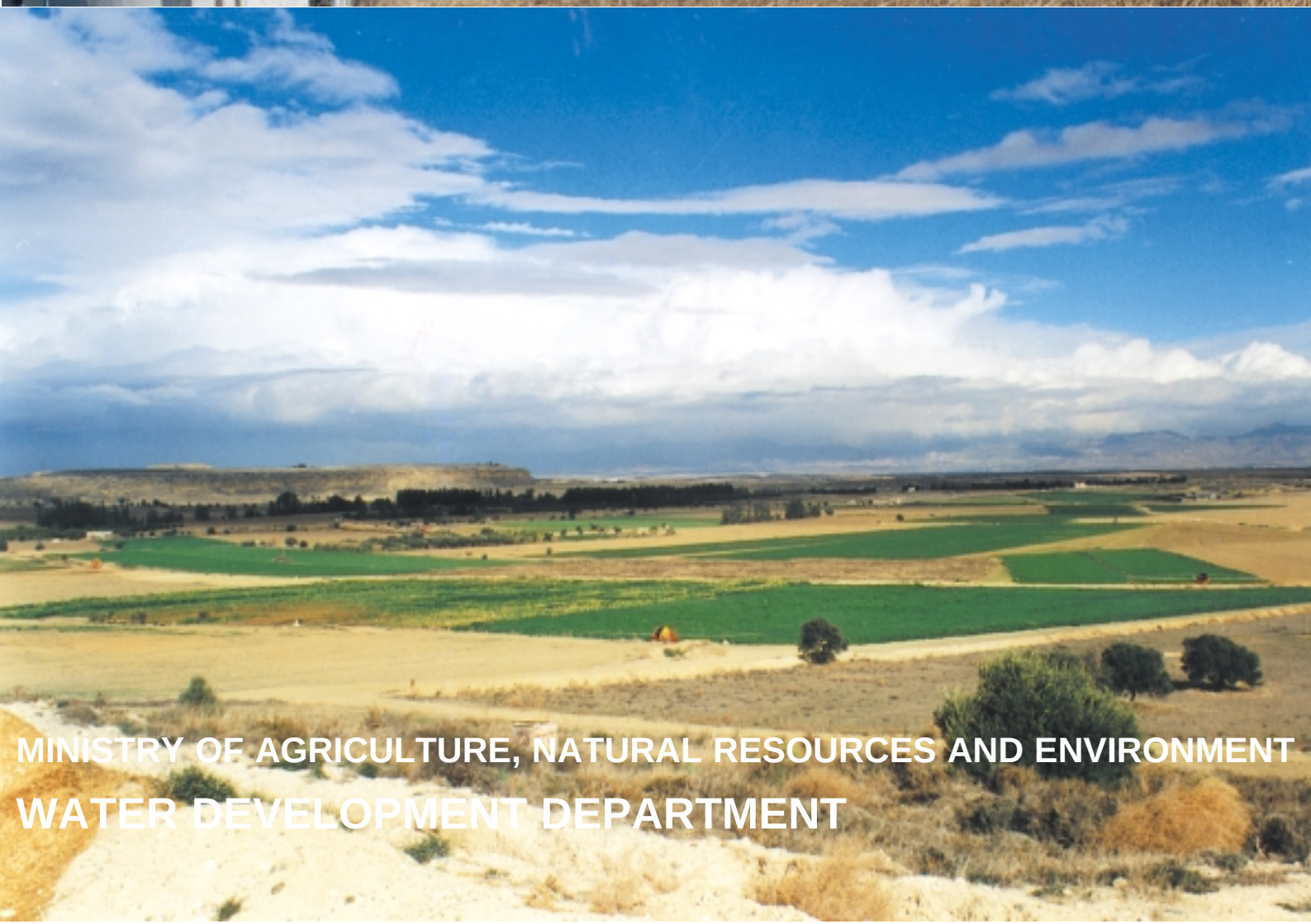
THE CENTRAL WASTEWATER TREATMENT PLANT AT VATHIA GONIA



MINISTRY OF AGRICULTURE, NATURAL RESOURCES AND ENVIRONMENT

WATER DEVELOPMENT DEPARTMENT

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- Area irrigated with recycled water

FOREWORD

The protection of the environment and the re-use of water, which results from the treatment of wastewater, are the central axes of the policy of the Ministry of Agriculture, Natural Resources and Environment.

In divided Cyprus the protection of the environment is of vital importance. This protection aims at the improvement of the quality of life, the protection of the ecosystem and the conservation of the natural resources together with the securing of the sustained economic development of our country.

