		Apparent equity.	3.0	4.0	I-7E	
43	I-5	**Actual** Water Delivery Service by the Main Canals to the Second Level Canals		1.8		I-4	Main Canal
44	I-5A		Flexibility	2.0	1.0	I-4A	
45	I-5B		Reliability	2.0	1.0	I-4B	
46	I-5C		Equity	1.0	1.0	I-4C	
47	I-5D		Control of flow rates to the submain as stated	2.0	1.5	I-4D	
48	I-6	**Stated** Water Delivery Service by the Main Canals to the Second Level Canals		2.8		I-8	Project Office Questions
49	I-6A		Flexibility	3.0	1.0	I-8A	
50	I-6B		Reliability	3.0	1.0	I-8B	
51	I-6C		Equity	2.0	1.0	I-8C	
52	I-6D		Control of flow rates to the submain as stated	3.0	1.5	I-8D	
53	I-7	Social "Order" in the Canal System operated by paid employees		2.3		I-9	Final deliveries
54	I-7A		Degree to which deliveries are **NOT** taken when not allowed, or at flow rates greater than allowed	2.0	2.0	I-9A	
55	I-7B		Noticeable **non**-existence of unauthorized turnouts from canals.	2.0	1.0	I-9B	
56	I-7C		Lack of vandalim of structures.	3.0	1.0	I-9C	
57							
58		**MAIN CANAL**					
59	I-8	Cross regulator hardware (Main Canal)		1.7		I-I0	Main Canal
60	I-8A		Ease of cross regulator operation under the current target operation. This does not mean that the current targets are being met; rather this rating indicates how easy or difficult it would be to move the cross regulators to meet the targets.	3.0	1.0	I-10A	
61	I-8B		Level of maintenance of the cross regulators.	2.0	1.0	I-10C	
62	I-8C		Lack of water level fluctuation	1.0	3.0	I-10D	
63	I-8D		Travel time of a flow rate change throughout this canal level	2.0	2.0	I-10E	



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	A	B	C	D	E	F	G
19	Indicator Label	Primary Indicator Name	Sub-Indicator Name	Value (0-4)	Weighting Factor	Old Indicator Label (FAO Water Reports 19)	Worksheet Location
64	I-9	Turnouts from the Main Canal		2.7		I-12	Main Canal
65	I-9A		Ease of turnout operation under the current target operation. This does not mean that the current targets are being met; rather this rating indicates how easy or difficult it would be to move the turnouts and measure flows to meet the targets.	3.0	1.0	I-12A	
66	I-9B		Level of maintenance	3.0	1.0	I-12C	
67	I-9C		Flow rate capacities	2.0	1.0	I-12D	
68	I-I0	Regulating Reservoirs in the Main Canal		0.0		I-13	Main Canal
69	I-10A		Suitability of the number of location(s)	0.0	2.0	I-13A	
70	I-10B		Effectiveness of operation	0.0	2.0	I-13B	
71	I-10C		Suitability of the storage/buffer capacities	0.0	1.0	I-13C	
72	I-10D		Maintenance	0.0	1.0	I-13D	
73	I-11	Communications for the Main Canal		1.9		I-14	Main Canal
74	I-11A		Frequency of communications with the next <u>higher</u> level? (hr)	1.0	2.0	I-14A	
75	I-11B		Frequency of communications by operators or supervisors with their customers	4.0	2.0	I-14B	
76	I-11C		Dependability of voice communications by phone or radio.	1.0	3.0	I-14C	
77	I-11D		Frequency of visits by upper level supervisors to the field.	2.0	1.0	I-14D	
78	I-11E		Existence and frequency of remote monitoring (either automatic or manual) at key **spill** points, including the end of the canal	0.0	1.0	I-14E	
79	I-11F		Availability of roads along the canal	3.0	2.0	I-14F	
80	I-12	General Conditions for the Main Canal		1.8		I-15	Main Canal
81	I-12A		General level of maintenance of the canal floor and canal banks	2.0	1.0	I-15A	
82	I-12B		General lack of <u>undesired</u> seepage (note: if deliberate conjunctive use is practiced, some seepage may be desired).	2.0	1.0	I-15B	
83	I-12C		Availability of proper equipment and staff to adequately maintain this canal	1.0	2.0	I-15C	
84	I-12D		Travel time from the maintenance yard to the most distant point along this canal (for crews and maintenance equipment)	3.0	1.0	I-15D	
85	I-13	Operation of the Main Canal		2.1		I-16	Main Canal
86	I-13A		How frequently does the headworks respond to realistic real time feedback from the operators/observers of this canal level? This question deals with a mismatch of orders, and problems associated with wedge storage variations and wave travel times.	1.3	2.0	I-16A	
87	I-13B		Existence and effectiveness of water ordering/delivery procedures to match actual demands. This is different than the previous question, because the previous question dealt with problems that occur AFTER a change has been made.	2.7	1.0	I-16B	
88	I-13C		Clarity and correctness of instructions to operators.	2.7	1.0	I-16C	
89	I-13D		How frequently is the whole length of this canal checked for problems and reported to the office? This means one or more persons physically drive all the sections of the canal.	2.7	1.0	I-16D	
90							

