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The Netherlands Programme for the Institutional Strengthening of Post-Secondary Education and Training Capacity (NPT)

Capacity Building for Sustainable Development of Water Resources and Environmental Sanitation in Ghana and the Sub-Region (NPT/GHA/049)

Annual Progress Report 2007

University of Science and Technology, Kumasi, Ghana

IRC	IRC International Water and Sanitation Centre	The Netherlands
TU Delft Technische Universiteit Delft	Delft University of Technology	The Netherlands
	Kwame Nkrumah University of Science and Technology	Ghana

UNESCO-IHE Institute for Water Education

50 years of wise water

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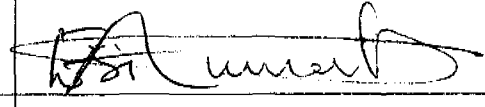
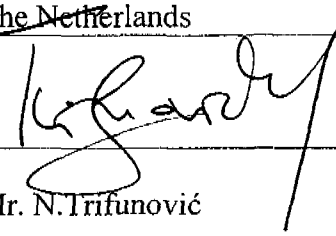
Statement of approval

	For the Southern implementing organisation: KNUST, Kumasi, Ghana	For the lead Dutch organisation: IHE – Delft, Delft, The Netherlands
Signature:		
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Position:	Head DCE, Project Director	Project Director
Date:	1st April 2008	15/4/2008

List of abbreviations

AVRL	- Aqua Vitens Rand Ltd
Cap-Net	- International Network for Capacity Building in IWRM (Pretoria, South Africa)
CoE	- KNUST College of Engineering
CWSA	- Community Water & Sanitation Agency
DANIDA	- Danish International Development Aid Agency
DCE	- Department of Civil Engineering under KNUST College of Engineering
ECOWAS	- Economic Community of West African States
EPA	- Environmental Protection Agency – Accra, Ghana
EE	- Environmental Engineering (section within DCE)
GDLN	- Global Development Learning Network (by World Bank)
GIMPA	- Ghana Institute of Management and Public Administration – Accra
GL	- Guest lecturer
GoG	- Government of Ghana
GWCL	- Ghana Water Company Ltd
GWP	- Global Water Partnership
HSD	- Hydrological Services Department
IDA	- Irrigation Development Authority
ISS	- Institute for Social Studies – Den Haag, NL
IRC	- International Water and Sanitation Centre – Delft, NL
IWRM	- Integrated Water Resources Management
KNUST	- "Kwame Nkrumah" University of Science and Technology
KVCIT	- Kumasi Virtual Centre for Information Technology
MDGs	- Millennium Development Goals
MLGRD	- Ministry of Local Governments & Rural Development
MSE	- Ministry of Science and Environment
MWRWH	- Ministry of Water Resources, Works and Housing
MAI	- Management and Institutions (Academic Department at UNESCO-IHE)
NUFFIC	- Netherlands Organisation for International Cooperation in Higher Education
NPT	- Nuffic Prog. for Strengthening of Post-Secondary Education and Training
NWRI	- National Water Resources Institute – Kaduna, Nigeria
PM	- Project Management
PoWER	- Partnership for Water Education and Research (Dutch government funded project)
SWITCH	- Sustainable Water Management Improving Tomorrows Cities Health (EU project)
TUD	- Delft University of Technology (TU-Delft)
UAWS	- Union of African Water Suppliers
UPS	- Uninterrupted power supply unit
UWS	- Urban Water and Sanitation (Academic Department at UNESCO-IHE)
VCS	- Video conferencing studio
VRA	- Volta River Authority
WAC	- Managing Water for African Cities (UN-Habitat sponsored project)
WA-Net	- West African Network in IWRM (under Cap-Net umbrella)
WaterNet	- South East African Network in IWRM
WARAP	- West African Regional Action Plan (for IWRM)
WRC	- Water Resource Commission
WRE	- Water Resources Engineering (section within DCE)
WREM	- Water Resources Engineering and Management (MSc programme in)
WRI	- Water Research Institute - Accra
WS(S)	- Water Supply (and Sanitation)
WSES	- Water Supply and Environmental Sanitation (MSc programme in)
WSESP	- Water Supply and Environmental Sanitation Project
2iE	- International Institute for Water and Environmental Engineering (former EIER/ETSHER group, Ouagadougou Burkina Faso)

1 Background

During the last decades, the demand for water has increased significantly, whilst the rainfall patterns seem to become less reliable, possibly as a result of climate change. All projections indicate further major increases in the future; Ghana projects a five-fold increase in consumptive water use between 2000 and 2020. Interconnections in the water resources system are therefore becoming more apparent than in the past, demanding an inter-sectoral and transboundary approach. The West African region have articulated the need for a holistic and integrated approach towards water resources development and management, expressed in the West African Regional Action Plan for Integrated Water Resources Management (WARAP-IWRM), agreed among 16 countries, including Ghana. Moreover, in 1999 the six riparian states of the Volta Basin formally agreed to collaborate on IWRM (The Accra Declaration).

The formulation and adoption by the UN of the Millennium Development Goals (MDGs) has given a new urgency to proper water resources management. The Ministerial Conference of the 3rd World Water Forum in March 2003 declared that "water is a driving force for sustainable development including environmental integrity, and the eradication of poverty and hunger, indispensable for human health and welfare." The Conference also "recognised capacity building as one of the three utmost important prerequisites to succeed in our efforts."

In its efforts to address the problems, The Government of Ghana (GoG) has formulated a number of strategic documents: "Ghana Water Vision – 2025", "National Environmental Sanitation Policy" and most recently, "Ghana Poverty Reduction Strategy". The Ghana Water Vision addresses four themes:

1. Water for Food, meaning availability of water in sufficient quantity and quality for cultivation of food crops, watering of livestock and sustainable freshwater fisheries to meet the nutritional needs of the population.
2. Water (and Sanitation) for People, meaning accessibility to safe drinking water and sanitation facilities for the entire population, both rural and urban.
3. Water and Nature, ensuring availability of water in adequate quantity and quality to sustain nature, bio-diversity and the aquatic ecosystem.
4. Integrated Water Resources Management, ensuring an effective management system for sustainable use of water that is fully integrated into the socio-economic development of the country and national development planning.

Realising this Vision, as well as achieving the MDGs, requires a well-planned and staged approach over the coming decades. Ghana has started to implement Integrated Water Resources Management (IWRM), with the establishment in 1998 of the Water Resource Commission (WRC) as the central authority governing the entire water sector. New legislation streamlines the coordination between sectors and the introduction of a system of water licensing ensures that water is viewed as a valuable and scarce resource. A new water policy has been formulated, which acknowledges the importance of transboundary cooperation with riparian countries.

In order to pay more attention to the problems of rural water supply and sanitation, a semi-autonomous division of the then Ghana Water and Sewerage Corporation (GWSC), named Community Water & Sanitation Division was established in 1994. This division became fully

independent in 1998 and changed its name into Community Water & Sanitation Agency (CWSA), taking the rural component out of the scope of GWSC. In this direction, the provision of water and sanitation facilities in rural areas under CWSA was to be based on the demand-driven approach i.e. to enable the communities not only to request for assistance but to co-finance and own the facilities including full financial responsibility for operation and maintenance.

In parallel development, the discussions on further transformation of the then GWSC started with the objective of increasing the role of private sector participation in urban water supply. In 1999, the Corporation changed its name to Ghana Water Company Limited (GWCL), concentrating its activities exclusively on provision of water for urban areas and reducing further its control over wastewater collection and disposal.

Environmental sanitation problems in Ghana have been tackled structurally, only recently. The Government's National Environmental Action Plan for 1991-2000 placed a high priority on establishment and implementation of environmental health standards. The main responsibilities have been delegated to the metropolitan, municipal and district assemblies, monitored by the Ministry of Local Governments and Rural Development (MLGRD). These responsibilities can be classified in four main groups:

- waste management (solid and liquid, including drainage),
- public health management,
- environmental monitoring,
- planning and monitoring of operation and public relations.

The Environmental Protection Agency (EPA) was created in 1994 as a regulatory body for environmental affairs, subject to the Ministry of Science and Environment (MSE). Included in its responsibilities are the control and prevention of discharge of waste into the environment, and the protection and improvement of the quality of the environment in addition to ensuring the compliance with any laid down environmental impact assessment procedures in the planning and execution of development projects.

The current project has thus been established with the aim of building capacity for the wider sector, consequently improving water resources management, and efficient delivery of water supply and sanitation services.

2 Project data

1.1	Country	Ghana
1.2	Project name/acronym	Capacity Building for Sustainable Development of Water Resources and Environmental Sanitation in Ghana and the Sub-Region (WRESP)
1.3	Nuffic project number	NPT/GHA/049
1.4	Implementing organisations	Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana IHE – Delft, Delft University of Technology, International Water and Sanitation Centre, Delft, The Netherlands
1.5	Reporting year	2007
1.6	Annual report no.	3
1.7	Timeframe of project	1 January 2005 - 31 December 2008
1.8	Previous annual report submitted on	April 2007
1.9	Total project budget	€ 1,999,924
	- NPT contribution	€ 1,499,924
	- Counterpart's contribution	€ 400,000 (facilities and equipment)
	- Other funding	€ 100,000

3 Project summary

The project under the name: 'Capacity Building for Sustainable Development of Water Resources and Environmental Sanitation in Ghana and the Sub-Region' (WRESP) is conducted at the Department of Civil Engineering (DCE) Kwame Nkrumah University of Science and Technology (KNUST) in Kumasi, in cooperation with IHE-Delft, The Netherlands, who formed a consortium including Delft University of Technology (TUD) and International Water and Sanitation Centre (IRC) in Delft. The four-year project sponsored by the Nuffic-NPT programme, under the project code NPT/GHA/049, started on 1 January 2005.

The overall objective of the project is to contribute to human resources development in the water resources sector, as well as the water supply and environmental sanitation sub-sector, in Ghana and the sub-region in order to enhance the sustainable development and management of water resources, and the delivery of water supply and sanitation services. The ultimate beneficiaries are the wider stakeholders in the sector: Water Resources Commission, Ghana Water Company Ltd, Community Water and Sanitation Agency, Water Research Institute, Environmental Protection Agency, Ministry of Water Resources, Works and Housing, and Ministry of Local Government and Rural Development. These and other organisations and agencies, together with metropolitan, municipal and district assemblies, are target groups who will benefit from the capacity building programme to be developed under this project. Consequently, communities and the poor are expected to benefit from the project, too. The following outputs are expected from the project implementation:

1. Academic strengthening, achieved by staff training at MSc and PhD levels.
2. KNUST accredited MSc programme in Water Resources Engineering and Management (WREM) of 18 months.
3. Revised and KNUST accredited MSc programme in Water Supply and Environmental Sanitation (WSESP) of 18 months.
4. Revised BSc curriculum in Civil Engineering by strengthening the foundation courses required for pursuing the WREM- and WSES MSc programmes.
5. Strengthened research capacity, achieved by structured research plan, a number of completed research projects with publications in national, regional and international conferences and scientific journals.
6. Developed and implemented tailor-made short course curricula for sector professionals in WREM and WSES.
7. Developed framework for distance learning education in IWRM and WSES.
8. Strengthened regional cooperation, achieved by surveys leading to assessment of the situation in IWRM and WSES in the West-African Region. A book on the main issues and strategies for IWRM in the West Africa is going to be published.

To be able to achieve these outputs, a substantial investment is planned for refurbishment of the MSc training facilities and equipment. A video conferencing studio is to be established and connected into a Global Development Learning Network of World Bank. It is believed that after the completion of the project, the department will have sufficient capacity to strengthen the sector in Ghana and the region by providing modern educational and training programmes supported by relevant research and consulting assignments.

This progress report gives an overview of the achievements in the project implementation in 2007, which was the third project year.

4 Project progress and achievements

4.1 Summary of achievements prior to the reporting period

The project was officially approved in November 2004, and started on 1 January 2005. This section summarises the achievements up to 31 December 2006, reported in the previous progress reports.

4.1.1 MSc programmes

The first discussions about the contours of the 18-month MSc programmes, the new one in Water Resources Engineering and Management (WREM) and the revised one in Water Supply and Environmental Sanitation (WSES), took place during the inception mission conducted by the UNESCO-IHE/TU-Delft team at KNUST in February 2005. The collection of references and materials started during the training of the two KNUST-DCE staff at UNESCO-IHE, in period March-May 2005, while the discussions on the curriculum continued during the visit of the KNUST Project Director and the Project Manager, in May, and were wrapped up in November 2005 with the stakeholders workshop organised in Accra. The main departure points in assembling the curricula were:

- to address all key issues in the management of water resources, water supply and environmental sanitation, Ghana is trying to cope with;
- to maintain the generalist nature of the contents, having in mind unpredictable job opportunities in Ghana;
- to share the relevant parts of the curricula between the two programmes, in view of integrated and multidisciplinary nature of many of the problems, as well as to arrive at more cost effective means for implementing and participating in the programmes.

At the beginning of 2006, the draft proposal was ready for the departmental discussions, which took place in April, before being submitted for the approval to the KNUST School of Graduate Studies in May, with the idea of launching both programmes in the coming academic year. After preliminary assessment, the School issued temporary permission to start preparations for the launch of the programmes in August 2006, in view of the longer regular procedure required for definitive approval. In the follow up, the interviews of the applicants took place and 10 and 12 candidates were selected for the first batch of the MSc programme in WREM and new 18-month programme in WSES, respectively. Most of them were fresh university graduates from the KNUST BSc programme. The programmes were officially launched in August as a part of KNUST academic year 2006/2007.

In the meantime, the last two batches of the old WSES MSc programme, Batch 8 with ten participants and Batch 9 with seven participants, attended their programmes in 2005 and 2006 according to the old 2-year scheme. The final MSc exam of Batch 8 was held in July 2006 and nine students obtained MSc degree, while one was awarded an MPhil degree. With this result, total 77 students completed the MSc programme in WSES since the first graduations in 1999. Batch 9 completed their taught course and started the research phase in 2006.

The list of all MSc students and graduates since the beginning of the MSc programme in WSES is shown in Appendix 7.5.

4.1.2 Short course training

In the first project year, 2005, the focus was primarily on the preparations for take-off of the MSc programmes, whilst the short courses were planned at later stage. The first list of the courses, of duration of one- and two weeks, was prepared in November 2006. The topics included:

1. Water Quality and Standards – 1 week
2. O & M of Boreholes – 1 week
3. Groundwater Treatment – 1 week
4. Surface Water Treatment – 1 week
5. Water Treatment Processes and Plants I – 2 weeks
6. Water Treatment Processes and Plants II – 2 weeks
7. Urban Water Distribution – 2 weeks (generalist programme)
8. Pumping station design –1 week
9. Water Distribution Modelling – 1 week (basic course)
10. Water Distribution Modelling – 2 weeks (extended course)
11. Leakage Management – 1 week (basic course)
12. Water Demand and Leakage Management – 2 weeks (extended course)
13. Water Quality in Distribution Networks – 1 week
14. GIS in Water Distribution – 1 week
15. Organisation of Maintenance of WDS – 1 week
16. Managing Organisations and Change – 2 weeks
17. Financial Management of Water Utilities – 2 weeks

These courses were identified based on the request of Aqua Vitens Rand Ltd (AVRL), which is the consortium of two water companies, Vitens from The Netherlands and Rand Water from South Africa. AVRL acquired the 5-year management contract from the GoG to improve the performance of Ghana Water Company Limited (GWCL). The courses were to be implemented jointly by KNUST and UNESCO-IHE, and sponsored by the consortium. Due to the problems in implementation of their own contract, AVRL postponed its training component and as a consequence, there were no short courses implemented in 2006.

On the design of the short courses in the field of WREM, DCE was of strong opinion that they are still in the process of building their own capacity in this field, through ongoing staff training at UNESCO-IHE, and would not feel confident yet to run specialist short courses independently. It was therefore a bit premature to come up with the list of credible course subjects that could attract the sector organisations to participate. Instead, the agreement was made to use the opportunity of marketing the MSc programmes in 2007 to approach each sector organisation bi-laterally and survey the subjects that would be the most attractive for tailor-made training. In the meantime, the training of trainers should almost be completed and some of these courses could be organised with support from UNESCO-IHE.