In addition to the above, the expected accession of Cyprus to the European Union and the actions demanded in order to meet the requirements of the European Acquis, have created new commitments for the promotion of projects of environmental infrastructure.

Related to the protection of the environment is the serious water shortage problem that Cyprus faces. The appropriate utilisation of every water resource in the country is a steadfast policy of the Government. A vital source of water is the recycled water that originates from the treatment of wastewater, which replaces equal quantities of potable water.

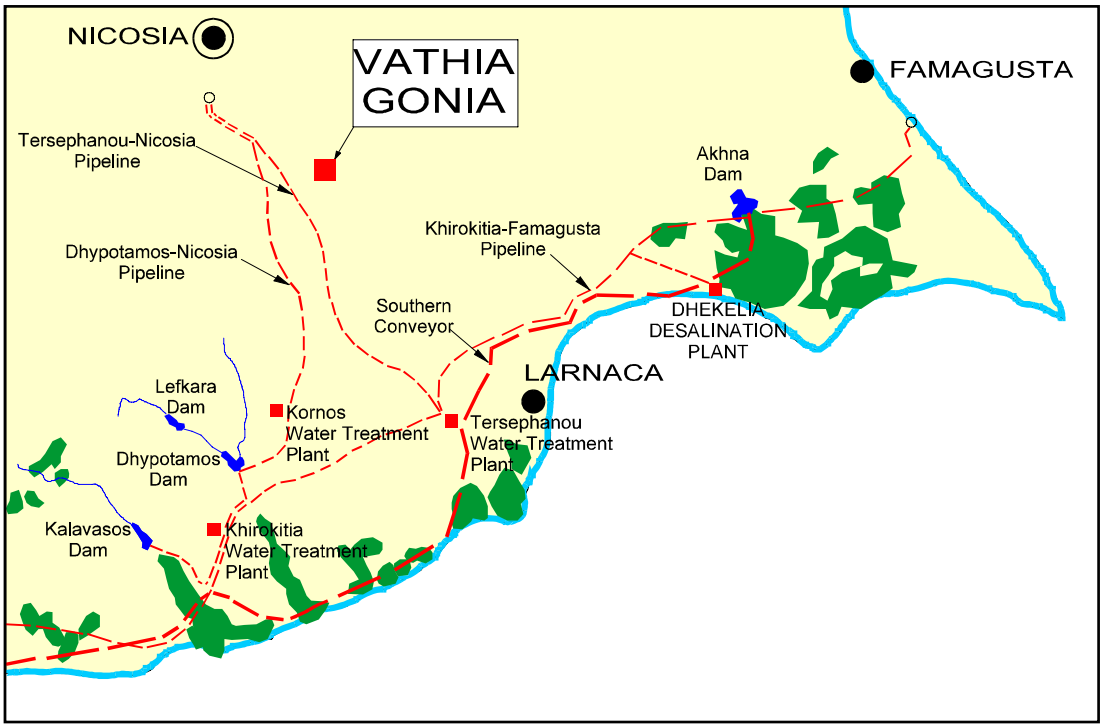
In this framework, the Government promoted the construction of the Wastewater Treatment Plant at Vathia Gonia for the treatment of domestic septage and industrial wastewaters. Apart from the sewerage networks, this Treatment Plant is the largest project of environmental infrastructure, which has been implemented up to now. The latest technology has been applied to the Plant and since the commencement of its operation both its targets, namely the protection of the environment and the saving of water resources for re-use as irrigation water, have been fulfilled.

The protection of the environment and the saving of the limited water resources are the duty and commitment of the Government as well as of every citizen. There is no doubt that a lot has to be done so that all targets may be fulfilled. The road will not be easy and there are no alternatives.

This publication aims to describe, in a simplified manner, the Central Wastewater Treatment Plant at Vathia Gonia, and the significant benefits, which have resulted from its operation. The implementation of this project would have not been possible without the contribution of the employees of the Ministry and of the Water Development Department whom I would like to thank and congratulate.

Costas Themistocleous
Minister of Agriculture,
Natural Resources and Environment

October, 2000


NICOSIA
VATHIA GONIA
FAMAGUSTA
Tersephanou-Nicosia Pipeline
Dhypotamos-Nicosia Pipeline
Khirokitia-Famagusta Pipeline
Akhna Dam
Southern Conveyor
DHEKELIA DESALINATION PLANT
LARNACA
Lefkara Dam
Kornos Water Treatment Plant
Tersephanou Water Treatment Plant
Dhypotamos Dam
Kalavasos Dam
Khirokitia Water Treatment Plant

Secondary settlement tank

Introduction

The Central Wastewater Treatment Plant at Vathia Gonia, which is located near Potamia village, has been built in order to treat domestic septage and industrial wastewaters from the districts of Nicosia and Larnaca. All wastes are transferred to the Plant by tankers.

