



Department of Potable Water Supply
Ministry of Industry, Mining and Energy (MIME)
Phnom Penh, Royal Kingdom of Cambodia

**Provincial and Peri-Urban Water Supply and
Sanitation Project, Royal Kingdom of Cambodia**

**Initial Environmental
Impact Assessment Report**

Boeung Trakunn (M12)

**District of Thma Pourk
Banteay Meanchey Province**

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DRAFT, December 2002

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LIST OF ABBREVIATIONS

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DBL	Design/Build/Lease
DD	Detailed Design
DPWS	Department of Potable Water Supply
DPWT	Department of Public Works and Transport (Municipality)
EA	Environmental Assessment
EEA	Environmental Examination Application
EIA	Environmental Impact Assessment
EMiP	Environmental Mitigations Plan (part of an EMP)
EMoP	Environmental Monitoring Plan (part of an EMP)
EMP	Environmental Management Plan
FS	Feasibility Study
FT	Fraser Tomas (Engineering Consultants)
GHD	Gutteridge, Haskins & Davey (Engineering Consultants)
IEIA	Initial Environmental Impact Assessment
JICA	Japan International Cooperation Agency
LCPSS	Low Cost Pilot Sewerage System
Lpcd	Liters per capita per day
Mg/l	Milligrams per liter
MIME	Ministry of Industry, Mines, and Energy
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MPP	Municipality of Phnom Penh
MWRM	Ministry of Water Resources and Meteorology
MPWT	Ministry of Public Works and Transport
NGO	Non Governmental Organization
PCD	Pollution Control Department (Ministry of Environment)
PG	Provincial Government
PMU	Project Management Unit
PO	Project Owner
PPWSA	Phnom Penh Water Supply Authority
PPUWSSP	Provincial and Peri-Urban Water Supply and Sanitation Project
RGC	Royal Government of Cambodia
ToR	Terms of Reference
TSS	Total Suspended Solids
WB	World Bank
WHO	World Health Organization
WSS	Water Supply and Sanitation
WTC	Willingness to Connect

PROJECT SUMMARY

General

The purpose of the Environmental Assessment is to identify and evaluate the significance of any potential environmental impacts on the proposed construction and development program for a new water supply system for Boeung Trakunn (District of Thma Pourk, Banteay Meanchey Province) and to recommend avoidance, preventive and mitigation measures to ensure that residual environmental impacts are acceptable and are within the applicable limitation standards prescribed by the Ministry of Environment and the World Bank.

The Local Government of Boeung Trakunn has initiated the current project, with support of the Provincial Government of Banteay Meanchey and the Department of Potable Water Supply (DPWS) of MIME. The actual 'Project Owner' is the Ministry of Industry, Mines and Energy.

Project description

Based upon the evaluation of the various options for a possible water supply scheme, MIME, with support of the Engineering Consultants GHD/FT, has prepared a viable project proposal. The project will provide piped water supply for a population estimated at 2,716 persons (492 households), with service initially to some 51 to 60 percent of the population within the service area at 40 l/cd, increasing to 60 l/cd and serving 90 percent of the population in the service area. Preliminary calculations indicate a required water demand (ADP) of 260 m³/day.

The water source will be groundwater through 2 deep bores. The necessary treatment will be applied to comply with Cambodian drinking water quality standards. The treatment plant will be located on the land identified by the Commune to the south of the NPA development area. Treatment comprises aeration, chemical dosing and sedimentation, slow sand filter and disinfection. Water will be pumped from a Clearwater tank through a booster pump into the system. A single metered connection will be provided to each house, where it is assumed that household "water jar" storage will continue to be used.

No resettlement will be required.

Land Acquisition

The scheme is based on the treatment plant being located on the land to the south of the new NPA settlement area identified as being available for the scheme. This has been adopted not only because it is readily available but also it is in the general vicinity of the geo-resistivity survey arrays identifying the best groundwater target zones.

An alternative with the treatment plant relocated at the bore-field has been examined as a desk study. This appears to show a worthwhile saving in costs however the land in question has yet to be de-mined and so it has not been possible to confirm the suitability of the suggested site. This option could be left to a future Contractor to evaluate, on the basis that the Contractor would have to acquire the land (with suitable safeguards to ensure the purchase occurred at market rates) and offer an appropriate reduction in tariff.

The land for the proposed wells and pumping stations should be purchased (or made available by the Commune) with official documentation as soon as the locations of wells are confirmed by the private operator. The treatment plant will be established on the land identified by the Commune, behind the existing Commune office.

The land to be purchased is estimated at ...m². The acquisition of land will be facilitated by MIME as part of their responsibility to the project. If possible, the PMU representative will facilitate the issuance of "Deed of Donation" or statements on the willingness to sell prior to the construction to avoid any conflict with the lot owner.

Consultations

After series of meetings/consultations with concerned Provincial Government Officials of the Banteay Meanchey Province and the local officials and residents of Boeung Trakunn, the Project was approved and endorsed. Overall, the project is perceived to be of great help to the community since it will significantly improve the quality of the drinking water supply and public health conditions by reducing common cases of water borne diseases (diarrhea, gastroenteritis and parasitism). The project will further stimulate socio-economic growth through increase in the number of commercial and economic activities thus adding revenue to the community.

The Willingness to Connect (WTC) indicated that ??? of the ??? households within the service area of Boeung Trakunn approved a tariff of 2425 Riel/m³.

Environmental Management Plan

To mitigate possible general adverse environmental impacts (e.g. drainage, sanitation, damage to soils and water and economic losses), discussions are held with all major stakeholders. The findings and conclusions on the actions to be taken have been summarized in an Environmental Management Plan (EMP), including:

- An Environmental Mitigation Plan (EMiP), outlining the measures to be taken to mitigate adverse environmental impacts;
- An Environmental Monitoring Plan (EMoP), defining the environmental parameters to be observed and reported;
- Overview of the implementation arrangements, defining the responsibilities and timing.

Monitoring arrangements

MIME will have the overall responsibility for the proper implementation of the Environmental Management Plan (EMP). Upon the signing of the DBL contract, the Project Management Unit (PMU) will proceed with the necessary steps for the environmentally sound construction and operation of the water supply system, as defined in the EMP. During the construction phase, PMU will be responsible for securing that proper measures are taken by the different contractors. The PMU will inform DPWS/MIME if violations occur, and appropriate actions will be taken. Moreover, DPWS/MIME staff will carry out control inspection during their regular visits to the Provinces.

During operation of the water supply system, the Contractor and the PMU will have the main responsibility for the proper implementation of the monitoring plan. The monitoring data will be well documented and be available with the Contractor and PMU for consultation and inspection.

Brief quarterly monitoring reports will be submitted to DPWS/MIME and the Ministry of Environment, including: Presentation of the collected data; Discussion of the compliance and non-compliance to the EMP; and Conclusion and Recommendation.

Regular annual monitoring reports will be submitted to the World Bank during the operation phase. The environmental data will be available with the DPWS/MIME and the Contractor for consultation and inspection.

Environmental Mitigation Plan (EMiP) for Boeung Trakunn, Banteay Meanchey

Phase	Mitigation measures	Responsibility	Schedule
Pre-construction	<ul style="list-style-type: none"> Lack of control of water source Acquire land directly around the facilities (or secure a possible purchase), Reduction in flow Locate the well in an area where other water users are not affected Disturbance of land use and economic activities Usage of public areas, Provision for proper compensation 	MIME, World Bank	Prior to DBL Contracts
Construction	<ul style="list-style-type: none"> Disturbance of land use due to drilling/construction Minimize impacts, Restore damages Loss of natural vegetation: Replanting of affected areas Disturbance of stream channels, aquatic plant and animal habitats Erosion and sedimentation control Soil and water contamination (e.g. spilling of oil products and other construction materials) Control (collection, disposal) of waste water Hindrance (noise, air pollution, traffic, etc) due to drilling/construction activities Minimize hindrance, Usage of main roads when possible. Soil erosion and compaction Proper runoff and erosion control measures, Heavy traffic restrictions Safety hazards Proper safety and warning measures, Provision of temporary crossings/bridges; Public information campaign 	Operator, with supervision of MIME consultant	Continuous during construction phase
Operation	<ul style="list-style-type: none"> Public health hazards due to increase of wastewater Support the construction of proper on-site sanitary facilities (if lacking), Improve storm drainage system for sullage, Contamination of the groundwater: Acquire and fence a protection zone directly around the well, Regulate potential polluting activities in recharge zone; Monitor water level and groundwater abstraction. Lowered groundwater table. Space wells at larger distances, Avoid over-abstraction and consequent lowering of groundwater table, Calculate safe yield (abstraction), Assure/prove that other water users are not affected Increase of noise. Usage of electrical submersible pumps, Construction of pumping house 	Operator, with supervision of MIME	To be determined during feasibility study
Abandoning phase	<ul style="list-style-type: none"> Water availability keep traditional water sources available 		

