F I E L D R E P O R T

WASTEWATER TREATMENT PLANT PROCESS CONTROL TRAINING IN ROMANIA

WASH Field Report No. 452
December 1994

WATER AND SANITATION for HEALTH PROJECT

Sponsored by the U.S. Agency for International Development
Operated by CDM and Associates

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Prepared for the ENI Bureau and
Bureau for Global Programs, Field Support and Research
Office of Health and Nutrition
U.S. Agency for International Development
under WASH Task Nos. 543 & 544

by

Douglas Abbott
Barnes R. Bierck
David A. Ogden

December 1994

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WATER AND SANITATION
FOR HEALTH PROJECT

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for International Development

WASH Operation Center
1611 N. Kent St., Room 1001
Arlington, Virginia 22209-2111 USA

Telephone (703) 243-8200
Telex No. WUI 64552
Cable Address: WASHAID
FAX No. (703) 243-9004

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December 31, 1994

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Dear Colleague:

I am pleased to provide you with a copy of "Wastewater Treatment Plant Process Control Training in Romania", WASH Field Report No. 452 by Dough Abbott, Barnes Bierck, and David Ogden. The report describes the results of a number of workshops designed to improve the operations and maintenance of the wastewater treatment plants in three municipalities in the Arges River Basin in south central Romania. The report includes descriptions of the workshop, conclusions, recommendations and lessons learned.

Please let me know if you wold like additional copies of this report. Comments or suggestions are always welcome.

Sincerely yours,

Craig Hafner
Deputy Director

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ABOUT THE AUTHORS

Douglas Abbott, a licensed water and wastewater systems superintendent, is also a certified environmental trainer. He is a former municipal public works manager and has 17 years of experience in the management and operation of numerous types of water and wastewater facilities. He has 10 years of experience in the training of management, operations and regulatory personnel and has participated in the development and delivery of training programs throughout the United States and in Bulgaria and Romania. Through his association with the Maryland Center for Environmental Training, Mr. Abbott has conducted comprehensive performance evaluations, carried out energy audits, delivered process control training and managed on-site technical assistance programs at over 100 water and wastewater facilities.

Barnes R. Bierck is a registered professional engineer with 20 years of experience addressing pollution control and health problems associated with contamination of water, soil and air. He taught at the university level for five years, leading sponsored research projects on hazardous waste site remediation and sludge treatment, utilization and disposal. He has earned master's degrees in public health and environmental engineering, and a doctorate in environmental engineering, and has consulted for government and industry on a variety of domestic and international projects.

David A. Ogden is a registered professional engineer with ten years of planning, design and construction experience in the United States and abroad, including Jordan, Oman, Mexico, Venezuela and Romania. His experience has focused on wastewater treatment facilities, groundwater remediation systems, pumping stations and piping systems. In addition, Mr. Ogden has broad field experience involving the inspection of hazardous waste sites and materials storage facilities, as well as the sampling and analysis of surface water, groundwater and soil.

ACRONYMS AND UNITS

AID	U.S. Agency for International Development
A/S	activated sludge
ATC	aeration tank concentration (sludge)
BOD_5	biochemical oxygen demand (5-day incubation)
Cd	cadmium
CDM	Camp Dresser & McKee
cm	centimeters
COD	chemical oxygen demand
CO_2	carbon dioxide
DO	dissolved oxygen
DOB	depth of blanket (sludge)
DoD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
EDILUL	municipal utility responsible for the operation of the WWTP in Cimpulung
EPA	Environmental Protection Agency (either U.S. or Romanian equivalent)
F/M	food-to-microorganism ratio
g	grams
GOSARG	municipal utility responsible for the operation of the WWTP in Curtea de Arges
HAP	Humanitarian Assistance Program
HRA	Humanitarian and Refugees Affairs Office
ICIM	Environmental research institute in Romania
judet	provincial region in Romania
kg	kilograms
km	kilometers

L	liters
lei	Romanian currency (1,750 lei = $1 U.S. as of October 1994)
m	meters
m^3	cubic meters
mg	milligrams
mm	millimeters
MCRT	mean cell residence time
mg/L	milligrams per liter
MLDO	mixed liquor dissolved oxygen
MLSS	mixed liquor suspended solids
N	nitrogen
O&M	operation and maintenance
OSPA	Office for Pedological and Agricultural Studies
OUR	oxygen uptake rate
P	phosphorous
P/C	process control
pH	measurement of the Hydroxyl Ion
PROED	environmental design firm in Romania
QA/QC	quality assurance/quality control
RAS	return activated sludge
REGOCOM	municipal utility responsible for the operation of the WWTP in Pitesti
RSC	return sludge concentration
s	seconds
SSV	settled sludge volume
SVI	sludge volume index
T/A	technical assistance
TSS	total suspended solids
USAID	U.S. Agency for International Development (same as AID)

USEUCOM	U.S. European Command
VSS	volatile suspended solids
WAS	waste activated sludge
WASH	Water and Sanitation for Health Project
WWTP	wastewater treatment plant

ACKNOWLEDGMENTS

The WASH team gratefully acknowledges the support and willing cooperation of officials and other individuals in the municipalities of the Arges River basin. We extend particular thanks to the wastewater treatment plant managers (Gheorghe Balan - Pitesti, Mihail Badea - Curtea de Arges, and Lucian Stan - Cimpulung) and their respective laboratory managers and chief operators, as well as to Mercea Vasalescu (Apele Romane).

The team also wishes to thank those in the Europe Bureau and WASH Project staff who gave their support and energies to the undertaking, especially James Taft and William Hogrewe of the Europe and Newly Independent States Bureau of USAID, John Austin of USAID's Office of Health and Nutrition, and Craig Hafner and Jonathan Darling of the WASH Project.

WASH further acknowledges the logistical and translation support of the staff of Inginerie Urbana S.A., including Alexandru Ionescu, Florina Mirescu, Daniela Frunza and Sorin Ciupa.

EXECUTIVE SUMMARY

Background

The Arges River in south central Romania is seriously polluted, due to contamination from inadequately treated discharges of industrial and municipal wastewater plant effluent from the communities of Pitesti, Curtea de Arges and Cimpulung. These discharges are adversely affecting the quality of the drinking water in Bucharest, the capital city.

WASH Working Paper No. 118, *Arges River Basin, Romania Wastewater Treatment Plant Operations & Maintenance Improvement Study*, identified several operational deficiencies at the wastewater treatment plants in these three cities and indicated that improvements in effluent quality could be realized by : (1) developing sludge management approaches to remove excess sludge from treatment facilities and on-site disposal areas, (2) optimizing equipment O&M practices, (3) upgrading laboratory equipment, (4) providing training on analytical laboratory procedures to support process control decisions and (5) implementing a comprehensive process control program.

Purpose

The purpose of Task Nos. 543 and 544 was to conclude the training planned under the *O&M Improvement Study*. The workshops for these tasks were specifically designed to address the process control, laboratory improvement and sludge disposal needs of the three wastewater treatment plants. The workshops were developed and presented during two separate visits by WASH consultants to the Arges Basin and included Process Control I & II , Laboratory Improvement, Sludge Dewatering and Conditioning and Sludge Beneficial Reuse.

Workshop Objectives

Each workshop was developed through a combination of "Team Planning Meetings" (TPM) and individual preparation by the trainer involved. The general objectives and delivery dates of each of the five workshops are presented below.

Process Control I & II (September 19 - October 7 and November 7 - 18, 1994)

The objective of the process control training and technical assistance effort was to provide the personnel at each treatment plant with the training and tools necessary to achieve a long-term improvement in effluent quality at minimal cost. This would be accomplished through a thorough review of plant operations theory and techniques, establishment of an ongoing

process performance monitoring program and an analysis of collected data for effecting changes in the process control of each plant.

- providing technical literature and training on activated sludge theory and operational practices, anaerobic digester theory and operational practices and advanced wastewater treatment theory and techniques;
- training plant personnel to conduct process control tests, using the new laboratory equipment provided under these tasks;
- establishing an on-going process performance monitoring program specific to each plant; and
- providing assistance with interpretation of monitoring program data and application of the data to plant operations.

Laboratory Improvement (November 8 - 11, 1994)

The objective of the Laboratory Improvement Workshop was two-fold: (1) to help set up and instruct on the proper use of new laboratory equipment provided by the EHP under these tasks; and (2) to ensure that laboratory testing procedures are sound and that results are accurate and reproducible, so appropriate process control decisions can be made, using the best possible information.

Sludge Dewatering and Conditioning (September 19 - 23, 1994)

The objective of this workshop was to provide theoretical and practical instruction on sludge conditioning and dewatering methods, with particular emphasis on the needs at the Pitesti WWTP, which will be installing plate and frame filter presses in the near future.

Sludge Beneficial Reuse (November 16 - 18, 1994)

The overall goal of this workshop was to provide regulatory and public health officials, as well as interested plant personnel, with up-to-date information for pursuing sludge beneficial reuse options, with an emphasis on land application for agriculture. Specific topics of discussion included the nutrient value and soil conditioning properties of sludges, criteria and standards depending on soil and crop types, sludge quality considerations and testing requirements, application rates and methods for various crops, forestry approaches, composting methods and use, influence of conditioning agents on land application options and sludge disposal at landfills in the context of current U.S. and European standards.

Results and Recommendations

Each of the workshops was generally well-attended by the target audiences anticipated during planning and preparation. Wherever possible and appropriate, workshops were conducted at each of the treatment plants in order to assess and deal with their specific needs and concerns. Many participants wrote or verbally expressed their appreciation for the training provided and, in particular, for the new laboratory equipment, supplies and reference materials which accompanied the training.

Process Control I & II

A total of 44 individuals from the various utilities, the local EPA and Apele Romane received training in process control theory and application in this two-part workshop. They also received a variety of technical reference texts and manuals, with pertinent sections translated into Romanian. In addition, monitoring programs and schedules tailored to each treatment plant were established and strategies were implemented to assess and improve plant operations over time.

Several positive accomplishments have been noted at all three plants as a result of the process control training. For example, there was a slight improvement in biomass quality and secondary effluent quality at each plant after process adjustments resulting from each task were implemented. The full impact and range of improvements cannot yet be completely assessed, however, since each facility must now institute all of the recommended procedures and continue to fine tune the process and quality control practices. This can only be done as reliable operational data are collected and analyzed over time.

A follow-up visit by EHP consultants in the spring of 1995 is recommended to help interpret data generated over the winter. Due to the short amount of time between Tasks 543 and 544, a limited amount of data were available for evaluation purposes. As a result, "what if" scenarios were sometimes substituted for actual conditions during the training exercises. Assistance with a review of actual data would improve the supervisors' abilities to relate the test results to process control actions and plant performance.

Laboratory Improvement

The Laboratory Improvement workshop was delivered to 15 participants representing the three WWTPs, the local EPA and Apele Romane. Instructional material for the proper operation and maintenance of the new laboratory equipment was translated and delivered to each of the trainees. Other reference texts and materials were also donated, covering key lab test procedures, QA/QC methods, sampling schedules, record-keeping charts and safety considerations.

Although it is still too early to tell, the impact of the laboratory equipment and accompanying training should be very positive. BOD bottles can now be incubated at constant temperature,

for example, which should substantially improve the accuracy of and confidence in the results. If the QA/QC methods and perspectives emphasized at the workshop are fully implemented, accurate and reproducible results will significantly support and augment process control decision-making. A follow-up visit to the three plants is recommended within the next few months to address questions and assess how effectively quality and safety practices have been implemented.

Sludge Dewatering and Conditioning

Eleven individuals participated in this five-day workshop, representing the Pitesti and Cimpulung WWTPs, the local EPA, Apele Romane and ICIM (a Romanian research and environment institute).

The goals of the workshop were achieved. The Pitesti sludge, which has historically been difficult to dewater, responded well to conditioning, and no problems are anticipated with optimizing filter press operations. The participants appeared to understand and appreciate the theoretical and practical application of the information presented for screening conditioning chemicals and optimizing dosages. The participation of both laboratory and operations personnel engendered improved communication and a sense of teamwork between these groups. The hands-on nature of the training, in combination with the translated reading materials left with each workshop participant, should leave plant personnel well prepared to meet future developments associated with the use of mechanical dewatering equipment.

