



REPORT OF THE ENVIRONMENTAL AUDIT OF THE

CITY OF LARNACA, CYPRUS

FINAL REPORT AFTER CONSULTATION ON DRAFT

May 1999

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CHAPTER 1 INTRODUCTION

1.0 BACKGROUND

Years of pollution, overfishing and tourist driven over-development have left the Mediterranean Basin in a state of crisis. The 46,000 kilometres of coastline attracts an estimated one third of world tourism which annually adds around 100 million visitors to the 130 million residents. The marine and coastal environment suffers as the basic infrastructure is often unable to cope with the increasing development and the consequent demand for essential services and diminishing resources.

Not all is gloom, however, numerous agencies and networks are working to raise awareness and improve the infrastructure. Economic drivers are at work too as an increasing number of more discerning tourists, faced with a wider range of alternative venues, are seeking a better quality environment. Many destination countries are responding by reviewing their approach and are aiming to provide that quality rather than continue to cater solely for the 3 S's mass market. Some are developing environmental positive programmes, or so called eco-tourism, where carefully controlled tourism is being developed in consultation with the local population and is being used to assist their economic development as well as to protect the natural environment, or historical sites or both.

2.0 THE MEDCITIES ENVIRONMENTAL AUDIT PROGRAMME

One of the positive networks created to contribute towards improving the situation is MedCities, an environmental network of Mediterranean cities which was established in 1991. The aims of the network are to:

Forge an awareness of the need to protect their common heritage.

Establish a policy of cooperation and to implement bilateral 'town to town' partnerships.

Develop a dialogue with all partners and local stakeholders.

Act to take positive action to improve the environment.

The network is administered by the Paris based United Towns which seeks to promote decentralised cooperation by providing local authorities throughout the world with the assistance needed to identify, plan and implement action in decentralised cooperation, and supporting networks and associations established by towns and cities.

Amongst the many collaborative ventures undertaken by MedCities is a programme of environmental audits of coastal towns and cities. The introduction of this

programme firmly placed the network at the cutting edge of environmental technology.

The concept of auditing the environment of a whole city and developing a corporate strategy based on multi-sectoral participation was new but is now being developed worldwide as the approach to the local implementation of Agenda 21, or the Local Agenda 21 as it has become known.

The idea of a 'flash' audit conducted by a fairly subjective local team in collaboration with a more objective international team of foreign experts has much to offer. Experience to date has demonstrated that those cities which have participated have benefitted from the concentrated corporate review of local environmental conditions and most are developing and implementing corporate action plans. One of the major lessons learnt by this participation is the need for a more holistic approach to the environment in preference to the commonly practised departmental approach so common in all forms of government all over the world.

To date the following cities have carried out audits and developed 'green' strategies or Local Agendas: Gaza (Palistine), Haifa (Israel), Limassol (Cyprus), Oran (Algeria), Silifke (Turkey), Sousse (Tunisia), Tangier (Morocco), Tetouan (Morocco), Tirana (Albania), and Tripoli/El Mina (Lebanon). To which will be added this audit of Larnaca and one soon to be conducted in Ashdod (Israel). The first round of audits was funded by the European Union under the METAP Programme and the more recent ones through the LIFE programme.

2.1 The Aim and Objectives of the Audit

The overall aim of the programme is for the city to prepare and implement a comprehensive integrated strategy, or Local Agenda, for a sustainable future in consultation with its citizens. The audit is an essential part of that programme but it is only the first step in the direction of a long term strategic plan for the sustainable development of the city.

The four primary goals of a municipal environmental audit are to :

- Establish the current condition of the local environment.
- Identify and assess the strengths and weaknesses of the environment within the city and its surrounds.
- Develop a broad-based strategy.
- Ensure the participation of all sectors in the development of such a strategy

Some secondary goals are to:

- Increase public awareness and understanding of the local and global environment.
- Provide a baseline against which future changes to the condition of the environment can be assessed.
- Assess the effectiveness of present and future policies in respect of the environment.
- Improve liaison and co-operation between those involved in the management of the local environment.

3.0 THE AUDIT TEAMS

The international team worked closely with the team of local experts whose knowledge and experience of the City and District enabled the audit to be carried out and this report to be produced. The 'external' expertise and experience supplied by the 'visiting' team would have been of little value without the help and support provided by the local experts.

3.1 The 'Home' Team

Eleftherios Embedoklis, (Local Co-ordinator) Municipal Town Planner, Larnaca Municipality.

Sotiris Zirkis, Town Clerk, Larnaca Municipality.

Andreas Charalambous, Municipal Engineer, Technical Department, Larnaca Municipality.