Environmental Monitoring Plan (EMoP) for Boeung Trakunn, Banteay Meanchey

Phase	Monitoring activities	Responsibility	Implementation
Pre-construction	<ul style="list-style-type: none"> Land acquisition Check if the required land has been acquired properly, or that a proper "Deed of Sale/Donation" has been prepared Resettlement and Compensation If applicable, check if proper arrangements are made and documented 	MIME, World Bank	Prior to DBL Contract
Construction	<ul style="list-style-type: none"> Hindrance to local population Noise, air pollution (odor, TSP, fume emissions), land damage, traffic EMP compliance of the contractors Erosion control, vegetation protection, soil and water contamination Safety precautions of contractors Conform professional standards Sanitary control Proper construction of on-site facilities, Proper construction of sullage drainage system 	Operator, with supervision of MIME consultant	Continuous, through regular construction supervision
Operation	<ul style="list-style-type: none"> Quality of distributed water. conform official standard procedures (microbiology, standard parameters, Arsenic, heavy metals), Groundwater resources water level (2 X per month (after pumping recovery period), operation of pumps (abstraction). 	Operator, with supervision of MIME	Regular, according to professional standards
Abandoning phase	<ul style="list-style-type: none"> None 		

1 INTRODUCTION

1.1 Background of the Project

The 'Provincial and Peri-Urban Water Supply and Sanitation' project (PPUWSSP) is being prepared and implemented by the Department of Potable Water Supply (DPWS) of the Ministry of Industry, Mining and Energy (MIME), and the Phnom Penh Water Supply Authority (PPWSA), Kingdom of Cambodia. The PPUWSSP is financed through a loan from the World Bank.

The MIME component aims at financing water supply and sanitation projects targeting provincial towns and district towns that express demand for improved services and low-income communities in urban centers. It finances investments that (i) respond to what consumers want and are willing to pay, (ii) facilitate and develop private sector participation in financing, operating and maintaining constructed facilities, while designing specific instruments that ensure inclusion of low income communities residing in the service areas.

Upon the request of the local governments, the town of Boeung Trakunn, Province of Banteay Meanchey (Figure 1-1), has been included in the first batch of the project. Boeung Trakunn has expressed its interest in the project as it does not have a proper water supply system yet. During the dry season, serious water shortages occur.

Figure 1-1 – Location map of the project area



The purpose of the present Initial Environmental Impact Assessment (IEIA) is to identify possible environmental and social impacts arising from the proposed construction and development of a piped water supply system for Boeung Trakunn, Province of Banteay Meanchey (M12).

As described below, many sections of the current report have been obtained from the Feasibility Study reports, prepared by the Engineering Consultant GHD/FT

1.2 Environmental Assessment

The EA has been prepared in accordance with the guidelines of the Ministry of Environment (MoE, see also section 1.3), combined with World Bank guidelines on Environmental Assessment. Both within the Cambodian and the World Bank regulatory framework an environmental clearance is required before the project implementation can start. Environmentally sound practices have been incorporated in the project planning and design, and possible negative impacts have been identified to be mitigated to acceptable levels.

The EA was carried out by a technical team, comprising of engineers and environment specialists (See Annex I - List of EA preparers). Multiple consultations with the staff of MIME, Provincial Government, Commune chiefs, and the local beneficiaries were conducted in order to solicit their comments, reactions and finally seek their proper approval and endorsement of the proposed project (see Annex II – WTC Process documentation and Annex III - Proof of social acceptability).

Desk research was carried out through obtaining available data about the physical, socio-economic, environmental characterization, political profiles from the Engineering Consultants GHD/FT. Data were also gathered and reviewed from the national line agencies/offices such as Ministry of Rural Development (MRD), Ministry of Agriculture (MoA), and Ministry of Environment (MoE). These available reports/literatures and other materials relevant to the conduct of the Environmental Assessment report were compiled and reviewed.

Aside from data gathering activities, actual interview and constant coordination with the members of the Provincial Management Unit (PMU) at the Provincial and Municipal/City levels were carried out to gather first hand information/data.

1.3 Institutional and legal framework

Overall management of the environment lies with the Ministry of Environment (MoE), which was created in 1993. The MoE has wide responsibilities, which are spelled out in the Law on Environmental Protection and Natural Resources Management. At the provincial and city levels, there are corresponding Provincial/City Environment Departments. These local departments have the responsibility of enforcing the environmental legislation coming under the competence of the MoE. However, the daily operational functions of these departments would normally come under the direct control of the provincial/city authorities.

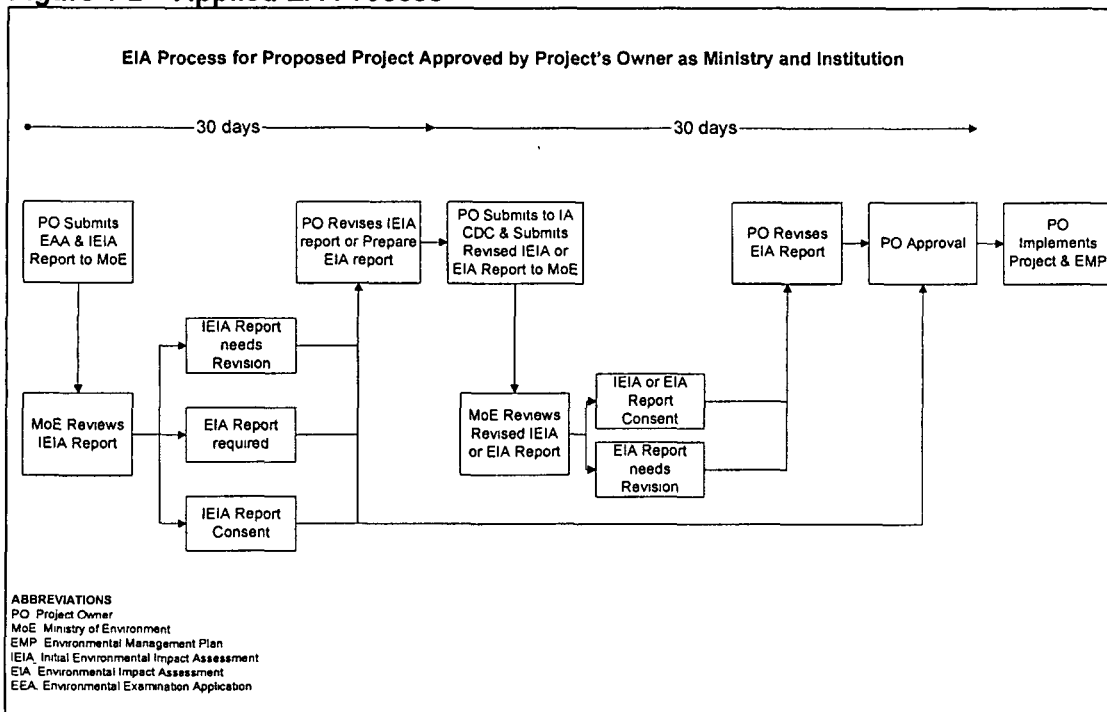
The objectives of the framework Law are to protect environmental quality through the prevention, reduction and control of pollution, to establish an Environmental Impact Assessment (EIA) system, to ensure sustainable use of natural resources, to encourage public participation and to suppress acts which are harmful to the environment.

The framework Law calls for an EA to be conducted for every private or public project, to be reviewed by the Ministry of Environment before submission to the Government for a final decision. All proposed and existing activities are to be covered under this requirement. Sub-decrees are anticipated to provide for the finer details of the system.

The Sub-degree on Environmental Impact Assessment Process, which was issued in December 1999, details specific procedures to be followed and the nature and size of projects which are required to submit EIAs. The Cambodian EIA requirements for water supply projects start with 10,000 users.

Based on the above mentioned documents, the MoE have drafted flowcharts showing the EIA procedure to be applied. For the present project, with MIME being the Project owner, the applied process is shown in Figure 1-2.

Figure 1-2 – Applied EA Process



The first step in the EA process is the preparation of an Initial Environmental Impact Assessment (IEIA), to be submitted by the Project Owner to the MoE, supplemented with an Environmental Examination Application (EEA). Based on the review of the IEIA, the Project will either be approved, additional changes to the IEIA will have to be made, or a full scale EIA report will have to be prepared.

Furthermore, the MoE has prepared draft guidelines for the set-up and contents of the EIA reports). Although still in draft form, they have been applied as the basis for the IEIA reports

2 PURPOSE OF THE PROJECT

2.1 Objectives

The objective of the project is to supply safe drinking water through a piped water supply system to the town of Boeung Trakunn, Banteay Meanchey Province. The project is anchored on the principals that:

- Water can be managed as an economic good;
- The project must be “*demand-driven*” oriented meaning, that the prospective end users must be willing and capable to pay for services;
- The system will be operated and managed by a private operator.