It is recommended that plant personnel at Pitesti continue to test various conditioning agents and dosing requirements, preferably under a pilot plant operation, in preparation for the 1995 installation of the sludge dewatering equipment. In the meantime, testing should also be performed to assess the effectiveness of conditioning for dewatering sludge on the existing drying beds.

Sludge Beneficial Reuse

A total of 16 people participated in the three-day Sludge Beneficial Reuse workshop, comprised primarily of government regulatory officials from the Arges River basin.

The information presented at the workshop helped the participants begin developing an appreciation for land application as a sludge management option in the basin. The multidisciplinary nature of land application design should not be problematic, since individuals who are well educated in the various disciplines needed are available in the region.

The atomic absorption spectrometer will be of considerable help in setting up sludge (and soil) monitoring programs for studying and implementing land application, if chosen as a disposal option. Each participant received a copy of the U.S. EPA-published *Land Application of Municipal Sludge Manual* published October 1983.

There appears to be significant interest in pursuing beneficial sludge reuse options in the basin. However, it has been noted that mechanical dewatering equipment, once installed at the Pitesti plant site, will substantially reduce generated sludge volumes. This volume reduction may lead local authorities to favor and require sludge landfilling for the foreseeable future.

Chapter 1

INTRODUCTION

1.1 Background

The Arges River in south central Romania is seriously polluted, due to contamination from industrial and municipal wastewater treatment plant effluent discharges from the communities of Pitesti, Curtea de Arges and Cimpulung (see Figure 1). These discharges are adversely affecting the quality of the drinking water supply of Bucharest, the capital city.

Results from treatment plant audits conducted by WASH consultants in early 1994 (see WASH Working Paper No. 118: *Arges River Basin, Romania Wastewater Treatment Plant Operations & Maintenance Improvement Study*) indicated that improvements in effluent quality could be realized by: (1) developing sludge management approaches for removing excess sludge from treatment facilities and on-site disposal areas, (2) optimizing equipment O&M practices, (3) upgrading laboratory equipment, (4) providing training on analytical laboratory procedures to support process control decisions and (5) implementing a comprehensive process control program.

Since that time, several training workshops focusing on the needs identified by the earlier audits have been developed and delivered to target audiences within the river basin. In addition, laboratory equipment funded by the Environmental Health Project has been purchased and delivered to the three WWTPs, and training on the use of the new equipment has been provided. A listing of the equipment provided to Romania with these EHP funds is included in Appendix 2.

In addition to the laboratory equipment purchased under these tasks, a total of ten flat bed trucks were donated to the WWTPs through an arrangement with the Excess Property program of the Department of Defense. Appendix 3 outlines the steps involved in obtaining equipment and supply donations under this program.

1.2 Purpose

The purpose of Task Nos. 543 & 544 was to conclude the training planned under the Romania Operations and Maintenance Improvement Activities for the WASH Danube III Project. The workshops for these tasks were designed to focus on the process control, laboratory improvement and sludge disposal needs of the three treatment plants. The workshops were delivered in September/October and November 1994 during two separate visits by WASH consultants to Romania. The specific workshops provided included Process Control I & II, Laboratory Improvement, Sludge Dewatering and Conditioning and Sludge Beneficial Reuse.

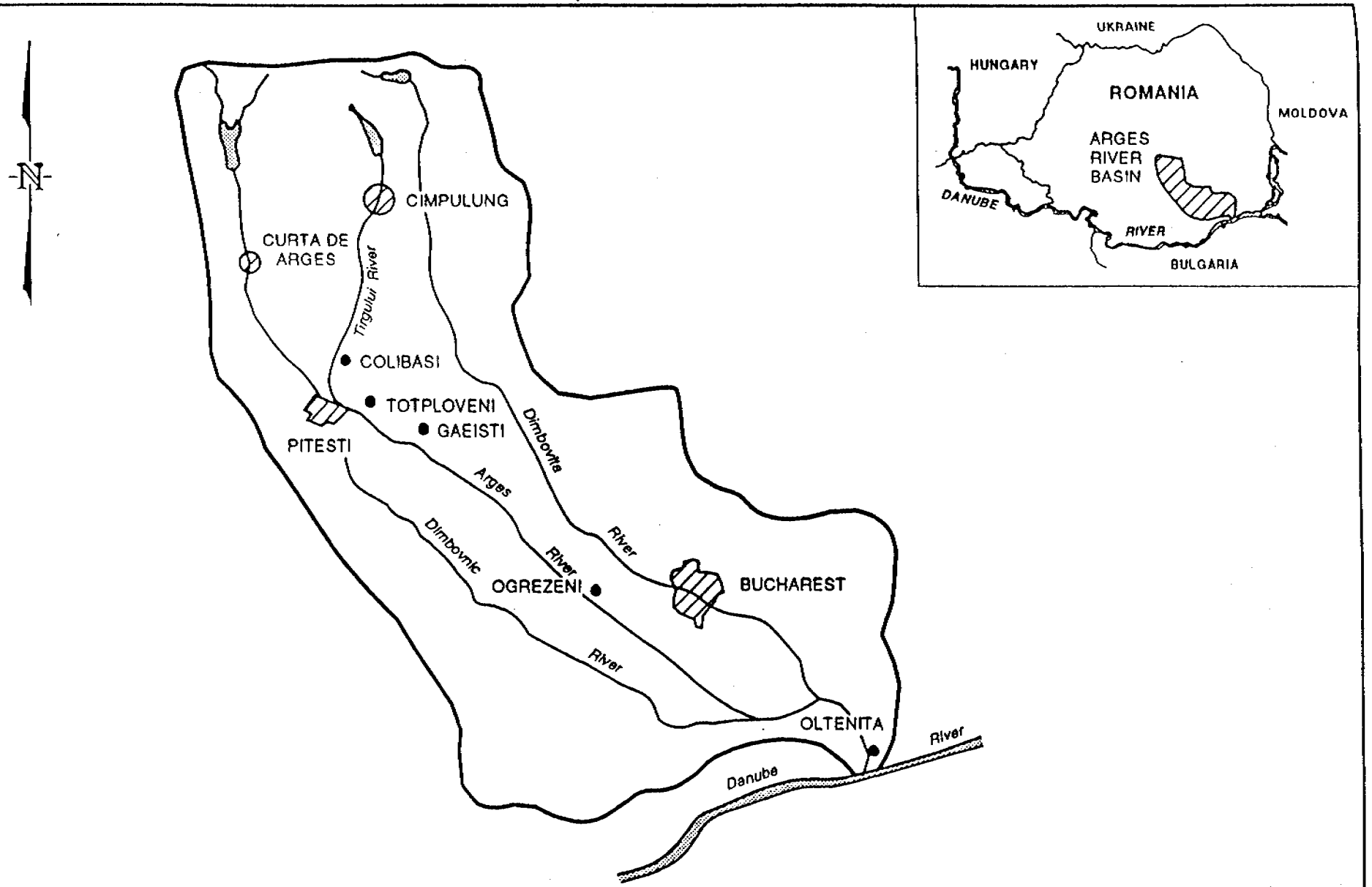


Figure 1

Map of the Arges River Basin

1.3 Workshop Overviews

The workshops under Tasks 543 and 544 were conducted during two separate visits to Romania by WASH consultant teams in September/October and November 1994. Lists of workshop participants may be found in Appendix 1. The general objectives of each workshop are discussed below.

Process Control I & II

The objective of the process control training and technical assistance effort was to provide the various personnel at each treatment plant with the training and tools necessary to achieve a long-term improvement in effluent quality at minimal cost.

Significant limiting factors identified during this and previous WASH tasks were included in the workshop discussions and factored into the evaluation of process control alternatives. Conditions that are evident at all three plants include: uncontrolled industrial discharges, inflow/infiltration, poor design and/or construction of treatment processes and equipment failures due to poor maintenance. These factors limit the operator's ability to control the processes adequately. In addition, correcting these problems will be difficult, expensive and time consuming. In consideration of these facts, the workshop focused on the best methods for managing these conditions on a daily basis.

Laboratory Improvement

The objective of the Laboratory Improvement Workshop was two-fold: (1) to help set up and instruct on the proper use of new laboratory equipment provided by the EHP under these tasks; and (2) to ensure that laboratory testing procedures are sound and that results are accurate and reproducible, so appropriate process control decisions can be made, using the best possible information.

Workshop components targeted the proper operation and maintenance of the donated laboratory equipment, appropriate QA/QC methods and key laboratory tests for process control monitoring, safety procedures and record-keeping. The theoretical bases of each laboratory test were reviewed in a classroom setting to enhance understanding prior to hands-on demonstrations of each test in the laboratory.

Sludge Dewatering and Conditioning

The objective of this workshop was to provide theoretical and practical instruction on sludge conditioning and dewatering methods, with particular emphasis on the needs at the Pitesti WWTP, which will be installing plate and frame filter presses in the near future. Sludge fed to these mechanical dewatering devices must be conditioned, and plant personnel had no previous experience with conditioning. Workshop activities included hands-on demonstrations in the selection and testing of conditioning chemicals and in the determination of proper application rates.

Sludge Beneficial Reuse

The overall goal of this workshop was to provide regulatory and public health officials, as well as interested plant personnel, with up-to-date information for pursuing sludge beneficial reuse options, with an emphasis on land application for agriculture. Specific topics of discussion included the nutrient value and soil conditioning properties of sludges, criteria and standards depending on soil and crop types, sludge quality considerations and testing requirements, application rates and methods for various crops, forestry approaches, composting methods and use, influence of conditioning agents on land application options and sludge disposal at landfills in the context of current U.S. and European standards.

1.4 Training Strategy

Each workshop was developed through a combination of "Team Planning Meetings" (TPM) and individual preparation by the trainer involved. The steps taken in the development of these workshops included:

- development of the overall goal and specific learning objectives;
- identification of the target audience;
- formation of the training delivery schedule;
- development of the lesson plans; training delivery included a combination of lectures, group discussions, demonstrations, hands-on exercises and (as appropriate) field work;
- selection of pertinent technical literature for handouts during the training; handout material was translated and assembled into volumes by subject; and
- coordination with the local WASH subcontractor in Romania (Inginerie Urbana) for logistical arrangements, translation and interpreting assistance.

Chapter 2

PROCESS CONTROL

2.1. Introduction

WASH Field Report No. 441, *Arges River Basin, Romania Wastewater Treatment Plant Operations & Maintenance Improvement Study*, identified several deficiencies at the plants in the Arges River Basin, which included inadequate process control. The report recommended the provision of laboratory equipment for process performance monitoring and the conduct of training in the area of process control.

In response to the recommendations contained in Report 441, technical workshops covering wastewater treatment plant process control were carried out under WASH Tasks 543 and 544. Task 543 (Process Control I) included training and technical assistance specific to control of the activated sludge process at each of the three treatment plants (Pitesti, Curtea de Arges, and Cimpulung). Task 544 (Process Control II) involved follow-up technical assistance relative to the activated sludge process, training on anaerobic digester operation and a brief presentation on advanced wastewater treatment (AWT). The AWT discussion included enhanced BOD and TSS removal, conversion and removal of nitrogen and phosphorus removal.

The goal of the process control training and technical assistance effort was to provide plant personnel with the tools necessary to accomplish a long-term improvement of the effluent quality. In order to achieve this goal, the following strategies were employed:

- provide technical literature and training on activated sludge theory and operational practices;
- train plant personnel to conduct process control tests, using the laboratory equipment provided as part of this project;
- establish an on-going process performance monitoring program at each plant; and
- provide assistance with interpretation of monitoring program data and application of the data to plant operations.

2.2 Goals and Objectives

The main goal of the process control workshops was to provide course participants with the tools that will enable them to make more informed decisions and maximize the treatment plant performance.