4.1.3 Staff capacity building

Next to the development of MSc curricula and procurement of the project equipment, most of the activities in 2005 and 2006 were dedicated to the staff capacity building. According to the plan of operation, four PhD- and two MSc studies were to be executed, on the line of the DCE forecast about the staff capacity required after a few senior colleagues retirement by the end of the project. Following prolonged process of the selection of the PhD candidates (search for suitable candidates outside the department, definition of research areas, arranging of residence permits for study in NL, etc.), the first one arrived in Delft only in November

2005, whilst the fourth candidate was known by the end of 2005 and started in 2006. The four candidates nominated for the PhD programme in the new project were:

1. Emmanuel Owusu-Ansah, in Hydrological Modelling (Promoter: Prof. Nick van de Giesen, TUD). Mr. Owusu-Ansah is the KNUST staff member of the Department of Mathematics.
2. Sampson Oduro-Kwarteng, in Solid Wastes Disposal (Promoter: Prof. Gary Amy, UNESCO-IHE); DCE staff member.
3. Helen Essandoh, in Wastewater Treatment (Promoter: Prof. Gary Amy, UNESCO-IHE); DCE staff member.
4. Eric Ofosu Antwi, in Water Resources Management (Promoter: Prof. Pieter van der Zaag, UNESCO-IHE); under consideration for position at DCE; active as the WRESP Project Assistant.

The local supervisor nominated for Mr. Owusu-Ansah and Mr. Ofosu-Antwi was Dr. Samuel Odai whilst the supervisor of Mr. Oduro-Kwarteng and Mrs. Essandoh was Mrs. Esi Awuah, both then the Sectional Heads at DCE. Despite the initial delays, the start of the studies was encouraging and the research areas were formulated in all cases except for Mr. Ofosu Antwi.

Regarding the MSc studies, two candidates selected for the 18-month programme at UNESCO-IHE, started their studies in October 2005:

1. Mr. Kwaku Amaning Adjei – MSc in Hydrology
2. Mr. Frank Ohene Annor – MSc in Water Resources Management

Both candidates were fresh KNUST graduates, not yet the staff members of the Department but would be considered for the positions upon successful completion of their programme.

The decision agreed between the counterparts was to put the most of the departmental research funds planned in the budget next to the above PhD and MSc studies, to bring the three PhD studies, started in the previous Water Supply and Environmental Sanitation Project, to the end. The late completion of these studies was discussed during the visit of the KNUST Vice-Chancellor, late Prof. Kwesi Andam and Dr. Samuel Odai, on occasion of the closure of the UNESCO-IHE academic year, in September 2005, and a concrete plan of action was made. The situation at the end of 2005 was as follows:

1. Mrs. Esi Awuah submitted all parts of her thesis except the last chapter. During the finalising of the work, she temporarily took over the position of the KNUST Project Manager, which caused some delay.
2. Mr. Kwabena Nyarko spent two months at UNESCO-IHE in period of November-December 2005 working on the improvement of his thesis, which was also in the last stages prior to submission to the reading committee.
3. Mr. Richard Buamah continued his experiments at UNESCO-IHE with a prospect of expanding them throughout 2006.

Furthermore, DCE approved the financial assistance for the PhD study of Mr. Ebenazer Mensah to conduct part of his research in the USA. Mr. Mensah is the staff of the KNUST Department of Agricultural Engineering that closely cooperates with DCE in the field of irrigation, which was supposed to be the subject in the new WREM MSc programme. The thesis title is: 'Modelling Vegetables Uptake of Cadmium and Lead from Irrigated Wastewater by Transpiration; Case study: Kumasi, Ghana'.

Next to the funding of the PhD and MSc programmes, the other staff training in 2005 was substantially supported by the PoWER ('Partnership for Water Education and Research')

project. This project, funded by the Dutch government to enhance the cooperation between the educational organisations in the North and South, has established the network of 18 partners, KNUST being one of them. In 2005, PoWER funded the above-mentioned three-month training of Dr. Fred Anyemedu and Dr. Geoffrey Anornu, both members of the DCE Water Resources Engineering Section, who were attending the specialist modules of the UNESCO-IHE Master Programme in Integrated Water Resources Management. In addition, three members from DCE, Dr. Odai, Mr. Oduro-Kwarteng and Dr. Adom-Asamoah (DCE Structures Section) were funded to attend the one-week workshop on innovative learning held in May in Indonesia and hosted by the Parahyangan Catholic University in Bandung, who is also the PoWER partner. Dr. Odai was also a member of the organising committee for this event. For this purpose, Dr. Odai spent the month of January 2005 at UNESCO-IHE where he was also trained how to manage large capacity building projects.

From the efforts outside the WRES and PoWER projects, Dr. Odai was awarded a six-month fellowship by the UK government, which he was to spend at Imperial College in London starting in October 2005. Part of this period he also used studying the similar curricula and materials for the MSc programme in Water Resources Engineering and Management. During his absence, his management duties in the project were taken over by Mrs. Esi Awuah.

2006 was the year of the first PhD graduation out of cooperation between KNUST and UNESCO-IHE. At the same time, some unforeseen events resulted in a setback in two of the PhD studies started in this project. The status with the DCE PhD staff training conducted in 2006 was as follows:

1. Emmanuel Owusu-Ansah, in Hydrological Modelling (Promoter: Prof. Nick van de Giesen, TUD). This study was the first to start, and was progressing according to the plan agreed with his supervisor. Part of the time, the candidate spent in Ghana but was ill, which however did not imply serious delays.
2. Sampson Oduro-Kwarteng, in Solid Wastes Disposal (Promoter: Prof. Gary Amy, UNESCO-IHE). The UNESCO-IHE Academic Board approved the PhD research proposal in February 2006 and the study continued by designing the experimental set-up that was to be installed in Kumasi. Somewhere in July, the UNESCO-IHE mentor of Mr. Oduro-Kwarteng, Ms Annete Ochs, suddenly changed her job and left the institute, which interrupted the progress for a few months. While searching for alternative solution for rather highly specialised topic, the candidate expressed strong desire to modify the topic departing from the process design into the management aspects of solid wastes disposal. He received the support of DCE for such a move, which required resubmission of his research proposal and search of the new supervisor. After preliminary discussions, UNESCO-IHE Prof. Meine Pieter van Dijk accepted to take over the supervision of the candidate from Prof. Amy, while Mr. Klaas Schwartz was nominated as his UNESCO-IHE mentor. By the end of 2006, Mr. Oduro-Kwarteng was doing the literature study and was scheduled to follow the specialist management module in February 2007 at UNESCO-IHE, required to upgrade his research proposal.
3. Helen Essandoh, in Wastewater Treatment (Promoter: Prof. Gary Amy, UNESCO-IHE); DCE staff member. In a very similar way as with Mr. Oduro-Kwarteng, the original PhD research proposal of Mrs Essandoh was approved in February 2006 and the study continued by designing the experimental set-up that was to be installed in Kumasi. During this process, Mrs. Essandoh delivered a baby, the second since the beginning of the project, which significantly changed her family situation. To be able to organise the childcare, she temporarily halted her PhD study, in the second half of 2006. Making the entire family repatriation to the Netherlands virtually impossible,

according to the current Dutch immigration law, Mrs. Essandoh requested her employer, DCE, for the transfer of her PhD to University of Bradford, where her husband is currently also doing his PhD. In agreement with Prof. Amy, Helen's UNESCO-IHE PhD Mentor and the WRESP Project Director visited the Department of Civil Engineering at Bradford University in December and met Dr. Chadli Tizaoui who agreed to supervise the research. The conclusions of this short visit were that the research interests comply on both sides and that the department has sufficient laboratory facilities to accommodate the research as initiated at UNESCO-IHE. Nevertheless, some modifications of the research plan were to be introduced to fit it into generally shorter duration of PhD studies in UK than in NL. The decision on precise plan of research and financial implications of the transfer of the PhD of Mrs. Essandoh was to be surveyed in the first quarter of 2007. The preliminary investigations suggested that the work done up to that stage could qualify Mrs Essandoh for an additional two-year PhD programme, ending in 2009.

4. Eric Ofosu Antwi, in Water Resources Management (Promoter: Prof. Pieter van der Zaag, UNESCO-IHE). Mr. Ofosu Antwi was the last one of the four candidates to start the PhD programme. As he is also the youngest i.e. with least professional experience, more time was necessary to develop the research area. After following a number of specialist modules at UNESCO-IHE, in September 2006, Mr. Ofosu Antwi was joined by his supervisor for a short fieldtrip organised in potential catchments of his study. The last part of 2006 was used to produce the research proposal that was to be approved in 2007.

Out of the three PhD candidates who started their studies in the previous project (WSESP):

1. Mrs. Esi Awuah finalised her PhD study with the graduation held on 29 November 2006 at UNESCO-IHE, as the very first PhD out of cooperation between KNUST and UNESCO-IHE. The degree was awarded by Agricultural University at Wageningen. A high-level delegation from KNUST, headed by Prof. Kwasi Adarkwa, new Vice-Chancellor, attended the ceremony, which was also an occasion to mark the tenth anniversary from the first capacity building project at KNUST-DCE sponsored by Nuffic-SAIL programme.
2. Mr. Kwabena Nyarko completed his PhD manuscript that received positive opinion of his co-promoter from the Institute of Social Studies (ISS), which awards the degree. The manuscript was submitted to the reading committee and the PhD defence was tentatively scheduled for July 2007.
3. Mr. Richard Buamah continued his experiments at IHE. His progress in 2006 was evaluated as very satisfactory and some of the experiments were planned to continue in 2007 to verify interesting findings. For this purpose, KIWA research institute agreed to join the research by investing € 15,000 that would be sufficient to complete the experimental work of Mr. Buamah. After this, he would continue the thesis writing with expected end of the research planned for 2008.

The status of the MSc training in 2006 was as follows:

1. Mr. Kwaku Amaning Adjei – MSc in Hydrology. The candidate successfully completed the taught programme at UNESCO-IHE and started the research phase in September, with the graduation planned in April 2007.
2. Mr. Frank Ohene Annor – MSc in Water Resources Management. The candidate successfully completed his taught programme at UNESCO-IHE and started the research phase that included the fieldwork in Ghana; his graduation was also planned in April 2007.

Both of the candidates demonstrated sound academic performance, which increased their chances to join DCE immediately after the completion of their MSc studies.

Due to relatively large number of DCE staff involved in the PhD and MSc programmes, and the efforts in preparation for the take-off of the MSc programmes in Kumasi, there was no other specific training of trainers organised in 2006. Dr. Odai completed his six-month period at Imperial College in London and returned to Ghana in March, when he restored his position as the Project Manager. Further staff training, in 2007 and 2008, was to be based on the staff development plan, whose contours were drawn in the meantime, by identifying the knowledge gaps in specific fields, and/or the replacement of the colleagues who are on contract (already retired) or are about to retire. For each subject in the MSc programme, the department allocated one of its members as responsible for the development and implementation; the general intention of the plan was to minimise the input of the guest lecturers. This list has been shown in Appendix 7.6.

Finally, Mr. Ebenazer Mensah, the staff of the KNUST Department of Agricultural Engineering, who was making use of the project funds earmarked for general research, completed his PhD research in 2006. The draft manuscript was evaluated by his local supervisors and he was expected to graduate at KNUST in June 2007.

4.1.4 Investments

The investments made in the first project year amounted close to € 100,000. Approximately € 84,000 was booked in 2005 and the rest of the procurements done close to the end of that year appeared in the financial report for 2006.

The main investment, of approximately € 38,000, was done for procurement of the laboratory/field equipment for education and research in water resources management. This is all new equipment that did not exist in DCE before and was also to be used for the PhD study of Mr. Ofosu Antwi. Formally, this equipment was allocated to the DCE Water Resources Engineering Laboratory.

Furthermore, a part of the laboratory investments (approximately € 15,000) was used to improve the conditions in the Environmental Quality Engineering Laboratory, established during the previous project period. Some pieces of the equipment there were not operational and spare parts were to be procured. The head of the UNESCO-IHE laboratory, Mr. Fred Kruis, paid a visit to KNUST-DCE in December 2005 and made further recommendations in this respect. Furthermore, the project also procured a car, Toyota - Land Cruiser, for approx. € 36,000. The department decided to postpone the procurement of the 2nd vehicle as long the existing vehicles are functional.

The rest of the investments in 2005, of some € 10,000 was used for the computer equipment: the laptops for the PhD fellows and the project management and minor peripheral equipment. A few library books have also been procured serving in the first place the need of the new PhD fellows.

The procedure for awarding the contract for delivery and installation of the equipment for the video conferencing studio, funded by the PoWER project, was initiated in November 2005. One lecturing room in the new complex in the College of Engineering, allocated for this purpose, was under construction in that year.

The investments made in 2006, which was the second project year, amounted up to approximately € 120,000. The main investment, of approximately € 70,000, was done for the procurement of the electronic equipment for the video conferencing studio, which was

sponsored by the PoWER project, as originally planned. This equipment was delivered and installed by the supplier 'Telindus' from Belgium. Out of the remaining € 50,000, the project has contributed € 12,000 for furnishing of the space in the new building of the College of Engineering where the studio is located. With this, the studio was completed and internal testing of the audio/video connections was successful. The external connections were however yet to be tested, which required an adaptation of the bandwidth in the main Internet communication centre of KNUST. That was expected soon and the first video transfer was planned in 2007.

Furthermore, the major investments included the procurement of two photocopiers, one of them a heavy-duty model specifically meant for production of lecture notes in the programmes (approximately € 11,000). Additional € 7000 was invested into the procurement of the project office furniture, which was the first major renovation of this space since the beginning of the cooperation in 1996. Finally, the rest of approximately € 20,000 was used for the procurement of computers and peripheral equipment and a few library books. Six laptops were bought for the PhD and MSc participants and two desktop computers for the project office (approx. € 10,000). As already mentioned, four of the laptops were actually bought at the end of 2005 but were booked in the financial report for 2006.

4.1.5 Networking and spin-off activities

No substantial spin-off activities took place in the first year of the project implementation. Nevertheless, the DCE commitments from the previous cooperation with UNESCO-IHE, and their contacts developed out of it, resulted in the following initiatives:

- Development of joint research topics under the PoWER partnership
- Participation in lecturing programmes in water supply and environmental sanitation at University of Rwanda (where another Nuffic-NPT funded capacity building project is running).
- Participation in the EU funded SWITCH project ('Sustainable Water Management Improving Tomorrows' Cities Health')

Moreover, the department was approached by the Universite D'Abomey-Calavi from Cotonou in Benin, who runs another Dutch sponsored capacity building project in cooperation with the Larenstein University of Professional Education. A delegation consisting of the Director of the University, Prof. A.M.T. Kpodékon and the Project Coordinator from The Netherlands, Mr. G. van den Wall Bake, visited Kumasi and the MoU was signed that should include cooperation in the implementation of the academic programmes at both universities. Finally, the department was still active in the West-African network in integrated water resources management and would play a role in the second phase of the UN-Habitat sponsored project 'Managing Water for African Cities'.

It was hoped that some of these opportunities would materialise in the near future, which in one way would be a positive development but on the other hand could impose additional strain for the DCE staff involved in the project implementation.

4.2 Progress and achievements in 2007

The overall assessment of the Plan of Operation for the third project year (period 1 January to 31 December 2007), as specified in the Annual Plan 2007 submitted to Nuffic in November 2006, is summarised in the table in Appendix 7.1. More detailed description of the achievements is given in the following paragraphs.

4.2.1 MSc programmes

2007 was the year of official ending of the MSc programme in WSES according to the old two-year curriculum. In July, all seven participants of Batch 9 defended their thesis, concluding this programme with a total of 84 graduates, since its start in 1997.

In the meantime, the first batch of the new WREM MSc programme (10 students) and the revised WSES MSc programme (12 students) completed their taught part and were conducting their MSc research phase. No serious problems were encountered in the programme implementation. The lecturing was supported by the Dutch consortium (UNESCO-IHE, TU-Delft, IRC), who were using the opportunity to transfer the knowledge to the local teachers. Some of these missions were executed to facilitate the absence of the DCE staff currently busy with their PhD programme.

After conducting interviews for the new academic year, the second batch of both programmes was approved, coincidentally consisting of the same student numbers but changed balance compared to the first batch (WREM-12 and WSES-10). The programmes commenced in August, with the first semester.

The list of all MSc students and graduates since 1999 is shown in Appendix 7.5.

4.2.2 Short course training

A training course on Sustainable Waste Water Treatment and Reuse was held at Erata Hotel in Accra from Monday September 24 to Friday September 28, 2007. This was the first short course in the framework of the WRESP project organised and implemented and co-financed in collaboration with SWITCH project (Accra City Learning Alliance). Twenty six participants from various organisations including Accra Metropolitan Assembly (Sewerage unit, Treatment Plant, Waste Management Department), Universities (University of Ghana, Valley View University, University of Cape Coast) and District Assemblies (Wa, Wassa-West, Ga-East and Ga-West), including some individual participants, attended the programme. The training was made up of interactive lectures, exercises and a field trip, and was conducted by Prof.Mrs. Esi Awuah (KNUST-DCE), Dr. Peter van der Steen (UNESCO-IHE) and Dr. Olufanke Cofie from International Water Management Institute (IWMI) in Accra. At the end of training, the participants were presented with certificate of attendance.