The project design is consistent with the water supply and sanitation policy framework of Cambodia, and finance investments that (i) respond to what consumers want and are willing to pay, (ii) facilitate and develop private sector participation in financing, operating and maintaining constructed facilities, while designing specific instruments that ensure inclusion of low income communities residing in the service areas.

2.2 Public participation

Public participation and consultations of the PPUWSSP focused on two main objectives:

1. To assist national and local governments in arriving at a decision to finance the development of their water supply system based on their financial capacity and to select the most feasible management and operation system of the water utility;
2. To encourage user’s participation in the selection of a technically feasible water supply system, that is based on their demand/wants and their capacity and willingness-to pay for that desired service.

Bearing these principles in mind GHD/FT designed strategies that would promote these principles during the conduct of the Rapid Feasibility Study. Among these strategies are the series of presentation and consultation activities with the different stakeholders at the local level. The areas for consultation and negotiations were focused on the following:

- Technical options for the water supply system, the project investment cost, and the required equity contribution;
- Cost recovery options and water tariff structure ;
- Operation and management scheme for the system; and
- Project implementation arrangement (Design/Build/Lease) of the water utility.

There were two levels of consultations during the feasibility study. The first level was with the local governments (see section 5.1). The second level of consultation focused on for the prospective users in the service areas (see section 5.2).

For a Project Town to proceed to full preliminary design, at least 51% of the heads of households living within the Service Area(s) must indicate their support for the new scheme (see section 5.3).

3 PROJECT DESCRIPTION

3.1 Service area

The proposed service area or the project is shown in Figure 3-1. The central town and new settlement area developed by the Norwegian People's Assistance to the south of the town center as well as the smaller development area in the south-west sector of the town which has been de-mined by the people themselves. The town comprises an underdeveloped central sector and sparse settlement elsewhere with a large transient population. Boeung Trakoun is located within 200 m of the international border with Thailand in the northwest of Banteay Meanchey province.

Service area currently contains 492 households. Number confirmed by discussions with the District and Commune Governments and inspection and count in the field. The town is a development area and including de-mined vacant lots there are 615 residential allotments. It is assumed that efforts will be made to encourage people to the town and that growth will be by rapid take-up of the vacant lots. This is substantially higher rate of household formation than the average for Cambodia. It is therefore assumed that growth outside the development area will be nominal and 0.5% per year net increase in lots has been adopted.

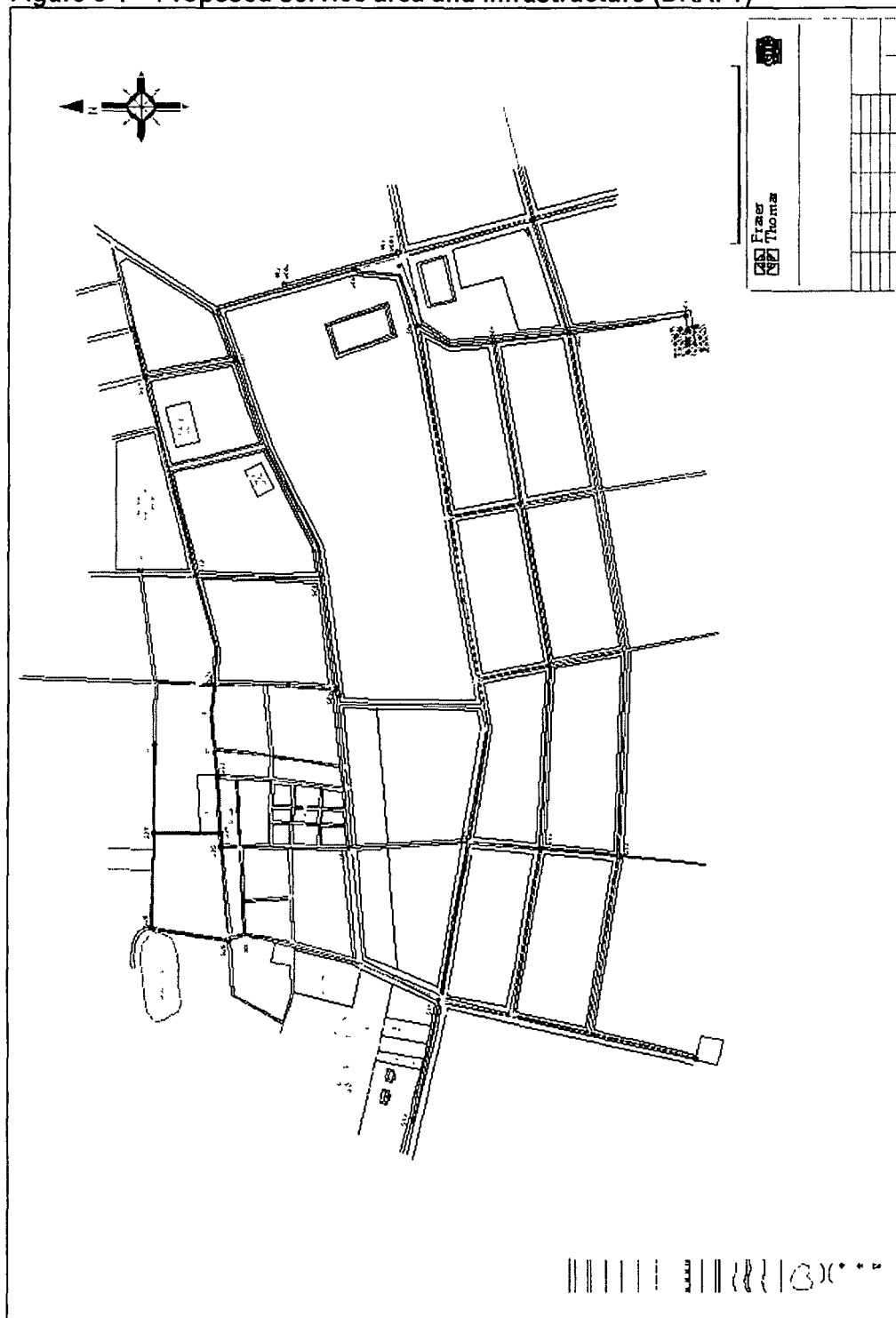
3.2 Summary of Infrastructure

The proposed infrastructure to be constructed for the project is summarized in Table 3-1. The listing is based on the feasibility study, as prepared by GHD/FT. Figure 3-1 shows the layout of the proposed infrastructure.

Table 3-1 – Summary of proposed infrastructural works

- Groundwater abstraction via deep bores
 - The establishment of a treatment plant on the land identified by the Commune to the south of the NPA development area.
 - Treatment comprising aeration, chemical dosing and sedimentation, slow sand filter and disinfection.
 - Pumping from a Clearwater tank through a booster pump into the system.
 - Distribution network along the main roads.
 - A single metered connection provided to each house, where it is assumed that household "water jar" storage will continue to be used.
-

Figure 3-1 – Proposed service area and infrastructure (DRAFT)



Source GHD/FT, 2002

3.3 Water quality standards

There are currently not yet official water quality standards of Cambodia. In general, the World Health Organization (WHO) guidelines are being applied.

Official standards are however under preparation by an Inter-ministerial Committee, with support from WHO. The proposed water quality standards are included in Annex IV, and will be applied for the proposed water supply system.

The recommendations are especially important for the Arsenic level. As it seems that the WHO guideline of 10µg/l is unrealistic to apply currently, a (temporary) value of 50µg/l will be proposed for Cambodia.

3.4 Project planning and implementation

Boeung Trakunn is part of a first batch of the PPUWSSP, to be implemented under World Bank financing, through the joint effort of MIME, the PPWSA, and Ministry of Finance (MoF). MIME has the implementation responsibility for the provincial town program. A Project Management Office (PMO) has been established by the MIME in Phnom Penh for directing, supervising and coordinating all day-to-day implementation activities. The Provincial Government of Banteay Meanchey has established a Project Management Unit (PMU) for actual implementation of the water system.

The adopted strategy for implementing the water supply systems in the towns is to bid a Design/Build/Lease (DBL) scheme to private operators. Under the DBL scheme, MIME will enter into a contract with a private operator who will be responsible for the design, construction and operation of a cluster of systems. The lease contract is expected to cover a period of fifteen (15) years and will establish the conditions and provisions under which the operator must operate and maintain the water system. After the 15 years contract period, the private operator should turn over the water system in operating conditions to MIME or may enter into a new agreement with MIME to renew the lease contract for a similar period of time.

The project construction is expected to commence, after approval of the proposed water charges by the respective beneficiaries, beginning of 2003, with the bidding for the DBL contract and to be implemented over a period of 18 months. The confirmation of the water sources recommended in the feasibility study, particularly the drilling and construction of exploratory/production well; is considered a critical activity. In fact only when capacity and quality of the water sources are confirmed and detailed design can be prepared including any necessary revision in the scheme outlines in the feasibility study.