Specific learning objectives included the following competencies:

- Explain the principles of the activated sludge, anaerobic digestion and advanced treatment processes and the factors that influence and control these processes.
- Identify the common modifications of the activated sludge and anaerobic digestion processes and the options that are available at the WWTP.
- Identify the significant limitations at the WWTP that will affect the operator's ability to control the processes.
- Identify the components of a comprehensive process control program.
- Establish an *ongoing* process control program that is specific to the WWTP.
- Demonstrate the correct procedures for operating and maintaining the laboratory equipment that will be used for process control testing.
- Collect samples; conduct observations and lab tests; perform process calculations; interpret results of observations, tests and calculations; and identify appropriate adjustments to the activated sludge process.
- Recognize the factors that indicate that the activated sludge and anaerobic digestion processes are not performing properly. Identify the source(s) of the problem(s) and take corrective action.

2.3 Process Control Issues

Pitesti WWTP: Workshop 543-PC-1: Activated Sludge Process Control September 19 - 23, 1994

The planned agenda for the workshop (see block calendar) was followed, with the exception of a few adjustments due to time limitations. It was decided during a meeting with the plant manager on Monday that the entire group (operations supervisors, lab technicians) would participate in Tuesday's session, lab staff only on Wednesday and the entire group for the sessions on Thursday and Friday. The plant manager would participate in all sessions.

At the request of the plant manager (Mr. Gheorghe Balan), the workshop hours were limited to 8:30 AM - 3:00 PM, due to staff obligations. This limited the amount of time available to cover each subject area. As a result, the problem-solving exercises were omitted, the time spent on repeat sampling and analysis were reduced substantially and the monitoring program was developed after the class and presented to the plant manager for review and comment who met with Mr. Balan on Monday, September 26 to review the suggested program.

There were 11 workshop participants (eight REGOCOM, two EPA-Pitesti, one Apele Romane). Translations were provided by Alex Ionescu of Inginerie Urbana.

Due to a malfunction of the overhead projector, transparencies could not be used, but pre-prepared flip charts and specific figures in the course manuals were referenced. Due to the

small class size, this approach worked out very well. Workshop participants took notes and recorded the information from the translated flip charts.

Discussion and questions were slow at first but improved as the course progressed.

Prior to the afternoon of September 21, Barnes Bierck (WASH consultant) set up the lab equipment for use during the process control workshop exercises.

Based on the observations and analyses conducted during the workshop, the following problems were identified:

- There was a small quantity of inactive sludge in the aeration basins.
- Organic loading on the aeration basins was low.
- Hydraulic loading on the clarifiers was high (due to recycle rates).
- The WAS flow was inadequate, and recycle of secondary sludge to the primary clarifiers was causing problems with sludge quality and settling.
- By far the most significant problem was inadequate aeration tank mixing and DO.

The following recommendations were agreed upon during the workshop:

- Reduce hydraulic load on primary and secondary clarifiers by operating two RAS pumps instead of three (currently two are used for RAS 1 for recycle of WAS to P/C). WAS to be diverted from RAS flow at rate required to maintain target MCRT.
- Improve aeration tank mixing & DO. Although this is a design related problem improvement may be realized by adding blowers (will evaluate MLDO and mixing using one, two, and three blowers).
- Increase frequency of sludge removal from primary clarifiers (use sludge judge and centrifuge test to determine pumping time required).
- Initiate monitoring program (including trend charts). Evaluate trends and make process adjustments based on analysis of ALL data. Record date and description of all operational changes for evaluation in November.
- Conduct a special "one time" monitoring program specific to aeration tank mixing and DO. This includes sampling at pre-determined locations and measurement of DO at specific depth intervals, measurement of sediment depth, analysis of TSS and VSS. Separate samples and data to be collected during operation of one, two, and three blowers.
- Be prepared to modify these recommendations depending on the results obtained. Use your own judgement.
- Conduct repeat and duplicate sample analysis to verify accuracy of lab tests.

Pitesti WWTP: Anaerobic Sludge Digestion & Overview of Advanced Wastewater Treatment (AWT)
November 8, 1994

Seven individuals attended this one-day workshop: four from REGOCOM (Pitesti WWTP), one from GOSARG (Curtea de Arges WWTP), one from the local EPA and one from Apele Romane.

One day of classroom training was conducted on the subject areas noted above. The anaerobic sludge digestion module included fundamentals of the anaerobic digestion process, operational parameters and process control strategies. The module on AWT included a discussion of physical facilities and operational considerations related to reduction of BOD_5 below secondary limits, conversion/reduction of nitrogen compounds and phosphorus removal.

Each workshop participant was provided with a suggested monitoring/process control program for anaerobic digester operation.

In addition to excerpts from the California State University wastewater operations manuals, the course participants received typed versions of the lecture flip charts as handouts. Copies were also sent to EDILUL (Cimpulung WWTP), which was unable to send a representative to the workshop, due to problems at the WWTP.

Pitesti WWTP: Workshop 544-PC-2: Process Control Follow-up
November 7, 9-11, 1994

This exercise consisted of individual technical assistance to the Pitesti plant manager, Mr. Gheorghe Balan.

Recommendations made during the workshop in September were reviewed. All of the recommendations had been implemented, with the exception of operation of two blowers to improve aeration tank mixing and dissolved oxygen. Mr. Balan wanted to review the monitoring data with WASH prior to implementing this recommendation.

A thorough review of the trend charts and other monitoring data was conducted, including an analysis of the data as they relate to plant process control. Where actual trends could not be established due to a limited amount of data or erratic results, "what if" scenarios were discussed.

Procedures for process control tests, which were not being dealt with in concurrent laboratory training, were reviewed. These tests included DO, DOB, flow measurement, OUR, SSV, centrifuge test and microscopy.

Results of process calculations were reviewed and discussed. These calculations included hydraulic and organic loadings, removal efficiencies, SVI, F/M ratio, MCRT and sludge production (mass balance).

The institution of composite sampling on process control samples for BOD and TSS was recommended to minimize erratic test results and to provide representative data.

As a result of the operational changes made following the workshop in September, a visible, although minor, improvement in mixed liquor and effluent quality was evident. This appears to be the result of:

- a reduction in hydraulic loading on the clarifiers (primary and secondary) by reducing the quantity of secondary sludge pumped to the primary clarifiers;
- increased attention to the build-up of sludge in the primary clarifiers, by pumping primary sludge more frequently (based on sludge judge and centrifuge test results); and
- increased MLDO due to cooler temperatures.

Data generated by the special monitoring program set-up to evaluate dissolved oxygen and mixing in the aeration basins were collected and provided to WASH. Most of this data was generated through sample collection and analysis by the Pitesti WWTP staff, following the September workshop. The remainder was collected by the plant staff and the WASH consultant during this workshop. A review of the data indicates that the design configuration requires that a minimum of two blowers be operated during warm weather in order to maintain a minimum MLDO of 2.0 mg/l. However, even with two blowers, the aeration system design does not provide very good mixing. In addition, aeration diffusers in trains 1 and 2 are in need of repair. Recommendations were provided for maintaining a consistent MLDO through proper blower operation and diffuser maintenance. This aeration system should receive further evaluation.

The establishment of an on-going process control program was discussed. The monitoring program was adjusted, based on a reasonable frequency for sampling. Mr. Balan agreed to institute the program on a permanent basis.

Curtea de Arges WWTP: Workshop 543-PC-2: Activated Sludge P/C
September 26 - 30, 1994

The workshop was carried out according to a revised schedule, which was very similar to the original. However, the "hands-on" exercises were initiated earlier during the session on Tuesday in order to reduce the consecutive time spent in the classroom.

More time was made available each day to conduct this workshop than in Pitesti. The plant manager (Mr. Mihail Badea) requested that the sessions begin at 8:30 AM, but said they could go on until 4:30 PM. We utilized this time to go into greater detail on subjects of particular interest to the participants. In addition, the longer day schedule allowed more time than in Pitesti for repeat lab analyses.

Nineteen people participated in the workshop (all from GOSARG). Translations were provided by Daniela Frunza of Inginerie Urbana.

Discussion and questions were frequent and added substantially to the success of this workshop. Course participants took notes and recorded the information from the translated flip charts.

Mercea Vasalescu from Apele Romane assisted with set-up of lab equipment and some portions of the training. Several lab items were missing, including low and high temperature ovens, a cable for the DO field probe and various minor items. This equipment was provided during the implementation of Task 544 in November 1994.

Based on the observations and analyses conducted during the workshop, the following problems were identified:

- Extremely inactive biomass. The causes of this were narrowed down to toxicity and/or low organic loads. Monitoring will be conducted to determine the problem.
- Inadequate sludge wasting. The quantity wasted was much less than the solids produced (based on BOD removal).
- Aeration was not continuous. Planned shut-downs (20-30 min/hour) were causing DO sags and filamentous bacteria development.
- Flow imbalances to trains still exist. The operator cannot adjust these flows, due to the absence of suitable gates.

Although the original plan was not to recommend substantial changes to the treatment process during this visit, tests confirmed that the biomass was completely inactive. Therefore, some very basic recommendations, aimed at improving the plant performance, were provided.

The following recommendations were agreed upon during the workshop:

- Develop new (active) biomass.
- Remove all of the sludge from four of the 10 A/S basins.
- Divert the primary effluent to the other six basins for one day and gradually add primary effluent to the four basins at a rate that will allow biomass development without causing solids carry-over in the secondary clarifiers.
- Start with a low RAS rate and increase gradually as solids develop. If this procedure were a success, the remaining six channels should be put through the same regime.
- Initiate sludge wasting at low rate to maintain target MLSS and SVI.
- Operate one blower continuously.
- Balance flows to trains by measuring the weir overflow rate (WOR) and adjusting flows using a temporary tapered weir. Apele Romane agreed to follow up and assist on this.

- Initiate monitoring program (including trend charts.) Evaluate trends and make process adjustments based on analysis of ALL data. Record date and description of all operational changes for evaluation in November.
- Be prepared to modify these recommendations, depending on the results obtained. Use your own judgement.
- Conduct repeat and duplicate sample analyses to verify accuracy of lab tests.

Mr. Badea and Mrs. Iliana Dragut (lab manager) agreed to implement the recommendations and advised that data would be available in November for review.

Because the DO probe had to be returned to Pitesti, Curtea de Arges had no way of accurately measuring the MLDO during the development of the new biomass. As stated earlier, a DO probe was supplied during the November workshop.

Curtea de Arges WWTP: Workshop 544-PC-3: Process Control Follow-up November 14-16, 1994

This exercise consisted of technical assistance with the plant manager, Mr. Mihail Badea, and the laboratory manager, Mrs. Iliana Dragut. Mr. Daniel Muntenu from Apele Romane was in attendance for part of this exercise.

The lab equipment supplied as part of the latest shipment was distributed and set up.

Translated manuals on lab equipment operation and maintenance were provided.

Recommendations made during the workshop in September were reviewed. All of the recommendations had been implemented.

A thorough review of the trend charts and other monitoring data was conducted, including an analysis of the data as they relate to plant process control. Where actual trends could not be established, due to a limited amount of data or erratic results, "what if" scenarios were discussed.

Procedures for process control tests, not dealt with during Task 544 group laboratory training in Pitesti, were reviewed. These tests included DO, DOB, OUR, SSV, centrifuge test and microscopy.

Results of process calculations were reviewed and discussed. These calculations included hydraulic and organic loadings, removal efficiencies, SVI, F/M ratio, MCRT and sludge production (mass balance).

Composite sampling on process control samples for BOD and TSS was recommended to minimize erratic test results and to provide representative data.

The plant staff was partially successful in developing a good quality sludge biomass, but due to high peak influent flows, they could not keep the sludge from washing out of the plant. It

was determined through data evaluation that, in addition to peak influent flows, one of the main problems that created difficulties in developing and maintaining a suitable biomass was the substantial hydraulic load placed on the secondary clarifiers by the RAS pumps. The average hydraulic detention time was only 1.2 hours in the secondary clarifiers. The RAS flow rate to aeration basin influent ratio ranged from 1.5:1.0 to 2.0:1.0. It was recommended that the RAS pumps be throttled at the discharge valves to reduce the ratio to 1:1 or less and to thicken the RAS to 1.5 to 2.0 times the thickness of the mixed liquor.