Two more short courses are planned out of cooperation with SWITCH project: on integrated urban water management, in April 2008, and soil aquifer (water) treatment, in November 2008. Moreover, two additional short courses will be funded by the project: one in collaboration with IRC and the other, conducted by UNESCO-IHE/KNUST, on water quality and standards. The latter programme was initially offered to AVRL (mentioned in the previous report) but due to still unclear situation with their training programme at GWCL, a

choice has been made to offer the support from the project budget, in order to demonstrate the capability of KNUST-DCE in organising and implementing this kind of events. To recover the costs of organisation, at least partially, a moderate fee will be charged for the participants in this course.

Finally, DCE has made strategic choice of developing specialised and tailor-made courses in the following subject areas (also published at the new project website):

- Water supply and environmental sanitation area
  - Water treatment
  - Water distribution
  - Management of water systems in small towns
  - Rural water supply
  - Wastewater treatment
  - Solid waste management
  - Municipal engineering
  - Municipal infrastructure management
- Water resources engineering and management
  - Hydrological measurements and data processing
  - Urban drainage and storm water management
  - Water systems modelling and GIS
  - Groundwater development and pollution control
  - Flow modelling in un-gauged catchments
  - Water law and institutions
  - Integrated water resources management

The covering of specific subjects in the field of WREM would still require external support in this stage. Nevertheless, through the staff training executed during four years of the project implementation, it is expected that DCE should be sufficiently equipped to run most of the courses independently, by the end of the project.

4.2.3 Staff capacity building

The status with the DCE PhD staff training conducted in 2007 was as follows:

1. Emmanuel Owusu-Ansah, in Hydrological Modelling (Promoter: Prof. Nick van de Giesen, TUD). The candidate spent the first part of 2007 doing his study in Delft. Somewhere before summer, he returned to Ghana to continue the work but failed to report his progress timely. Part of the period he was again ill and at later stage he referred to the complex family situation as the reason for the delays in his work. It is therefore that his study faced a setback in the latter part of 2007 and the assessment of the supervisor was that the plan for 2007 was not fulfilled. The candidate is scheduled to continue his work in The Netherlands in February 2008 and pending his progress, he will be confronted with possibly revised plan of the study, based on the advice of the supervisors and available budget in the project.
2. Sampson Oduro-Kwarteng, in Solid Wastes Management (Promoter: Prof. Meine Pieter van Dijk, UNESCO-IHE). Based on the change of the subject and the supervisor, described in the previous progress report, Mr. Oduro-Kwarteng managed to produce the revised research proposal in March. This proposal was approved by the UNESCO-IHE Academic Board in April. Given this change and completion of his own PhD study (and the field of expertise), Dr. Nyarko took over the local supervision from Prof. Mrs. Awuah, effective in August. In the meantime, the

candidate followed a 3-week short course on Water Services Management at UNESCO-IHE, in February, meant to improve the skills needed to approach the modified subject of his study. Furthermore, he attended the International Solid Waste Association Annual World Congress in Amsterdam in September, where he presented a paper together with his supervisor. After this, he returned to Ghana where he started the fieldwork and data collection. The progress of this study in 2007 can be considered satisfactory. The general impression is that the candidate managed to compensate with his hard work a part of the delay caused by the change of the subject.

3. Helen Essandoh, in Wastewater Treatment (Promoter: Dr. Chadli Tizaoui, Bradford University, UK). Based on the change of the family situation of Mrs Essandoh, described in the previous progress report, an arrangement has been made to transfer her PhD to Bradford University where her husband is doing his PhD. According to the agreement between the university and UNESCO-IHE, Mrs Essandoh shall be funded by the project for a period of two years, starting in June 2007, which includes the tuition and bench fees, and her stipend. Based on her previous work done in Delft, it is expected that the upcoming 2-year period will be sufficiently long to complete the PhD study, which according to the UK regulations has official duration of three years. The end is therefore expected somewhere in 2009. The period of settling in the new conditions took a part of 2007, but according to the communication with her new supervisor, the progress in the later part of the year was assessed as satisfactory and the laboratory study was on schedule. In view of the fact that this study has now been outsourced, and will take place full time outside Ghana, there will be no need for the role of a local supervisor, hence the role of Prof. Mrs. Awuah was terminated in May.
4. Eric Ofosu Antwi, in Water Resources Management (Promoter: Prof. Pieter van der Zaag, UNESCO-IHE). Mr. Ofosu Antwi spent the first part of 2007 in the field collecting data. The period May-July he was in Delft, where he completed his research proposal that was approved by UNESCO-IHE Academic Board in June. He also followed the 3-week short course on groundwater modelling and upgraded his knowledge on remote sensing, needed for his PhD research. Finally, he presented his progress in the annual PhD seminar at UNESCO-IHE. Starting in August, he resumed his fieldwork in the catchment of Upper-East Region in Ghana, and across the border in Burkina Faso, where he spent the rest of the year. To facilitate his mobility in the field, the project has procured a motorbike (Yamaha, 125 cc), and safety helmet for him.

Compared to 2006, it can be concluded that the overall performance of all PhD candidates in 2007 improved, except in case of Mr. Owusu-Ansah. Measures have been taken to mitigate his problems. Mr. Oduro-Kwarteng and Mrs Essandoh, managed to adjust to the new situation after changing their supervisors and modifying the research topic, and can be considered back on track. Moreover, all initial dilemmas in case of the research topic of Mr. Ofosu Antwi have been removed and his study in 2007 was on schedule. Nevertheless, like it was already mentioned in the Plan of Operation submitted for 2008, none of these studies shall be completed in 2008, which is the last project year. Thus, a budget neutral extension will be required to continue with the work in 2009. According to the initially submitted research plans, most of the work would be completed by the end of that year. At this stage, it is estimated that some 30-40 thousand € from the current budget could be reserved for this purpose, but an attempt should be made to increase this figure, in view of unforeseen delays experienced so far.

Out of the two remaining PhD candidates who started their studies in the previous project (WSESP):

1. Dr. Kwabena Nyarko completed his PhD study by the graduation that was held at UNESCO-IHE on 26 July, which is the second successfully defended PhD out of the cooperation between KNUST and UNESCO-IHE. This degree was awarded by the Institute of Social Studies (ISS).
2. Mr. Richard Buamah spent almost the entire year at UNESCO-IHE working in the laboratory. He completed his experimental part and returned to Ghana in December. It has been agreed to invite him again to Delft for a few months in 2008, to facilitate his thesis writing and submission of a few research papers that shall be published in scientific journals. He will also attend three conferences in 2008. His work in 2007 was completely funded by KIWA research institute. Expected end of this research is in 2008, with the graduation possibly moving to 2009.

Regarding the capacity building through the MSc programmes at UNESCO-IHE, both participants completed their studies in 2007:

1. Mr. Kwaku Amaning Adjei – MSc in Hydrology.
2. Mr. Frank Ohene Annor – MSc in Water Resources Management. The candidate completed his MSc study with the distinction (meaning the top 5% performance at UNESCO-IHE).

Having sufficient proof in their exceptional performance at UNESCO-IHE, and looking at their great potential and ambition to develop academic careers, KNUST-DCE put the request to recruit these two young people as departmental staff members. This has been approved effective from November 1. In the meantime, both of them returned to Delft in period June-July, where they followed additional two 3-week short courses, outside the scope of their MSc programme: Applied Groundwater Modelling and Watershed & River Basin Management (Mr. Adjei) and Water Transport and Distribution I & II (Mr. Annor). These programmes were meant to widen their academic scope and enable them to lecture these subjects in the MSc programme at KNUST, upon need. After their definitive return to Ghana, both immediately took the project management tasks, mainly in the MSc course organisation. To bridge the period before the official start of their contract, the project paid their salaries.

From the other training in 2007: Dr. Samuel Odai followed the 3-week short courses on Water & Environmental Law and Institutions, and on Watershed & River Basin Management. Next to that, 2-week training has been organised for Mr. George Acquah, the WRE laboratory technician. Due to unavailability of suitable training facilities for hydraulic experiments at UNESCO-IHE, this training was organised in collaboration with University of Bristol in UK, where Mr. Acquah stayed in July. Finally, Mr. Emmanuel Yaw Botchway, the technician of the EQE laboratory, followed 3-week training at UNESCO-IHE in period November-December.

Finally, Mr. Ebenazer Mensah, the staff of the KNUST Department of Agricultural Engineering, who was making use of the project funds earmarked for general research, completed his PhD laboratory work and has submitted his thesis. The PhD defence and graduation is expected in 2008 at KNUST.

Last but not least, Dr. Odai started in October his 6-month research visit to the Tokyo University of Agriculture and Technology, in Japan. This visit is part of his sabbatical leave, hence scheduled outside the project plan of operation, but generally in line of staff capacity building at DCE.

4.2.4 Distance learning

Activities related to the development of blended learning programmes in 2007 included implementation of online courses in Water Transport and Distribution, and Flood Modelling for Management, developed with contributions from KNUST-DCE. Both programmes were run only from UNESCO-IHE due to still unstable situation with the speed of Internet at KNUST. Furthermore, the electronic materials of the programme in water distribution were offered to the regular students of the MSc programme in WSES at KNUST.

Finally, the video conferencing studio has been tested and declared fully operational. Nevertheless, the studio could have been used only in the off-peak hours and while the larger proportion of the Internet outlets at the campus were temporarily disconnected.

Combining the IT infrastructure problems with the shortage of DCE staff to work more actively on this project objective resulted into its implementation below the planned level, so far. In view of other immediate priorities (MSc programmes and staff capacity building), it shows that some milestones related to distance learning ambitions were set a bit prematurely, although the main objectives are still considered as valid. More on distance learning is expected in 2008, following the strengthening of DCE with younger and more capable staff, as far as electronic education is concerned. Moreover, KNUST is making efforts to improve the bandwidth overall at the campus, so that the Internet use should normalise during regular lecture periods.

4.2.5 Regional collaboration

The major efforts in 2007, as far as this project objective is concerned, were made in regional collaboration through WA-Net network. KNUST-DCE hosted the General Assembly of WA-Net that was held on June 25 and 26 in Accra. Total 30 participants attended this meeting, including the delegates from Niger, Benin, Nigeria, Cameroun, Mali, Burkina Faso, Senegal, Togo and Ghana. The representatives of ECOWAS, GWP, CAP-Net and UNESCO-IHE were also attending per invitation.

The major contribution from DCE, described in the report from this meeting, was to the organisation of the Regional Training Course on Conflict Resolution and Negotiation Skills in IWRM, which was implemented by Water Resources Commission of Ghana in Accra, Ghana from 7-11 May 2007. The 5-days training dealt with strengthening and facilitating the ability and skills of water managers from Anglophone West Africa in negotiation and conflict resolution to ensure that mediation and negotiations are incorporated in water management. The course was attended by 16 participants from Ghana, Nigeria and Gambia.

Completing the 4-year period of hosting the WA-Net Secretariat, this role has moved from KNUST-DCE to International Institute for Water and Environmental Engineering (2iE) in Ouagadougou, Burkina Faso. Next to this decision, both Anglophone and Francophone part of the network presented their working plans for period July 2007 – August 2008, with a number of interesting initiatives including project opportunities co-funded by EU Water Facility, capacity building initiatives of Glowa-Volta project (www.glowa-volta.de), 2iE and UNESCO-IHE. Discussions in the meeting underlined the need for more collaboration between Anglophone and Francophone countries, specifically those sharing the Volta River Basin. On that note, the representatives of 2iE, KNUST-DCE and UNESCO-IHE agreed to continue the discussions leading to more concrete collaboration in education and research in the region. This is expected to materialise in 2008.

4.2.6 Marketing

To facilitate the marketing of their MSc programmes, once the first experiences from their implementation were gained, a full-colour course brochure has been designed and printed; the layout is shown in Appendix 7.7. Furthermore, an effort has been taken to renew the project web site. The hosting has also been taken over by KNUST and the new web address has been changed from: www.wresp.org into www.wrespknust.org. The redesign is still going on and in the future, the link shall be provided with the main KNUST website at www.knust.edu.gh. The basic structure of the website has been developed and put online and the ongoing effort is to fill the menus with appropriate contents. The idea is to make the data base of all alumni and abstracts of their MSc/MPhil theses. Eventually, the new website will become more functional and attractive allowing communication with the participants and download of the documents and electronic lecture materials. Meanwhile the old website is still active but its maintenance has been stopped. It will be phased-out once the new one has been fully functional.

4.2.7 Investments

The investments made in the second project year amounted up to approximately € 62,000.

The main investment, of approximately € 30,000, was done for procurement of the computer equipment, peripherals and furniture for refurbishing of the MSc computer room. The room has been furnished with 15 state-of-the-art desktop PCs, connected into the network and with the Internet service available. Another seven PCs have been placed in the staff offices. Out of the remaining € 32,000, the project has contributed € 12,000 for procurement and minor repair of the equipment in the EQE laboratory, including a stock of consumables not available in Ghana (mainly for research purposes). Furthermore, some € 6500 has been spent for the improvement of the library stock, € 2000 for the educational equipment (PC beamers), and € 2500 for completion of the office renovation. To improve the wellbeing of the students, the faulty fridges and freezers in the MSc hostel have also been replaced by the new ones, as an emergency measure (total € 2500). Finally, approximately € 2500 has been paid for the motorbike for the PhD fieldwork of Mr. Ofosu Antwi. The remaining expenditures, totalling to some € 4000, are related to minor procurements and repairs (external hard-disks, memory pens, etc.).

With this, the remaining investment budget in the project by the end of 2007 was around € 98,000.

From the contingencies for support of the MSc programmes, approved by Nuffic at € 25,000 for 2007, the following expenditures were submitted in the financial report:

1. € 16,278.10 – Contribution to the hostel fee. In the absence of external sponsorship, the project has released the financial burden of the students by reducing their hostel fees. These funds were used for regular maintenance and salaries of the hostel personnel.
2. € 6593.60 – The costs of laboratory experiments conducted in MSc programmes.
3. € 1323.23 – The costs of fieldwork data collection in the MSc programmes.
4. € 578.47 – The fieldtrip costs.

The total amount spent is € 24,773.40. By adding the external audit fee of € 1500, the total contingencies booked in 2007 amount € 26,273.40.

5 Adjustments in project planning

5.1 Adjustment in plan of operation

The project plan of operation for 2007 has been implemented according to the document submitted to Nuffic in November 2006, with three minor modifications:

- The third MSc scholarship intended for study at UNESCO-IHE has been converted for the study of the WREM MSc at KNUST (the candidate enrolled in this programme in August), while the part of the research funds have been earmarked for the take-off of the PhD study of Mr. Emmanuel Donkor, DCE lecturer, which is intended to take place overseas.
- The advertising campaign for the launch of distance learning programmes has been postponed for the reasons explained in paragraph 4.2.4.
- The implementation of the short course in IWRM has also been postponed. This programme shall be run in 2008 in the context of integrated urban water management, as indicated in paragraph 4.2.2.

The following planned outputs were fulfilled less than expected:

- The tailor made training prepared for Aqua Vitens Rand Ltd (AVRL), for the training of the Ghana Water Company Ltd (GWCL) employees has not materialised yet, due to disappointingly slow response of AVRL. The hope is that at least some components of this training programme shall be implemented in 2008.
- There were still little activities on the development and implementation of the distance learning programmes. Next to the above-mentioned problems with Internet speed, this was also originating from the consolidation of the MSc programmes, which in view of the shortage of staff has been receiving the higher priority in 2007. In the meantime, DCE contributed to the development of the above-mentioned online courses run at UNESCO-IHE. The process will continue by identifying the subjects to be run at the MSc programmes at KNUST, which will be one of the focuses of the project implementation plan in 2008.

It is anticipated that these delays shall not affect the overall project implementation except that the planned PhD programme will unlikely be completed by the official end of the project in December 2008, as indicated in paragraph 4.2.3. According to the current developments and submitted plans of research, all four PhD studies should be completed in 2009. This has also been indicated in the WRESP plan of operation 2008, in order to possibly reserve funds for continuation of the PhD programme beyond the official end of the project.

5.2 *Implications for annual budget*

The table of the budget request submitted with the Plan of Operation 2007 and actual expenditures booked in 2007 looks as follows:

BUDGET LINE	*PLANNED*	*BOOKED*	*RESULT*
Dutch staff time	€ 152,584	€ 170,594	112%
Local staff time	€ 64,700	€ 43,242	67%
Investments costs	€ 124,300	€ 62,385	50%
Operational costs	€ 27,000	€ 17,120	63%
Training	€ 136,900	€ 95,511	70%
Contingencies	€ 25,000	€ 26,273	105%
TOTAL NPT	€ 530,484	€ 419,355	79%
Contribution PoWER	€ 0	€ 0	n/a
TOTAL PROJECT	€ 530,484	€ 419,355	79%

Like in the previous two years, it appears that less project funds were spent than originally planned, although the difference between the plan and the result reduced in 2007. The main reasons can be summarised in the following bullets:

- The procurement budget has been utilised slower than planned. For part of the infrastructure improvement of the teaching and laboratory facilities, DCE was using their own funds. Moreover, the wish has been expressed to postpone the procurement of the lab generator for 2008. Finally, in the discussions with the laboratory personnel, the amounts planned for the equipment have been reduced and, based on the savings made on other planned equipment, it was proposed to channel these funds into procurement of a fieldtrip bus, which has been approved in the plan of operation for 2008.
- The delay in PhD training of the four candidates from this project resulted in under spending of the funds that will be reserved for PhD implementation in 2009 (output 1).
- The majority of DCE staff was undergoing various forms of training outside the department for shorter or longer periods of time, which caused delays in realisation of short courses and distance learning programmes (outputs 6 and 7), i.e. the lower input of local staff than originally planned.