4 DESCRIPTION OF ENVIRONMENTAL RESOURCES

4.1 Physical resources

Topography

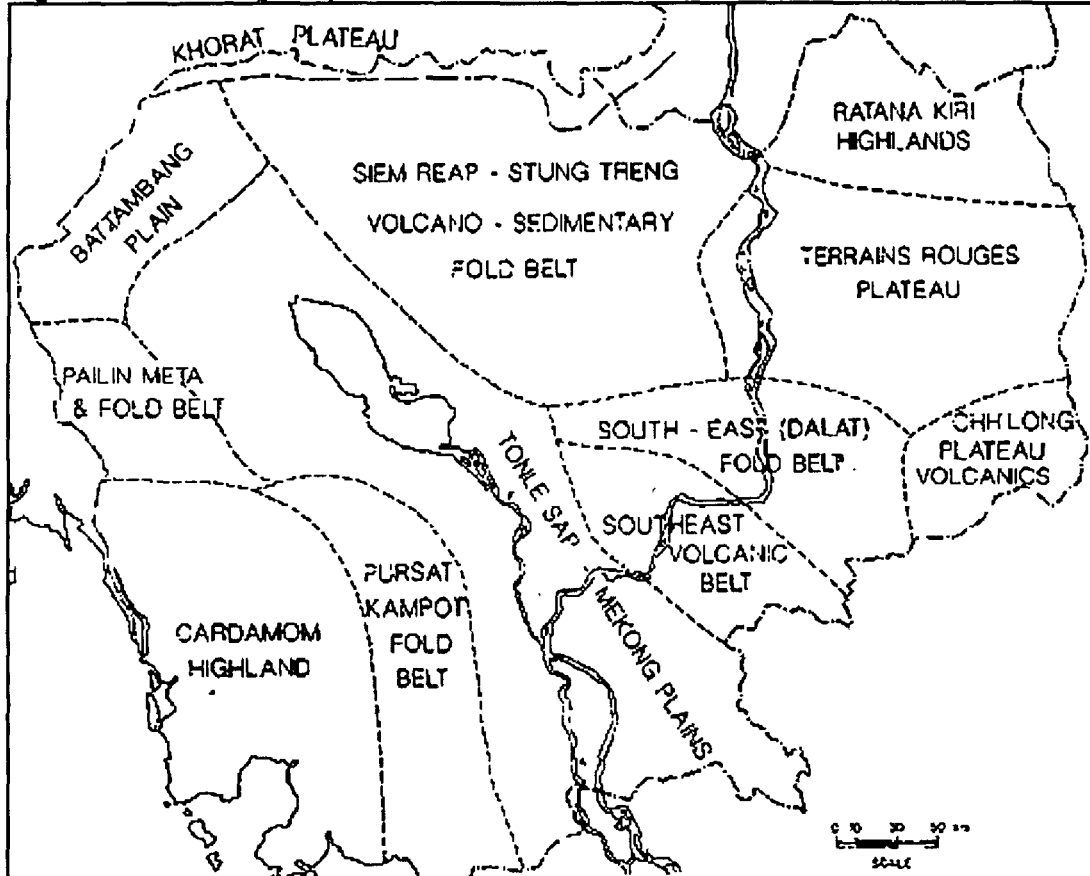
Boeung Trakoun lies within 200 m of the border with Thailand northwest from Sisaphon in what was, until 1999, within a disputed zone. The name Boeung Trakoun is not recognised in the geographic listings in Cambodia as a village or commune reference. The commune name is Kok Romiet and the name of the core village is Banteay Mean Rith. Boeung Trakoun is the name of the lake inside this village, called after the vegetation that grew there in the past. With agreement from MIME it has been decided to follow the convention applied by the local population, and to use the name Boeung Trakoun to describe the core village and thereby the town.

The existing settlement is in the north west near lake Boeung Trakoun. The town center is confined and not extensively developed, comprising a new market and an adjacent smaller market, some shops and related activities. The town also contains one school, one Wat, a small health center, an army camp and a border control point. The latter has the presence of all the relevant government departments comprising, police, customs, CAMcontrol, immigration police and the provincial border authority. There is no development beyond the border check point. The southern section of the town has been developed by the Norwegian Peoples Aid (NPA) as a new development zone. Other organizations present in the town include the Halo Trust de-mining activities.

Geology

Cambodia can be divided by '*geological provinces*', as shown in Figure 4-1 (ESCAP, 1993). Boeung Trakunn is part of the "Battambang plain", and is located on the "Old Alluvium", bordering the outcropping sandstone and conglomerates (Cretaceous to Paleocene 'Upper Indosinias' formation).

Figure 4-1 – Geological provinces



Source ESCAP, 1993

Quaternary deposits are widespread in Cambodia, especially in the broad central plains of the Mekong and Togle Sap River systems and across the northern uplands, generally occupying levels from 0 to 40m above sea-level. The Quaternary occupies 'grabens' and depressions in the broad area, build up of intercalations of continental and marine rocks revealing a history of periods of transgression and regression of the sea. In general the following units are distinguished:

- The Holocene (Q_4) sediment cover is represented on the coastal and interior plains, and in small upland valleys, by recent deposits of fluvial, lacustrine (lakes), and shallow-sea origin.
- The Middle-Upper Quaternary (Q_{2-3} , a principal sedimentary aquifer, is widespread in the north, southeastern and northwestern sectors of Cambodia, where it is known as the Battambang formation. On the Mekong Plain the upper Quaternary (Q_3) is recognized as the Mochoa formation, occupying the 10-15m terraces in the areas southeast of Phnom Penh. It is composed of grits, sands and clays outcropping on higher relief levels on the outer parts of the central plains.
- Quaternary plateau basalts (QB) of Middle-Upper Pleistocene age and Neogene-Quaternary platform basaltic rocks
- The Lower Quaternary (Q_1) consists of sands, silts and clay-stones of both fluvial and marine origin. It is here combined with the Pleistocene deposits (unit N_2-Q). The Middle Quaternary (Q_2) of the plains comprises red sandy sediments occupying terraces above 15 metres.

The whole of the Tertiary is represented by Pliocene sedimentation. The Neogene-Early Pleistocene (N₂-Q) is seen in large basins in eastern Cambodia. These are represented by the Bamieu formation, comprising of clay-stones and siltstones usually laid upon well-developed conglomerate horizons. Large volumes of this material fill the broad lowland grabens of the Mekong valley and the Togle Sap Region, overlain by younger alluvial materials. The deposits of this age are often referred to as the "alluvions anciens", the "older alluvium". These sediments generally form terrains and plains in the levels 25-150m above sea level. The upper levels are strongly laterized and this has been used as building materials (for example at Angkor Wat).

Mesozoic and Paleozoic sedimentary units and intrusive rocks are generally referred to basement rocks.

Climate

The climatic conditions for Boeung Trakunn are monsoonal. Table 4-1 shows the main climatic parameters recorded in Cambodia.

Table 4-1 - General climate conditions in Cambodia

Measure	Wet Season	Dry Season
Months	May - November	December - April
Wind Direction	Southwest	Northeast
Cool Months	November	December - February
Hot Months	May	March - April
Cambodian Average Rainfall	1300 to 3600 mm per annum	
Phnom Penh Average Rainfall	1300 mm per annum	
Mean Rainfall	200 mm per month September - October	3 - 15 mm per month December - March
Evaporation	69 - 105 mm per month	170 mm per month
Average Temperatures	30 Degree Celsius	April 35 Deg C peak
Humidity	Sept-Oct 85% average	Jan-April 75% average

Source GHD/FT, 2002

Surface Water

There are no significant and/or reliable surface water resources in the vicinity of the town. There is a small stream around 88 m from the central markets and while the quality is reported to be good the stream dries up for around two months annually. There are no other surface water sources apart from small natural or man made ponds, and Norwegian Peoples Aid (NPA) ponds, immediately east of the settlement area.

All have insufficient capacity to sustain the town water supplies. The small stream also lies within the town and cannot be protected from pollution and degradation as the town expands and grows.

Hydrogeology

Several existing bores representative of the town were selected and tested with field equipment along with the lake and the NPA ponds. Samples were collected and subjected to testing by a central laboratory in a controlled environment in Phnom Penh. The bores tested had depths of 59 m and 72 m respectively. The testing showed

variable and elevated levels of iron, variable and in several instances high chloride levels, and marginally low pH for one sample. Generally all water displayed turbidity, coloration and had a muddy and somewhat metallic taste and smell.

The water testing results indicate that the ground water has quite variable parameters and high turbidity and discolouration. The actual quality will not be known with any certainty until the tests bores are constructed and sampled. It is considered likely however the treatment involving aeration cascades, dosing and sedimentation, slow sand filter and disinfection will be required. The scheme has been costed on this basis

4.2 Ecological resources

Boeung Trakunn is located in a flat agricultural area, mainly used for cultivating rice. The area has no other specific ecological resources and/or protected nature areas in its surroundings.