Due to the low organic loading (measured as BOD-5 kg/day), it was recommended that two of the four aeration basins in train #3 be removed from regular service, to be used only during high flow periods for flow equalization. The four secondary clarifiers in train #3 should remain in service and collect mixed liquor flows from the two aeration basins.

Wasting of secondary sludge on a continuous basis at a low rate (based on sludge production and target MLSS) was recommended. The plant staff was advised to adjust wasting as necessary to develop and maintain a biomass suitable for BOD and TSS reduction.

On trains #1 and #2, each secondary clarifier has a dedicated RAS pump that discharges into a common line for return to all aeration basins. The RAS pumps occasionally shut down due to amperage overloads. This problem will be reduced by discharge valve throttling. It was noticed, however, that during periods when a RAS pump is out of service, the operators do not stop the incoming RAS flow to the corresponding aeration basin. It was recommended that during RAS pump shut-down, the RAS input line also be shut down to avoid building excess sludge in the secondary clarifier.

The establishment of an ongoing process control program was discussed. Adjustments were made to the monitoring program, based on a reasonable sampling frequency. Mr. Badea and Mrs. Dragut agreed to institute the program on a permanent basis.

Cimpulung WWTP: Workshop 543-PC-3: Activated Sludge P/C
October 3 - 7, 1994

The workshop was carried out according to the same plan used in Curtea de Arges.

At the request of the plant manager (Mr. Lucian Stan), the workshop hours were limited to 8:30 AM - 3:00 PM due to staff obligations. As was the case in Pitesti, this limited the amount of time available to cover each subject area.

Thirteen people participated in the workshop (eight from EDILUL and two from Apele Romane). Translations were provided by Alex Ionescu of Inginerie Urbana.

Discussion and questions began slowly but became more frequent as the week progressed. The laboratory manager was especially interested in process control techniques and asked several questions. Course participants took notes and recorded the information from the translated flip charts.

Mercea Vasalescu of Apele Romane assisted with set-up of lab equipment and some portions of the training. All equipment was accounted for except the BOD (DO) probe and the vacuum pump, which were provided during the implementation of Task 544 in November.

Based on the observations and analyses conducted during the workshop, the following problems were identified:

- A small quantity of inactive sludge was maintained in the secondary system. While inactive sludge can be caused by toxicity and/or the low organic loading, the operating strategy can also be a contributing factor because sludge remains in the secondary clarifier too long. The RAS pumps are not operated continuously, but must be controlled manually and are out of service for several hours each day (between 6:00 P.M. and 6:00 A.M.). Also, the hydraulic detention time in the secondary clarifiers is excessively long.
- There is poor mixing and air distribution. Train #2 is receiving a much higher quantity of air than train #3. Also, the blowers are shut down for 15-20 minutes out of every hour in order to conserve energy.
- The A/S basins are operated in the step-feed mode.
- The WAS removal strategy was inadequate.
- Flow distribution to trains #2 and #3 is uneven.

The following recommendations were agreed upon during the workshop:

- Operate RAS pumps continuously. Concentrate on head of secondary clarifiers by running the bridge twice over the first half to every one time over the second half (based on DOB and RSC test results).
- Improve mixing and air distribution by adjusting air flow control valves.
- Repair air relief valves.
- Install pressure gauges on blower discharges (monitor during valve adjustments to ensure proper operation of relief valves).
- Improve flow distribution to trains #2 and #3 by monitoring WOR and adjusting inlet gates.
- Operate one A/S basin in train #3 in contact stabilization mode. Begin with 100 percent of flow equally distributed across the last 50 percent of basin. Work toward applying 100 percent of flow to the final 33 percent of basin.
- Initiate WAS removal from secondary at 10-15 minutes per day (using RAS pumps). Adjust to maintain target MLSS / SVI.
- Operate blower(s) continuously. Maintain minimum MLDO of 2.0.

- Remove one secondary clarifier on train #3 from service to reduce hydraulic detention time.
- Increase frequency of sludge removal from primary clarifiers (use sludge judge and centrifuge test to determine pumping time required).
- Initiate flow-proportioned composite sampling of influent and effluent.
- Initiate monitoring program (including trend charts). Evaluate trends and make process adjustments based on analysis of ALL data. Record date and description of all operational changes for evaluation in November.
- Conduct repeat and duplicate sample analyses to verify accuracy of lab tests.
- Be prepared to modify these recommendations, depending on the results obtained. Use your own judgement.

Mr. Stan and Ms. Rodica Isbasoiu (lab manager) agreed to implement the recommendations and advised that data would be available in November for review.

Cimpulung WWTP: Workshop 544-PC-4: Process Control Follow-up
November 16-18, 1994

This exercise consisted of technical assistance with the plant manager, Mr. Lucian Stan, and the laboratory manager, Ms. Rodica Isbasoiu. Daniel Muntenu of Apele Romane was in attendance for part of this exercise.

The lab equipment supplied as part of the latest shipment was distributed and set up.

Translated manuals on lab equipment operation and maintenance were provided.

Recommendations made during the workshop in September were reviewed. Most of the recommendations had been implemented. There was no progress, however, in the areas of:

- balance of aeration and mixing in aeration trains #2 and #3;
- operation of blowers to maintain minimum MLDO of 2.0 mg/L;
- mechanical improvements to the blower air relief valves; and
- operation of aeration basins in contact-stabilization mode.

According to the plant manager, there was no progress in the areas listed above because soon after the workshop in October, one of the blower motors burned out, leaving only one unit for aeration of the mixed liquor. The manager said that the director of EDILUL instructed him to operate this unit only on alternating hours (one hour on, one hour off) and to make no adjustments to the air flow until the other blower was repaired. The plant manager agreed to implement the remaining recommendations at that time, not knowing when or if the blower would be repaired.

A thorough review of the trend charts and other monitoring data was conducted, including an analysis of the data as they relate to plant process control. Where actual trends could not be established, due to a limited amount of data or erratic results, "what if" scenarios were discussed.

Procedures for process control tests, not dealt with during Task 544 group laboratory training in Pitesti, were reviewed. These tests included DO, DOB, OUR, SSV, centrifuge test and microscopy.

Results of process calculations were reviewed and discussed. These calculations included hydraulic and organic loadings, removal efficiencies, SVI, F/M ratio, MCRT and sludge production (mass balance).

The problems with the aeration system substantially limited the potential for improvement to plant performance. However, because other recommendations were implemented, such as better control over RAS, WAS and primary sludge flows, as well as improvements to the hydraulic loadings, the plant staff was successful in improving biomass quality. Data indicated that when the MLSS increased to a level exceeding 700 mg/L, the aeration system, under the current strategy, caused the MLDO to drop to 1.0 mg/L or less. In order to prevent oxygen starvation of the biomass, the MLSS is now being maintained at below 600 mg/L by regular wasting of sludge. This approach is resulting in a small quantity of semi-active biomass, and although not optimum, is producing a final effluent that is marginally complying with the discharge standards for BOD and TSS. Ammonia concentrations in the final effluent still exceed the discharge standards. Consistent BOD, TSS and ammonia reduction will not be possible until the blowers are repaired and the air flow is balanced between the two trains.

Establishing an ongoing process control program was discussed. Adjustments were made to the monitoring program, based on a reasonable frequency for sampling. Mr. Stan and Ms. Isbasoiu agreed to institute the program on a permanent basis.

2.4 Results

The overall goal of this project and the specific leaning objectives were successfully accomplished.

Forty-four Arges River area wastewater professionals have received training in the areas of activated sludge theory, process control and troubleshooting.

Seven individuals have been trained in the areas of anaerobic digestion and advanced wastewater treatment.

Fifteen laboratory personnel have been trained in procedures for sampling and testing of wastewater samples for process control purposes.

Reference manuals on operation and troubleshooting of activated sludge processes and anaerobic digesters, as well as process testing procedures, are available at each treatment facility.

Options for operating the activated sludge process at each plant were discussed and considered for implementation. These included the modes of plug flow, step feed and contact stabilization.

Monitoring programs were established and are in effect at all three plants, including the use of trend charts to track key process parameters.

Supervisory personnel at each plant are beginning to utilize the monitoring data and trend charts to identify variations in the activated sludge process. With the trend charts, they can visualize the effects of their process control actions on sludge quality and quantity, as well as the quality of the plant effluent.

Based on the results of visual observations, testing and calculations conducted during the workshops, the group considered implementation of various process control options and recommended those options to the plant managers.

At each plant, the staff now possesses the laboratory equipment and basic skills necessary to perform effective process control and to maximize the treatment plant performance, to the extent that uncontrollable conditions allow.

Strategies were established at each facility for:

- control of MLDO and aeration tank mixing;
- RAS flow control;
- wasting of excess sludge; and
- control of hydraulic and organic loads.

There have been several positive accomplishments at all three plants as a results of this training. In terms of direct impact on the effluent quality, a slight improvement in biomass quality and secondary effluent quality was observed at all three plants during Task 544. However, to place a numerical value on the improvement to overall plant performance as a result of this project would not be appropriate at this time. The reasons for this are discussed below.

Three main indicators of process performance are the efficiencies in removal of BOD, TSS and ammonia. Accuracy in sampling procedures, sample preservation, analytical techniques, and quality control are essential to produce reliable data and determine plant performance. Prior to WASH Tasks 543 and 544, the absence of proper testing equipment, as well as less-than-adequate procedures in the areas described above, rendered the data generated by the plant laboratories unreliable. In addition to providing the suitable equipment, the completion of WASH Task 544 - Laboratory Training also fully addressed training on laboratory procedures. Each facility must now institute all of the recommended procedures and fine tune the quality

control practices before the data can be considered reliable. At that point in time, an accurate assessment of plant performance, as determined by reductions in BOD, TSS, and ammonia, can be carried out. An analysis of the plants' performance in terms of compliance with effluent quality standards several months after completion of WASH Tasks 543 and 544 would certainly be appropriate. However, it must be recognized that a comparison of discharge permit compliance before and after WASH Tasks 543 and 544 may not reflect a measurable improvement, as the ability to generate accurate test data has only now become possible. Additionally, influences that are evident at all three plants—including design deficiencies, equipment malfunctions, uncontrolled industrial discharges and excessive inflow/infiltration—will continue to have an adverse effect on plant performance until dealt with properly. However, it can be concluded that WASH Tasks 543 and 544 substantially improved the plant staffs' abilities to accurately identify and quantify performance deficiencies and to react to problems using the best available process control techniques.

Chapter 3

LABORATORY IMPROVEMENT

3.1 Introduction

Laboratory equipment was provided as part of the overall effort to enhance process control decision-making at the three Arges River Basin wastewater treatment plants. Earlier evaluations had indicated that much of the equipment on hand was either insufficient to meet process control needs and/or in disrepair. The ensuing procurement effort resulted in a series of shipments; plant personnel installed most laboratory equipment items provided between September 19 and October 7, 1994, with supervision by WASH.

As at many wastewater treatment facilities world-wide, many laboratory procedures were being performed by rote. As a result, opportunities for improving procedures and for instituting quality assurance/quality control (QA/QC) were identified. This component of Task 544 focused on utilization of the laboratory equipment in concert with key laboratory analyses necessary for monitoring and controlling unit operations at the treatment plants.

All training was held at the Pitesti wastewater treatment plant. Participants included representatives from each of the three WWTPs, the local EPA and Apele Romane.

3.2 Workshop Goals and Objectives

The overall goal of the workshop was to ensure that laboratory testing results are accurate and reproducible, enabling sound process control decision-making. Workshop components targeted methods for operating and maintaining donated laboratory equipment, appropriate QA/QC and key laboratory tests for process control monitoring, safety procedures and record-keeping. The theoretical bases of key laboratory tests were reviewed in a classroom setting to enhance understanding, enabling better interpretation of results and making test modifications as appropriate.