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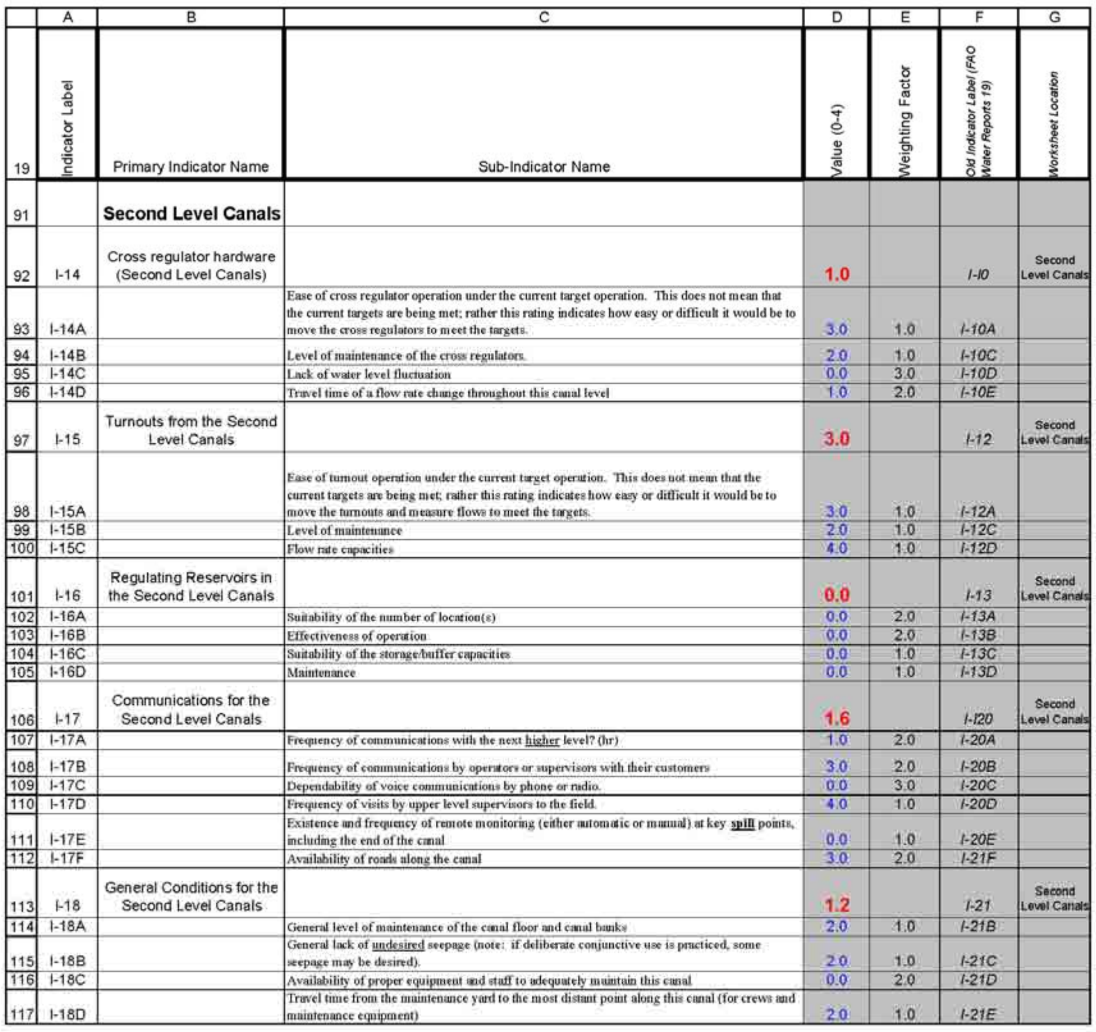
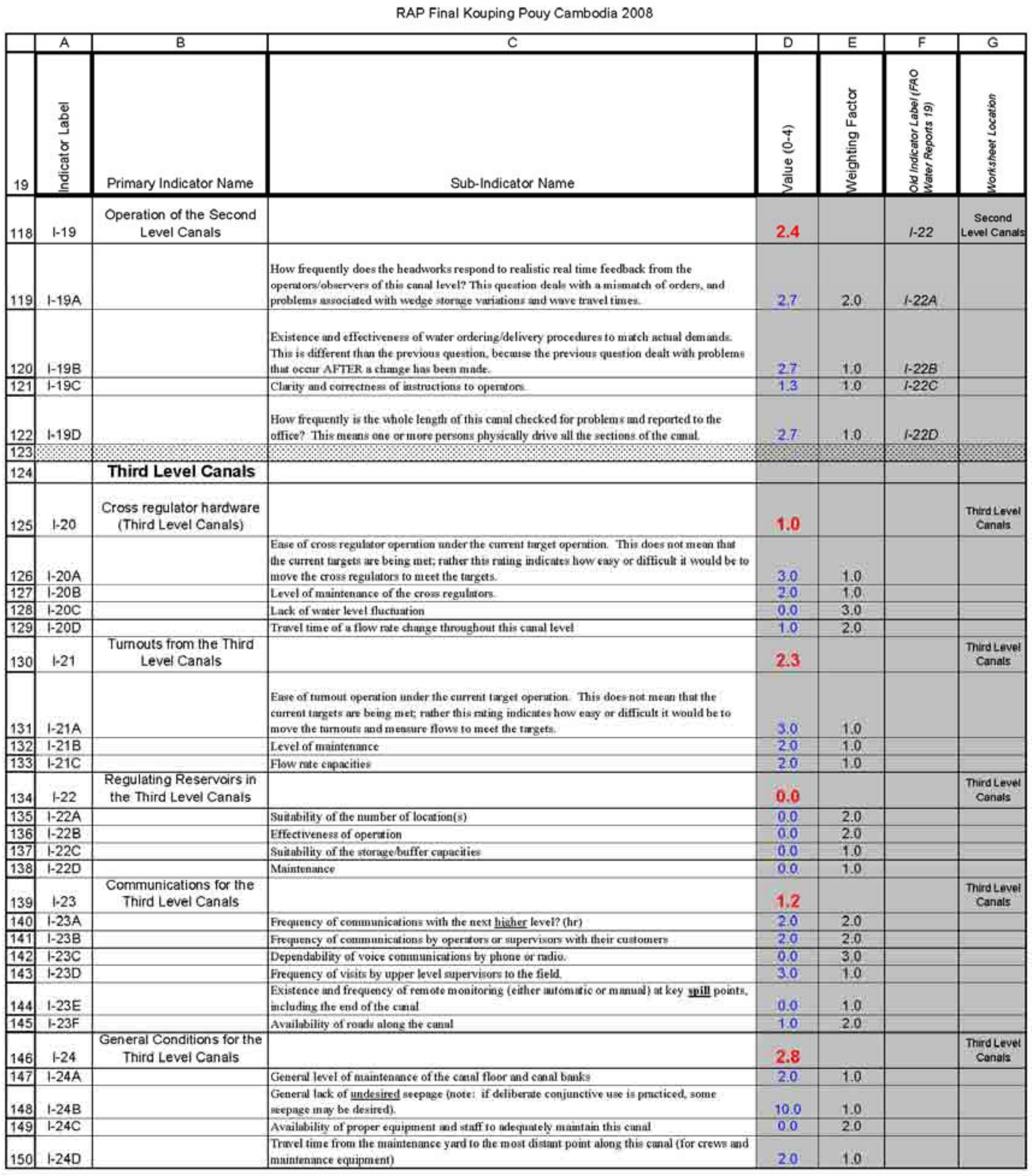