4.3 Socio-economical resources

Population

A count of houses and institutions was conducted within the identified service areas during the rapid appraisal phase and again confirmed in later town visits and surveys. Major discrepancies in the information provided by commune officials were identified requiring reconciliation with the circumstances identified in the individual towns. All information and statistics on population and household size were rigorously reviewed due to the impact of these on the design and sizing of the scheme. The population to benefit from a reticulated water supply system was derived from the discussions with the communes and their expression of the area they would wish to see reticulated. This was followed by a review of the town development, population densities and the extent to which a viable system could be sustained on technical and operating grounds.

The total population of the service area for Boeung Trakunn was estimated by GHD/FT at 2,716 (492 houses). No count of commercial establishments and institutions is available.

Population forecasts in Cambodia are hampered by an absence of reliable data and information on population trends. The population forecasts from the 1998 national census indicate an average annual population increase for Cambodia of 2.5 percent. This latter figure has been used for the current project.

Standard of living and Income

In Cambodia, a number of the population live in well-built houses (up to 60% in some towns), although the majority, 62% overall, live in poor quality or makeshift homes. The immediate environment of the homes differs sharply between those located in the core of each town, usually along the main roads, and those on the periphery or in nearby satellite villages, which remain largely rural in character. While development is occurring in the central core of the towns, with new commercial buildings and houses now evident, the immediate surroundings are often squalid, with prominent deposits of solid waste

blocked, stagnant drains. In contrast, the areas around many homes outside the core areas are decidedly well kept, even in the case of some of the poorest quality houses.

With regard to the economic status of the beneficiary group, the survey indicates high levels of poverty, with average incomes equating to some USD 0.54 per person per day (as low as USD 0.48 in Svay Rieng).

As a comparative indicator for the living conditions in Boeung Trakunn (GHD/FT, 2002), the town has electricity supply from 4am to 10pm, supplying an estimated 69% of the households. Furthermore it is estimated that around 43% of the households own a TV.

Public Health

Reviews of the health sector in Cambodia show that life expectancy and infant mortality, both principal indicators of the state of health of the population, have declined in recent years. However, they remain high by international and regional standards, with some 56 years life expectancy and 89 infant deaths per 1000 live births. Health issues that feature prominently in the project towns include parasite infestations, nutritional deficiencies, sexually transmitted diseases and waterborne diseases (e.g. diarrhea).

Diarrhea alone inhibit economic activity, is a potentially life threatening hazard, and is a continual nuisance among the population of the project towns. The socio-economic survey carried out for this project found that at least 5 percent of households had suffered cases of diarrhea among its members within the previous two weeks. In the worst cases, up to 12 percent of households had suffered diarrhea among its adult members during this period. While the source of infection of diarrhea diseases vary, most can be attributed to polluted water supplies inadequate supplies for drinking, food preparation and hygiene and inadequate sanitation.

Water Supply

No piped water supply system exists in Boeung Trakunn. Water supplies are coming from rainwater collection and surface waters during the wet season, abstraction from shallow wells and similarly abstraction from the few deep bores that exist as the primary water sources for the town. The shallow wells inspected gave very turbid and coloured water with elevated chloride levels. People currently buy water from water vendors at a price of 5 bath per 30 l. The water is taken from a pond near the Thai border, but is not clean. Sometimes water is also taken from a pond located in Thailand.

Sanitation

With regard to sanitation in general in Cambodia, many people (at least 49%) use field or bush around their homes for defecation. This arrangement is often considered more or less satisfactory, though many town dwellers (40 %) have latrines and of those that do not, the majority (57%) would like to install one and meet the cost of doing this, suggesting a high level of awareness of sanitation issues and their role in improved living conditions.

In Boeung Trakunn, it is estimated that the use of the field, latrines and other facilities is 42.6%, 14.8%, and 42.6%, respectively (FHD/FT, 2002).

5 PUBLIC PARTICIPATION

5.1 General

The only way of ensuring that proposed water supply and sanitation investments lead to sustainable services in the long run is to foster interaction between DPWS/MIME and the Provincial Governments, District and Commune-level institutions, consultants, operators and contractors, and the main beneficiaries, i.e. the users who will benefit directly from the project. Creating ownership and responsibility at the various levels is the final objective of the participative process

During the meetings with District Governors and Boeung Trakunn Commune Chiefs a measure of the community's interest in receiving a piped water supply and to participate in a sanitation program was gained.

Earlier in the project a sample of households in each Commune in the Project Towns was interviewed, according to a questionnaire that gathered basic demographic and socio-economic information, information on existing water supply and sanitation costs and arrangements, and basic hopes and aspirations for future improvements in these two services. The survey team took care to ensure that sampling was done evenly through each Commune, gaining a sample that was representative in terms of different income groups and that included any minority groups in each Commune.

Formal discussions also occurred with the Provincial, District and Commune administrations to familiarize the team with the areas and communities and to build up confidence of the administrations and residents in the team members. From these discussions, it became clear that the Commune Chiefs, their committees and the communities want, and would demand, information on a number of issues, primarily:

1. Cost (tariff and connection cost)
2. Scheduling and likely implementation
3. Providers (information about the possible companies, namely the owners)
4. Protection of consumers
5. Roles of Government and authorities

The earlier meetings with the Boeung Trakunn Commune Councils and representatives of the Thma Pourk District and Banteay Meanchey Province attempted to gauge overall interest in obtaining piped water supplies from a private sector operator and views held regarding the nature of any technical and management options. Items which were seen to require elaboration and answers at the Willingness to Connect stage included:

1. Connection cost and repayment scheme
2. How will the operator be controlled and who will be responsible?
3. If a breakdown occurs who will be responsible for the cost, especially for water meters?
4. Where would the water meter be located for households (and what distance would the free connection be)?
5. How long will it take to implement the project if it goes ahead?

5.2 Consultations with the Prospective Users

The participation of end users (the community) in the design and operation of water supply and sanitation systems is, along with engineering, resource and environmental considerations, key to the sustainability of the services to be established in the Project Towns. Effective participation ensures that, to the extent practicable, the services provided will be acceptable to the users, appropriate to their conditions, and affordable to them. In order for participation to be effective, representative views from members of different age groups, gender, income categories, religious and minority groups need to be heard and understood.

The project comes at a time when fundamental steps have been taken by the Royal Government of Cambodia to put community representation structures into place, and to develop participatory methods for development at Commune and village level in the country, but also at a time when processes for developing such structures are still at an early stage. The communication and information strategy for the PPUWSSP has worked with the structures that have been, or are being set up, so as to help strengthen them and avoid the conflicts and confusion that would arise from establishing new structures or processes. The communication and information strategy has also been arranged to ensure regular and feedback to the Commune Councils, the village representatives and their communities.

5.3 Willingness-to Connect (WTC)

The WTC area meetings are instruments for the dissemination of key information on the proposed water supply and sanitation improvements, by means of facilitated presentation and discussion, hand-out leaflets and, information sheets and follow-up discussion. The team has prepared a simple text for information brochures designed to introduce the purpose of the project, (with reference to Government policy on water and sanitation), the basic principles behind the private sector involvement, and an outline of what is planned in terms of further project preparation and the construction of facilities. These documents are contained in the Volume of Appendices.

The strategy has therefore focused on a communication process reinforcing the beneficiaries (Commune, village and households) understanding of the project, its rules and thereby increasing ownership. The process has also highlighted the benefits of safe and reliable water supply and sanitation and the means of achieving sustainable and affordable town water supply systems. This underpins the foundations of the WTC process and has worked to establish an environment for a knowledgeable response from the community.

The communications strategy involved the following initiatives in the period leading up to, and during the WTC activities:

- Information: Meetings organized with the Commune Chief and Commune Council to reaffirm their understanding of the project rules and the process of project preparation and implementation, especially for the newly-elected Commune Chiefs and Commune Councils.
- Dissemination: After the above consultation meetings, the organization of a meeting at village level with the village chief and representatives of the village development committee, where these existed, with the participation of the Commune Chief, Commune Council and MIME / Consultants for preliminary discussion about the project rules, proposed options and service.
- Decision: Thereafter a series of focused group discussions with beneficiaries (communities) on the selected options by MIME and Council to discuss the Willingness-To-Connect (WTC). These meetings were arranged with the Commune and Village representatives to determine the most suitable time, venue and structure to ensure strong attendance and participation. With the assistance of the Commune and Village representatives the WTC forms were distributed to the proposed beneficiaries after the meeting, and a date was agreed with the beneficiaries for the return of the "signed WTC agreement forms" to the Commune Chief / MIME, and verification by the Commune Chief.

The Willingness to Connect (WTC) indicated that ??? of the ??? households within the proposed service area for Boeung Trakunn approved a tariff of 2425 Riel/m³.

6 ENVIRONMENTAL IMPACT ANALYSIS

6.1 Methodology

General environmental checklists were used as the basis for developing the project checklist that would suit the assessment intended for the proposed waterworks supply project. Project impacts are classified into the four stages: ¹Pre-construction; ²Construction, and ³Operation.