The Plant has a capacity for the treatment of 2 200 cubic metres per day of waste and population equivalent of 55 000. The water, which results from the treatment of the wastewater, is stored in a 284 000 cubic metre lagoon. From there it is distributed via a pumping main, break pressure tank and irrigation network to 50 hectares of land in Potamia and Geri villages for the irrigation mainly of fodder crops.

Background Information

Due to the absence of a sewerage network in large areas of Nicosia and Larnaca, as well as in small communities of the two districts, the septage collected by tankers from overflowing absorption pits, was disposed, for Nicosia District, in lagoons near Potamia village and, for Larnaca District, in similar lagoons near Kellia village. In addition to the above, a number of small industries, either due to lack of space or to their small size, were not in a position to build their own treatment plants. As a result they disposed their wastewater in the above lagoons as well as in lagoons near Aglangia.

The operation of the above lagoons caused serious environmental problems such as pollution

of the groundwater and soil, as well as serious odour and vector nuisance to the nearby communities.

In December 1993, the Government decided to proceed with the construction of a central wastewater treatment plant where all domestic septage and industrial wastewaters would be treated.

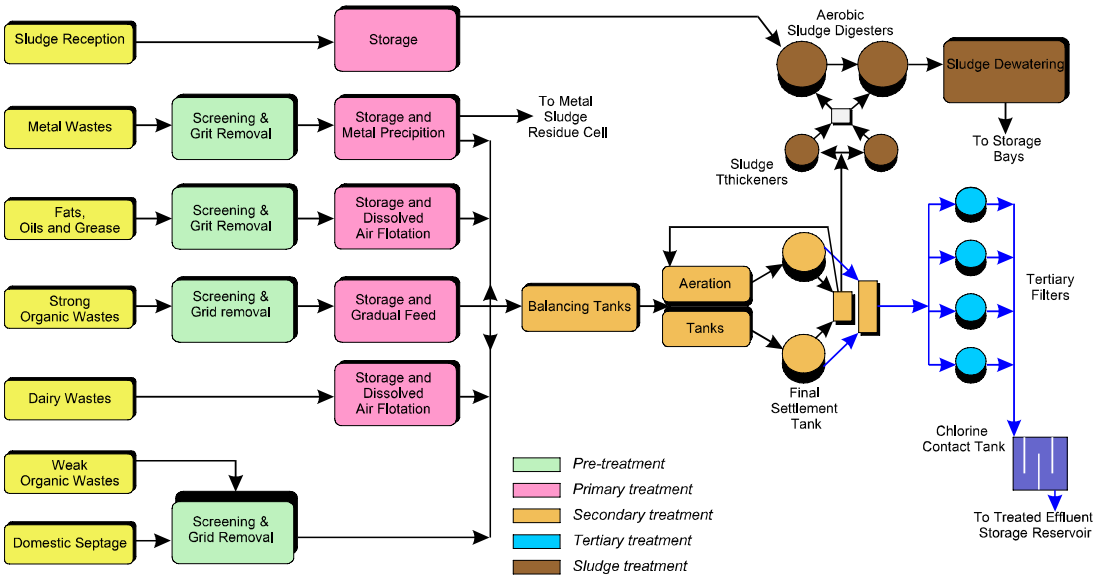
The responsibility for the implementation of the project was given to the Ministry of Agriculture, Natural Resources and Environment.

In April 1994, the Consulting Engineers, Howard Humphreys and Partners Ltd., of UK, in association with J. A. Theophilou Consulting Engineers Ltd., of Nicosia, were awarded the contract for the preparation of the Environmental Impact Study and the Contract Documents for the construction of a new green field treatment plant on a turnkey basis.

After the completion of the above studies tenders were sought and the contract was awarded to the British Company Biwater Europe Ltd. for the sum of £8,3 million for the construction and £1,4 million for a five-year operation and maintenance period.

The construction of the plant commenced in February 1996 and was completed in February 1998. The operation of the plant started gradually with the discharge of domestic septage and then of the industrial wastewaters. Simultaneously the operation of the lagoons at Kellia and Potamia was terminated.

PROCESS BLOCK DIAGRAM



Description of the Plant

General

All wastewaters that are discharged at the plant have been classified in one of seven categories. The criteria on which the plant was designed appear on the table below.