Similar conclusions can be drawn analysing the expenditures per project output:

No.	Output	Budget (€)	Booked per 31/12/06 (€)	Booked in 2007 (€)	Balance per 31/12/07 (€)	Plan 2008 (€)
1	Academic strengthening	491,096	212,085.23	98,610.19	180,400.58	126,717
2	MSc in WREM	82,446	56,871.50	59,906.84	-31,332.34	10,342
3	MSc in WSES	69,639	26,686.86	73,021.49	-30,369.35	12,674
4	BSc programme	4500	0	0	4500.00	0
5	Research strengthening	136,629	45,682.17	13,087.92	77,858.91	54,006
6	Short courses	28,563	2757.87	8618.95	17,186.18	10,000
7	DL modules	11,040	1576.97	0	9463.03	5000
8&9	Regional & int. cooper.	25,997	6,859.47	7,750.35	11,387.18	23,205
10	Investments	296,300	136,141.11	62,385.36	97,773.53	97,000
11	Project management	278,714	103,242.14	72,700.72	102,771.14	68,844
	Contingencies	75,000	0	26,273.40	48,726.60	50,000
	TOTAL PROJECT	1,499,924	591,903.32	419,344.21	488,665.47	457,788

A few additional conclusions can be drawn from this table:

- Due to the above-mentioned staff shortage, more lecturing support from UNESCO-IHE was used than initially planned, actually in both programmes (outputs 2 & 3). In few cases, the lecturers will have to be invited to repeat their programme also in 2008. This problem will be partially solved by giving some lectures on distance, using the video conferencing studios in Kumasi and Delft.
- The balance per 31/12/07 shows more favourable situation in outputs 1, 5 & 11 than in reality, due to a few delayed declarations within the Dutch consortium, and claims from KNUST that are yet to be submitted in order to account for the advances already sent from UNESCO-IHE.
- Nevertheless, it is expected that the savings can be achieved, e.g. through co-financing of the realisation of outputs 6 and 8, or shifting the funds from one output to another, such as in case of output 4, which will be sufficient to reserve the funds for the PhD programme implementation in 2009. At this moment, the estimate is that some € 31,000 could be available for that purpose.

6. Sustainability

6.1 General strategy

6.1.1 DCE staff plan

By the end of 2007, the DCE consists of the following staff members in the two sections involved in the project implementation:

DCE - Water Resources Engineering Section				
1	Samuel Odai	PhD	Senior Lecturer, Section Head	Project Manager; 1-year sabbatical leave started in October 2007
2	Fred Anyemedu	PhD	Senior Lecturer	Former WSES Project Manager; sabbatical leave started in August 2006, extended until July 2008
3	Geoffrey Anornu	PhD	Lecturer	Deputy Project Manager as of October 2007
4	Frank Ohene Annor	MSc	Lecturer	Recruited in November 2007
5	Kweku Amaning Adjei	MSc	Lecturer	Recruited in November 2007
6	C. S. K. Kpordze	PhD	Senior Lecturer	On annual contract
7	Isaac Nyameche	PhD	Senior Lecturer	On annual contract

DCE - Environmental Engineering Section				
1	Esi Awuah, Mrs.	PhD	Associate Professor, Department Head	Project Director
2	Kwabena Nyarko	PhD	Lecturer, Section Head	Deputy Project Manager until September 2007; Project Manager as of October 2007
3	Emmanuel Donkor	MSc	Lecturer	PhD applicant
4	Richard Buamah	MSc	Lecturer	PhD fellow (from WSES), graduation in 2008
5	Sampson Oduro-Kwarteng	MSc	Lecturer	PhD fellow (IHE)
6	Helen Essandoh, Mrs.	MSc	Lecturer	PhD fellow (Bradford)
7	A. O. Anakwa	MSc	Research Fellow	On annual contract

The three senior colleagues who are working on contract are on retirement. They have been invited to continue for a few more years, which is regular practice at KNUST. Since August, Dr. Nyarko has taken the position of the Deputy Project Manager, after completing his PhD study. Soon after the departure of Dr. Odai for sabbatical leave, Dr. Nyarko's role has been upgraded into the Project Manager, while Dr. Anornu was nominated as the deputy, as of October. Finally, the two fresh MSc graduates, Mr. Amaning Adjei and Mr. Ohene Annor, started their contracts in November. With this strengthening, the situation in the department improved despite the temporary absence of Dr. Odai and extension of the leave of Dr.

Aneymedu. This is very important in view of very ambitious plan of operation for 2008, which is the last project year.

Also in 2007, the staff shortage problems in the project management and administration were successfully tackled with the support of the Civil Engineering graduates (national service personnel) in the department. The project kept funding the project secretary, while the position of the project assistant and video conferencing studio manager has been transferred to the two new staff members, Mr. Ohene Annor and Mr. Amaning Adjei. The latter position is temporary, while it will be assessed if the (frequent) use of the studio justifies paying a full-time studio manager.

Hence, the starting position for 2008 looks more favourable than it was at the beginning of 2007. Nevertheless, the responsibilities are also growing as, next to the project implementation, it is expected that the level of spin-off activities (described further) shall also be growing. Looking at the issue of sustainability on a longer term, the idea of establishing a water centre at KNUST that could recruit additional staff on a contract basis, including further development of regional and international collaboration, seems to be maturing. It has been therefore agreed to give special attention to this idea, as the project end will be approaching in 2008. A concept paper that would formulate the objectives of such a centre and regional collaboration more in details, should be prepared leading to a project proposal for possible funding of these initiatives.

The list of the MSc subjects and the resource persons in the MSc programmes in WREM and WSES in 2007 is given in Appendix 7.8.

6.1.2 Research strategy

No new developments were registered with regard to the departmental research strategy, in 2007. The list of the five core research themes mentioned in the previous annual report is still valid:

1) Natural wastewater treatment and re-use
2) Removal of Manganese, Fluoride and Arsenic from groundwater
3) Management of water utilities
4) Solid waste management and disposal
5) Hydrological modelling of catchments

The new situations with regard to the change of the PhD subjects and mentors of Mrs. Essandoh and Mr. Oduro-Kwarteng had no negative implications for the research themes one and four, as the modified topics still fit them appropriately.

6.1.3 Management of assets

The state of the project assets in 2007 can be considered as satisfactory. The injection used in the form of contingencies was very useful to keep the hostel and the EQE laboratory running. The key hostel expenditures are the salaries of the hostel personnel (porter, security) normally paid from the student fees. Due to the problems described in the previous progress report, there were delays in paying these salaries, which was solved by transferring part of the project money as a co-financing of the hostel fees. Moreover, the conditions in the two hostel kitchens have been improved by buying a number of cooling appliances from the investment budget. Two possibilities are considered for the future:

1. To transfer the hostel to the KNUST student housing corporation who take care about student accommodation on the campus. This would release the pressure on DCE to run the hostel in a sustainable way, but would deprive them of having influence on the occupancy and the fees.
2. To share some maintenance costs with the new hostel built at the same complex for students of the new MSc programme run by the DCE Road and Transportation Section.

The decision on the way forward shall be made in 2008.

As for the EQE laboratory, the facilities and equipment were heavily used in 2007, also by BSc students. To provide smooth implementation of the lecturing programme, the project supported the procurement of chemicals and glassware. A few measuring devices are still malfunctioning and are to be repaired, most importantly the Atomic Absorption Spectrophotometer (AAS) that was out of operation the whole year. The problem here is that the authorised dealer for this equipment does not operate in Ghana. A tentative agreement has been made to organise collective repair of these devices, as there are three more available in other KNUST faculties, and share the costs between the faculties/departments who own them.

Furthermore, the project has refurbished the MSc computer room which now has high class PCs to be used by the students in both MSc programmes. Due to the security issues, the decision has been made not to put the PCs into the former computer room in the hostel. This space has been therefore converted into a study room that can also be used for smaller group sessions. This is not necessarily seen as a big problem; the students increasingly possess their own laptops, as well as the distance between the hostel and the MSc lecturing facilities is not too long.

Next to the use of regular facilities, a few online meetings have been conducted in the video conferencing studio. Due to delayed completion and the problem with the bandwidth, the studio was underutilised in 2007, but this is expected to improve in 2008.

Finally, the project office has been refurbished and the project car was fully functional. Some effort is considered to do a facelift of the two vehicles procured in the WSES project that are despite rather old age (10 and 8 years, respectively) and huge mileage (> 300,000 km) still in use.

6.2 Sustainability of MSc programmes

The similar obstacles regarding the funding of the two MSc programmes popped up after the second batch started in August 2007: most of the students are young graduates streaming directly from the KNUST BSc programme in Civil Engineering and sponsoring themselves from private funds. In view of the growth of living costs in Ghana in the past few years (reflected also in the increase of hostel accommodation fees), it becomes obvious that such way of funding the programme is affordable only for a fraction of well-settled Ghanaian families. In the absence of structured sponsorship by other donor agencies in Ghana, the choice is to try the ideas brainstormed during the stakeholder workshop in late 2005. These assume more lobbying in relevant ministries to support at least Ghanaian fellowships from their funds. In 2008 at least, the programmes will be running with minor support from the project and the students are doing their best to provide at least partial funding from their side.

Another issue is the maintenance of academic level of the programmes, which has not been assessed in the first batch for the sake of ongoing transfer of knowledge, absence of some local teachers and tuning of curricula. A quality assessment shall be done upon the completion of the second batch, in 2008, to make a plan of measures for improvement where necessary and eventually leading to possible external accreditation of these programmes.

All in all, the feeling is that the MSc in WSES, already in its 12th year since the start in 1997 and with nearly 100 graduates, has taken roots in Ghana and is less vulnerable than the MSc in WREM, which is still unknown and more challenging for the implementation than the first one. As a consequence, the marketing of this programme should be amplified proportionally to the growth of confidence in its implementation, in order to avoid false expectations of the applicants boosted by aggressive advertising.

6.3 Networking and Spin-off activities

As a result of the project implementation and overall cooperation with UNESCO-IHE the Department continued with the following activities in 2007:

- Participation in the PoWER partnership; Dr. S. Odai was active member of the PoWER task force, prior to his departure on sabbatical leave. Nevertheless, due to the restructuring of the partnership initiated by UNESCO-IHE, the level of activities in the task force was lower in 2007.
- Participation in the NPT capacity building project in Rwanda; Dr. F. Anyemedu extended his 1-year sabbatical leave at the University of Rwanda as a Senior Lecturer, Head of Civil Engineering Department, until July 2008.
- Participation in the WA-Net (West African) Network in IWRM, described in paragraph 4.2.5.
- Participation in the EU funded SWITCH project; the participation of the DCE in the SWITCH project took more time than originally planned but resulted in the initiatives for two short courses, mentioned above. Also, the department organised the workshop of the SWITCH partners on the development of the methodology for urban water governance, held in Accra August 13-18. Next to this, Prof. Mrs. Awuah, Dr. Nyarko and Dr. Odai participated in the 1st scientific meeting of the SWITCH partners, held in January in Birmingham, where he presented a paper on optimising social inclusion in urban water supply in Ghana. Furthermore, Prof. Mrs. Awuah and Dr. Nyarko, attended the 2nd scientific meeting organised in Tel Aviv in November.

Finally, Dr. Nyarko attended a two day regional workshop conducted for interested researchers involved in the water field, as well as research administrators and trainers, to receive all necessary information to participate in the EU FP7 programme. The workshop programme included sessions introducing the EU and FP7, water research opportunities within the programme, how to get involved in a project, and how to prepare a proposal, contractual and financial issues, etc. The workshop was held in Dakar, Senegal, on November 15 and 16.

7. Appendices

7.1 Project achievement table

PROJECT ACTIVITIES IN YEAR 3	01-Jan-07	31/Dec/07
	Shedule	Implemented
OUTPUT 1: ACADEMIC STRENGTHENING		
MSc training at UNESCO-IHE (Amaning-Adjei, Ohene-Annor)	Jan-Apr	100%
MSc training at UNESCO-IHE (Kabo-bah, enrolled MSc WREM at KNUST)	Aug-Dec	100%
PhD programme (Buamah, Nyarko)	Jan-Dec	100%
PhD programme (Essandoh, Oduro-Kwarteng, Owusu-Ansah, Ofosu-Antwi)	Jan-Dec	90%
Training of trainers in WREM & WRES	May-July	100%
Training of WRE Technitians	June-Nov	80%
OUTPUTS 2 – 4: MSc POGRAMMES, BSc PROGRAMME IN CE		
MSc programmes WREM & WRES, Batch 2006, Session 2 & MSc thesis	Jan-Dec	100%
Interview of the MSc candidates, Batch 2007	July	100%
MSc programmes WREM & WRES, Batch 2007, Session 1	Aug-Dec	100%
Development of lecturing materials	Feb-Dec	40%
Development of promotion materials	Feb-June	100%
Marketing campaign	Mar-June	60%
OUPUT 5: STRENGTHENING OF RESEARCH CAPACITY		
Review of the PhD research lines and related publications;	Feb-Apr	60%
Review of the MSc thesis subjects;	Feb-Apr	70%
Electronic data base of the MSc thesis and research publications;	May-June	60%
Selection of the titles for the DCE library and electronic journals for subscription;	Feb-June	90%
Literature study on IWRM in Ghana;	Feb-June	60%
Setting the 5-year research plan of DCE;	Feb-June	50%
MSc and PhD research seminars;	Sep-Dec	100%
OUTPUTS 6 & 7: TAILOR MADE PROGRAMMES & BLENDED LEARNING		
Implementation of three short courses for local sector;	May-Dec	50%
Plan for development of DL products at DCE;	Feb-June	30%
Identification of the WSES modules to be converted into DL format;	Feb-June	50%
Staff training on the design of DL modules and materials;	July-Dec	40%
Development of DL curricula and materials;	Feb-Dec	40%
Development of logistical support for implementation of DL programmes;	May-Dec	60%
Start of advertising campaign for DL programe;	July-Aug	0%
Launch of the DL modules (at UNESCO-IHE)	September	100%
Implementation of the DL programme (at UNESCO-IHE);	Sep-Dec	100%
Approval of the KNUST Academic Board for DL module in the WSES MSc;	November	N/A
OUTPUTS 8 & 9: REGIONAL & INTERNATIONAL COOPERATION		
Establishing the contacts with regional GDLN centres;	Feb-June	N/A
Survey on the main issues in IWRM in West Africa;	July-Oct	40%
WA-Net seminar on IWRM in West Africa;	May-June	100%
Curriculum and materials for the regional short course in IWRM (IUWM);	July-Dec	20%
Implementation of the short course in IWRM (IUWM, postponed for 2008);	July-Dec	0%
Establishing of editorial committee for book on IWRM in West Africa;	September	N/A
Selected materials used in the MSc in IWRM & WSES at DCE adapted;	July-Dec	10%
OUTPUTS 10: INVESTMENT PLAN		
Refurbishing of the second lecturing room;	Feb-June	50%
Upgrading of the equipment in the EE laboratory (repair and minor expansion);	Feb-June	20%
Renovation of the space for the WRE laboratory;	July-Dec	50%
Procurement of the furniture and equipment for WRE laboratory;	July-Dec	50%
Procurement of the books for departmental library;	July-Dec	90%
Renewal of the obsolete office equipment;	Jan-Apr	90%
PROJECT MANAGEMENT & TRAINING		
Annual Progress Report 2006;	Jan-Feb	100%
Annual Plan 2008;	September	100%
Auditing 2006;	Jan-Feb	100%

7.2 List of staff studying with project funding

The status on 31 December 2007

	Name	Type of study	Stage	Remarks
1	Mr. Emmanuel Owusu-Ansah	PhD, Hydrology	Research proposal approved; modelling work	KNUST Department of Mathematics Lecturer
2	Mr. Sampson Oduro-Kwarteng	PhD, Solid Wastes Management	Revised research proposal approved; fieldwork data collection	DCE Lecturer
3	Mrs. Helen Essandoh	PhD, Wastewater Treatment	Revised research proposal approved; PhD transferred to Bradford University (UK); experimental work	DCE Lecturer
4	Mr. Eric Ofosu-Antwi	PhD, Water Resources Management	Research proposal approved; fieldwork data collection	KNUST MPhil Degree
5	Mr. Kwabena Nyarko	PhD (WSESP), Water Utility Management	Graduated on 26 July 2007	DCE Lecturer
6	Mr. Richard Buamah	PhD (WSESP), Water Treatment	Experimental work completed; thesis writing	DCE Lecturer, Laboratory Head
7	Mr. Kwaku Amaning Adjei	MSc, Hydrology	Graduated in April 2007	KNUST BSc Degree
8	Mr. Frank Ohene Annor	MSc, Water Resources Management	Graduated in April 2007 (with the distinction)	KNUST BSc Degree

7.3 List of project staff

	Name	Title	Position	Remarks
1	Dr. Mrs. Esi Awuah	Assoc. Professor Head DCE	KNUST Project Director	
2	Dr. Samuel Odai	Senior Lecturer, DCE Sectional Head	KNUST Project Manager	Until September; on sabbatical leave since October 2007
3	Dr. Kwabena Nyarko	Lecturer, DCE Sectional Head	KNUST (Deputy) Project Manager	Took the position of the Project Manager in October 2007
4	Dr. Geoffrey Anornu	Lecturer	KNUST Deputy Project Manager	Took the position in October 2007
5	Mrs. Gertrude Sangumah	Secretary	Project Secretary	

7.4 Sustainability barometer

Sustainability barometer NPT projects

Project number: 049 *Project name:* WRESP

All project coordinators are requested to use the barometer as a basis for the section on sustainability in the NPT annual progress reports.