A rapid comparison of the “no project” and “with project” scenarios have been carried out in the form of a Summary Matrix of Environmental Issues/Impacts (Table 6-1). This analysis briefly presents the main environmental issues and possible positive and negative impacts. Impacts are classified as being significant negative environmental impact (--), moderate negative environmental impact (-), none or insignificant environmental impact (o) and beneficial environmental impact (+).

Table 6-1 – Summary matrix of Environmental Issues/Impacts

Phase	Environmental Parameter	'No Project'	'With Project'
Pre-Construction	Reliability of water availability	-	+
	Reliability of water quality	-	+
	Land acquisition and resettlement	o	o
	Disturbance of land use and economic activities	o	o
Construction	Disturbance of the land use	o	o
	Loss of natural vegetation	o	-
	Disturbance of stream channels, aquatic plant and animal habitats	o	o
	Soil and water contamination	o	-
	Hindrance (noise, air pollution, traffic, etc) due to construction activities	o	-
	Soil erosion and compaction	o	-
	Employment	o	+
Operation	Public Health	--	+
	Contamination of stream channels	o	-
	Water logging and salinization	o	o
	Soil erosion	o	o
	Land subsidence	o	o
	Increase Land Value		
	Enhance Economic Activity		
Legend			
--	Significant negative environmental impact		
-	Moderate negative environmental impact		
o	None or insignificant environmental impact		
+	Beneficial environmental impact		

The possible environmental impacts are elaborated in the sections below. If available, quantitative/numerical data are further elaboration in the mitigation and monitoring plans (see Chapters 8).

6.2 Pre-Construction Considerations

Water source selection

Selection of the water source has been done on the basis of security of supply and possibilities for protection of the source. Firstly, the water source should be sufficient to provide enough water during the dry season, and during dryer years. Accordingly, smaller creeks and ponds were considered not acceptable. Moreover, a water source, for which the Local Government may not be able to provide proper protection against pollution, has been rejected for the present water supply system.

Of the options considered for Boeung Trakoun the only viable water resource is groundwater abstraction. The recommended location is for an array of two bores to be located in the target zone identified by the geo-electrical survey on the array notated as Boeung Trakoun 2. The bores will be located at the edge of an existing secondary road at 200 m separation. The treatment plant will be sited on land identified for this purpose by the Commune, with the site being to the south of the NPA settlement area.

Preliminary calculations indicate a required water demand (ADP) of 260 m³/ day. The geo-electrical survey has indicated a target location for boreholes with predicted bore yields.

Land acquisition

Land acquisition will be minimal. The scheme is based on the treatment plant being located on the land to the south of the new NPA settlement area identified as being available for the scheme. This has been adopted not only because it is readily available but also it is in the general vicinity of the geo-resistivity survey arrays identifying the best groundwater target zones.

An alternative with the treatment plant relocated at the bore-field has been examined as a desk study. This appears to show a worthwhile saving in costs however the land in question has yet to be de-mined and so it has not been possible to confirm the suitability of the suggested site. This option could be left to a future Contractor to evaluate, on the basis that the Contractor would have to acquire the land (with suitable safeguards to ensure the purchase occurred at market rates) and offer an appropriate reduction in tariff.

The land for the proposed wells and pumping stations should be purchased (or made available by the Commune) with official documentation as soon as the locations of wells are confirmed by the private operator. The treatment plant will be established on the land identified by the Commune, behind the existing Commune office.

The land to be purchased is estimated atm². The acquisition of land will be facilitated by MIME as part of their responsibility to the project. If possible, the PMU representative will facilitate the issuance of "Deed of Donation" or statements on the willingness to sell prior to the construction to avoid any conflict with the lot owner.

The laying of distribution pipes will mainly be located in public property along the roads. Only minor parts of the distribution system will have to be excavated into private property. During the public consultations, the local residents expressed their cooperation to allow the laying of the pipes in their property as "*right of way*".

Involuntary resettlement

No involuntary resettlement will be required.

6.3 Environmental impacts during project construction

General

Negative environmental impacts due to the construction of the proposed water works system are limited. Impacts will be mainly on the terrestrial (land), air environment and on affected persons due to noise and possibly relocation. The impacts could be temporary or permanent, significant or not significant depending on the nature and existing quality of sensitive receptors.

Major activities for the construction will be site-clearing, excavations, pipe-laying, and material hauling. Potential environmental impacts observed in similar construction activities include interference with existing utilities, damage to properties (e.g. displacements, cracks, etc.), and conflicts with existing transportation infrastructure. All damages can be mitigated by applying proper professional construction methods and supervision of compliance with international standards.

Common other impacts from construction activities like dust, noise, limited erosion, and traffic effects can not be fully mitigated, but can be kept within acceptable limits by applying professional standards and construction methods.

The construction of the water supply is not expected to have significant impacts on drainage characteristics of the region. However, it will be important to avoid local flooding or the blocking any natural drainage channel during construction. If applicable, appropriate temporary drainage infrastructure will have to be constructed.

Site specific impacts

There are no other important site specific impacts.

The total workforce to be employed by the DBL Operator during construction is estimated at approximately of 25 persons until completion of the project.

Economic Losses

The construction of the system may have some negative impacts on the income of selected people. Agricultural activities are disturbed, and some damage to the soil can be expected due to the construction activities and the increased traffic.

Compensation to affected persons will be applied according to general project rules (using market values) as set out in the Operations Manual, prepared in accordance with standards and regulations of the Government of Cambodia.

6.4 Environmental impact during project operation

As the proposed project will improve the existing water supply and sanitary conditions in the town, considerable benefits will be achieved for improving public health situation

during the operation of the project. Also, the installation of water meters and appropriate pricing of water will reduce leakage and thus result in water conservation.

The construction and improvement of the water supply conditions will increase the amount of toilet waste and wastewater. Especially a possible change from pour flush to flush type toilets and the direct disposal of the effluent of septic tanks into the surface water or drainage system are concerns.

The main environmental risk regarding (temporary) disruption of the water supply service (e.g. through mal-performance of the operator) is that currently used water sources may not be available anymore to fall back to. It is therefore necessary to continue protecting the traditional ponds and water sources from pollution and depletion.

There are no environmental harmful materials to be disposed of in case of a failure of the project.

6.5 Summary of significant environmental impact

Depending on the implementation and precautions taken by the contractor, the construction activities may have various adverse environmental impacts. Although most of them are temporary, they should be mitigated in the best possible manner.

In summary, the most significant adverse environmental impacts are:

- Damage to soil and natural habitat (temporary);
- Contamination of soil and water (temporary);
- Hindrance to local population, e.g. noise, air pollution, and traffic (temporary);
- Increase of wastewater flow (continuous).

A higher concentration of Arsenic is a potential risk for all water supply systems. Extensive water quality testing will be carried out for the water source during development and operation. If necessary, new water sources will be developed.

7 ECONOMICAL ANALYSIS AND ENVIRONMENTAL VALUE

7.1 General

The project is considered economically feasible and sustainable. The water supply system will operate on a commercial basis, and all operating and maintenance costs are in principle paid through the water fee. By securing a reliable water source, sufficient pressure in the network, a minimum number of connections during the preparation stage, and by creating sufficient incentives and obligations for the operator to provide good services, it is not foreseen that the water supply will be disrupted once initiated.

7.2 Financial Data

The following summarizes the principal financial data, as prepared in the feasibility study by GHD/FT.

Capital Cost

Construction cost of USD219,070. Total Project Capital Cost after contingencies etc. of USD278,961. Adoption of the alternative treatment location could save \$16,870 in pipe network costs offset by the cost of acquiring the land package and any additional site works necessary. A considerable net saving is likely to result unless there are especially large unknown problems with the alternative site. Analysis shows that the difference in operations cost between the two schemes is trifling.

Tariff and Financial returns

The financial model indicates the following tariffs for the different levels of capital recovery and the required return to the investor at Boeung Trakoun.

FIRR	to	MIME Capital Recovery	TARIFFS – Riel / m ³		Net Present Value – USD	
			Original	Alternative	MIME	Operator
20%		90%	2740	2630	-157,156	58,299
20%		50%	2425	2330	-188,038	26,998
20%		0%	2030	1955	-215,644	-984
16%		0%	2000	--	-225,938	-11,417
0%		100%	2645	2550	--	--

The tariffs marked 'original' reflect the scheme analysed in detail with the treatment plant located at the site identified by the Commune. The 'Alternative' tariffs are indicative and relate to the scheme with the relocated treatment plant. For the purposes of the above table, it has been assumed that there is a net Capital saving of \$14,000 in the Alternative scheme. (The Net Present Values are those for the Original scheme)

For each chosen tariff level the financial model indicates the FIRR on the total investment, and on the operator's investment, for each ten percent decrease in the recovery of the Government's investment. The relatively high tariff for this town (for a given level of capital recovery, and compared to other towns of similar size) reflects the dispersed nature of the town, and the need for more demanding treatment than at other towns. Both these factors result in high capital costs. The initial low population in

permanent housing (and potentially willing to connect) also increases the tariff, but only slightly. Recurrent costs of pumping are also relatively high.