	A	B	C	D	E	F	G
19	Indicator Label	Primary Indicator Name	Sub-Indicator Name	Value (0-4)	Weighting Factor	Old Indicator Label (FAO Water Reports 19)	Worksheet Location
91		**Second Level Canals**					
92	I-14	Cross regulator hardware (Second Level Canals)		**1.0**		*I-I0*	Second Level Canals
93	I-14A		Ease of cross regulator operation under the current target operation. This does not mean that the current targets are being met; rather this rating indicates how easy or difficult it would be to move the cross regulators to meet the targets.	3.0	1.0	*I-10A*	
94	I-14B		Level of maintenance of the cross regulators.	2.0	1.0	*I-10C*	
95	I-14C		Lack of water level fluctuation	0.0	3.0	*I-10D*	
96	I-14D		Travel time of a flow rate change throughout this canal level	1.0	2.0	*I-10E*	
97	I-15	Turnouts from the Second Level Canals		**3.0**		*I-12*	Second Level Canals
98	I-15A		Ease of turnout operation under the current target operation. This does not mean that the current targets are being met; rather this rating indicates how easy or difficult it would be to move the turnouts and measure flows to meet the targets.	3.0	1.0	*I-12A*	
99	I-15B		Level of maintenance	2.0	1.0	*I-12C*	
100	I-15C		Flow rate capacities	4.0	1.0	*I-12D*	
101	I-16	Regulating Reservoirs in the Second Level Canals		**0.0**		*I-13*	Second Level Canals
102	I-16A		Suitability of the number of location(s)	0.0	2.0	*I-13A*	
103	I-16B		Effectiveness of operation	0.0	2.0	*I-13B*	
104	I-16C		Suitability of the storage/buffer capacities	0.0	1.0	*I-13C*	
105	I-16D		Maintenance	0.0	1.0	*I-13D*	
106	I-17	Communications for the Second Level Canals		**1.6**		*I-I20*	Second Level Canals
107	I-17A		Frequency of communications with the next higher level? (hr)	1.0	2.0	*I-20A*	
108	I-17B		Frequency of communications by operators or supervisors with their customers	3.0	2.0	*I-20B*	
109	I-17C		Dependability of voice communications by phone or radio.	0.0	3.0	*I-20C*	
110	I-17D		Frequency of visits by upper level supervisors to the field.	4.0	1.0	*I-20D*	
111	I-17E		Existence and frequency of remote monitoring (either automatic or manual) at key **spill** points, including the end of the canal	0.0	1.0	*I-20E*	
112	I-17F		Availability of roads along the canal	3.0	2.0	*I-21F*	
113	I-18	General Conditions for the Second Level Canals		**1.2**		*I-21*	Second Level Canals
114	I-18A		General level of maintenance of the canal floor and canal banks	2.0	1.0	*I-21B*	
115	I-18B		General lack of undesired seepage (note: if deliberate conjunctive use is practiced, some seepage may be desired).	2.0	1.0	*I-21C*	
116	I-18C		Availability of proper equipment and staff to adequately maintain this canal	0.0	2.0	*I-21D*	
117	I-18D		Travel time from the maintenance yard to the most distant point along this canal (for crews and maintenance equipment)	2.0	1.0	*I-21E*	



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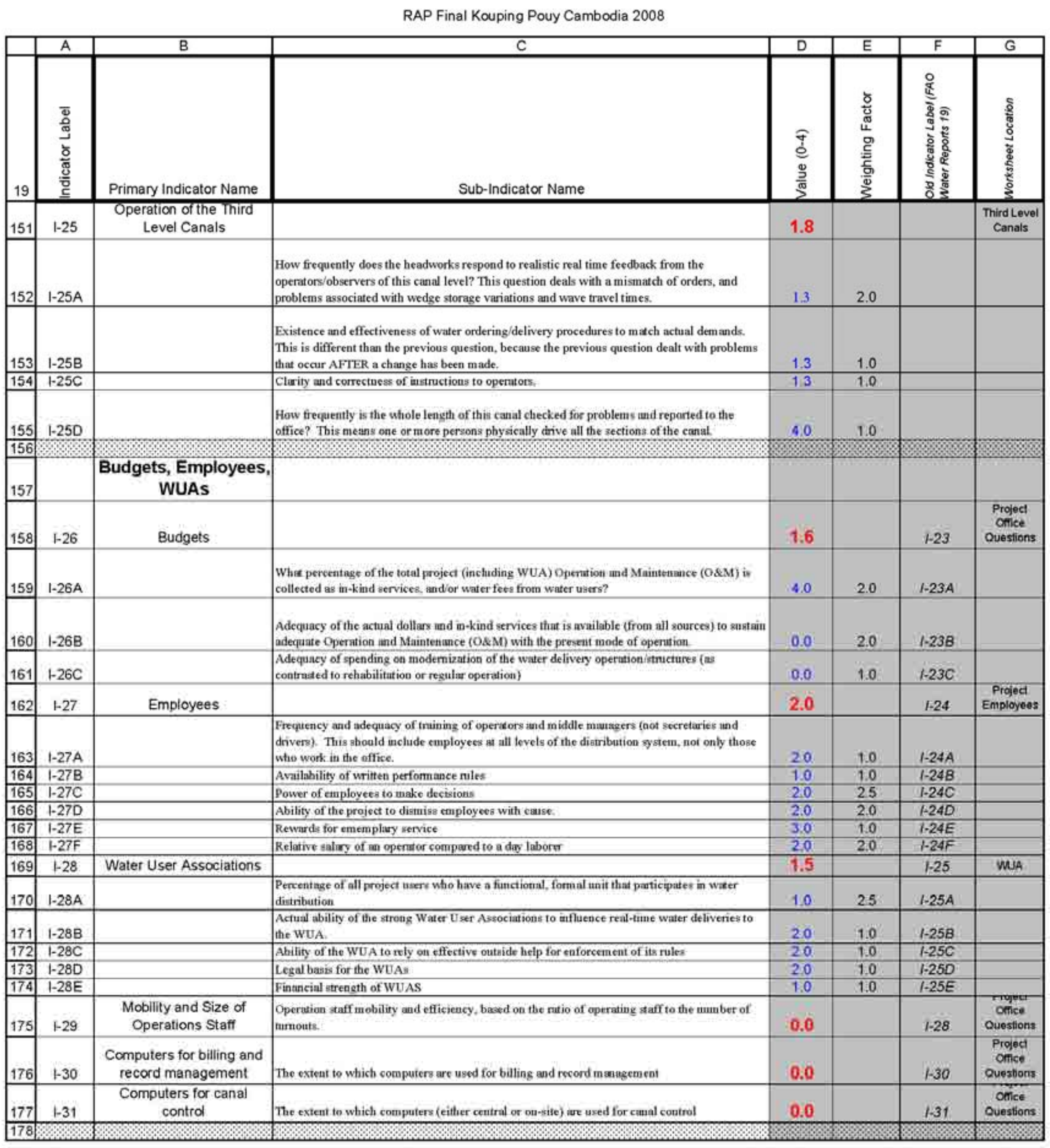
	A	B	C	D	E	F	G
19	Indicator Label	Primary Indicator Name	Sub-Indicator Name	Value (0-4)	Weighting Factor	Old Indicator Label (FAO Water Reports 19)	Worksheet Location
118	I-19	Operation of the Second Level Canals		2.4		*I-22*	Second Level Canals
119	I-19A		How frequently does the headworks respond to realistic real time feedback from the operators/observers of this canal level? This question deals with a mismatch of orders, and problems associated with wedge storage variations and wave travel times.	2.7	2.0	*I-22A*	
120	I-19B		Existence and effectiveness of water ordering/delivery procedures to match actual demands. This is different than the previous question, because the previous question dealt with problems that occur AFTER a change has been made.	2.7	1.0	*I-22B*	
121	I-19C		Clarity and correctness of instructions to operators.	1.3	1.0	*I-22C*	
122	I-19D		How frequently is the whole length of this canal checked for problems and reported to the office? This means one or more persons physically drive all the sections of the canal.	2.7	1.0	*I-22D*	
123							
124		**Third Level Canals**					
125	I-20	Cross regulator hardware (Third Level Canals)		1.0			Third Level Canals
126	I-20A		Ease of cross regulator operation under the current target operation. This does not mean that the current targets are being met; rather this rating indicates how easy or difficult it would be to move the cross regulators to meet the targets.	3.0	1.0		
127	I-20B		Level of maintenance of the cross regulators.	2.0	1.0		
128	I-20C		Lack of water level fluctuation	0.0	3.0		
129	I-20D		Travel time of a flow rate change throughout this canal level	1.0	2.0		
130	I-21	Turnouts from the Third Level Canals		2.3			Third Level Canals
131	I-21A		Ease of turnout operation under the current target operation. This does not mean that the current targets are being met; rather this rating indicates how easy or difficult it would be to move the turnouts and measure flows to meet the targets.	3.0	1.0		
132	I-21B		Level of maintenance	2.0	1.0		
133	I-21C		Flow rate capacities	2.0	1.0		
134	I-22	Regulating Reservoirs in the Third Level Canals		0.0			Third Level Canals
135	I-22A		Suitability of the number of location(s)	0.0	2.0		
136	I-22B		Effectiveness of operation	0.0	2.0		
137	I-22C		Suitability of the storage/buffer capacities	0.0	1.0		
138	I-22D		Maintenance	0.0	1.0		
139	I-23	Communications for the Third Level Canals		1.2			Third Level Canals
140	I-23A		Frequency of communications with the next higher level? (hr)	2.0	2.0		
141	I-23B		Frequency of communications by operators or supervisors with their customers	2.0	2.0		
142	I-23C		Dependability of voice communications by phone or radio.	0.0	3.0		
143	I-23D		Frequency of visits by upper level supervisors to the field.	3.0	1.0		
144	I-23E		Existence and frequency of remote monitoring (either automatic or manual) at key **spill** points, including the end of the canal	0.0	1.0		
145	I-23F		Availability of roads along the canal	1.0	2.0		
146	I-24	General Conditions for the Third Level Canals		2.8			Third Level Canals
147	I-24A		General level of maintenance of the canal floor and canal banks	2.0	1.0		
148	I-24B		General lack of undesired seepage (note: if deliberate conjunctive use is practiced, some seepage may be desired).	10.0	1.0		
149	I-24C		Availability of proper equipment and staff to adequately maintain this canal	0.0	2.0		
150	I-24D		Travel time from the maintenance yard to the most distant point along this canal (for crews and maintenance equipment)	2.0	1.0		