Wastewater Reception

For control and billing purposes a uniquely coded transponder has been fitted to every tanker. Using ground induction loops every tanker is automatically recognised, upon its arrival, by the signal from its transponder, and is recorded in the computer in the reception building. After its recognition the tanker driver hands to the operator a completed copy of a docket on which the source of the waste or wastes is written.

DESIGN CRITERIA

	Year 1994			Year 2004		
Waste Category	**Flow (m^3/day)**	**BOD_5 load (kg/day)**	**SS load (kg/day)**	**Flow (m^3/day)**	**BOD_5 load (kg/day)**	**SS load (kg/day)**
Domestic Septage	1263	904	2100	1683	1207	2804
Dairy Waste	108	1073	748	144	1430	997
Fats, Oils and Greases	26	70	48	35	93	64
Metals Waste	36	10	9	48	13	12
Strong Organic Waste	56	310	192	75	413	256
Weak Organic Waste	161	153	43	215	204	57
Sludge	80	-	-	108	-	-

BAO_5 = Biochemical Oxygen Demand

The wastewaters of each category are pre-treated in a different line, the design of which is based on the waste category characteristics.

After pre-treatment all wastewaters are collected in a balancing tank from where they are forwarded to the secondary and tertiary treatment units. After tertiary treatment the recycled water is stored in a 284 000 cubic metre lagoon from where it is distributed, via an irrigation network, to a 50 hectares area near the villages of Geri and Potamia.

Tankers at the Reception Building

Reception Building - Registration of tankers for control and billing purposes

By entering the number of the docket into the computer, the source and category of the waste is validated and the computer allocates a discharge bay compatible with the pre-treatment that is required by the incoming waste.

Following the above, the tanker driver proceeds to the discharge bay where the vehicle is again recognised so as to ensure that it is in the right position for the type of waste to be discharged.

For the discharge of the wastewaters there are 21 bays that have been allocated as follows:

Discharge bay

Category of Wastes	**No. of Discharge Bays**
Domestic Septage	14
Dairy Waste	2
Fats, Oils and Greases	1
Metals Waste	1
Strong Organic Waste	1
Weak Organic Waste	1
Sludge	1

Pre-treatment of Wastewater

For each one of the categories of wastes there is a separate pre-treatment line. During pre-treatment, solids or other constituents of the wastewater, which could cause physical or biochemical damage to the plant, are removed. The pre-treatment units for each one of the seven categories of wastes and the purpose of each one appear on the next page.

PRE - TREATMENT UNITS

Waste Category	Pre-Treatment Processes	Purpose
Domestic Septage	Screening, grit removal	Physical protection of mechanical equipment; avoiding siltation of tanks.
Dairy Waste	Dissolved air flotation	Removal of fats and floating material; reduction of organic load to secondary treatment.
Fats, Oils and Greases	Screening, grit removal, dissolved air flotation	Physical protection of mechanical equipment; avoiding siltation of tanks; removal of floating matter harmful to the biological process.
Metals Waste	Screening, grit removal, chemical precipitation of metals	Physical protection of mechanical equipment; avoiding siltation of tanks; removal of metals harmful to the biological process and vegetation to be irrigated.
Strong Organic Waste	Screening, grit removal, storage for gradual feed into the system	Physical protection of mechanical equipment; avoiding siltation of tanks; avoiding shock loads to the biological treatment.
Weak Organic Waste	Treated in the same line as domestic septage	Physical protection of mechanical equipment; avoiding siltation of tanks.
Sludge	Storage and transfer to the aerobic digesters via macerating pumps	Maceration of gross solids that might settle in the aerobic digesters.

Screenings and grit removal units

The sludge, which is produced during the pre-treatment of the wastewaters that contain metals, after dewatering by a filter press, is transferred via a belt conveyor and discharged to a waste storage cell lined with 1 mm HDPE membrane. The design capacity of the cell is 20 years.

The sludge and the scum, which are produced from the dissolved air flotation units of the dairy and fats, oils and greases wastewater, are pumped into the aerobic digesters.

After pre-treatment all industrial wastewaters are mixed with the domestic septage for secondary treatment.

Secondary Treatment

The purpose of secondary treatment is to remove the polluting organic components, which are found in wastewater. This is achieved by the mixing of wastewater with Mixed Liquor Suspended Solids (MLSS) in which bacteria and other microorganisms are found. The mixed liquor is aerated with mechanical means so that the micro-organisms will obtain the required oxygen to oxidise the organic matter.