The barometer is intended to give some insight into the sustainability of the project's achievements, no one indicator can do so. The barometer is also no more then a snap-shot of the situation e exists currently. If this barometer is filled-out each year, one could assess whether the project is reaching higher levels of sustainability as the project matures. It also might expose possible probl areas in which specific action might be appropriate, in order to reach a sufficient level of sustainability when the project is concluded.

Some indicators fall into more than one category. The indicator "*sufficient funds for operation and maintenance*" might also fall under technical sustainability. We advise you not to get distract by this as sustainability as such is intricately related to many different facets. In the barometer there are no right or wrong answers, as the context of each project is different. Furthermore, one sin indicator as such does not necessarily say much about the sustainability of the project as a whole.

Institutional sustainability	**YEAR 2007**		
Requirement:	***Indicators***	***Level of achievement ****	
1. Institutionalisation of project activities in academic environment	1.1 Strategic Plan (Developed, Approved and Implemented)	D (concept)	(indicate **D, A, I** or a combination of letters)
	1.2 Research Plan (Developed, Approved and Implemented)	D (concept)	(indicate **D, A, I** or a combination of letters)
	1.3 Policies & procedures (Developed, Approved and Implemented)	I	(indicate **D, A, I** or a combination of letters)
	1.4 Commitment (top) management	+	(indicate -, +/- or +)
	1.5 Management capacity of department/unit in which the project is executed	+/-	(indicate -, +/- or +)
2. Adequate number of staff available for continued implementation	2 *Staff retention/mobility figures in department/unit in which the project is executed:*		
	2.1 total no. of staff	14	(indicate number)
	2.2 no. of staff who left for employment elsewhere during the year	0	(indicate number)
	2.3 no. of current vacancies	0	(indicate number)
	2.4 Bonding agreements, continuation of payment of staff on study leave	CP	(if in use indicate **BA** (for Bonding agreement) and/or **CP** for continuation of payment)
3. Local ownership of the project	3.1 Percentage of staff involved in project implementation	90%	(project staff as a % of staff in department/unit,etc)
	3.2 Project activities integrated into regular tasks of project staff	+/-	(indicate -, +/- or +)
	3.3 Initiative for writing project plan, progress reports, budgets, etc	B	(**D**utch partner, **L**ocal, **B**oth)
Technical sustainability			
Requirement:	***Indicators***	***Level of achievement ****	
4. Appropriate equipment and software installed	4. User rates of computers, equipment, etc.	70%	(indicate percentage of time in use)
5. Adequate number of technical staff available for use and maintenance	5. *Staff mobility figures of technical staff in department/unit:*		
	5.1 no. of qualified technical staff	6	(indicate number)
	5.2 no. of technical staff who left for employment elsewhere during the year	0	(indicate number)
	5.3 no. of technical staff newly employed during the year	0	(indicate number)
	5.4 no. of current vacancies for technical staff	0	(indicate number)

* (if a certain indicator is not applicable to the specific circumstances/conditions of the project please indicate **n/a**)

Academic sustainability					
Requirement:	***Indicators***	***Level of achievement ****			
6. Academic improvement	6. Curriculum/modules (Developed, Approved and Implemented)	D			(indicate **D, A, I** or a combination of letters)
7. Demand for developed courses	7. Student enrolment trend (for new or improved courses)	2006	2007	2008**	
	course MSc WSES	12	10	10	(indicate number of students
	course MSc WREM (new)	10	12	10	registered throughout the years)
8. Qualified academic staff	8. Academic staffing situation trend (related to qualification level):	2006	2007	2008**	
		6	7	7	(indicate number of PhD's)
		6	5	5	(indicate number of MSc's)
9. Outward orientation	9.1 (External) relations with entities outside the university exist		+/-		(indicate -, +/- or +)
	9.2 (Internal) relations with entities inside the university exist		+		(indicate -, +/- or +)
	9.3 Publication trend	2006	2007	2008**	(indicate number of publications
		6	10	10	throughout the years)
	9.4 Participation in seminars, conferences, etc	6	6	6	(indicate number of active participation during the year)
Financial sustainability					
Requirement:	***Indicators***	***Level of achievement ****			
10. Good financial management and administration	10.1 Strategic/financial plan for use, maintenance and replacement of equipment and software (Developed, Approved and Implemented)	I (outdated)			(indicate **D, A, I** or a combination of letters)
	10.2 Adequate and sufficient financial staff available	+/-			(indicate -, +/- or +)
11. Adequate and timely funding of staff salaries	11.1 Competitive salary level in comparison with external market	+/-			(indicate -, +/- or +)
	11.2 Reliable transfer of monthly salary	+			(indicate -, +/- or +)
12. Adequate and timely funding of operational cos	12. Sufficient funds for operation and maintenance reserved in yearly budget	-			(indicate -, +/- or +)
13. Sufficient demand for products and services	13. Market study executed	No			(indicate Yes or No)
14. Realistic pricing of services/products offered for cost recovery	14. Business plan (Developed, Approved and Implemented)	I (outdated)			(indicate **D, A, I** or a combination of letters)
15. Cost recovery mechanism in place	15.1 Third party funds generated	2006	2007	2008**	(indicate amount generated
		40k$	60k$	80k$	throughout the years)
	15.2 Prospects for continued donor support	- (outside NPT)			(indicate -, +/- or +)

* (if a certain indicator is not applicable to the specific circumstances/conditions of the project please indicate **n/a**)

** for the year 2008 the amount indicated logically represents a planned amount

7.7 List of students and graduates

1999

No	Name of Student	Thesis Title	Internal Examiners
1	**Anohene,** Felix (Gh., M)	Determination of design parameters for macrophyte-based and algal-based ponds in Ghana, 1999.	Prof. (Mrs.) Esi Awuah Dr. F. O. K. Anyemedu
2	**Atiemo,** Nicholas Akuffo (Gh., M)	Performance evaluation of a community managed water supply system (case study "Aboransa System"), 1999.	Mr. Kwabena Nyarko Dr. I. K. Nyameche
3	**Boateng** Michael Yeboah (Gh., M)	Studies to investigate the presence of heavy metals and other pollutants in the Owabi raw water reservoir, 1999.	Dr. G. J. Monney Prof. (Mrs.) Esi Awuah
5	**Enu,** Francis Kwasi (Gh., M)	The impact of ownership and management on the sustainability of rural piped systems in Ghana, 1999.	Dr. George Akosa Mrs. Araba Ntsiful
6	**Konadu** Owusu (Gh., M)	Manpower needs and its cost implication on the transfer of "small towns water supply systems" into "community ownership and management", 1999.	Dr. George Akosa Mrs. Araba Ntsiful
7	**Obeng** Michael Konadu (Gh., M)	Effectiveness of slow sand filtration for improvement of surface reservoir waters for rural water supply, 1999.	Mr. A. O. Anakwa Dr. G. J. Monney
8	**Ofosu-Boateng,** Samuel Kwabena (Gh., M)	Disinfection of water using chlorine generated onsite by the electrolysis of sodium chloride (common salt), July 1999.	Dr. G. J. Monney Mr. A. O. Anakwa

2000

No	Name of Student	Thesis Title	Internal Examiners
1	**Armah,** Edward Annang (Gh., M)	Assessment of water quality of two wetlands -Chemu and Laloi lagoons in the Tema export processing zone, 2001.	Dr. J. G. Monney Mr. Prof. (Mrs.) Esi Awuah
2	**Atiogbe,** Richard Beacon Foli (Gh., M)	Evaluation of the strategies adopted in the implementation of Kumasi ventilated improved pit (KVIP) as a household latrine, 2001.	Dr. George Akosa Dr. G. J. Monney
3	**Boateng,** Joseph (Gh., M)	Influence by pH and dissolved oxygen on faecal coliform removal in algal and macrophyte based wastewater treatment systems, 2000.	Prof. (Mrs.) Esi Awuah Dr. G. J. Monney
4	**Clarke,** Bernadine (Gh., F)	Performance evaluation of a water distribution network with the help of a computer model; a case study at Breman Asikuma in the Central Region of Ghana, 2000.	Mr. N. Trifunović Dr. S. N. Odai
5	**Payne,** Joseph (Gh., M)	Performance evaluation of septage treatment plant, - AGC Obuasi plant as case study, 2000.	Mr. A. O. Anakwa Prof. (Mrs.) Esi Awuah

2001

No	Name of Student	Thesis Title	Internal Examiners
1	**Agyapong,** Michael Owusu (Gh., M)	A feasibility study for planning on erosion control and drainage management for rural poverty alleviation, 2000.	Dr. I. K. Nyameche Dr. F. O. K. Anyemedu
2	**Aidoo,** Albert Isaac (Gh., M)	Performance Evaluation of Agordome (near Sogakope) and Keseve (near Oda) water treatment plants in the South Tongu District of the Volta Region, 2000.	Dr. George Akosa Mr. C. T. Oguaah
3	**Amponsah,** Richard (Gh., M)	Performance of two types of biofilters for a rural stream, 2000.	Prof. (Mrs.) Esi Awuah Mr. Emmanuel Donkor
4	**Anipa,** Helen Michelle Korkor (Gh., F)	Performance evaluation of the Kpong water treatment plant, 2001.	Dr. George Akosa Mr. C. T. Oguaah
5	**Ayamga,** Gilbert Amoah (Gh., M)	Evaluation of community ownership and management of point sources of water supply in two Districts – Bolgatanga and Bawku East Districts in the Upper East Region of Ghana, 2001.	Mr. Kwabena Nyarko Dr. George Akosa Mr. Emmanuel Donkor
6	**Dadzie,** Martin Kodjo (Gh., M)	The assessment of groundwater quality for domestic purposes -a case study of Obuasi, 2001.	Dr. George Asomaning Dr. S. N. Odai
7	**Donkor,** Thomas Atteh (Gh., M)	Performance evaluation of Achimota faecal sludge treatment plant, 2001.	Dr. G. J. Monney Mr. A. O. Anakwa Mr. Collins Annoh
8	**Dugbartey** Divine Dornu (Gh., M)	Assessment of groundwater pollution form on-site sanitation, a case study of Sekyere East District in Ashanti Region, 1999.	Dr. George Asomaning Dr. S. N. Odai
9	**Dwamena-Boateng,** Philip (Gh., M)	Comparative studies of the use of moringa oleifera and alum in the treatment of surface waters from the Tamale and Tolon-Kumbungu Districts in the Northern Region of Ghana, 2001.	Dr. J. A. M. Awudza Dr. J. G. Monney
10	**Farouk-Gomda,** Alhassan Imoro (Gh., M)	An appropriate system for solid waste management for Wenchi.(2001)	Mr. A. O. Anakwa Mr. Anthony Mensah
11	**Kotoka,** Prosper (Gh., M)	Physical analysis of solid waste in selected high income communities in Kumasi, 2001.	Mr. A. O. Anakwa Mr. Anthony Mensah
12	**Mounirou,** Soumaila (Benin, M)	Technical feasibility study on Ilauko raw water reservoir to supplement ground water supply to save, Glazoue and Dassa-zoume (Benin), 2001.	Dr. G. J. Monney Dr. F. O. K. Anyemedu Dr. D. Babalola
13	**Oduro-Kwarteng,** Sampson (Gh., M)	Performance evaluation of Bamag and Canadian water treatment plants at Weija waterworks in Accra, 2001.	Dr. George Akosa Mr. C. T. Oguaah

14	**Ouikotan,** Blandine (Benin, M)	Appropriate water supply scheme for some communities in the west coast of Benin, 2001.	Dr. F. O. K. Anyemedu Dr. J. G. Monney
15	**Quashigah,** Godfred K. (Gh., M)	Catchment yield studies for water supply schemes, using Mampong water supply catchment as a case study, 2001.	Dr. S. N. Odai Mr. Afful-Ashun

2002

No	Name of Student	Thesis Title	Internal Examiners
1	**Agbesi,** Ernest Kotoku (Gh., M)	Evaluation of Sunyani water supply augmentation scheme, July 2002.	Dr. G. Asomaning Mrs. Mary Glover-Amengor
2	**Agbottah,** Seth (Gh., M)	Characterisation and anaerobic treatment of leachate from sludge drying beds of a pilot co-composing plant in Kumasi-Ghana.	Dr. S. N. Odai Prof. (Mrs.) Esi Awuah
3	**Amoako-Mensah,** Samuel (Gh., M)	Assessment of the operations and performance of activated sludge treatment at Juapong Textiles Limited (JTL), Juapong, 2002.	Dr. K. T. Nyadziehe Mr. S. A. Larmie
4	**Attiogbe,** Francis Kwaku (Gh., M)	Empirical correlation between BODs and cod of effluents from selected industries in the Kumasi metropolis, 2002.	Dr. K. T. Nyadziehe Mrs. Mary Glover-Amengor
5	**Djimedo,** Amegnran Yaotree (Burkina Faso, M)	Storm water drainage of "Fada N'gourma" urban community in Burkina Faso, using "GIS" as a tool, 2002.	Dr. F. O. K. Anyemedu Dr. S. N. Odai
6	**Esseku,** Harold (Gh.,)	Use of drying beds or faecal sludge/septage pretreatment: monitoring a pilot scheme at Buobai-Kumasi.	Mr. Collins Annoh Dr. F. O. K. Anyemedu
7	**Hackman,** Sarah Fanny (Gh., F)	Feasibility studies on the use of activated clays as coagulants / coagulant aids for water treatment, 2002.	Dr. J. A. Awudza Mr. R. Buamah
8	**Hounkpe,** Peace Sena (Benin, F)	Proposal for an effective wastewater disposal system for Jak city in Cotonou (Benin republic), 2002.	Prof. (Mrs.) Esi Awuah Dr. Mousa Yarou
9	**Mensah,** Isaac (Gh., M)	Impact of surface gold mining on surface water quality at Bibiani, 2002.	Dr. S. N. Odai Mrs. Mary Glover-Amengor
10	**Musa,** Buba Siam (Nigeria, M)	Technical feasibility study for the improvement of Jalingo water supply scheme in Taraba state of Nigeria, 2002.	Dr. N. A. A. Okereke Dr. S. N. Odai
11	**Obuobisa-Darko,** Alexander (Gh., M)	Assessment of operation and maintenance of water point systems at north Tongu (Adidome) District Volta Region, Ghana, 2002.	Mr. Emmanuel Donkor Mr. Kwabena Nyarko
12	**Osiakwan,** Gustav Merritt	Baseline studies into the groundwater resources in the Bosomtwi-Atwima-Kwanwoma District of Ashanti Region, Ghana, 2002.	Dr. G. Asomaning Dr. S. Dapaah-Siakwan

	(Gh., M)		
13	**Saleh,** Jamal A. (Gh., M)	Assessment of a pilot franchised solid waste collection scheme in Kumasi, 2002.	Mr. Anthony Mensah Mr. E. A. Donkor
14	**Siabi** Worlanyo Kwadjo (Gh., M)	Application of granular activated carbon and iron oxide coated sand for the removal of iron and manganese from groundwater point sources, 2002.	Mr. R. Buamah Dr. B. Ali
15	**Tutu-Yeboah,** George (Gh., M)	Solid waste minimization initiative in brewery industries (Case study-Guinness Ghana Limited).	Dr. K. T. Nyadziehe Mr. Anthony Mensah