3.3 Approach

Subconsultant Inginerie Urbana, S.A., of Bucharest, translated into Romanian detailed laboratory procedures from *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association, 1992). These procedures, which were distributed at the beginning of the workshop, included the five-day Biochemical Oxygen Demand (BOD_5), alkalinity, volatile acids, chemical oxygen demand, solids (suspended, volatile and fixed) and nitrate and ammonia electrode procedures. In addition, a practical method for measuring the percentage of carbon dioxide in digester gas was reviewed and demonstrated.

Some alternate laboratory methods were translated and provided for information purposes only. Suspended solids and chemical oxygen demand (COD) procedures used at the plants are adequate and in conformance with Romanian standard analytical methods. The translated methods were suggested as alternatives because they permit significant cost savings on chemical reagents and materials. In addition, methods for digesting (that is, removing all organic components from) sludge samples were provided in preparation for metals analyses via atomic absorption (AA) spectrophotometry. (Sample preparations may also be performed by Apele Romane, where the donated AA unit will reside.)

Relevant portions of instructions for donated equipment operations and maintenance were also translated into Romanian, and one set was provided to each plant.

Theoretical overviews of a number of key tests were provided in a classroom setting. Detailed explanations of the theory and accompanying procedures were reviewed for the BOD_5 and alkalinity tests. QA/QC methods were reviewed for a number of specific tests (such as the glucose-glutamic acid check for the BOD_5 test), and sample preservation methods were reviewed. Test results were discussed in view of how important developments and/or trends should be followed and discussed with operations staff.

Another emphasis was placed on running duplicate samples, particularly while new methods are being implemented, so that checks can be maintained on reproducibility. Also, opportunities for making comparisons between methods were noted, such as determining the dissolved oxygen concentration of a sample using both the donated dissolved oxygen probe and the Winkler method.

3.4 Specific Issues

Many Romanian water analysis procedures are similar to classical methods used world-wide. Thus, the Romanian Chemical Oxygen Demand (COD) method is a standard one, and a critical evaluation indicated that the procedure in use was understood and properly performed (except that one chemical—a catalyst—was not available). Translated materials included a spectrophotometric COD method requiring far fewer chemicals than the classical approach, and this method was demonstrated.

In a similar vein, solids measurement methods were understood well, with the Romanian standards including a gravity filtration method using particularly large (and expensive) filter paper sections not of the glass fiber variety. Methods using much smaller, glass fiber filter paper with a vacuum flask were demonstrated, and it was noted that the glass fiber variety will not ignite at the high temperatures required for volatile solids determinations.

Time pressures did not permit as much hands-on training as originally hoped, but detailed demonstrations were performed for a number of tests.

Regarding nitrogen determinations, use of the ammonia electrode method was demonstrated, and the stage was set for measuring nitrate after the appropriate reference electrode arrives. The Romanian standards include spectrophotometric methods for nitrogen species

determinations, and the plants are using these methods. Thus, the utility of comparing results obtained with the electrodes to results with more elaborate spectrophotometric methods was emphasized, along with the need for making standard solutions of known concentration for calibrating and checking techniques. It was suggested that nitrite determinations be curtailed.

Sampling and analysis frequencies were discussed in conjunction with the suggested process control monitoring schedule. Although there were some indications that the process control schedule had become somewhat burdensome, there was significant room for reducing testing frequencies in some areas of the rote analysis schedule. The need for flow-proportional sampling of influent and effluent samples was discussed with plant and regulatory personnel. It was emphasized that accurate assessments of plant performance would be much more realizable using such a sampling technique, which provides representative samples.

The rote aspects of the analysis schedule were investigated in terms of regulatory requirements. It appeared that internal plant monitoring schedules were totally at the discretion of the plant manager; however, some believed that the regulators mandated these monitoring schedules. These issues were discussed, and it was suggested that the monitoring schedules be tailored to plant requirements as much as possible, and that this reconfiguration might be approached in consultation with regulatory authorities.

Communications between laboratory and operations staff was emphasized. However, both morale and motivational levels are low, due to the low salary scales at the plants.

A series of kits for analyzing metals concentrations in aqueous samples arrived at the end of the trip. These kits, which involve colorimetric determinations, were donated to allow quick qualitative checks on heavy metals content in industrial discharges to the wastewater systems. The methods are quite straightforward, and translated procedures will be provided.

Laboratory safety issues are of major concern. Cigarette smoking and eating were understood to be inappropriate in laboratories but went on non-stop anyway. Use of eye goggles was discussed and demonstrated. Donated equipment included portable laboratory hoods for handling volatile toxic reagents.

3.5 Results

Laboratory personnel were very attentive and interested in the material and methods provided. They especially appreciated the equipment, with some expressing that never in their wildest dreams did they expect to have access to modern equipment such as pH meters.

Although it is too early to tell, the impact of the laboratory equipment and accompanying training should be very positive. BOD bottles can now be incubated at constant temperature, for example, substantially improving confidence in the results. If the QA/QC methods and perspectives emphasized at the workshop are put into place, accurate and reproducible results will significantly augment process control decision-making. This should lead to increased confidence among both the laboratory and process control staff, while simultaneously enhancing communications between these groups.

Chapter 4

SLUDGE DEWATERING AND CONDITIONING

4.1 Introduction and Approach

This trip report summarizes activities by Barnes Bierck on the sludge conditioning/dewatering workshop held the week of September 26 - 30, 1994 in Pitesti, Romania.

The purposes of the workshop included providing theoretical and practical information on sludge conditioning to various Arges River basin entities. Particular emphasis was to be placed on needs at the Pitesti Wastewater Treatment plant, which will be obtaining plate-and-frame filter presses in the near future. Sludge fed to these mechanical dewatering devices must be conditioned, and plant personnel had no previous experience with conditioning.

Providing demonstrations and hands-on laboratory training were other major workshop activities. These components included use of equipment supplied as a part of the effort for selecting and screening conditioning chemicals and for optimizing dosages. The approaches and methods are directly transferrable to chemicals other than those used during the training.

Another workshop goal was to examine the dewaterability of the Pitesti plant sludge. Previous reports had indicated that sludge at Pitesti released water at a particularly low rate. Thus, it was considered prudent to ensure that the sludge would be amenable to conditioning.

4.2 Initial Activities

Barnes Bierck and Alex Ionescu met in Bucharest on September 16 with a representative of PROED, the design firm contracted by the Pitesti utility company, REGOCOM, to upgrade the plant. The purpose of the meeting was to learn details about the sludge conditioning system to be installed at the Pitesti wastewater treatment plant.

The conditioning system will include means for adding both a ferric chloride solution and an aqueous solution of polyelectrolyte to the sludge streams. The absence of lime as a component of the ferric system was noted and discussed with a number of basin personnel. Although lime handling and dosing facilities are not part of the design because of cost considerations, the system will provide flexibility by allowing ferric chloride or polyelectrolyte solutions to be used alone or together.

Initial sludge conditioning studies were performed at the Pitesti plant during the week of September 19 - 23. This testing was conducted in preparation for the conditioning/dewatering workshop to be held the following week. The plant manager had obtained in advance a large quantity of cationic polyectrolyte (Medasol C24, Lot No. 2, produced 31 August 1994). Tests

were performed with this polyectrolyte and with ferric chloride, with ferric chloride and lime and with a typical cationic electrolyte, 750 M (manufactured by Secodyne, Detroit, Michigan, USA).

The Medasol C24 proved to be uniformly ineffective at conditioning the anaerobically digested sludge at Pitesti, while typical dosages of the Secodyne 750 M were very effective, as were typical dosages of ferric chloride alone and ferric chloride with lime.

One of the workshop participants was Ion Rosu, a chemical engineer with ICIM, the Romanian environmental research institute in Bucharest. Mr. Rosu had previously tested this Medasol C24 (i.e., from the same batch) using Pitesti plant sludge, and he confirmed that this batch was not effective as a conditioning agent. (Barnes Bierck suggested inviting a representative of the Medasol manufacturer to the workshop, but this was deemed futile, as was attempting to get back REGOCOM's money—about $900 US—for the polyelectrolyte.)

It was reported that ICIM was a subcontractor to PROED for the design of the dewatering system. For about a year, ICIM ran a pilot plate-and-frame filter press at the Pitesti plant to develop the design. Interactions between ICIM and the Pitesti plant will continue and will be very beneficial for all parties concerned.

Mr. Rosu is in contact with a Romanian affiliate of a US-based company that may be able to distribute polyelectrolytes via in-country sale. ICIM tested some samples of their polyelectrolyte and found them to be very effective at conditioning the Pitesti sludge. The Romanian distributor has asked to go unnamed at present, but its products may provide a workable alternative to Medasol in the future.

4.3 Workshop

Eleven individuals participated in this five-day workshop, representing the Pitesti and Cimpulung WWTPs, the local EPA, Apele Romane and ICIM. Discussions at the Pitesti plant led to the conclusion that the workshop should concentrate on practical matters. Thus, a large part of the workshop was held in the laboratory.

Theoretical components of the workshop included fundamental factors influencing dewatering, with an emphasis on filtration mechanisms. The action of dewatering chemicals was also considered. Demonstrations were held during the second day of the workshop to show visually what properly dewatered sludge looks like and to demonstrate use of the capillary suction timer and Buchner funnel filtration test apparatus.

Approximately two and one-half days were spent on hands-on training, which involved optimizing dosages of ferric chloride, ferric chloride and lime and polyectrolyte. These optimizations were conducted using the capillary suction timer and time-to-filter tests.

After various tests were completed, methods for calculating dosages on a dry sludge solids basis were reviewed.

A pressurization cell was used to produce filter cakes under conditions approximating a plate-and-frame filter press. Effects of compressibility on filter cake formation were demonstrated to illustrate how different conditioning chemicals can result in cakes of different thickness and water content.

The Pitesti sludge responded well to conditioning; problems with water release are not anticipated.

4.4 Conclusions

The goals of the workshop were achieved. Participants absorbed both theoretical and practical information for screening conditioning chemicals and optimizing dosages. Because both laboratory and operations personnel participated, communication between these groups was fostered. Many participants took copious notes, which, when combined with materials translated for the workshop, will prepare the Arges basin wastewater treatment plants for future developments accompanying the future use of mechanical dewatering equipment.

The Pitesti sludge responded very well to conditioning chemicals, so no unusual problems are anticipated.

Chapter 5

SLUDGE BENEFICIAL REUSE WORKSHOP

5.1 Introduction

In June 1994, WASH Consultants met with the Arges River basin Sludge Committee, which consists of representatives from the three basin utility companies and various Romanian regulatory authorities, regarding future technical assistance priorities. There was considerable interest in a workshop on sludge beneficial reuse to examine more closely this sludge management option. Particular interest was expressed in land application approaches, and results from recent heavy metals analyses of sludge samples indicated that the use of sludge as a soil amendment for agricultural purposes would be feasible.

This workshop was developed to provide basic information for decision-making about beneficial reuse options in the Arges River basin.

5.2 Goals and Objectives

The overall goal of the workshop was to provide the various Romanian entities with information for pursuing sludge beneficial reuse options, with an emphasis on land application for agriculture. Information concerning typical sludge and soil properties, application rationales and regulations (both in the US and in Europe) were covered, and a detailed design example was reviewed.

It was considered important not to advocate one system of sludge management or another, but to cover the pros and cons of land application and to engage the participants in a debate over the important issues.

5.3 Participants

A list of participants present at the beginning of the workshop may be found in Appendix 1. Although attendance tapered off over the following two days, a representative of the chief regulatory body of concern, an English-speaking employee of the local EPA office, was present at all times. Representatives of the Pitesti plant maintained an active presence as well. Apele Romane, the water authority, had important meetings during the second two days of the workshop and did not have a representative present during that time.

Ing. Ion Creanga, the director of the Arges Judet Department of Pedology and Agronomy was an active participant during the first day of the workshop and clearly was well informed on the issues involved in land application of sludge. Mr. Creanga invited Barnes Bierck and Florina Mirescu of Inginerie Urbana, S.A. to visit his office to discuss sludge land

application issues that had been addressed over some years in the Arges River Basin. Mr. Creanga, in fact, had been an active participant in obtaining the sludge analytical results noted above, and he will probably play a key role in future decision-making pertaining to these issues in the Arges River basin.