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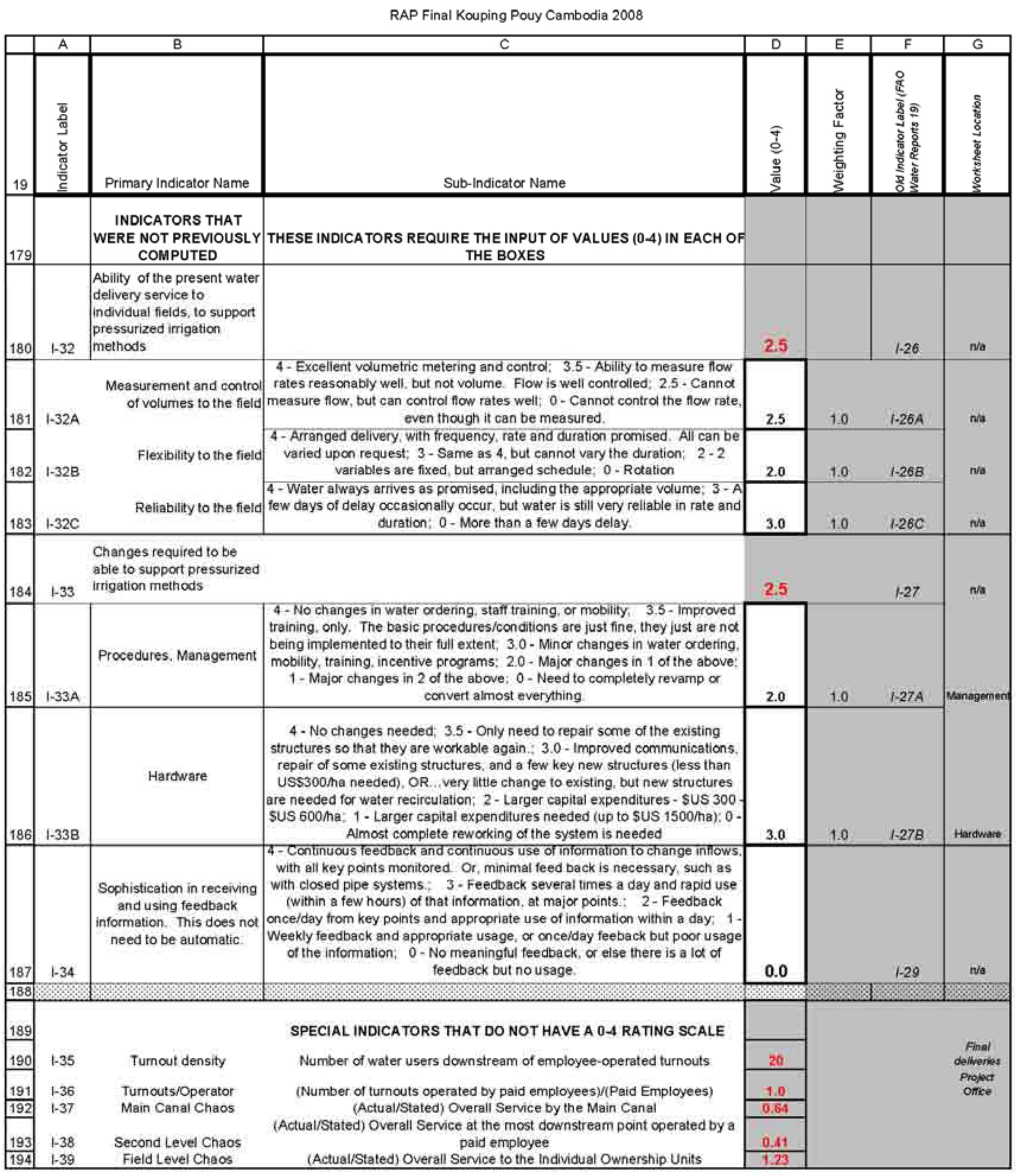
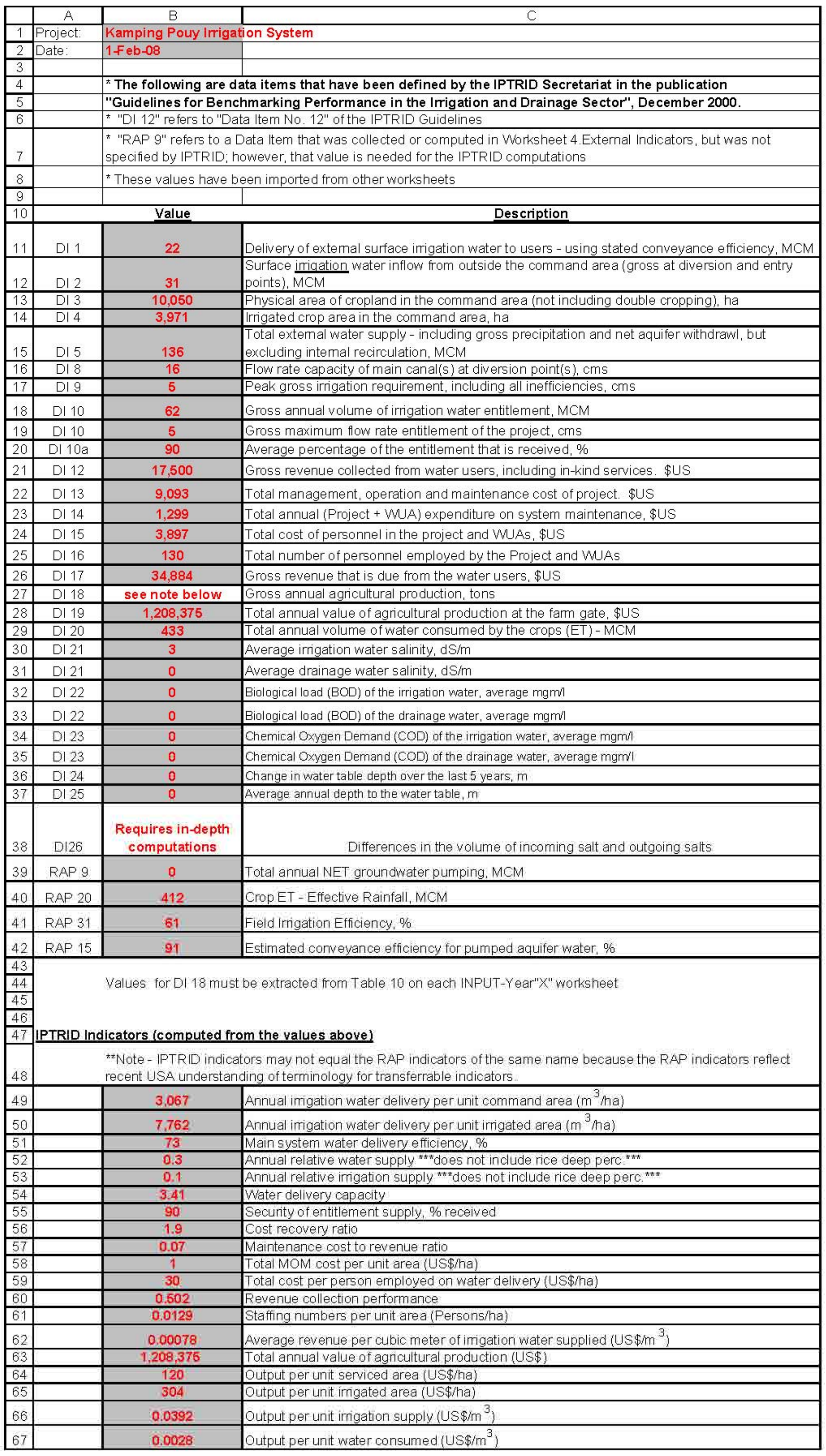
	A	B	C	D	E	F	G
19	Indicator Label	Primary Indicator Name	Sub-Indicator Name	Value (0-4)	Weighting Factor	Old Indicator Label (FAO Water Reports 19)	Worksheet Location
151	I-25	Operation of the Third Level Canals		1.8			Third Level Canals
152	I-25A		How frequently does the headworks respond to realistic real time feedback from the operators/observers of this canal level? This question deals with a mismatch of orders, and problems associated with wedge storage variations and wave travel times.	1.3	2.0		
153	I-25B		Existence and effectiveness of water ordering/delivery procedures to match actual demands. This is different than the previous question, because the previous question dealt with problems that occur AFTER a change has been made.	1.3	1.0		
154	I-25C		Clarity and correctness of instructions to operators.	1.3	1.0		
155	I-25D		How frequently is the whole length of this canal checked for problems and reported to the office? This means one or more persons physically drive all the sections of the canal.	4.0	1.0		
156							
157		**Budgets, Employees, WUAs**					
158	I-26	Budgets		1.6		*I-23*	Project Office Questions
159	I-26A		What percentage of the total project (including WUA) Operation and Maintenance (O&M) is collected as in-kind services, and/or water fees from water users?	4.0	2.0	*I-23A*	
160	I-26B		Adequacy of the actual dollars and in-kind services that is available (from all sources) to sustain adequate Operation and Maintenance (O&M) with the present mode of operation.	0.0	2.0	*I-23B*	
161	I-26C		Adequacy of spending on modernization of the water delivery operation/structures (as contrasted to rehabilitation or regular operation)	0.0	1.0	*I-23C*	