2003

No	Name of Student	Thesis Title	Internal Examiners
1	**Abanyie,** Samuel Kojo (Gh., M)	Critical project implementation problems associated with urban water supply projects in Ghana, 2003	Mr. Emmanuel Donkor
2	**Adusei,** Kwabena (Gh., M)	Pricing and tariff design in the Ghana water supply sector a case study of the Ashanti Region of Ghana, 2003	Mr. Kwabena Nyarko
3	**Akonor,** Alexander Opare (Gh., M)	Assessing the financial sustainability of small town water supply systems of southern Ghana (case study –Volta and Eastern Regions) , 2003	Mr. Kwabena Nyarko Mr. S. Oduro-Kwarteng
4	**Ansah-Berkoh,** Albert Owusu (Gh., M)	Assessing filter media for purification of biogas from anaerobic digester, 2003.	Dr. F. O. K. Anyemedu
5	**Asante,** Abrokwa (Gh., M)	Performance evaluation of the UASB sewage treatment plant at James town, Accra, 2003	Prof. (Mrs.) Esi Awuah
6	**Asiam,** Godfred (Gh., M)	Absorption of iron and manganese by locally available filter media in water treatment, 2003.	Mr. R. Buamah
7	**Boateng,** Daniel Amankwah (Gh., M)	Evaluation of Hydrofracture technology in some geological formations in Ghana, 2003	Dr. C. S. K. Kpordze Mr. R. K. D. Van Ess
8	**Jonah,** Joseph Emmanuel (Gh., M)	Assessment of the performance of some selected small town water projects.	Mr. K. B. Nyarko Mr. C. T. Oguaah
9	**Turyahumura,** Abel (Rwanda, M)	Investigation of an appropriate treatment system for a wet coffee processing in the Maraba District of Rwanda, 2003	Dr. F. O. K. Anyemedu

2004

No	Name of Student	Thesis Title	Internal Examiners
1	**Adama,** Issifu (Gh., M)	Cost recovery of water services of community- managed piped water systems, 2004	Mr. Kwabena Nyarko
2	**Asigbey,** Jerry Kofi (Gh., M)	Assessment of groundwater potential in the Jasikan district of Volta Region, Ghana, 2004	Dr. G. K. Anornu Dr. B. K. Kortatsi
3	**Kotoka,** Michael Kwame (Gh., M)	Terminal evaluation of the Volta Region community water and sanitation Programme-phase II, 2004	Mr. Emmanuel Donkor Dr. I. Mensah-Bonsu
4	**Norgbey,** Evans Kojo (Gh., M)	Determinants of water use in community managed piped systems, 2004	Mr. Kwabena Nyarko
5	**Oppong,** Joseph (Gh., M)	Mathematical modeling for estimating water consumption in the unmetered areas a case study of Kumasi (Ashanti Region), Ghana, 2004	Mr. Kwabena Nyarko
6	**Sanjok,** Edward Akwasi Mensah (Gh., M)	Management of conventional sewerage system case study of Tema sewerage system, 2004	Prof. (Mrs.) Esi Awuah Mr. Emmanuel Donkor
7	**Simpeh,** Bediako (Gh., M)	Urban water supply to the unconnected in low-income settlements: the role of connection charges. A case study of Accra and Kumasi, 2004	Mr. Kwabena Nyarko Dr. S. N. Odai

2005

No	Name of Student	Thesis Title	Internal Examiners
1	**Addae-Mensah,** Afiba (Gh., M)	Adsorptive removal of arsenic and manganese from groundwater, 2005.	Mr. R. Buamah Prof. (Mrs.) Esi Awuah
2	**Agbesi,** Emmanuel Mike K. (Gh., M)	Environmental impact assessment of the Ejisu water supply project, 2005.	Prof. (Mrs.) Esi Awuah Dr. S. N. Odai
3	**Amanfu,** Gabriel Kwesi (Gh., M)	Private provision of water supply in unserved areas of Ghana – a case study of Kyekyewere in the Bosomtwe Atwima Kwanwoman District of Ashanti, 2005.	Dr. F. O. K. Anyemedu Mr. Kwabena Nyarko
4	**Kankam,** Ebenezer Appiah (Gh., M)	Computer modeling of Teteman small town water supply system, 2005.	Dr. S. N. Odai Mr. S. Oduro-Kwarteng
5	**Obeng,** Peter Appiah (Gh., M)	Assessment of institutional arrangements for solid waste management in Kumasi, 2005.	Mr. E. A. Donkor Mr. Anthony Mensah
6	**Quarshie,** Sharon (Gh., F)	Quality of filter material and loading rate for optimal dewatering of faecal sludge, 2005.	Prof. (Mrs.) Esi Awuah Mr. Anthony Mensah

7	**Rajee,** Ibrahim Babalola (Gh., M)	Feasibility study of rainwater harvesting potential as an alternative source of water supply for domestic and agricultural use: case study of some selected communities in Bongo District of the upper east region, 2005.	Dr. G. K. Anornu Dr. S. N. Odai
8	**Zango,** Musah Saeed (Gh., M)	Assessment of groundwater recharge potential of the basement complex of Ghana: a case study of Ejisu-Juaben district of Ashanti Region, 2005.	Dr. G. K. Anornu Dr. C. S. K. Kpordze

2006

No	Name of Student	Thesis Title	Internal Examiners
1	**Ackon,** Stephen E. D. (Gh., M)	Performance evaluation of the Dompoase faecal sludge treatment plant, 2006.	Mrs. H. M. K. Essandoh Mr. Anthony Mensah
2	**Ahimbisbwe,** Reuben (Gh., M)	Assessment of performance of private companies involved in municipal solid waste management in Kumasi, 2006.	Mr. S. Oduro-Kwarteng Mr. Anthony Mensah
3	**Attakora,** Sampson (Gh., M)	Assessment of the performance of selected small towns water supply systems in Ghana, 2006.	Mr. Kwabena Nyarko Mr. S. Oduro-Kwarteng
4	**Babisma,** Enoch M. (Gh., M)	Household slow sand filtration for Guinea worm eradication, 2006.	Mr. A. O. Anakwa Mr. Kwabena Nyarko
5	**Fosuhene,** Bruce Kwadwo (Gh., M)	Assessment of water supply and sanitation services for urban poor, 2006.	Mr. Kwabena Nyarko Dr. S. N. Odai
6	**Laryea,** Lawrence (Gh., M)	Proposal for an effective faecal sludge management system for Keta-Anloga coastal stretch in the Keta District, 2006.	Prof. (Mrs.) Esi Awuah Mr. A. O. Anakwa
7	**Nkansah-Boadu,** Frank (Gh., M)	Socio-cultural and economic factors influencing faecal sludge use in agriculture in Manya Krobo District, 2006.	Prof. (Mrs.) Esi Awuah Dr. (Mrs.) Olufunke Cofie
8	**Ofori-Agyemang,** Michael Carl (Gh., M)	Guidelines for sustainable use of marginal yield boreholes in selected geological formations in Ghana, 2006.	Dr. C. S. K. Kpordze Dr. G. K. Anornu
9	**Sarpong,** Daniel	Effect of different solid loading rates on faecal sludge dewatering on sand filter bed, 2006.	Dr. F. O. K. Anyemedu
10	**Wilson,** Aaron (Gh., M)	Management of medical waste from teaching hospitals in Ghana, 2006.	Dr. F. O. K. Anyemedu Mr. S. Oduro-Kwarteng

2007

No	Name of Student	Thesis Title	Internal Examiners
1	Chelteau Barajei (Gh, M)	Cadmium and Lead concentration of vegetables from selected markets in Ghana	Dr. S. N. Odai Mr. Ebenezer Mensah
2	Bismark Siabi-Mensah (Gh., M)	Social inclusion in urban water delivery: a case study of Accra	Dr. K. B. Nyarko Dr. S. N. Odai

3	Sipitey Dela (Gh., M)	Heavy metals uptake by vegetables cultivated on waste dump sites in Kumasi, Ghana	Dr. S. N. Odai Mr. Ebenezer Mensah
4	Aboagye Benard (Gh., M)	Social inclusion in urban water supply delivery; a case study of Kumasi	Dr. S. N. Odai Dr. K. B. Nyarko
5	Amfo-Otu Richard (Gh., M)	Behaviour of cadmium and lead concentrations from irrigation water in the soil at five urban irrigation sites in Ghana	Mr. Ebenezer Mensah Dr. S. N. Odai
6	Niyonzima Steven (Rwanda, M)	Grey water treatment using constructed wetland at KNUST in Kumasi	Prof. (Mrs.) Esi Awuah Dr. K. B. Nyarko
7	Muzola Aime (Rwanda, M)	Grey water treatment using natural wetland at KNUST	Prof. (Mrs.) Esi Awuah Mr. S. O. Kwarteng

STUDENT LIST – WATER RESOURCES ENGINEERING AND MANAGEMENT, BATCH 1 - 2006

NAME

1. Samuel Ofosu Anim
2. Ebenezer Boakye
3. Mawuli Dzakapsu
4. Leonard Tettey Bortey
5. Fadlurrahman Mashod
6. Godfrey Mills
7. Thomas Aikins
8. Afua Adwubi
9. Ruby Juvah Damalie
10. Sampson Aheleh Tettey

STUDENT LIST – WATER SUPPLY AND ENVIRONMENTAL SANITATION, BATCH 1 - 2006

NAME

1. Anthony Kofi Bruku
2. David Edem Yeboah
3. Joseph Amoako Addai
4. Isaac Kwesi Nooni
5. Francis Buah
6. Michael Oteng Peprah
7. Ernest Ansu-Gyeabour
8. Frank Owusu-Ansah
9. Samuel Wiafe
10. Michael Owusu-Ansah
11. Martha Ansah
12 Albert Ebo Duncan

STUDENT LIST – WATER RESOURCES ENGINEERING AND MANAGEMENT, BATCH II - 2007

NAME

1. Amos Tiereyang Kabobah
2. Anna Odeh-Agbozo
3. Charles Prince Nyarko
4. Eric Akomeah
5. Charles Nana Baiden
6. Dwuodwuo Yamoah Antwi
7. Kofi Asante
8. Evlyn Rose Mamle Kabukoor Debrah
9. Ebbin Abaka-Yankson
10. Enoch Ofosu
11. Emmanuel Sungnumah Kogo
12. Johnson Opoku

STUDENT LIST – WATER SUPPLY AND ENVIRONMENTAL SANITATION, BATCH II - 2007

NAME

1. Prince Antwi Agyei
2. Eugene Appiah-Effah
3. Edward Babalola
4. Bismark Dwumfour-Asare
5. Prince Osei Bonsu
6. Daniel Gyabaah
7. Jane Nkai Tetteh
8. Boniface Yaayin
9. Barbara Gyapong-Korsah
10. Clement M. Gafishi (from Rwanda)

7.6 List of course subjects and resource lecturers

MSc Programme in WREM

Module	Module Name	Course Code	Course Name	1st	2nd	Remarks
1	Introduction to Water Resources	CEWR 511	Integrated Water Resources Management	KP	SO	DCE
		CEWR 513	Meteorology and Hydrometry	FA	KA	DCE
		CEWR 515	Applied Hydraulics	FA	GA	DCE
		CEWR 517	Urban Hydrology and Urban Drainage	IN	SO	DCE
			Total Credits	**5**	**4**	**5**
2	Mathematics and Research Methods	CEWR 521	Mathematics and Statistics for Water Engineers	EO	EO	KNUST
		CEWR 523	GIS and Data Management in Water Systems	GL	FO/ KA	DCE
		CEWR 525	Research Methodology	SO	KN	DCE
			Total Credits	**3**	**3**	**4**
3	Advanced Hydrology and Modelling	CEWR 531	Applied Hydrology	KA	GA	DCE
		CEWR 533	Hydrogeology	GL	KA	DCE
		CEWR 535	Water Systems Modelling	FO	SO	DCE
			Total Credits	**5**	**3**	**6**
4	Environmental Quality	CEWS 541	Environmental Issues and Impact Assessment	EA	EA	DCE
		CEWS 543	Water Quality Management and Public Health	RB	RB	DCE
			Total Credits	**3**	**2**	**3**
			Sub-total for Semester 1	**16**	**12**	**18**
5	Water Resources Engineering	CEWR 552	Reservoir Development & Operation	FA	FA	DCE
		CEWR 554	Small Hydraulic Structures	FA	FA	DCE
		CEWR 556	Irrigation Engineering	GA	IN	DCE
		CEWR 558	Hydro-Power Development	KP	KP	DCE
			Total Credits	**6**	**1**	**6**
6	Water Resources Management	CEWR 562	Water and Environmental Law	GL	SO	DCE
		CEWR 564	River Basin Management	FA	GA	DCE
		CEWR 566	Water Resources Planning	GL	SO	DCE
			Total Credits	**6**	**2**	**6**
7	Management and Institutions	CEWS 572	Community Participation and Institutional Development	GL	KN	DCE
		CEWS 574	Water Project Management	GL	ED/ KN	DCE
		CEWS 576	Engineering Economy and Financial Management	GL	ED/ KN	DCE
			Total Credits	**3**	**1**	**3**
8	Project Design WREM	CEWR 582	Group Project	WR	WR	DCE
			Total Credits	**0**	**6**	**3**
			Sub-Total for Semester 2	**15**	**10**	**18**
9	Thesis WREM	CEWR 691	Individual Research Dissertation	WR	WR	DCE
			Sub-Total for Semester 3	**0**	**24**	**12**
			TOTAL COURSE CREDITS	**31**	**46**	**48**

Abbreviations:

1st	-	Current situation	2nd	-	Future situation
KP	-	K.Kpordze	SO	-	S. Odai
FA	-	F. Anyemedu	GA	-	G. Anornu
IN	-	I. Nyameche	EO	-	E. Owusu-Ansah
FO	-	F. Ohene Annor	EA	-	E. Awuah, Mrs.
RB	-	R. Buamah	ED	-	E. Donkor
KA	-	K. Amaning Adjei	KN	-	K. Nyarko
GL	-	Guest lecturer (NL, GH)			