5.4 Approach

The approach taken included putting beneficial reuse in the context of developing multiple sludge management options. Public health implications were stressed in terms of both potential contaminants (pathogens, heavy metals and organic chemicals) and contaminant pathways.

Sludge quality criteria reviewed included nutrient content (nitrogen and phosphorus) and availability. Sludge quality criteria for heavy metals, as well as for various biological and physical properties, were also reviewed. In addition, relevant soil properties, including texture and permeability, slope and water table level fluctuations, were reviewed; and geohydrological monitoring methods were discussed.

The multidisciplinary nature of land application process design was stressed, and the need for public participation in all phases of the process was emphasized.

During an interactive session, the advantages and disadvantages of land application were examined in detail, and participants' opinions were drawn out as the debate unfolded. Using sludges to condition soil and/or provide nutrients for forestry was also discussed and compared with more conventional land application approaches.

US and European Union standards for land application were reviewed, and a detailed land application design example was developed, using typical values of sludge metal content. The design example included sample calculations for land application, based on nitrogen uptake by a feed crop.

Translations were provided from two texts (Metcalf and Eddy, 1991; and Lue-Hing, et. al., 1992). Liberal use was made of the EPA Technology Transfer publication, *Process Design Manual—Land Application of Municipal Sludges*, EPA-625/1-83-016 (1983). Copies of this manual and a summary of the current (503) US sludge regulations will be distributed to workshop participants in a future equipment shipment.

Fundamental principles of composting were reviewed at the end of the workshop. The high temperatures achieved during composting provide excellent pathogen reductions, while providing a useful product. Use of such products for growing ornamental plants was also considered.

5.5 Issues

Informal land application of sludges already occurs in the Arges River basin. Farmers use substantial portions of the sludge generated by the smaller plants at Cimpulung and Curtea de Arges. There is a desire on the part of the Sludge Committee to better regulate this usage and to perform some controlled research projects (using test plots) before formally permitting land application.

Mr. Creanga of the Arges Judet Department of Pedology and Agronomy is very knowledgeable about the public health and agronomic issues involved in land application of sludges. He has been involved with at least one land application study on the Pitesti plant site in which crops were successfully grown, although detailed monitoring was not conducted.

The atomic absorption spectrophotometer to be donated to Apele Romane will be used to monitor heavy metals in industrial discharges to the wastewater carriage system and in the sludges themselves. Thus, basin authorities will be positioned to do long-term monitoring of sludge quality and to effectively regulate discharges of metals that can accumulate in the wastewater sludges.

Jurisdictional issues do not seem to be problematic. The local EPA would regulate land application of sludges, while Apele Romane would play a role in regulating runoff and groundwater monitoring. However, Romania has little groundwater monitoring capability, and there are no standards for land application, although there are published guidelines.

Some fertilizers in use are contaminated with trace quantities of heavy metals that can accumulate in soils. This problem is understood, as is the accompanying need to monitor background soil metals concentrations in developing a land application site.

There is a sense that because Romanian society is overall very healthy in terms of enteric diseases, pathogen transmission would not be a problem in developing land application alternatives. Nevertheless, the need for and utility of stabilizing sludges prior to land application was stressed, because stabilization substantially reduces pathogen concentrations in sludges.

Another important issue brought up repeatedly by the Romanians is that local industrial concerns are presently operating at very low capacities. If industrial production increases, discharges to the treatment plants will also increase, suggesting the need for vigilance in monitoring heavy metals inputs to the biological treatment systems. In addition, metals concentrations in sludges could increase substantially.

5.6 Results

The information provided for the workshop represents a good start on developing an appreciation for land application in the basin as a sludge management option. The multidisciplinary nature of land application design should not be problematic, as individuals who are well-educated in the various disciplines needed are available in the basin.

The atomic absorption spectrophotometer will be of considerable utility in helping to set up sludge (and soil) monitoring programs for studying and implementing land application, if it is chosen as an option.

There appears to be significant interest in pursuing beneficial sludge reuse options in the basin. However, it has been noted that mechanical dewatering devices, once installed at the Pitesti plant site, will substantially reduce sludge volumes. This volume reduction may lead basin authorities to require sludge landfilling for the foreseeable future.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

Each of the workshops was generally well-attended by the target audiences anticipated during planning and preparation. Wherever possible and appropriate, workshops were conducted at each of the treatment plants in order to assess and deal with their specific needs and concerns. Many participants wrote or verbally expressed their appreciation for the training provided and, in particular, for the new laboratory equipment, supplies and reference materials which accompanied the training.

It is believed that the majority of concepts and procedures presented, particularly in the process control and laboratory improvement workshops, could find application in many of the wastewater treatment facilities throughout Romania and would greatly benefit their operation. A national training program designed to extend this training around the country, sponsored by the Romanian government in coordination, perhaps, with USAID, is highly recommended.

6.1 Process Control

- Flow proportioned composite sampling was recommended for process control monitoring at the three wastewater treatment plants. This approach should be adopted and required by the permitting agencies for effluent quality compliance monitoring.
- A more intensive evaluation of the Pitesti WWTP aeration system, utilizing the data that were collected as part of this and previous tasks, would be beneficial. The study should provide options and recommendations for a system upgrade, including the costs of various options.
- Wastewater treatment plant operations and maintenance-oriented training in Romania is virtually non-existent. Continuing the delivery of training in this area would substantially increase the operators' skill levels and improve their abilities to control the processes and respond properly to problems in their plants.
- Additional operations and maintenance-related technical literature should be identified for translation and distribution to the treatment plants and governmental agencies.
- Development of an institutionalized national operator training program should be considered. To initiate such a program would require "seed money," the development of a network among Romanian governmental agencies and technical

assistance to translate technical materials, develop in-country trainers and facilitate development and delivery of training workshops.

- The current designs at the three facilities in the Arges River Basin are not suited for nitrification or phosphorus removal down to the limits imposed by the discharge permits. There is a question as to the scientific basis for some of the discharge permit limits, such as a total phosphorus maximum of 0.1 mg/L. A seminar would be beneficial for officials who are involved in the establishment of water quality regulations and the design of treatment plants. This seminar could address the methods for determining reasonable wastewater discharge standards, based on stream impact and on the capabilities of the best available wastewater treatment technologies.

- The problems of uncontrolled industrial discharges, inflow/infiltration, design and construction deficiencies and equipment failures must be addressed in order for the plants to achieve consistent compliance with the discharge permits. Specific recommendations relating to process control at each plant are provided in Chapter 2 of this report.

- A follow-up visit in the late spring of 1995 would be beneficial to assist with interpretation of data generated over the winter. As discussed earlier, because of the short amount of time between tasks 543 and 544, there was a limited amount of data available for evaluation purposes, and "what-if" scenarios were substituted for actual conditions. Assistance with the review of actual data would improve the supervisors' abilities to relate the test results to process control actions and plant performance.

- A serious examination and overhaul of the existing system for assessing, collecting and utilizing water and wastewater user fees should be performed in order to ensure funding design improvements, replacing defective equipment, and providing supplies and training at each treatment facility.

6.2 Laboratory Improvement

- The implementation of basic analysis and quality control methods should significantly increase the confidence and accuracy of lab test results, particularly for the BOD_5 test results. Vigilance by the plant manager will be necessary to ensure that these methods are practiced.

- The laboratory equipment donated was much needed and appreciated. An understanding exists about the need for proper maintenance of this equipment.

- Romania has its own water and wastewater analytical procedures. Some of the methods reviewed during the workshop will reinforce and/or supplement the Romanian procedures.

- Initial activities in-country should include obtaining copies of (and understanding) as many local manuals and standards as possible. Many analytical procedures for water and wastewater are classical in nature; however, it is not always easy to know whether the procedures are understood at the laboratory level without interviewing the laboratory personnel in detail.
- Detailed inventories of equipment and chemicals on-hand should also be conducted early in such a process.
- A number of analyses directly related to operations, such as tests for monitoring anaerobic digester performance, were previously not in use at the plants. Incorporation of these tests will significantly aid operations decisionmaking and process control.
- A full understanding of the end results and effectiveness of the training will become apparent only after the lab procedures and methods have been implemented over a period of several months.

6.3 Sludge Dewatering and Conditioning

- Personnel at Pitesti wastewater treatment plant are equipped with theoretical information and experimental equipment to
  i. Evaluate the effectiveness of a conditioner, and compare it to others
  ii. Optimize conditioner dosages
  iii. Determine the best order of addition when using combinations of metal cations, lime and/or polyelectrolytes
- The process of adapting to the needs and wants of workshop participants contributed to the success of the workshop. Initial intentions to provide more in-depth theoretical information proved to be not as important as addressing practical and hands-on training needs. It is important to elicit these needs and wants directly from the intended audience as early in the planning process as possible. This is particularly true when hands-on activities will be performed.
- The Medasol polyelectrolyte produced in Romania and purchased by REGOCOM for use at the workshop was not an effective conditioning agent.
- The sludge at the Pitesti plant can readily be conditioned using conventional, functioning polyectrolytes, ferric chloride alone, or using ferric chloride and lime combined.
- It is possible to add conditioner to the sludge as it flows to the present drying beds, thus increasing drainage and drying rates in the beds. The Pitesti plant personnel are considering this approach.

- The system planned by PROED for adding ferric chloride and a polyelectrolyte (with no lime) will result in a low-pH sludge, which may not be appropriate for land application because heavy metals release rates increase as pH values decrease, and lowering soil pH is deleterious to plant growth. Omitting lime will save money, however.

6.4 Sludge Beneficial Reuse

- The sludge at the three plants appears, preliminarily, to meet U.S. and European metals standards for land application.
- The workshop emphasis on the different skills and disciplines necessary for planning and regulating beneficial reuse proved successful, in part because all participants saw how their individual roles fit into the big picture.
- The mix of disciplines necessary to design land-application systems is present in the Arges basin. Mr. Crainga of the Arges Judet agriculture office can be a key resource person in coordinating an appropriate combination of people with different skills.
- The local EPA and Apele Romane should work together on matters dealing with the disposal and beneficial reuse of sludge.
- Workshop participants are now well informed about the advantages and disadvantages of land application of sludges.
- Groundwater monitoring is not generally conducted in Romania due to expense and the need for specialized equipment. The Romanians, in general, are focusing on surface water monitoring, where problems are more visible. The need for groundwater monitoring is better appreciated now, however, as a result of the workshop.
- Industrial monitoring will be a key factor in regulating heavy metals contents of sludges.
- Developing regulated beneficial reuse will take time. Informal sludge usage by farmers occurs currently without obvious problems. The regulators plan to monitor this situation more closely with the atomic absorption spectrophotometer being donated to Apele Romane.

Chapter 7

LESSONS LEARNED

The purpose of this chapter is to present some of the key "lessons learned" during the course of these workshops, in the hope that future technical training endeavors in Romania and elsewhere might benefit from the experiences obtained under Tasks 543 and 544. These lessons include:

- Using interpreters who have a technical background in wastewater treatment and knowledge of local design and regulatory standards unquestionably added to the success of these workshops. This background allowed for the accurate *explanation* of words and concepts when direct translations from English to Romanian were not known or did not exist. In workshops performed earlier this year at the WWTPs (as part of other related tasks), trainers found it much more difficult to explain certain ideas and lesson material using interpreters with limited technical understanding.

- The preparation and distribution of translated instructional materials, including overheads and flipcharts, helped in learning comprehension. While this approach required more up-front preparation on the part of WASH consultants, it made training efforts more effective. In addition course participants greatly appreciated receiving reference materials. Such technical documentation is considered essential for sustainability.

- A multi-phase approach, allowing for recurrent visit(s) for follow-up, data collection and review, questions and answers, trends analysis, etc., was employed for these workshops and proved to be a very effective way to provide meaningful and results-oriented training.