The secondary treatment comprises two parallel balancing tanks (total capacity 4 800 cubic metres), a pumping station for the transfer of the wastewater to the anoxic tank (capacity 650

Aeration tank

cubic metres), two parallel aeration tanks (total capacity 11 290 cubic metres) and two 9-metre diameter secondary settlement tanks. The suspended solids of the mixed liquor are maintained at about 4 000 mg/l and therefore the organic loading rate is approximately 0,09 kg BOD_5/kg MLSS. The tanks are aerated by six,9 metres length horizontal shaft aerators each one powered by a 45 kw motor.

From the aeration tanks, the MLSS overflows into two secondary settlement tanks where the micro organisms (sludge) settle out. From here a proportion is returned to the anoxic tank, maintaining a controlled balance in the system thus enabling continuous treatment. The excess sludge, which has a concentration of approximately 0,7% solids, is pumped into two parallel picket fence thickeners where it is thickened to a concentration of approximately 2,5% solids. The thickened sludge is then pumped from the thickeners into two aerobic digesters that have been designed for a retention time of 20 days thus ensuring that the sludge will be stabilised. The stabilised sludge is then dewatered in two centrifuges, to a solids content of approximately 20%. The dewatered sludge is transferred, via a screw conveyor, into a trailer and subsequently stored on a drained hard standing prior to being spread onto land as a soil conditioner/ fertiliser.

Tertiary Treatment

The secondary treated effluent from the secondary settlement tanks overflows into a pumping station and from there it is pumped into four sand filters. After filtration the water is chlorinated using gas chlorination in order to maintain the bacteriological standard of the final effluent. After disinfection the water is stored in the storage lagoon prior to being used for irrigation.

Recycled Water Storage Lagoon

The earth embankment lagoon for the storage of the recycled water has a capacity of 284 000 cubic metres and is lined with High Density Polyethylene (HDPE) membrane of 1 mm thickness so that leakage may be prevented.

The irrigation network covers approximately 50 hectares of land near Potamia and Geri villages for the irrigation of mainly fodder crops.

Sludge thickeners and aerobic digesters

Secondary settlement tank and tertiary filters

Odour Control

Odour control is one of the main features of the plant due to the peculiarity of the wastes that are treated, which being septic, can cause serious odour nuisance. Particular attention was given to cover all tanks that may emanate odours and to ensure that all air from the tanks is vented through biological filters for the removal of odorous compounds. There are two biological filters at the plant, one serving the pre-treatment area and one serving the sludge processing area.

Control and Monitoring

The whole plant is controlled and monitored from a central system supervisory computer located in the control room of the administration building. Also housed in the administration building is a fully equipped laboratory for the analysis, control and monitoring of the received wastewater and of the health of the plant itself.

Chlorination tank

Ancillary Works

Pressure Effluent System

For washing down purposes as well as for general non-potable use, a recycled water pressure effluent system has been installed with a number of standpipes and hydrants all over the fenced area.

Facilities for the Tanker Drivers

Mess room and toilet facilities for use by the tanker drivers are located in the reception building.

Emergency Storage Lagoon

In case of an emergency where the whole plant has to be put out of operation, a lagoon, lined with 1 mm HDPE membrane, having 1,5 days of wastewater inflow capacity has been constructed.

Administration Building

The administration building houses the control room. From a central computer in the control room all six PLCs located at different areas of the works are continuously monitored.

Apart from the control room in the administration building there are also the offices of the staff, the laboratory, a mess room for all the employees, a lecture room and a fully equipped workshop.

Recycled water storage lagoon

Land spreading of sludge

Irrigation with recycled water

General Information

• Contract System	" Turnkey Project - utilising modified FIDIC 3rd edition of the FIDIC Conditions of Contract
• Employer	Ministry of Agriculture, Natural Resources and Environment
• Consulting Engineers	Howard Humphreys and Partners Ltd.(a Halliburton Brown & Root Company) Hill Park Court Springfield Drive Leatherhead, Surrey, KT22 7NL U.K. In association with J. A. Theophilou Consulting Engineers Ltd. Nicosia
• Main Contractor responsible for Design, Construction, Commissioning and Operation	Biwater Europe Ltd. Gregge Street Heywood Lancs, OL10 2DX, UK
• Specialised Subcontractors	
• Civil Engineering Works	Charilaos Apostolides & Co. Ltd., Nicosia
• Electrical and Mechanical Works	Caramondani Bros., Nicosia
Contract Value	
• Design, Construction & Commissioning	£ 8,3 million
• Five year operation and maintenance	£ 1,4 million
• Financing	The Government of the Republic of Cyprus

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