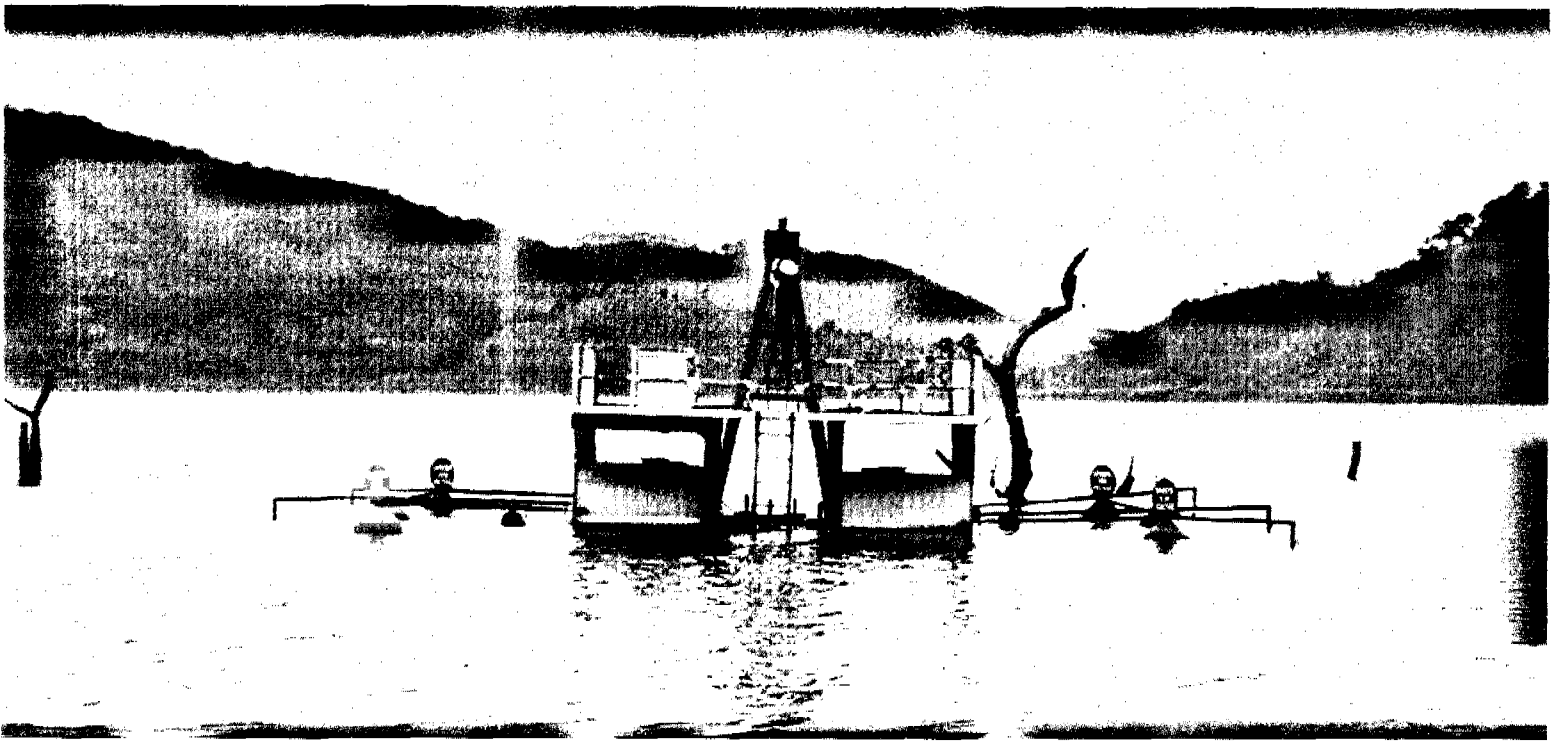
MSc Programme in WSES

Module	Module Name	Course Code	Course Name	1st	2nd	Remarks
1	Introduction to Environmental Sanitation	CEWR 511	Integrated Water Resources Management	KP	SO	DCE
		CEWS 513	Water and Sanitation Infrastructure Planning	X	KN	KNUST
		CEWR 515	Applied Hydraulics	FA	GA	DCE
		CEWR 517	Urban Hydrology and Urban Drainage	IN	SO	DCE
			Total Credits	**5**	**3**	**5**
2	Mathematics and Research Methods	CEWR 521	Mathematics and Statistics for Water Engineers	EO	EO	KNUST
		CEWR 523	GIS and Data Management in Water Systems	GL	FO/ KA	DCE
		CEWR 525	Research Methodology	SO	KN	DCE
			Total Credits	**3**	**3**	**4**
3	Environmental Science and Process Technology	CEWS 531	Microbiology for Engineers	EA	EA	DCE
		CEWS 533	Chemistry for Engineers	RB	RB	DCE
		CEWS 535	Process Technology	X	HE	DCE
			Total Credits	**5**	**4**	**6**
4	Environmental Quality	CEWS 541	Environmental Issues and Impact Assessment	EA	EA	DCE
		CEWS 543	Water Quality Management and Public Health	RB	RB	DCE
			Total Credits	**3**	**2**	**3**
			Sub-Total for Semester 1	**16**	**12**	**18**
5	Water Supply	CEWR 552	Source Water Development	KP	KP	DCE
		CEWS 554	Water Treatment	GL	RB	DCE
		CEWS 556	Water Distribution	KN	KN	DCE
			Total Credits	**5**	**5**	**7**
6	Waste Management	CEWS 562	Wastewater Management	EA	HE	DCE
		CEWS 564	Solid Waste Management	GL	OK	DCE
		CEWS 566	On-Site Sanitation	AA	X	KNUST
			Total Credits	**5**	**2**	**5**
7	Management and Institutions	CEWS 572	Community Participation and Institutional Development	GL	KN	DCE
		CEWS 574	Water Project Management	GL	ED/ KN	DCE
		CEWS 576	Engineering Economy and Financial Management	GL	ED/ KN	DCE
			Total Credits	**3**	**1**	**3**
8	Project Design	CEWS 582	Group Project	EE	EE	DCE
			Total Credits	**0**	**6**	**3**
			Sub-Total for Semester 2	**14**	**14**	**18**
9	Thesis WSES	CEWS 691	Individual Research Thesis	EE	EE	DCE
			Sub-Total for Semester 3	**0**	**24**	**12**
			TOTAL COURSE CREDITS	**30**	**50**	**48**

Abbreviations:

1st	-	Current situation	2nd	-	Future situation
KP	-	K.Kpordze	SO	-	S. Odai
FA	-	F. Anyemedu	GA	-	G. Anornu
IN	-	I. Nyameche	EO	-	E. Owusu-Ansah
FO	-	F. Ohene Annor	EA	-	E. Awuah, Mrs.
RB	-	R. Buamah	ED	-	E. Donkor
HE	-	H. Essandoh, Mrs.	AA	-	A. Anakwa
KN	-	K. Nyarko	X	-	KNUST lecturer outside DCE
GL	-	Guest lecturer (NL, GH)			

7.7 Course brochure



WATER RESOURCES AND ENVIRONMENTAL SANITATION AT KNUST GHANA

As African countries begin to take bold steps and initiatives to asser
ife, technological know-h
be made readily available
Current challenges of major concern facing developing countries in
water resou
African com
promote sustainable developm

The Water Resources and Environmental Sanitation (WREM) Project
the Department of Civil Engineering at KNUST
he UNESCO-IHE Institute for Water Educati
ell-packaged high-quality comprehensive
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ater Supply and Environmental Sanitation lea
Science Degree. The programmes are aimed at
dustry with the necessary skills and knowledge to meet the
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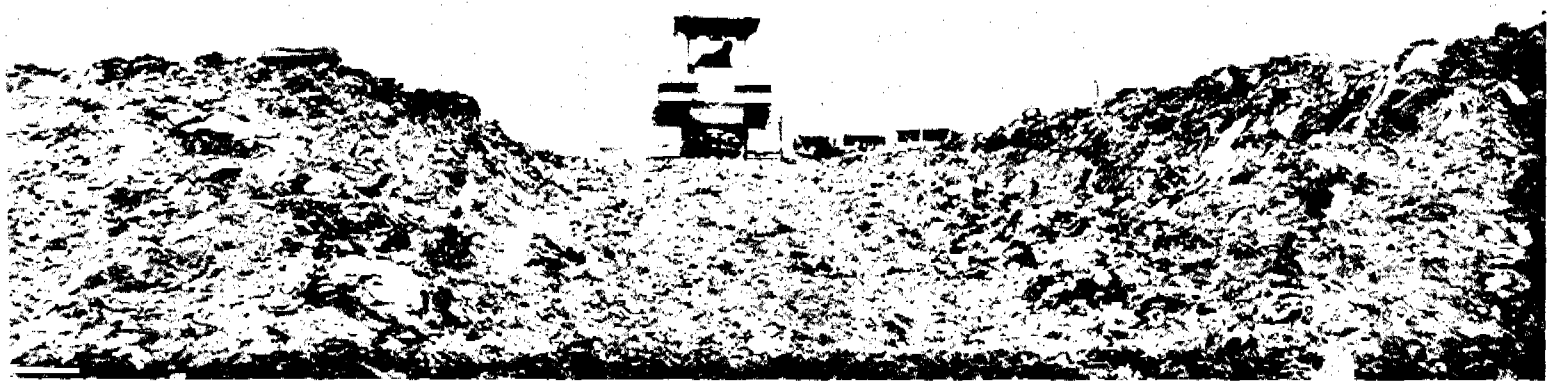
ities anticipated



University of Science and Technology Kumasi-Ghana
Department of Civil Engineering

MSc Programme in

WATER RESOURCES ENGINEERING AND MANAGEMENT

OBJECTIVES

The programme in Water Resources Engineering and Management aims at producing engineers and scientists with up-to-date knowledge in the field of water resources, hydrology, hydraulics, river basin management, financial management; and water policy and law. Participants will have clear understanding of integrated water resources management to play an essential role in government institutions and the private sector. The programme participants will be equipped with professional expertise and management skills to enable them plan, design, operate, maintain and rehabilitate water resources projects.

TARGET GROUPS

This course is particularly useful to professionals with a BSc Degree or its equivalent in Civil Engineering, Geological Engineering and other engineering and science backgrounds. In addition, it will also be useful to professionals in institutions involved in the planning and implementation of water resources projects.

COURSE STRUCTURE

The Water Resources Engineering and Management (WREM) programme consists of a total of nine modules consisting of 48 credits, made up of 31 credits from lectures and 17 credits from practical work. A credit is equivalent to 1 hour of lecture or 2 hours of practical work (in the same course) per week in a sixteen (16) week semester. Thus one credit of a module is equivalent to 16 hours of lecture or 32 hours of practical work. Upon completion of a module, students are given a few days to revise and examinations are offered on the courses. A five-day study tour (field trip) to at least some regions of Ghana will be organised at the end of semester 2 for the students. An MSc work of 12 credits is undertaken in the third semester which allows students to conduct research study into a locally relevant water resources problem and produce a report in a standard thesis format.

COURSE MODULES

Modules	Module Title
Module 1	Introduction to Water Resources
Module 2	Mathematics and Research Methods
Module 3	Advanced Hydrology and Modelling
Module 4	Environmental Quality
Module 5	Water Resources Engineering
Module 6	Water Resources Management
Module 7	Management and Institutions
Module 8	Project Design in WREM
Module 9	Thesis in WREM

EMPLOYMENT PROSPECTS

Employment opportunities exist in the water companies, like, Community Water and Sanitation Agency, consulting firms, ministerial departments (especially the Ministry of Water Resources, Works and Housing; Ministry of Local Government and Rural Development), research institutes, universities, NGOs and sponsored projects in the water resources fields. Additionally, an MSc education offers the opportunity of a faster career progression. The ongoing re-organisation of the water industry will create multiple opportunities for employment of the high level skilled manpower produced from the programme.

RESEARCH

The Water Resources Engineering and Management group undertakes active research in the following areas of specialisation

- Urban Drainage and Solid Waste Interaction
- Flood Resilient Planning and Building
- Sustainable Urban Drainage
- GIS for Watershed Management
- Reservoir Sediment Management
- Climate Change and Tropical Water Resources
- Irrigation Development and Management

SHORT COURSES

One of the major tasks undertaken by the Water Resources Engineering and Management group is to offer opportunities for career progression through organising of specialised and tailor-made short courses in the following areas:

- Hydrological Measurements and Data Processing
- Urban Drainage and Storm Water Management
- Water Systems Modeling and GIS
- Ground Water Development and Pollution Control
- Flow Modeling in un-gauged catchments
- Water Law and Institutions
- Integrated Water Resources Management

MSc Programme in

WATER SUPPLY AND ENVIRONMENTAL SANITATION

OBJECTIVES

The programme in Water Supply and Environmental Sanitation aims at training participants with diverse backgrounds from both Ghana and Africa for careers in the water supply and sanitation sectors, to play essential roles in government institutions and the private sector. The programme participants will be equipped with professional expertise and management skills to enable them plan, design, operate, maintain and rehabilitate water supply and sanitation installations. In addition they will be equipped to take positions in policy making and institutional development.

T GROUPS

The course is especially useful for professionals with a BSc Degree or its equivalent in Civil Engineering, Chemical Engineering, and Water Supply and Sanitation delivery practitioners.

RE

he Water Supply and Environmental Sanitation Course consists of a total of nine modules consisting of 48 credits, made up of 30 credits from lectures and 18 credits from practical work. A credit is equivalent to 1 hour of lecture or 2 hours of practical work (in the same course) per week in a sixteen (16) week semester. Thus one credit of a module is equivalent to 16 hours of lecture or 32 hours of practical work. Upon completion of a module, students are given a few days to revise before taking examinations. A five-day study tour (field trip) to at least some regions of Ghana will be organised at the end of semester 2 for the students. An MSc work of 12 credits is undertaken in the third semester which allows students to conduct research study into a locally relevant water supply or sanitation problem and produce a report in a standard thesis format.

COURSE MODULES

Modules	Module Title
Module 1	Introduction to Environmental Sanitation
Module 2	Mathematics and Research Methods
Module 3	Environmental Science and Process Technology
Module 4	Environmental Quality
Module 5	Water Supply
Module 6	Waste Management
Module 7	Management and Institutions
Module 8	Project Design in Environmental Sanitation

EMPLOYMENT PROSPECTS

In Ghana, employment opportunities exist in the Ghana Water Company Limited, Community Water and Sanitation Agency, consulting firms, ministerial departments (especially the Ministry of Local Government and Rural Development, and Ministry of Water Resource Works and Housing), research institutes, academia, NGOs and sponsored projects in professional fields. Additionally, an MSc education offers the opportunity of a faster career progression. The ongoing re-organisation of the water industry will create multiple opportunities for employment of the high level skilled manpower produced from the programme.

The Water Supply and Environmental Sanitation group undertakes active research in the following areas of specialisation

- Drinking Water Treatment
- Community Water Supply
- Water Distribution modeling and GIS
- Urban Water Services Management
- Sewage Treatment, Management and Disposal
- Ecological Sanitation and Solid Waste Management

SHORT COURSES

One of our major tasks is to offer opportunities for career progression through offering of specialised and tailor-made short courses in the following areas:

- Water Distribution
- Water Treatment
- Small towns water systems operation and Management
- Wastewater Treatment
- Municipal Engineering
- Municipal Infrastructure Management
- Solid Waste Management
- Rural Water Supply

COURSE DURATION

The MSc. Programmes are designed to be completed within 18 months in 3 semesters. Basically, semester 1 for each batch of students will commence with the University academic year.

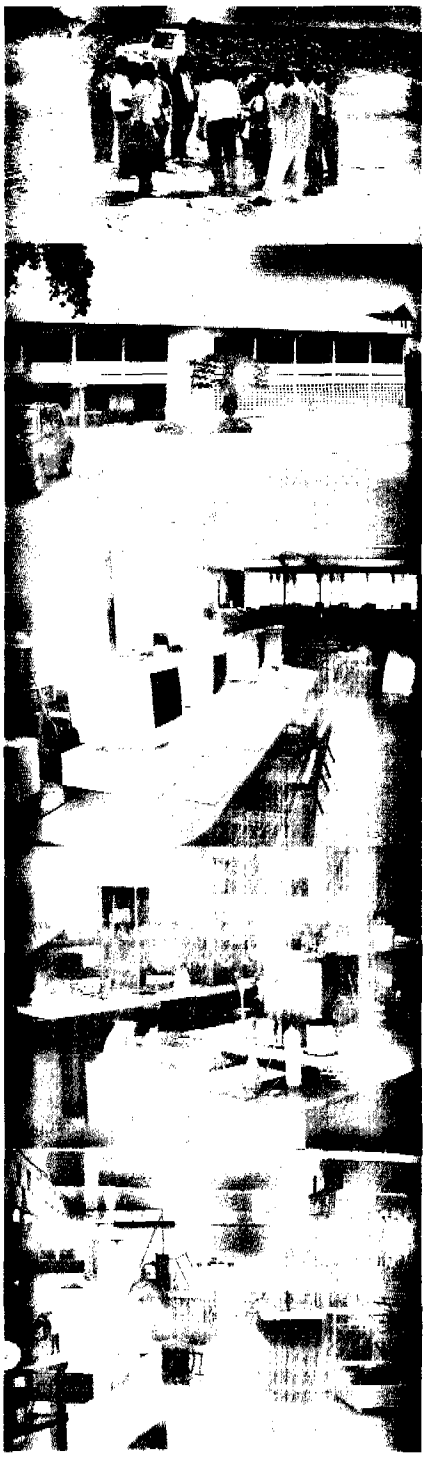
Semester 1: August to December for Modules 1 – 6
Semester 2: February to July for Modules 8 – 12
Semester 3: June to December (following year) for Module 13

PROGRAMME COST

The cost of attending the course is approximately US $14,555 for international students and participants without Ghanaian citizenship, and about US $8,955 for Ghanaian students. The estimated cost (including personal expenditure) is made up of the following:

Type of cost	Non-Ghanaian (US$)	Ghanaians (US $)
Tuition Fee	6,000	-
Academic User Fees	-	400
Miscellaneous University Fees	400	400
Application Forms	55	55
Accommodation (18 months)	2400	2400
Living Expenses	3,600	3,600
Books/lecture notes	500	500
Fieldtrips & laboratory	300	300
Incidental expenses	300	300
Thesis & report binding	1,000	1,000
Total	14,555	8,655

a. Foreigners pay tuition fees while Ghanaians pay academic user fees.
b. Students pay some miscellaneous fees known as user fees which vary from time to time.
c. The minimum living expenses for course participants are estimated at least $200/month to cover meals, clothing, toiletries and basic sustenance.
d. An amount of $1000 is to be budgeted to cover the cost of data collection, typing, printing and binding of MSc thesis which has to be organised by the students themselves. All printing and binding may be done at the University Printing Press but the student will be responsible for payment of all costs involved.
e. For foreign students, the cost of travel from and to their countries is not included in these fees.
f. Even though there will be a dedicated computer room accessible to course participants it is recommended that students procure their own lap top computers to facilitate their out of class learning and preparation of course work.
g. Students will be given core text learning material however, provision has to be made for purchase of text books recommended as additional reading material



FACILITIES

Accommodation: Course Participants stay on campus in the Steven Paris Hostel within 10 minutes walk from the teaching area. The hostel offers single cubicles with shared toilet facilities at $150/month or two in a cubicle for $80/month. Students may, however, arrange their own accommodation though it is strongly recommended that participants stay together to take advantage of group work in view of the intensive nature of the programme.

Computer Room: An Air-conditioned Internet-connected computer room with 15 computers is available to participants of the programme. This provides each participant with opportunity to a computer terminal during lectures and at study times. The room also has modern presentation facilities.

Laboratory: Course participants have access to a fully furnished water resources laboratory with GPS equipment; and a modern environmental laboratory.