- When planning multi-phase activities which involve data collection/analysis trend, an appropriately long amount of time should be allowed between visits. In this case, four months or more would have been preferred. Due to the short amount of time between the "in-country" work of Task 543 and Task 544, the data generated by all three plants, although complete, were marginal in terms of providing enough information to demonstrate noticeable trends. Unfortunately, the WASH schedule required that the two tasks be carried out with only a few weeks' separation. Nevertheless, data were interpreted using available test results and applying "what if" scenarios.

- When training involves and depends upon outdoor demonstrations and monitoring exercises, as was the case for each of the Process Control (I & II) workshops, it is best to schedule it during the warmer months. This ensures that adverse weather does not become a factor in whether or not complete training is provided. In

addition, during periods of cold weather, plant personnel are very busy attending to equipment problems. In order to ensure their participation in workshops and to obtain their full attention to the program, it is recommended that any future training in Romania be scheduled during the late spring, summer and early fall.

- When planning technical assistance and training, the performance-limiting factors of the treatment plant designs should be fully understood. This planning should optimally consider the input and requests of the target audience and take into account local performance and design standards, guidelines, laws, etc. In addition, plant management should be consulted during the training preparation phase to establish the time allotted for workshops and to ensure an accurate schedule.

- When deciding on instructional media (slides, overhead transparencies, etc.) for delivery of training at treatment plants that have less than adequate facilities for group training, a back-up plan should be established in the event of power outages, malfunctioning of audio/visual equipment, etc. The use of flipcharts is recommended, and hard copy handouts of all overhead transparencies are essential.

- Training and other technical assistance have a more positive impact and generate more interest when accompanied by the donation of needed equipment or supplies, whether expensive or not.

- Prior to purchasing equipment or supplies to be donated, a thorough analysis of what is already in place and what is locally available should be performed. This will ensure that items selected for donation to the plants are truly needed and will be put to beneficial use.

- The procurement of goods generally takes longer than planned, due to the many factors influencing purchase and delivery, including solicitation of bids, procurement approval, delivery lead times, customs clearance, etc. The scheduling of training associated with equipment should be kept flexible to allow for unforeseen difficulties with delivery. The use of an in-country representative to facilitate the receipt and distribution of goods is highly recommended.

- The resources of the Humanitarian Assistance Program (HAP) of the U.S. Department of Defense should be investigated when considering requesting the donation of vehicles and furniture, as well as other miscellaneous equipment items. Under this program, surplus government property can be made available without cost to requesting countries. As a part of these tasks, for example, arrangements were made with HAP for the donation of 10 2-1/2 ton capacity trucks, valued at $600,000 total. The steps involved in such donations are discussed in Appendix 3.

Appendix A

WORKSHOP PARTICIPANTS

PROCESS CONTROL - I WORKSHOP (Task 543)

Location: Pitesti WWTP

Dates: September 19 - 23, 1994

Instructor: Doug Abbott (WASH)

Interpreter: Alexandru Ionescu (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Gheorghe Balan	REGOCOM	Plant Manager
2. Elena Manescu	REGOCOM	Lab Shift Chief
3. Ioana Voineag	REGOCOM	Biochemist/Lab Technician
4. Marina Vasile	REGOCOM	Chemist/Lab Technician
5. Daniela Nitulescu	REGOCOM	Chemical Engineer
6. Cornelia Rizea	REGOCOM	Operations Supervisor
7. Florica Tutunara	REGOCOM	Operations Supervisor
8. Ilie Catanea	REGOCOM	Operations Supervisor
9. Elena Pana	EPA	Inspector
10. Anca Georgescu	EPA	Biologist
11. Mercea Vasilescu	Apele Romane	Chemical Engineer

PROCESS CONTROL - I WORKSHOP (Task 543)

Location: Curtea de Arges WWTP

Dates: September 26 - 30, 1994

Instructor: Doug Abbott (WASH)

Interpreter: Daniela Frunza (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Mihail Badea	GOGARG	Plant Manager
2. Ionica Dragut	GOSARG	Lab Manager
3. Liliana Ferreira	GOSARG	Lab Technician
4. Ana Sultana	GOSARG	Lab Technician
5. Aurelia Banea	GOSARG	Lab Technician
6. Doina Florescu	GOSARG	Lab Technician
7. Gheorghe Maria	GOSARG	Operator
8. Cristian Iorga	GOSARG	Operator
9. Briceag Giuca	GOSARG	Operator
10. Marian Canta	GOSARG	Mechanic
11. Cristian Popescu	GOSARG	Mechanic
12. Constantin Ilinca	GOSARG	Mechanic
13. Ion Bobic	GOSARG	Mechanic
14. Nicolae Ilie	GOSARG	Mechanic
15. Ion Maria	GOSARG	Electrician
16. Ristea Zinca	GOSARG	Electrician
17. Dumitru Floroiu	GOSARG	Electrician
18. Eugen Telinoiu	GOGARG	Furnace Operator
19. Nicolae Ungureanu	GOSARG	Furnace Operator

PROCESS CONTROL - I WORKSHOP (Task 543)

Location: Cimpulung WWTP

Dates: October 3 - 7, 1994

Instructor: Doug Abbott (WASH)

Interpreter: Alexandru Ionescu (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Lucian Stan	EDILUL	Plant Manager
2. Rodica Isbasoiu	EDILUL	Lab Manager
3. Maria Tarca	EDILUL	Lab/Biologist
4. Heluta Viya	EDILUL	Lab Technician
5. Adriana Ivan	EDILUL	Lab Technician
6. Petruta Ronamescu	EDILUL	Lab Technician
7. Marilena Catrimu	EDILUL	Lab Technician
8. Aurel Pirsan	EDILUL	Operator
9. Gabriel Potescu	EDILUL	Operator
10. Ara Pirsar	EDILUL	Operator
11. Ionel State	EDILUL	Electrician
12. Carmen Toma	Apele Romane	Engineer
13. Mariana Marina	Apele Romane	Chemical Engineer

PROCESS CONTROL - II WORKSHOP (Task 544)

Location: Pitesti WWTP

Date: November 8, 1994

Instructor: Doug Abbott (WASH)

Interpreter: Daniela Frunza (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Gheorghe Balan	REGOCOM	Plant Manager
2. Florica Tutunara	REGOCOM	Operations Supervisor
3. Ilie Catanea	REGOCOM	Operations Supervisor
4. Cornelia Rizea	REGOCOM	Operations Supervisor
5. Ionica Dragut	GOSARG	Lab Manager
6. Elena Pana	EPA	Inspector
7. Daniel Munteniu	Apele Romane	Engineer

PROCESS CONTROL - II WORKSHOP (Task 544)

Location: Pitesti WWTP

Dates: November 9 - 11, 1994

Instructor: Doug Abbott (WASH)

Interpreter: Daniela Frunza (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Gheorghe Balan	REGOCOM	Plant Manager

PROCESS CONTROL - II WORKSHOP (Task 544)

Location: Curtea de Arges WWTP

Dates: November 14 - 16, 1994

Instructor: Doug Abbott (WASH)

Interpreter: Alexandru Ionescu (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Mihail Badea	GOGARG	Plant Manager
2. Ionica Dragut	GOSARG	Lab Manager
3. Daniel Munteniu	Apele Romane	Engineer

PROCESS CONTROL - II WORKSHOP (Task 544)

Location: Cimpulung WWTP

Dates: November 16 - 18, 1994

Instructor: Doug Abbott (WASH)

Interpreter: Alexandru Ionescu (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Lucian Stan	EDILUL	Plant Manager
2. Rodica Isbasoiu	EDILUL	Lab Manager
3. Maria Tarca	EDILUL	Lab/Biologist
4. Daniel Munteniu	Apele Romane	Engineer

SLUDGE CONDITIONING AND DEWATERING WORKSHOP (Task 543)

Location: Pitesti WWTP

Dates: September 26 - 30, 1994

Instructor: Barnes Bierck (WASH)

Interpreter: Florina Mirescu (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Gheorghe Balan	REGOCOM	Plant Manager
2. Florica Tutunaru	REGOCOM	Operations Supervisor
3. Daniela Nitulescu	REGOCOM	Chemical Engineer
4. Vasile Boita	REGOCOM	Engineer
5. Ilie Catanea	REGOCOM	Operations Supervisor
6. Ioana Voineag	REGOCOM	Biochemist/Lab Technician
7. Rodica Isbasoiu	EDILUL	Laboratory Chief
8. Elena Pana	EPA	Inspector
9. Anca Georgescu	EPA	Biologist
10. Sofia Sorescu	Apele Romane	Biologist
11. Ion Rosu	ICIM	Research Engineer

LABORATORY IMPROVEMENT WORKSHOP (Task 544)

Location: Pitesti WWTP

Dates: November 8 - 11, 1994

Instructor: Barnes Bierck (WASH)

Interpreter: Florina Mirescu (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Gheorghe Balan	REGOCOM	Plant Manager
2. Dumitru Stanciu	REGOCOM	Operator
3. Ioana Voineag	REGOCOM	Biochemist/Lab Technician
4. Daniela Nitulescu	REGOCOM	Chemical Engineer
5. Virginia Otesteanu	REGOCOM	Biologist
6. Ionica Dragut	GOSARG	Lab Manager
7. Aurelia Banea	GOSARG	Lab Technician
8. Ana Sultana	GOSARG	Lab Technician
9. Ana Iacobescu	GOSARG	Lab Technician
10. Valeria Visteanu	GOSARG	Lab Technician
11. Rodica Isbasoiu	EDILUL	Lab Manager
12. Liliana Ferreira	EDILUL	Lab Technician
13. Anca Georgescu	EPA	Biologist
14. Mariana Marina	Apele Romane	Chemical Engineer

SLUDGE BENEFICIAL REUSE WORKSHOP (Task 544)

Location: Pitesti WWTP

Dates: November 16 - 18, 1994

Instructor: Barnes Bierck (WASH)

Interpreter: Florina Mirescu (Inginerie Urbana)

NAME	ORGANIZATION	POSITION
1. Gheorghe Balan	REGOCOM	Plant Manager
2. Cornelia Rizea	REGOCOM	Engineer
3. Marina Vasile	REGOCOM	Chemist
4. Daniela Nitulescu	REGOCOM	Chemical Engineer
5. Ioana Voineag	REGOCOM	Biochemist/Lab Technician
6. Virginia Otesteanu	REGOCOM	Biologist
7. Ilie Catanea	REGOCOM	Operations Supervisor
8. Elena Manescu	REGOCOM	Engineer
9. Rodica Isbasoiu	EDILUL	Lab Manager
10. Lucian Stan	EDILUL	Engineer
11. Anca Georgescu	EPA	Biologist
12. Lucian Balan	Apele Romane	Engineer
13. Adrian Stroe	Apele Romane	Engineer
14. Tatiana Diaconu	Apele Romane	Engineer
15. Ion Creanga	OSPA	Director/Engineer

Appendix B

EQUIPMENT PROCUREMENT LIST

The funding for technical assistance and training performed by WASH in the Arges River basin included supplemental amounts by the Environmental Health Project (EHP) for the purchase of related support equipment. The decisions regarding the specific equipment to be purchased with the EHP funds were based on the operational needs of the wastewater treatment plants in Pitesti, Curtea de Arges and Cimpulung, as established and prioritized through plant audits performed by WASH consultants, in consultation with plant personnel. As evidenced in the following equipment list, most of the items purchased were for the purpose of improving and upgrading plant laboratory capabilities. In addition to laboratory-related items, a wide variety of technical textbooks and guidance manuals dealing with the full range of plant operations and maintenance issues were provided as reference materials. A special front-end loader auger attachment was also purchased to help mix and aerate sludge placed into the drying beds at the WWTPs. This device should significantly reduce sludge drying time and help prevent the continued backup of sludge on-site, particularly at the Pitesti plant.

The total value of equipment purchased with EHP funds, including shipping, was approximately $175,000. In general, all laboratory equipment items, as listed below, were identically provided to each of the three WWTPs. Reference work sets were also provided to each of the WWTPs, as well as Apele Romane and the local EPA. The atomic absorption spectrometer was donated to Apele Romane, with the stipulation that its use in determining metals concentrations would be shared with the WWTPs. Only one front-end loader auger attachment was procured, due to cost constraints and the fact that its use and need is almost exclusive to the Pitesti plant. However, it is understood by the three operating utilities that this device is to be made available for sharing between the WWTPs.