162	I-27	Employees		2.0		*I-24*	Project Employees
163	I-27A		Frequency and adequacy of training of operators and middle managers (not secretaries and drivers). This should include employees at all levels of the distribution system, not only those who work in the office.	2.0	1.0	*I-24A*	
164	I-27B		Availability of written performance rules	1.0	1.0	*I-24B*	
165	I-27C		Power of employees to make decisions	2.0	2.5	*I-24C*	
166	I-27D		Ability of the project to dismiss employees with cause.	2.0	2.0	*I-24D*	
167	I-27E		Rewards for ememplary service	3.0	1.0	*I-24E*	
168	I-27F		Relative salary of an operator compared to a day laborer	2.0	2.0	*I-24F*	
169	I-28	Water User Associations		1.5		*I-25*	WUA
170	I-28A		Percentage of all project users who have a functional, formal unit that participates in water distribution	1.0	2.5	*I-25A*	
171	I-28B		Actual ability of the strong Water User Associations to influence real-time water deliveries to the WUA.	2.0	1.0	*I-25B*	
172	I-28C		Ability of the WUA to rely on effective outside help for enforcement of its rules	2.0	1.0	*I-25C*	
173	I-28D		Legal basis for the WUAs	2.0	1.0	*I-25D*	
174	I-28E		Financial strength of WUAS	1.0	1.0	*I-25E*	
175	I-29	Mobility and Size of Operations Staff	Operation staff mobility and efficiency, based on the ratio of operating staff to the number of turnouts.	0.0		*I-28*	Office Questions
176	I-30	Computers for billing and record management	The extent to which computers are used for billing and record management	0.0		*I-30*	Project Office Questions
177	I-31	Computers for canal control	The extent to which computers (either central or on-site) are used for canal control	0.0		*I-31*	Office Questions
178							