Library Facility: Main Student library has over 200,000 volumes in addition to the over 16,000 volumes in the College of Engineering library.

University Hospital: Available for students consultation and medical examination.

Video Conferencing Studio: Modern and advanced video conferencing studio used for innovative and distance learning. The studio also has modern presentation facilities.

CONTACT

Programme Manager
WRESP, Civil Engineering Dept.,
KNUST, Kumasi, Ghana

E-mail: info@wresp.org
Web-site: www.wresp.org
Tel: +233 51 60235
Fax: +233 51 60235
E-mail: wresp.coe@knust.edu.gh
Web-site: www.knust.edu.gh

7.8 Statement of expenses

WRESP-Ghana Project	Budget	Costs 2005	Costs 2006	Costs 2007	Cumulative as at 31/12/2007	Budget Balance as at 31/12/2007
Output 1 Academic strengthening						
Number: 10.0177.X1						
Codes						
2010 Time in NL	€ 13.884,00	€ 1.779,00	€ 2.499,00	€ 1.847,69	€ 6.125,69	€ 7.758,31
2020 Time short mission	€ 22.959,00	€ 918,00	€ 3.940,13	€ -	€ 4.858,13	€ 18.100,87
3011 Time direct booking	€ 36.013,00				€ -	€ 36.013,00
3031 Internat. travel ticket	€ 8.800,00				€ -	€ 8.800,00
3032 DSA staff	€ 9.240,00	€ -	€ -		€ -	€ 9.240,00
3033 Travel costs NL	€ 1.000,00		€ 945,18		€ 945,18	€ 54,82
3034 Travel costs abroad	€ 2.000,00	€ 69,51	€ -		€ 69,51	€ 1.930,49
3041 Local expert time	€ 8.000,00				€ -	€ 8.000,00
3042 Local expert int. travel	€ 4.400,00	€ 8.998,30	€ 6.008,97		€ 15.007,27	€ (10.607,27)
3043 Local expert DSA	€ 4.400,00	€ 1.665,73	€ 4.440,31	€ 730,61	€ 6.836,65	€ (2.436,65)
3090 Miscellaneous	€ 1.000,00			€ 521,03	€ 521,03	€ 478,97
6701 MSc Fellowships	€ 60.000,00	€ 44.184,00	€ 21.785,84	€ 10.402,51	€ 76.372,35	€ (16.372,35)
6702 PhD - Owusu Ansah	€ 75.000,00		€ 23.062,25	€ 12.277,80	€ 35.340,05	€ 39.659,95
6703 PhD - Ofosu Antwi	€ 75.000,00	€ 3.411,66	€ 33.262,38	€ 12.520,31	€ 49.194,35	€ 25.805,65
6704 PhD - Oduro Kwarteng	€ 75.000,00	€ 3.149,39	€ 23.481,08	€ 8.358,93	€ 34.989,40	€ 40.010,60
6705 PhD - Essandoh	€ 75.000,00	€ 2.037,50	€ 17.856,90	€ 35.881,48	€ 55.775,88	€ 19.224,12
6706 Other training	€ 19.400,00	€ 7.254,04	€ 1.336,06	€ 16.069,83	€ 24.659,93	€ (5.259,93)
Sub-total	€ 491.096,00	€ 73.467,13	€ 138.618,10	€ 98.610,19	€ 310.695,42	€ 180.400,58
Output 2 MSc programme in WREM						
Number: 10.0177.X2						
Codes						
2010 Time in NL	€ 15.227,00	€ 2.565,00	€ 3.829,00	€ 21.565,13	€ 27.959,13	€ (12.732,13)
2020 Time short mission	€ 16.224,00	€ 10.132,63	€ 6.806,63	€ 16.492,00	€ 33.431,26	€ (17.207,26)
3011 Time direct booking	€ 14.075,00		€ 7.377,50	€ 6.559,00	€ 13.936,50	€ 138,50
3031 Internat. travel ticket	€ 1.100,00	€ 4.990,08	€ 4.492,45	€ 4.090,28	€ 13.572,81	€ (12.472,81)
3032 DSA staff	€ 4.320,00	€ 1.612,97	€ 3.482,81	€ 2.726,48	€ 7.822,26	€ (3.502,26)
3033 Travel costs NL	€ 200,00	€ 304,00	€ 53,60	€ 44,25	€ 401,85	€ (201,85)
3034 Travel costs abroad	€ 200,00	€ 179,99	€ 60,00	€ 387,80	€ 627,79	€ (427,79)
3041 Local expert time	€ 31.000,00		€ 859,45	€ 3.372,97	€ 4.232,42	€ 26.767,58
3042 Local expert int. travel	€ -	€ 898,90	€ 2.416,84		€ 3.315,74	€ (3.315,74)
3043 Local expert DSA	€ -	€ 793,99	€ 3.545,81	€ 1.621,98	€ 5.961,78	€ (5.961,78)
3090 Miscellaneous	€ 100,00		€ 60,16	€ 46,95	€ 107,11	€ (7,11)
6708 Workshop	€ -	€ 2.409,69	€ -		€ 2.409,69	€ (2.409,69)
Sub-total	€ 82.446,00	€ 23.887,25	€ 32.984,25	€ 56.906,84	€ 113.778,34	€ (31.332,34)
Output 3 MSc programme in WSES						
Number: 10.0177.X3						
Codes						
2010 Time in NL	€ 8.873,00	€ 2.779,50	€ 4.555,69	€ 2.672,13	€ 10.007,32	€ (1.134,32)
2020 Time short mission	€ 6.776,00	€ 918,00	€ 7.555,35	€ 16.223,38	€ 24.696,73	€ (17.920,73)
3011 Time direct booking	€ 25.790,00			€ 29.194,50	€ 29.194,50	€ (3.404,50)
3031 Internat. travel ticket	€ 4.400,00	€ 427,37	€ 519,63	€ 9.392,62	€ 10.339,62	€ (5.939,62)
3032 DSA staff	€ 4.800,00	€ 277,00	€ 1.129,63	€ 6.563,10	€ 7.969,73	€ (3.169,73)
3033 Travel costs NL	€ 300,00		€ 34,36	€ 130,09	€ 164,45	€ 135,55
3034 Travel costs abroad	€ 500,00		€ 2.057,40	€ 62,91	€ 2.120,31	€ (1.620,31)
3041 Local expert time	€ 18.000,00		€ 3.872,94	€ 5.319,28	€ 9.192,22	€ 8.807,78
3042 Local expert int. travel	€ -		€ 2.302,54	€ 2.900,09	€ 5.202,63	€ (5.202,63)
3043 Local expert DSA	€ -		€ 156,26	€ 451,50	€ 607,76	€ (607,76)
3090 Miscellaneous	€ 200,00		€ 101,19	€ 111,90	€ 213,09	€ (13,09)
Sub-total	€ 69.639,00	€ 4.401,87	€ 22.284,99	€ 73.021,49	€ 99.708,35	€ (30.069,35)
Output 4 BSc programme in Civil Engineering						
Number: 10.0177.X4						
Codes						
2010 Time in NL	€ -				€ -	€ -
2020 Time short mission	€ -				€ -	€ -
3011 Time direct booking	€ -				€ -	€ -
3041 Local expert time	€ 3.000,00				€ -	€ 3.000,00
3043 Local expert DSA	€ 1.000,00				€ -	€ 1.000,00
3090 Miscellaneous	€ 500,00				€ -	€ 500,00
Sub-total	€ 4.500,00	€ -	€ -	€ -	€ -	€ 4.500,00
Output 5 Research strengthening						
Number: 10.0177.X5						
Codes						
2010 Time in NL	€ 15.369,00			€ 3.596,75	€ 3.596,75	€ 11.772,25
2020 Time short mission	€ -			€ -	€ -	€ -
3011 Time direct booking	€ 3.260,00				€ -	€ 3.260,00
3031 Internat. travel ticket	€ -				€ -	€ -
3032 DSA staff	€ -				€ -	€ -
3033 Travel costs NL	€ -				€ -	€ -
3034 Travel costs abroad	€ -				€ -	€ -
3041 Local expert time	€ -	€ 2.489,43			€ 2.489,43	€ (2.489,43)
3042 Local expert int. travel	€ 14.000,00	€ 641,61			€ 641,61	€ 13.358,39
3043 Local expert DSA	€ 14.000,00			€ 58,33	€ 58,33	€ 13.941,67
3090 Miscellaneous	€ 10.000,00			€ 5.204,06	€ 5.204,06	€ 4.795,94
6707 Research fund	€ 80.000,00	€ 15.886,26	€ 26.664,87	€ 4.228,78	€ 46.779,91	€ 33.220,09
Sub-total	€ 136.629,00	€ 19.017,30	€ 26.664,87	€ 13.087,92	€ 58.770,09	€ 77.858,91

Output 6 Short courses
Number: 10.0177.X6

Codes							
2010 Time in NL	€ 9.190,00		€ 1.576,97	€ 827,50	€ 2.404,47	€ 6.785,53	
2020 Time short mission	€ -		€ 1.180,90	€ 2.328,00	€ 3.508,90	€ (3.508,90)	
3011 Time direct booking	€ 7.313,00				€ -	€ 7.313,00	
3031 Internat. travel ticket	€ 1.100,00			€ 1.339,00	€ 1.339,00	€ (239,00)	
3032 DSA staff	€ 960,00			€ 513,36	€ 513,36	€ 446,64	
3033 Travel costs NL				€ 31,50	€ 31,50	€ (31,50)	
3034 Travel costs abroad				€ 350,91	€ 350,91	€ (350,91)	
3041 Local expert time	€ 10.000,00				€ -	€ 10.000,00	
3042 Local expert int. travel	€ -			€ 117,41	€ 117,41	€ (117,41)	
3043 Local expert DSA	€ -		€ -	€ -	€ -	€ -	
3090 Miscellaneous	€ -		€ -	€ 3.111,27	€ 3.111,27	€ (3.111,27)	
Sub-total	€ 28.563,00	€ -	€ 2.757,87	€ 8.618,95	€ 11.376,82	€ 17.186,18	

Output 7 Distance learning modules
Number: 10.0177.X7

Codes						
2010 Time in NL	€ 9.040,00		€ 1.576,97		€ 1.576,97	€ 7.463,03
2020 Time short mission	€ -				€ -	€ -
3011 Time direct booking	€ -				€ -	€ -
3031 Internat. travel ticket	€ -				€ -	€ -
3032 DSA staff	€ -				€ -	€ -
3033 Travel costs NL	€ -				€ -	€ -
3034 Travel costs abroad	€ -				€ -	€ -
3041 Local expert time	€ -				€ -	€ -
3042 Local expert int. travel	€ 1.000,00				€ -	€ 1.000,00
3043 Local expert DSA	€ 500,00				€ -	€ 500,00
3090 Miscellaneous	€ 500,00				€ -	€ 500,00
Sub-total	€ 11.040,00	€ -	€ 1.576,97	€ -	€ 1.576,97	€ 9.463,03

Outputs 8 & 9 Regional and international cooperation
Number: 10.0177.X8

Codes						
2010 Time in NL	€ 2.052,00		€ 1.576,97	€ 1.469,25	€ 3.046,22	€ (994,22)
2020 Time short mission	€ -			€ 1.771,00	€ 1.771,00	€ (1.771,00)
3011 Time direct booking	€ 2.445,00				€ -	€ 2.445,00
3031 Internat. travel ticket	€ -			€ 2.820,95	€ 2.820,95	€ (2.820,95)
3032 DSA staff	€ -			€ 265,88	€ 265,88	€ (265,88)
3033 Travel costs NL	€ -			€ 63,70	€ 63,70	€ (63,70)
3034 Travel costs abroad	€ -				€ -	€ -
3041 Local expert time	€ -				€ -	€ -
3042 Local expert int. travel	€ 2.000,00		€ 3.145,50	€ 819,49	€ 3.964,99	€ (1.964,99)
3043 Local expert DSA	€ 2.500,00		€ 2.137,00	€ 540,08	€ 2.677,08	€ (177,08)
3090 Miscellaneous	€ 17.000,00				€ -	€ 17.000,00
Sub-total	€ 25.997,00	€ -	€ 6.859,47	€ 7.750,35	€ 14.609,82	€ 11.387,18

Output 10 Investments
Number: 10.0177.X9

Codes						
4220 Lab. equipment EQE	€ 30.000,00	€ 43.284,47	€ 1.902,89	€ 9.487,20	€ 54.674,56	€ (24.674,56)
4230 Lab. equipment WRE	€ 75.000,00		€ 794,12	€ -	€ 794,12	€ 74.205,88
4270 Other equipment	€ 131.300,00	€ 4.675,69	€ 49.454,97	€ 52.898,16	€ 107.028,82	€ 24.271,18
4310 Project vehicles	€ 60.000,00	€ 36.028,97			€ 36.028,97	€ 23.971,03
Sub-total	€ 296.300,00	€ 83.989,13	€ 52.151,98	€ 62.385,36	€ 198.526,47	€ 97.773,53

Project management
Number: 10.0177.X0

Codes						
2010 Time in NL	€ 72.494,00	€ 18.976,00	€ 23.654,53	€ 22.773,50	€ 65.404,03	€ 7.089,97
2020 Time short mission	€ 35.445,00	€ 5.967,00	€ 2.952,25	€ 10.120,00	€ 19.039,25	€ 16.405,75
3011 Time direct booking	€ 12.095,00				€ -	€ 12.095,00
3031 Internat. travel ticket	€ 9.900,00	€ 1.709,49	€ 1.412,47	€ 2.763,96	€ 5.885,92	€ 4.014,08
3032 DSA staff	€ 9.600,00	€ 1.108,00	€ 605,34	€ 1.333,74	€ 3.047,08	€ 6.552,92
3033 Travel costs NL	€ -	€ 163,56	€ 352,61	€ 135,02	€ 651,19	€ (651,19)
3034 Travel costs abroad	€ -	€ 81,54		€ 139,15	€ 220,69	€ (220,69)
3041 Local expert time	€ 28.800,00	€ 7.468,28	€ 11.040,41	€ 17.406,99	€ 35.915,68	€ (7.115,68)
3042 Local expert int. travel	€ 8.000,00	€ 1.480,02	€ 322,82		€ 1.802,84	€ 6.197,16
3043 Local expert DSA	€ 21.880,00	€ 663,29	€ 645,18	€ 700,39	€ 2.008,86	€ 19.871,14
3090 Miscellaneous	€ 1.500,00		€ 3,00	€ 207,88	€ 210,88	€ 1.289,12
5200 Consumables & mainten.	€ -	€ 935,90	€ 1.136,96	€ 1.004,76	€ 3.077,62	€ (3.077,62)
5300 Car expenses	€ 14.000,00	€ 987,69	€ 1.678,13	€ 3.836,08	€ 6.501,90	€ 7.498,10
5400 Office costs	€ 48.000,00	€ 5.506,98	€ 10.964,78	€ 12.279,25	€ 28.751,01	€ 19.248,99
5990 General operational costs	€ 17.000,00	€ 5,17	€ 3.420,74		€ 3.425,91	€ 13.574,09
Sub-total	€ 278.714,00	€ 45.052,92	€ 58.189,22	€ 72.700,72	€ 175.942,86	€ 102.771,14
Total	€ 1.424.924,00	€ 249.815,60	€ 342.087,72	€ 393.081,81	€ 984.985,13	€ 439.938,87
Contingencies	€ 75.000,00	€ -	€ -	€ 26.273,40	€ 26.273,40	€ 48.726,60
Grand total	€ 1.499.924,00	€ 249.815,60	€ 342.087,72	€ 419.355,21	€ 1.011.258,53	€ 488.665,47

4/4/08

7. 9 Audit report

PRICEWATERHOUSECOOPERS

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To the management of
UNESCO-IHE Institute for Water Education
Delft

Auditor's Report

Issued on behalf of the Netherlands Organization for International Cooperation in Higher Education (NUFFIC)

Introduction

We have audited and certified the enclosed statement of expenditures to the amount of EUR 419.355,21 which have been submitted by UNESCO-IHE Institute for Water Education as the costs of the project entitled 'Capacity Building for Sustainable Development of Water Resources and Environmental Sanitation in Ghana and the Sub-Region', with grant number CF1843/2004 and project number GHA/049. The expenditures took place in the period from 1 January 2007 until 31 December 2007. The statement of expenditures is the responsibility of the organization's management. Our responsibility is to express an opinion on the financial statement based on our audit.

Scope

We conducted our audit in accordance with auditing standards generally accepted in the Netherlands. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statement is free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. We believe that our audit provides a reasonable basis for our opinion.

Opinion

In our opinion, statement, accounting for expenditures of a total sum of EUR 419.355,21 complies with the requirements for this purpose.

The Hague, 21 April 2008
PricewaterhouseCoopers Accountants N.V.

M.A. Spaans-den Heijer RA

MS-52751a/jv/112723/kk