In addition to the donated items purchased with EHP funds, WASH was able to arrange for the donation, without charge, of ten 2.5 ton-capacity flat bed trucks to the treatment plant operating utilities. These trucks were obtained through the Excess Property program of the U.S. Department of Defense, and have a total value of approximately $600,000. A discussion of the process involved in procuring the trucks and the steps to follow in obtaining other types of equipment may be found in Appendix 3.

EQUIPMENT PROCUREMENT LIST

auger attachment for front-end loader (for sludge mixing and aerating)

atomic absorption spectrometer

analytic balances

forced air ovens

automatic muffle furnaces

incubators

centrifuges

portable composite automatic samplers

Imhoff settling cones

settleometer kits

hot plate/stirrers

air pumps with vacuum manifolds and regulators

mixers

oxygen meters and probes

ammonia probes

nitrate probes

portable pH meters

BOD probes

pressurization cell

fume hoods and fume disposal systems

sludge/soil samplers

pond samplers

assorted glassware, including beakers, bottles, flasks, cylinders, dishes, etc.

assorted safety equipment, including goggles, gloves, aprons, fire extinguishers, first aid kits and emergency eye wash stations

crucibles

forceps, tongs and clamps

funnels

spatulas

timers

transformers

rechargeable batteries

thermometers

filter paper

assorted chemical supplies

technical reference books and guidance manuals, including truck repair manuals

cleaning and disinfection supplies

pocket calculators

equipment reconditioning kits and spare parts, where applicable

Appendix C

EQUIPMENT PROCUREMENT THROUGH THE EXCESS PROPERTY PROGRAM OF THE DEPARTMENT OF DEFENSE

The Excess Property (EP) program is the largest of the humanitarian assistance program (HAP) efforts administered by the Department of Defense (DoD). "HAP-EP," authorized by Section 2547, Title 10 U.S.C., allows for the donation of excess nonlethal DoD property to foreign recipients for humanitarian purposes when tasked through and coordinated with the Department of State. All material provided by this program must be for the exclusive benefit of the civilian sector.

One of the main resources available to HAP-EP in performing its mission is the Defense Reutilization and Marketing Office (DRMO), located in Germany. The DRMO serves as a clearinghouse for DoD property and has the task of inventorying, temporarily storing, and then disposing of this excess property through reassignment to DoD installations or other government facilities, donation to requesting countries with demonstrated needs, or commercial sales and auctions. The DRMO receives a wide array of surplus property, which it obtains from U.S. government installations around the world, including trucks, tools, school equipment, medical equipment and supplies, and furniture.

A request for specific surplus equipment will generally be honored as long as the requested items are in stock and all of the necessary approvals are obtained. Competing requests for property in limited supply are generally treated on a priority basis, with the needs of U.S. government installations taking precedence over other requests. The DRMO acts on instruction from the DoD and is not directly involved in the actual decisions concerning equipment allocation and distribution.

Requests for excess property are generated by the country team, members of Congress, regional military commands, and USAID missions, usually in coordination with the host government. The various steps in the procurement process are graphically outlined in the accompanying figure and are explained in greater detail below. Contact names and phone numbers have been provided for follow-up purposes and are correct as of the publication time of this report.

Step 1 - Country Request. A formal request should be prepared in the form of a letter from an appropriate representative of the country for specific assistance or equipment items. This letter should be directed to the U.S. Ambassador or Consular Officer for that country, and should explain why the equipment is needed and in what capacity it will be used. A copy of the letter sent from the Ministry of Water, Forests and Environmental Protection in Romania to request trucks for the Arges River basin WWTPs is included in this appendix as an example.

This step could, as well, be preceded by an inquiry at the DRMO to determine ahead of time whether the desired items are currently in stock. The contact person at DRMO for such inquiries is Hershell Crittendon in Wiesbaden, Germany (phone: 49-611-380-7305, fax: 380-7302).

Step 2 - U.S. Embassy. The U.S. Ambassador or Consular Officer in the requesting country must approve the request before any further action can be taken. Once approved, the request is forwarded to the Department of State in Washington, D.C.

Step 3 - Department of State. Country requests should be directed to Commander Steve Ingalsbe (phone: 202/647-4111, fax: 202/647-4055) or Nicole Peacock (phone: 202/736-7717, fax: 202/647-4055), of the Bureau of Political-Military Affairs located at the State Department.

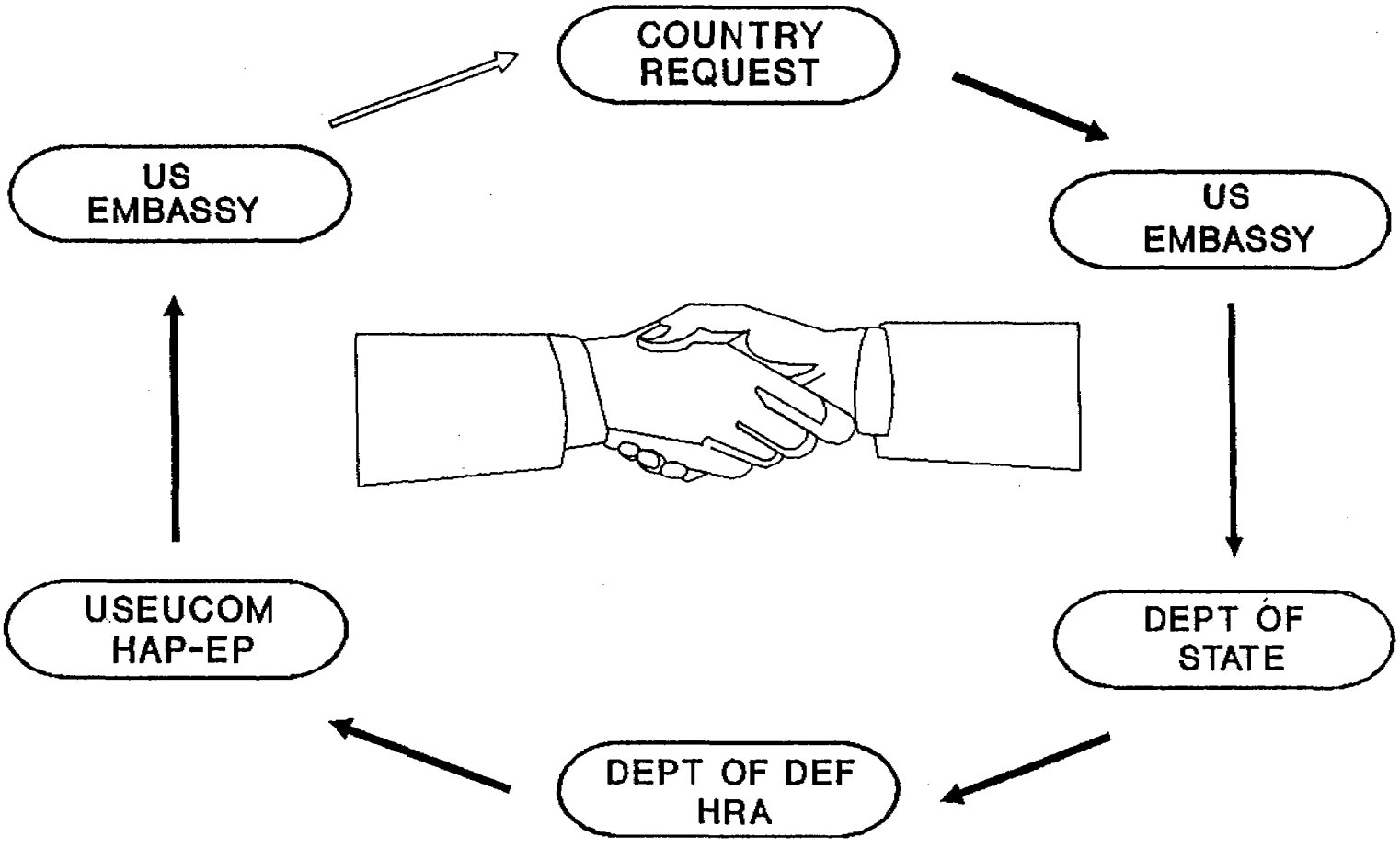
Step 4 - DoD/Humanitarian and Refugee Affairs (HRA) Office. If the request is approved at the State Department, it will then be forwarded to the DoD/HRA office at the Pentagon for further approval. Almost all requests approved by the State Department will eventually receive approval for funding by DoD/HRA. Contacts at DoD/HRA include: Colonel David Skalko, Major John Kershaw, or Carolyn Holmes (phone: 703/614-6944, fax: 703/697-6144).

Step 5 - USEUCOM/HAP-EP. Once HRA approves the request, it will notify HAP-EP in Germany to proceed with procuring the equipment items from DRMO and arrange for their repair (if necessary) and delivery to the requesting country. Contact Colonel Dave Houston (phone: 49-711-680-4052, fax: 680-7347) at the HAP office in Stuttgart, Germany.

Step 6 - U.S. Embassy. HAP-EP must transfer the requested items to a representative of the U.S. Embassy located in the receiving country, who then oversees delivery to the designated recipient within that country.

The time involved in the procurement of requested items will depend on whether they are in current supply, the availability of funding, the need for rehabilitation or repairs, etc. From the time of request to delivery, for example, the provision of trucks for Romania took just under four months. This included time for repairing and painting the trucks, as well as for arranging their transport from Germany to Romania. For most items, the procurement process will usually take between two and four months, assuming the necessary approvals are obtained.

HUMANITARIAN ASSISTANCE PROGRAM
EXCESS PROPERTY
HAP-EP



ROMÂNIA

MINISTERUL APELOR, PĂDURILOR ŞI PROTECŢIEI MEDIULUI

Bucureşti, Bd. Libertăţii nr. 12; Sector 5; Of.P. 42
Tel.: 781 24 07 ; Fax: 312 04 03 ; Telex: 11457 11248

Bucharest, 22 September 1994

Mr. Jonathan Rickert,
Charge d'Affairs
Unites State Embassy
Bucharest, Romania

Dear Mr. Rickert,

Ministry of Water, Forest and Environmental Protection which we the undersigned represent, hereby submit this request for humanitarian assistance to the Government of the United States of America. This assistance would supplement the aid we are currently receiving from your government for the containment of pollution to the Danube and tributary rivers in the Arges Basin and the protection of the Bucharest water supply downstream. The focus of this effort is on improving the treatment capability and overall operation of three regional waste water treatment plants located in Pitesti, Curtea de Arges and Cimpulung. This current effort is being sponsored by the US Agency for International Development (AID) through its Water and Sanitation for Health and Environmental Health Project.

We are specifically requesting the donation and delivery of five (5) large capacity (approximately 2-1/2 ton or more) trucks to be used for multiple purposes related to the operation and maintenance of the Pitesti, Curtea de Arges and Cimpulung waste water treatment plants. These purposes would include, but not be limited to, the hauling of materials, equipment and supplies on and off-site, as well as the transfer and disposal of treatment-generated debris and waste, including sludge, to approved disposal locations. The vehicles would be assigned directly to the three utilities (REGOCOM, GOSARG and EDILUL, respectively) which operate this plants.

We understand through the AID office that surplus, used trucks of this type may be available through the Department of Defense-Humanitarian Assistance Program (HAP) office in Germany, including several non-operational trucks which could serve as a source of spare parts in the maintenance of the five trucks.

We express our sincere gratitude for the assistance your country is currently providing us, and are particularly pleased with the extensive laboratory equipment recently donated to the three waste water treatment plants. This equipment will greatly help in improving plant performance and in increasing operating efficiency. We are certain that the procurement of these trucks will also help us reach this goal.

We appreciate your time in considering our request for additional assistance and again express our gratitude for your past efforts in our behalf.

Sincerely,

Florin Stadiu

Secretary of State

Head of Water Department