RAP Final Kouping Pouy Cambodia 2008

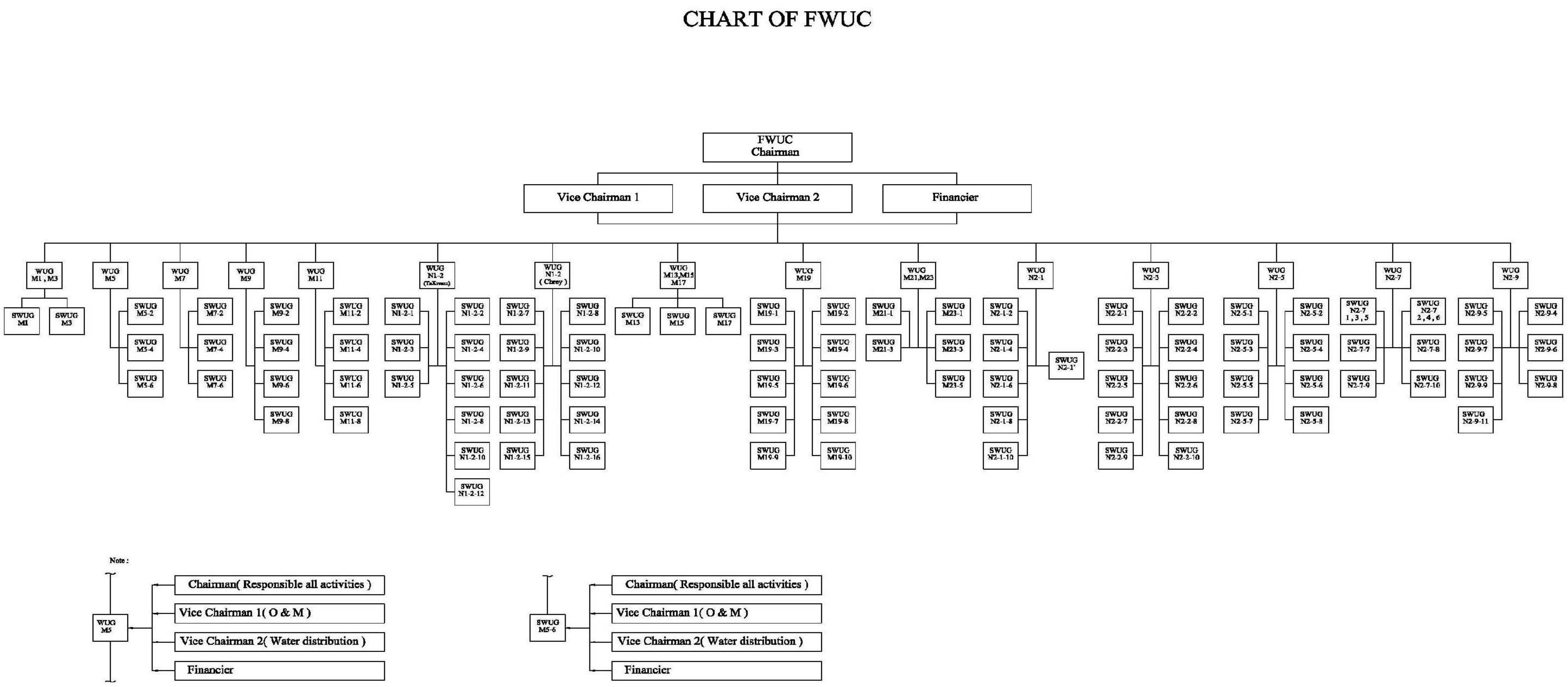
	A	B	C	D	E	F	G
19	Indicator Label	Primary Indicator Name	Sub-Indicator Name	Value (0-4)	Weighting Factor	*Old Indicator Label (FAO Water Reports 19)*	*Worksheet Location*
179		**INDICATORS THAT WERE NOT PREVIOUSLY COMPUTED**	**THESE INDICATORS REQUIRE THE INPUT OF VALUES (0-4) IN EACH OF THE BOXES**				
180	I-32	Ability of the present water delivery service to individual fields, to support pressurized irrigation methods		**2.5**		*I-26*	n/a
181	I-32A	Measurement and control of volumes to the field	4 - Excellent volumetric metering and control; 3.5 - Ability to measure flow rates reasonably well, but not volume. Flow is well controlled; 2.5 - Cannot measure flow, but can control flow rates well; 0 - Cannot control the flow rate, even though it can be measured.	2.5	1.0	*I-26A*	n/a
182	I-32B	Flexibility to the field	4 - Arranged delivery, with frequency, rate and duration promised. All can be varied upon request; 3 - Same as 4, but cannot vary the duration; 2 - 2 variables are fixed, but arranged schedule; 0 - Rotation	2.0	1.0	*I-26B*	n/a
183	I-32C	Reliability to the field	4 - Water always arrives as promised, including the appropriate volume; 3 - A few days of delay occasionally occur, but water is still very reliable in rate and duration; 0 - More than a few days delay.	3.0	1.0	*I-26C*	n/a
184	I-33	Changes required to be able to support pressurized irrigation methods		**2.5**		*I-27*	n/a
185	I-33A	Procedures, Management	4 - No changes in water ordering, staff training, or mobility; 3.5 - Improved training, only. The basic procedures/conditions are just fine, they just are not being implemented to their full extent; 3.0 - Minor changes in water ordering, mobility, training, incentive programs; 2.0 - Major changes in 1 of the above; 1 - Major changes in 2 of the above; 0 - Need to completely revamp or convert almost everything.	2.0	1.0	*I-27A*	Management
186	I-33B	Hardware	4 - No changes needed; 3.5 - Only need to repair some of the existing structures so that they are workable again.; 3.0 - Improved communications, repair of some existing structures, and a few key new structures (less than US$300/ha needed), OR…very little change to existing, but new structures are needed for water recirculation; 2 - Larger capital expenditures - $US 300 - $US 600/ha; 1 - Larger capital expenditures needed (up to $US 1500/ha); 0 - Almost complete reworking of the system is needed	3.0	1.0	*I-27B*	Hardware
187	I-34	Sophistication in receiving and using feedback information. This does not need to be automatic.	4 - Continuous feedback and continuous use of information to change inflows, with all key points monitored. Or, minimal feed back is necessary, such as with closed pipe systems.; 3 - Feedback several times a day and rapid use (within a few hours) of that information, at major points.; 2 - Feedback once/day from key points and appropriate use of information within a day; 1 - Weekly feedback and appropriate usage, or once/day feeback but poor usage of the information; 0 - No meaningful feedback, or else there is a lot of feedback but no usage.	**0.0**		*I-29*	n/a
188							
189			**SPECIAL INDICATORS THAT DO NOT HAVE A 0-4 RATING SCALE**				
190	I-35	Turnout density	Number of water users downstream of employee-operated turnouts	20			*Final deliveries Project Office*
191	I-36	Turnouts/Operator	(Number of turnouts operated by paid employees)/(Paid Employees)	1.0			
192	I-37	Main Canal Chaos	(Actual/Stated) Overall Service by the Main Canal	0.64			
193	I-38	Second Level Chaos	(Actual/Stated) Overall Service at the most downstream point operated by a paid employee	0.41			
194	I-39	Field Level Chaos	(Actual/Stated) Overall Service to the Individual Ownership Units	1.23			