Sensitivity Analysis

The sensitivity analysis shows the impact on the investor's return for any reduction in sales (revenue) for a 10, 15, and 20 percent reduction. The sensitivity analysis has adopted the option with a 90% Capital recovery by MIME (RGC), and based on the Original scheme.

Reduction in demand (revenue)	Reduction in households	Residual Households connected	Return to Investor
10% reduction	61	554	17.9
15% reduction	92	523	16.3
20% reduction	123	49	14.0

As mentioned, the sensitivity to estimated growth rate was also examined. Since the impact was found to be minimal, only a summary of results has been provided (in the main text).

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

Based on the findings of the environmental assessment and the discussions held with the concerned local residents, the Local and National Governments, an Environmental Management Plan has been drafted, including an Environmental Mitigation Plan (EMiP) and an Environmental Monitoring Plan (EMoP).

By submitting the present IEIA, the Ministry of Industry, Mines and Energy certifies that to their knowledge all the information in the enclosed IEIA for Boeung Trakunn (M12) is true, accurate, and complete (see Annex V), and is committed to its proper implementation.

8.2 Environmental Mitigation Plan

Table 8-1 summarizes the main environmental concerns, the necessary actions and mitigation measures to protect the environment, and the responsibilities of the different parties.

8.3 Environmental Monitoring Plan

In Table 8-2 the required Environmental Monitoring Plan is presented. It is considered necessary that selected data will be collected on a regular basis for the proper implementation and monitoring of environmental mitigation measures, as described in Table 8-1.

8.4 Responsibilities

MIME will have the overall responsibility for the proper compliance monitoring of the Environmental Management Plan (EMP). Upon the signing of the DBL contract, the Contractor will proceed with the necessary steps for the environmentally sound construction and operation of the water supply system, as defined in the EMP. During the construction phase, PMU will be responsible for securing that proper measures are taken by the Contractor. The PMU will inform DPWS/MIME if violations occur, and appropriate actions will be taken. Moreover, DPWS/MIME staff will carry out control inspections during their regular visits to the Provinces.

During operation of the water supply system, the Contractor will have the main responsibility for the proper implementation of the monitoring plan. The monitoring data will be well documented and be available with the Contractor and PMU for consultation and inspection. Environmental compliance chapter will be included in the agreed Project monitoring reports to be submitted to DPWS/MIME and the Ministry of Environment, including: Presentation of the collected data; Discussion of the compliance and non-compliance to the EMP; and Conclusion and Recommendation.

Regular Project monitoring reports will be submitted to the World Bank during the operation phase. The environmental data will be available with the DPWS/MIME and the Contractor for consultation and inspection.

Table 8-1 - Environmental Mitigation Plan

Phase	Mitigation measures	Responsibility	Schedule
Pre-construction	<ul style="list-style-type: none"> Lack of control of water source: Acquire land directly around the facilities (or secure a possible purchase), Reduction in flow: Locate the well in an area where other water users are not affected Disturbance of land use and economic activities: Usage of public areas, Provision for proper compensation 	MIME, World Bank	Prior to DBL Contracts
Construction	<ul style="list-style-type: none"> Disturbance of land use due to drilling/construction: Minimize impacts, Restore damages Loss of natural vegetation: Replanting of affected areas Disturbance of stream channels, aquatic plant and animal habitats: Erosion and sedimentation control Soil and water contamination (e.g. spilling of oil products and other construction materials): Control (collection, disposal) of waste water Hindrance (noise, air pollution, traffic, etc) due to drilling/construction activities: Minimize hindrance, Usage of main roads when possible Soil erosion and compaction: Proper runoff and erosion control measures, Heavy traffic restrictions Safety hazards: Proper safety and warning measures, Provision of temporary crossings/bridges, Public information campaign 	Operator, with supervision of MIME consultant	Continuous during construction phase
Operation	<ul style="list-style-type: none"> Public health hazards due to increase of wastewater: Support the construction of proper on-site sanitary facilities (if lacking), Improve storm drainage system for sullage; Contamination of the groundwater: Acquire and fence a protection zone directly around the well, Regulate potential polluting activities in recharge zone, Monitor water level and groundwater abstraction Lowered groundwater table: Space wells at larger distances; Avoid over-abstraction and consequent lowering of groundwater table, Calculate safe yield (abstraction), Assure/prove that other water users are not affected Increase of noise: Usage of electrical submersible pumps, Construction of pumping house 	Operator, with supervision of MIME	To be determined during feasibility study
Abandoning phase	<ul style="list-style-type: none"> Water availability: keep traditional water sources available 		

Table 8-2 - Environmental Monitoring Plan

Phase	Monitoring activities	Responsibility	Implementation
Pre-construction	<ul style="list-style-type: none"> Land acquisition Check if the required land has been acquired properly, or that a proper "Deed of Sale/Donation" has been prepared Resettlement and Compensation.If applicable, check if proper arrangements are made and documented 	MIME, World Bank	Prior to DBL Contract
Construction	<ul style="list-style-type: none"> Hindrance to local population Noise, air pollution (odor, TSP, fume emissions), land damage, traffic. EMP compliance of the contractors: Erosion control, vegetation protection, soil and water contamination. Safety precautions of contractors. Conform professional standards Sanitary control Proper construction of on-site facilities, Proper construction of sullage drainage system. 	Operator, with supervision of MIME consultant	Continuous, through regular construction supervision
Operation	<ul style="list-style-type: none"> Quality of distributed water: conform official standard procedures (microbiology, standard parameters, Arsenic, heavy metals), Groundwater resources water level (2 X per month (after pumping recovery period); operation of pumps (abstraction). 	Operator, with supervision of MIME	Regular, according to professional standards
Abandoning phase	<ul style="list-style-type: none"> None 		

9 INSTITUTIONAL CAPACITY

Organization structure

The Department of Potable Water Supply (DPWS) of MIME has the overall responsibility for the implementation of the project. A Project Management Office (PMO) will be established at MIME as part of the project loan. At the local level, Project Management Units (PMU) have been established already at Provincial level. The PMU will be responsible for the daily supervision of the project activities in the respective provinces.

Budget / Schedule

A special budget will be allocated for overall Project supervision and monitoring, including compliance monitoring of the EMP. Monitoring will be carried out by MIME and World Bank staff.

Staff skills

The capacity of MIME to properly monitor the project is admittedly limited. Although MIME has skilled and motivated staff, current financial, institutional and logistical constraints will obviously be a major factor in the successful implementation.

To reduce the amount of compliance monitoring, many of the responsibilities have been included in the Operators contract. Regular monitoring reports will be provided, which will include a Chapter on environmental compliance monitoring.

Methodological tools and equipment.

The principal equipment required as part of the compliance monitoring is for water quality testing. Most of the field equipment is already available and applied by MIME as part of their ongoing activities. Additional field equipment will be purchased during the project. More specialized water quality testing for the compliance monitoring (e.g. Arsenic) will be carried out by certified laboratories.

Daily water quality testing during the operation of the water supply system is part of the operators contract obligations.

Training

Environmental Management training will be provided 'on-the-Job', as part of the overall monitoring activities to be carried out. Support will be provided by World Bank staff if required.

10 CONCLUSIONS AND SUGGESTIONS

General

The Project, endorsed and approved by the and the beneficiaries of Boeung Trakunn (Banteay Meanchey Province) and the Ministry of Industry, Mines and Energy is not expected to create adverse potential environmental impacts. The impacts can be prevented and mitigated to an acceptable level using proven engineering practice and other measures. The proposed development of a water supply system would be beneficial to the entire municipality. It will bring significant health improvements through improvement of water supply and sanitary conditions. It will also increase economic development of the area, resulting in increased land values and employment.

List of Resolved Issues

The provision of clean and safe water will bring a significant improvement in the public health conditions of the participating households. It is expected that a decrease in the number of cases of water-borne diseases (diarrhea, gastroenteritis and parasitism) will occur.

The environmental monitoring program will provide the necessary data for improved environmental management of the water supply facilities. This will enable Ministry of Industry, Mines and Energy to identify and present solutions to possible environmental risks and concerns.

Proper sanitation and wastewater disposal mechanisms will be encouraged through public education and awareness programs to mitigate the adverse effect of an increase in the production of wastewater. Accordingly, the gained benefits in public health will not be negatively influenced. Also, appropriate measures (cleaning, maintenance of the current drainage system) will be addressed to prevent water logging and drainage problems arising from an increase in wastewater.

List of Partially Resolved Issues

All possible precautions will be taken to minimize negative impacts during the construction phase. Damage to soil and water will be restored and properly compensated. Other limited negative impacts that can not be fully mitigated (noise, traffic) will only be temporary.

Economic losses due to construction activities will be compensated according to standards developed and agreed upon with the Royal Government of Cambodia.

New issues arising from the IEIA that have been resolved

The IEIA emphasized on proper water source selection and protection, as currently incorporated in the feasibility study and final designs.

11 PRINCIPAL REFERENCES.

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Annex I - List of EA preparers

MIME staff

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Mr. Cheav Channy, Deputy Chief of Technical Office, DPWS

Local Government Representatives

Mr. Tourn DoL, Kok Romeit commune chief
Mr. Heng Sopheang, provincial PMU representative

World Bank supervision

Mr. P. Illangovan, Senior Environmental Specialist
Mr. Vijay Jagannathan, Task Team Leader
Mr. Luiz Tavares, Senior Sanitary Engineer

Consultant

Frank Radstake, Environmental and Water Resources Management Advisor

Annex II – WTC Process documentation

General

The meetings and discussions in each town conformed to a set pattern, varied only by the individual requests for change on the part of the Communes

1. The first day in each Province was devoted to the PMU training and familiarization workshop.
2. On entering a District the teams paid a short courtesy visit to the District Governor and the senior advisors to reinforce the project objectives and rules, and to seek his/her advice on matters they should take into account in their subsequent meetings.
3. The teams would then meet with the Commune Chief(s) and Commune Council members with an established agenda providing for:
 - Introduction of participants and the facilitator
 - Briefing on the meeting – why (project information sheet), objectives and action plan
 - The project – background, rules, roles and responsibilities, structure and implementation, and benefits
 - Feasibility Study – outline of work, technical options, management options, financial options and costs, tariffs
 - Open forum – questions and answers
 - Action planning – arrangements for area-wide meetings of villagers, schedule for meetings, program for area-wide meetings
 - Additional roles and responsibilities – Commune support and attendance at area-wide meetings, roles of Commune Chiefs and Commune before, during and after the village meetings
 - Willingness-To-Connect – how to distribute the agreement forms and generate the 51% positive return required, The involvement of the Commune Chiefs in collecting the returns and validating the responses, and confirmation and synthesis of agreement.
4. The teams also met with the Village Chiefs and members of the Village Development Council, if one existed. More often than not the Commune preferred the two meetings to occur together to ensure the same information was related to all parties and that a uniform interpretation of this was resolved. Where separate meetings occurred, these followed the same agenda as the meetings with the Communes.
5. On reaching agreement for the program and timing of the village meetings the team then departed for another town and meetings there with the Commune and Village Chiefs. After a space of several days the team returned to conduct the area-wide meetings, thus allowing time for local organization and arrangements for the meetings.

6. The area-wide meetings occurred in each village in a location suitable to the villagers. The pictorial displays and samples of fittings, meters and materials were used to support the presentation. The meetings were participatory and encouraged viewpoints and questions. In general the presentation followed the following structure:
 - Explanation of the purpose of the meeting – indication of the participatory nature and indication that views were welcome and invited
 - The project – background and description, socio-economic benefits
 - Presentation of options – summary of Feasibility Study, technical options, financial options, tariffs
 - Open forum – questions and answers
 - Summation and closure
7. Prepared information kits of all relevant information in the Khmer language were left with the Commune Chief and Commune members, the Village Chiefs and Development Committee members, and key/influential persons within each village – to ensure that advice could be provided to villagers seeking elaboration concerning the project.
8. Following work in each group of towns the teams were debriefed in the Consultants' office in Phnom Penh to embody the lessons learned and to refine the process.

At the conclusion of the above meetings the teams left WTC forms with the Commune Chiefs with instructions for their completion by the villagers. These instructions requested that:

1. The issue and collection of the forms should be controlled to allow these to be reconciled later for the calculation of the WTC ratio.
2. The forms should be distributed and collected by each Village chief.
3. The forms should be verified by the Commune to confirm:
 - The signatory was a bona fide head of household, or so authorized
 - The location of the property was correctly identified
 - There was only one form from each household
 - That the signatory was in fact the identified person (most signatures are in the form of a thumbprint).
4. The forms were collected around a week later and brought to the Consultants' office and subjected to a further audit and recount.
5. The forms have been collated, bundled and boxed for future reference, and will be handed over to MIME for safekeeping.
6. During the in-house audit a number of incomplete forms were observed and separated from the correctly-completed returns. MIME will need to follow-up on these returns to establish the intent of the signatory, to avoid later dispute regarding the provision of a free connection, or otherwise.

Boeung Trakunn (M12) WTC Summary

The following summarizes the findings of the WTC survey in Boeung Trakunn, as provided by GHD/FT. More details can be found in the Willingness-to-Connect report

..... Under preparation

Annex III - Proof of social acceptability

..... STILL TO BE PREPARED AND INSERTED

Annex IV – Applied Water Quality Standards

The following water quality standards are proposed at a seminar workshop on the development of national drinking water quality standards for Cambodia, Phnom Penh, June 24-25, 2002.

Table 1. Standard Values for Bacteriological Quality

	Bacteria	Standard value (number/100ml)	
I	All drinking water supplies under all circumstances	E. coli or thermotolerant (fecal) coliform bacteria	0
II	Treated water entering the distribution system	E. coli or thermotolerant (fecal) coliform bacteria	0
III	Treated water in the distribution system	E. coli or thermotolerant (fecal) coliform bacteria Total Coliforms*	0 0

* In case of large quantities where sufficient samples are examples, it must not be present in 95% of samples taken throughout any 12-months period

Table 2. Standard Values for Chemical Quality: Health significance

A. Inorganic constituents

Parameter	Maximum level (mg/liter)
antimony	0.005
arsenic	0.01*
barium	1
boron	0.5
cadmium	0.01
chromium	0.05
cyanide	0.07
fluoride	1.5
lead	0.01
mercury (total)	0.001
molybdenum	0.1
nickel	0.02
nitrate (as NO ₃ ⁻)	50
nitrite (as NO ₂ ⁻)	3
selenium	0.01

* Proposed interim Maximum Allowable Concentration until June 2007
 Arsenic 0.01-0.05

B. Organic constituents

Constituent	Maximum level ($\mu\text{g/liter}$)*
Pesticides	
Aldrin/Dieldrin	0.03
Altrazine	2
Chlordane	0.2
DDT	2
Endrin	0.2
Heptachlor and Heptachlor epoxide	0.03
Lindane	2
Aromatic hydrocarbons	
Petroleum oils & grease	0
Benzene	10
Toluene	700
Xylene	500
Ethylbenzene	300
Benzo[a]pyrene	0.7
Cyanobacteriacterial toxins	
Microcystin-LR***	1

*Note. The unit used in this table is $\mu\text{g/L} = \text{mg/l}/1000$

**Constituents can be added or deleted depending on the pesticides use in Cambodia.

***Microcystin-LR is an emerging concern in Cambodia in both urban and rural areas using surface water for drinking

Table 3. Standard Values for Physical and Chemical Quality: Aesthetic Quality

Parameter	Level (mg/l)
Taste	Acceptable
Odor	Acceptable
Color	10 TCU
Turbidity	5 NTU
Aluminum	0.2
Ammonia	1.5
Chloride	300
Copper	2
Hardness	300 (as CaCO_3) ^a
Hydrogen Sulfide	0.05
Iron	0.5
Manganese	0.5
pH	6.5 – 8.5 (no unit)
Silver	0.1
Sodium	200
Sulfate	500
Total Dissolved Solids (TDS)	1000 ^b
Zinc	5 ^a

TCU – true color unit, NTU – nephelometric turbidity unit

^a Secondary standards, compliance with the standard and analysis are not obligatory

^b TDS consist of calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulphates.

Table 4. Standard Values for Disinfectant and Disinfection By-Products

	Parameter*	Maximum Level (mg/L)
a	Disinfectant	
	Chlorine (residual)	0.2 – 0.5
b	Disinfection By-products	
	Chlorite	0.2
	2,4,6 trichlorophenol	0.2**
	Formaldehyde	0.9
	Trihalomethanes	
	Bromoform	0.1
	Dibromochloromethane	0.1
	Bromodichloromethane	0.06
	Chloroform	0.2

* Analyze only where chlorination is used for disinfection purposes

** Represents health-based guideline value for phenolic substances

Table 5. Standard Values for Radiological Constituents

Constituents	Activity level (Bq/litre)
Gross alpha activity	0.1
Gross beta activity	1

Analyze only when appropriate; not for regular monitoring purposes.

Annex V - Accountability statement of project owner

ACCOUNTABILITY STATEMENT OF THE PROJECT OWNER

This is to certify that to our knowledge all the information in the enclosed Initial Environmental Impact Assessment (IEIA) for Boeung Trakunn (Banteay Meanchey Province) is true, accurate, and complete. Should we learn of any information which would make the enclosed IEIA inaccurate, we shall bring said information to the attention of the Ministry of Environment.

We hereby bind ourselves jointly and solidarity with the preparers for any penalties that may be imposed arising from any misrepresentations or failure to state material information in the enclosed IEIA.

Ministry of Industry, Mines and Energy

Title/Designation