13. IPTRID Indicators

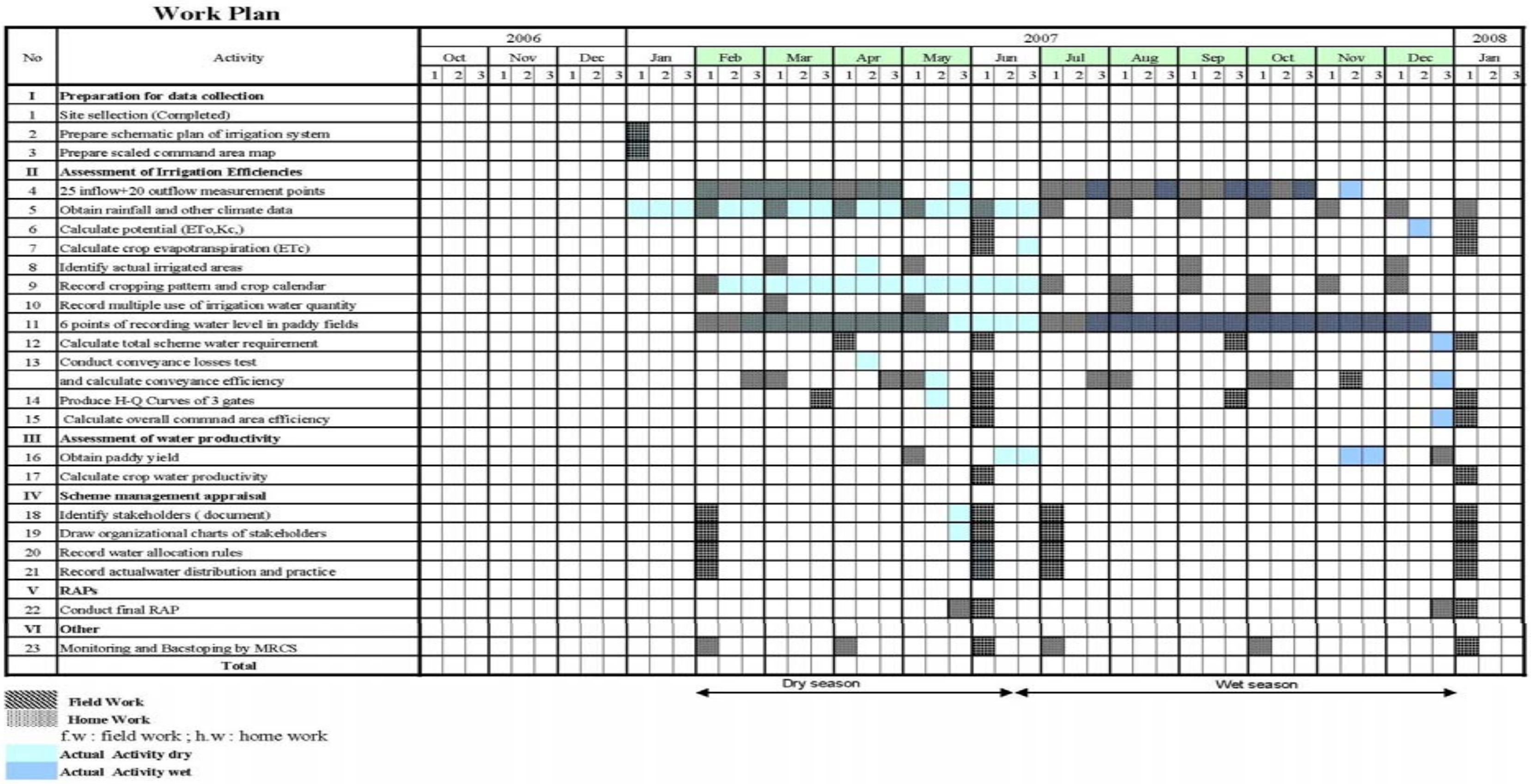


	A	B	C
1	Project:	**Kamping Pouy Irrigation System**	
2	Date:	**1-Feb-08**	
3			
4		*** The following are data items that have been defined by the IPTRID Secretariat in the publication**	
5		**"Guidelines for Benchmarking Performance in the Irrigation and Drainage Sector", December 2000.**	
6		* "DI 12" refers to "Data Item No. 12" of the IPTRID Guidelines	
7		* "RAP 9" refers to a Data Item that was collected or computed in Worksheet 4.External Indicators, but was not specified by IPTRID; however, that value is needed for the IPTRID computations	
8		* These values have been imported from other worksheets	
9			
10		**Value**	**Description**
11	DI 1	**22**	Delivery of external surface irrigation water to users - using stated conveyance efficiency, MCM
12	DI 2	**31**	Surface irrigation water inflow from outside the command area (gross at diversion and entry points), MCM
13	DI 3	**10,050**	Physical area of cropland in the command area (not including double cropping), ha
14	DI 4	**3,971**	Irrigated crop area in the command area, ha
15	DI 5	**136**	Total external water supply - including gross precipitation and net aquifer withdrawl, but excluding internal recirculation, MCM
16	DI 8	**16**	Flow rate capacity of main canal(s) at diversion point(s), cms
17	DI 9	**5**	Peak gross irrigation requirement, including all inefficiencies, cms
18	DI 10	**62**	Gross annual volume of irrigation water entitlement, MCM
19	DI 10	**5**	Gross maximum flow rate entitlement of the project, cms
20	DI 10a	**90**	Average percentage of the entitlement that is received, %
21	DI 12	**17,500**	Gross revenue collected from water users, including in-kind services. $US
22	DI 13	**9,093**	Total management, operation and maintenance cost of project. $US
23	DI 14	**1,299**	Total annual (Project + WUA) expenditure on system maintenance, $US
24	DI 15	**3,897**	Total cost of personnel in the project and WUAs, $US
25	DI 16	**130**	Total number of personnel employed by the Project and WUAs
26	DI 17	**34,884**	Gross revenue that is due from the water users, $US
27	DI 18	**see note below**	Gross annual agricultural production, tons
28	DI 19	**1,208,375**	Total annual value of agricultural production at the farm gate, $US
29	DI 20	**433**	Total annual volume of water consumed by the crops (ET) - MCM
30	DI 21	**3**	Average irrigation water salinity, dS/m
31	DI 21	**0**	Average drainage water salinity, dS/m
32	DI 22	**0**	Biological load (BOD) of the irrigation water, average mgm/l
33	DI 22	**0**	Biological load (BOD) of the drainage water, average mgm/l
34	DI 23	**0**	Chemical Oxygen Demand (COD) of the irrigation water, average mgm/l
35	DI 23	**0**	Chemical Oxygen Demand (COD) of the drainage water, average mgm/l
36	DI 24	**0**	Change in water table depth over the last 5 years, m
37	DI 25	**0**	Average annual depth to the water table, m
38	DI26	**Requires in-depth computations**	Differences in the volume of incoming salt and outgoing salts
39	RAP 9	**0**	Total annual NET groundwater pumping, MCM
40	RAP 20	**412**	Crop ET - Effective Rainfall, MCM
41	RAP 31	**61**	Field Irrigation Efficiency, %
42	RAP 15	**91**	Estimated conveyance efficiency for pumped aquifer water, %
43			
44		Values for DI 18 must be extracted from Table 10 on each INPUT-Year"X" worksheet	
45			
46			
47	**IPTRID Indicators (computed from the values above)**		
48		**Note - IPTRID indicators may not equal the RAP indicators of the same name because the RAP indicators reflect recent USA understanding of terminology for transferrable indicators.	
49		**3,067**	Annual irrigation water delivery per unit command area (m^3/ha)
50		**7,762**	Annual irrigation water delivery per unit irrigated area (m^3/ha)
51		**73**	Main system water delivery efficiency, %
52		**0.3**	Annual relative water supply ***does not include rice deep perc.***
53		**0.1**	Annual relative irrigation supply ***does not include rice deep perc.***
54		**3.41**	Water delivery capacity
55		**90**	Security of entitlement supply, % received
56		**1.9**	Cost recovery ratio
57		**0.07**	Maintenance cost to revenue ratio
58		**1**	Total MOM cost per unit area (US$/ha)
59		**30**	Total cost per person employed on water delivery (US$/ha)
60		**0.502**	Revenue collection performance
61		**0.0129**	Staffing numbers per unit area (Persons/ha)
62		**0.00078**	Average revenue per cubic meter of irrigation water supplied (US$/m^3)
63		**1,208,375**	Total annual value of agricultural production (US$)
64		**120**	Output per unit serviced area (US$/ha)
65		**304**	Output per unit irrigated area (US$/ha)
66		**0.0392**	Output per unit irrigation supply (US$/m^3)
67		**0.0028**	Output per unit water consumed (US$/m^3)

Annex 17. Organization chart of FWUC



Annex 18. Work Plan of Activities



Work Plan

No	Activity
I	**Preparation for data collection**
1	Site sellection (Completed)
2	Prepare schematic plan of irrigation system
3	Prepare scaled command area map
II	**Assessment of Irrigation Efficiencies**
4	25 inflow+20 outflow measurement points
5	Obtain rainfall and other climate data
6	Calculate potential (ETo,Kc,)
7	Calculate crop evapotranspiration (ETc)
8	Identify actual irrigated areas
9	Record cropping pattern and crop calendar
10	Record multiple use of irrigation water quantity
11	6 points of recording water level in paddy fields
12	Calculate total scheme water requirement
13	Conduct conveyance losses test
	and calculate conveyance efficiency
14	Produce H-Q Curves of 3 gates
15	Calculate overall commnad area efficiency
III	**Assessment of water productivity**
16	Obtain paddy yield
17	Calculate crop water productivity
IV	**Scheme management appraisal**
18	Identify stakeholders (document)
19	Draw organizational charts of stakeholders
20	Record water allocation rules
21	Record actualwater distribution and practice
V	**RAPs**
22	Conduct final RAP
VI	**Other**
23	Monitoring and Bacstoping by MRCS
	Total

Annex 19. Total Irrigation System Inventory in Cambodia

				Small Scale (ha)				**Medium Scale (ha)**				**Large Scale (ha)**			
No.	**Province**	**Total irrigation Systems**	**Total Irrigated area (Ha)**	**No.**	**Wet**	**Dry**	**Total**	**No.**	**Wet**	**Dry**	**Total**	**No.**	**Wet**	**Dry**	**Total**
1	Phnom Penh	10	6,328	4	400	550	**950**	6	4,350	1,028	**5,378**	0	0	0	**0**
2	Kandal	252	68,927	172	8,466	15,111	**23,577**	78	14,902	30,448	**45,350**	2	0	0	**0**
3	Kompong Cham	340	85,277	235	9,420	14,498	**23,918**	104	35,891	17,468	**53,359**	1	6,000	2,000	**8,000**
4	Prey Veng	241	71,221	148	7,346	9,103	**16,449**	92	24,224	24,548	**48,772**	1	0	6,000	**6,000**
5	Svay Rieng	43	102,256	16	1,673	1,165	**2,838**	24	9,126	8,489	**17,615**	3	46,603	35,200	**81,803**
6	Takeo	114	121,295	22	1,335	2,230	**3,565**	86	25,497	54,449	**79,946**	6	12,440	25,344	**37,784**
7	Kompong Chhnang	134	48,940	58	3,809	4,100	**7,909**	76	24,198	16,833	**41,031**	0	0	0	**0**
8	Pursat	64	25,435	16	650	410	**1,060**	45	21,425	950	**22,375**	3	2,000	0	**2,000**
9	Battambang	60	59,292	26	1,890	57	**1,947**	29	28,405	890	**29,295**	5	24,750	3,300	**28,050**
10	Pailin	1	520	0	0	0	**0**	1	520	0	**520**	0	0	0	**0**
11	Banteay Meanchey	125	35,576	95	8,921	292	**9,213**	27	17,562	721	**18,283**	3	8,000	80	**8,080**
12	Oddor Meanchey	29	48,364	7	735	201	**936**	19	12,871	2,147	**15,018**	3	29,760	2,650	**32,410**
13	Siem Reap	224	122,203	110	1,094	13,720	**14,814**	111	13,920	67,269	**81,189**	3	4,200	22,000	**26,200**
14	Kompong Thom	204	77,162	122	14,755	243	**14,998**	82	58,984	3,180	**62,164**	0	0	0	**0**
15	Sihanukville	20	15,530	13	1,870	0	**1,870**	6	1,660	0	**1,660**	1	12,000	0	**12,000**
16	Kep	9	3,786	5	328	210	**538**	4	2,798	450	**3,248**	0	0	0	**0**
17	Kompot	75	69,707	21	2,297	565	**2,862**	53	34,273	7,572	**41,845**	1	20,000	5,000	**25,000**
18	Koh Kong	13	5,307	5	1,193	0	**1,193**	8	4,114	0	**4,114**	0	0	0	**0**
19	Prea Vihear	94	30,366	65	7,170	1,626	**8,796**	29	16,900	4,670	**21,570**	0	0	0	**0**
20	Stung Treng	25	5,693	18	2,415	658	**3,073**	7	2,110	510	**2,620**	0	0	0	**0**
21	Rattanakiri	32	6,997	26	3,793	603	**4,396**	6	2,121	480	**2,601**	0	0	0	**0**
22	Mundulkiri	18	3,001	14	1,765	0	**1,765**	4	1,236	0	**1,236**	0	0	0	**0**
23	Kratie	169	9,235	155	2,949	1,737	**4,686**	14	1,301	3,248	**4,549**	0	0	0	**0**
24	Kompong Speu	107	23,845	62	6,880	1,999	**8,879**	44	13,733	1,233	**14,966**	1	0	0	**0**
	Total	**2,403**	**1,046,263**	**1,415**	**91,154**	**69,078**	**160,232**	**955**	**372,121**	**246,583**	**618,704**	**33**	**165,753**	**101,574**	**267,327**

Annex 20. Photos

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		R	60% R	25% R	7%		
1	M1+3	900000	540,000	225,000	63,000	45000	27000
2	M5	322,500	193,500	80,625	22,575	16,125	9675
3	M7	1596300	957780	399075	111741	79815	47889
4	M9	972,500	583500	243125	68075	48625	29175
5	M11	1404000	842400	351,000	98280	70200	42100
6	M13+15	960,000	576000	240,000	67200	48,000	28800
7	M17	702000	421200	175500	49140	35100	21060
8	M19	2172000	1303200	543000	152040	108600	65160
9	M21+23	670,000	402000	167,500	46,900	33500	20100
10	N1.2	3,414,000	2048,400	853,500	238980	170700	102420
11	N1.2	1,909,000	1145,400	477250	133,630	95450	57270
12	N2.1	485000	291000	121250	33950	24250	14550
13	N2.3	1,363000	817800	340750	95410	68150	40890
14	N2.5	911,000	546600	227750	63770	45550	27330
		17711300	[illegible]	4405325	1244691	889065	533439