Michalis Polydorides, Municipal Doctor, Health & Hygiene Department, Larnaca Municipality.

Demetris Kitromilides, Technical officer, Water Board of Larnaca.

Costas Kokkinos, Health Inspector, Health & Hygiene Department, Larnaca Municipality.

Spiro Spiridis, Cleansing Inspector, Health & Hygiene Department, Larnaca Municipality.

John Venturis, Treatment Plant Manager, Larnaca Sewerage & Drainage Board.

3.2 The 'Visiting' Team

Geoff Wright (Team Co-ordinator), Independent Environmental Consultant based in Leeds, England. Specialising in corporate environmental management, waste management and the efficient use of resources. In the latter capacity he is a Director of Urban Mines Ltd, a company established to create employment through the use of 'secondary' materials diverted from the waste stream.

Alvaro Feliu Jofre, a Civil Engineer (MBA) and lecturer in Waste Management at the Polytechnic University of Catalonia, Spain and an Independent Environmental Consultant with 16 years experience in strategic environmental planning.

Zwy Fuhrer, General Director of the Haifa District Association of Municipalities for the Environment, Israel. He has a BSc in Chemical Engineering and a MSc in Environmental Engineering. He is an expert in industrial pollution and pollution control at oil refineries, petrochemical industries, fertiliser industries, cement kilns, food industries, power stations, etc, and involved in interdisciplinary environmental group management and municipal environmental management.

Xavier Monbailiu, Ecologist (MSc.) and Landscape Architect (BILA) operating an environmental consultancy in Saint-Maxim (VAR), Southern France, specialising in environmental impact assessments, coastal ecology and land use planning. Xavier is Secretary General of MEDAMARAVIS, a leading Pan-Mediterranean NGO dealing with coastal ecology and conservation.

Ignacio Monfort, a Civil Engineer and Partner-General Director of ECODES, an engineering consultancy company based in Madrid, Spain, specialising in water and environmental engineering, urban and territorial planning

Dr Ariella Vraneski, an Architect and Town Planner. She teaches Urban Planning and Alternative Dispute Resolution courses at the Technion and at Haifa University, Israel, and works as researcher and planner with the urban and regional Studies Centre.

3.3 The Supporters

The Audit Team is grateful for the help which has been provided by many people but would particularly like to express their thanks to the following for their invaluable assistance and support with the project:

George Lycourgos, The Mayor of Larnaca.

Kypros Matheou, District Officer, Larnaca District.

Aristides Adamou, Technical Superintendent, Water Board of Larnaca.

Anna Caramondanis, District Planning Officer, Larnaca District.

Antonios Charalambides, Geological Survey Department, MANRE.

Sofoclis Christodoulides, Structural Engineer, Municipal Special Projects, Larnaca Municipality.

Panikos Christoulou, Ministry of Interior.

Demetra Costa, Statistics Assistant, Department of Statistics & Research.

Yinnakis Demetriou. Y. Demetriou Associates Ltd, Architects, Larnaca.

Fanie Eliades, Cyprus Green Party.

Nicos Georgiades, Director of Environment, MANRE.

Anna Iacovidou, Planning Technician, Larnaca Municipality.

Stalo Kalopedi Embedoklis, Cyprus Centre for Environmental Management and Planning.

Marios Kouraiyiannis, Architect, Larnaca District Office.

Costas Lambrianides, Managing Director, Lambrianides Ltd.

George Lambrou, General Manager, Cyprus Refinery Ltd.

Kenia Loizidou, Coastal Unit, Ministry of Communication & Works.

Themis Mighaelides, Architect, Larnaca District Office.

Athena Metaxa, Cypriot Tourism Organisation.

George Mousouliotis. Port Officer, Larnaca Marina.

C.A. Papadopoulos, Cyprus Petrol Refinery Ltd.

Despo Papaicolaou, Secretary, Technical Department, Larnaca Municipality.

Andreas Paris, Port Officer, Larnaca Marina.

Giorgios Perdikis, Cyprus Green Party.

Pambis Philippides, Director, Department of Statistics & Research.

Christodoulos Photiou, Department of Agriculture, MANRE.
Olga Sallangos, Plant Manager, Caramondani Desalination Plants.
Panayiotis A. Sardos, Larnaca Progressive Movement.
Andonis Semelides, Manager, BP Distribution Depot.
Sotinis Sotiriou, Municipal Accountant, Larnaca Municipality.
Christis Stylianakis, Architect, Larnaca District Office.
Eleftherios Stylianides, Public Works Department.
Pantelitsa Tembrias, Municipal Treasurer, Larnaca Municipality.
Andreas Themistocleris, Taxes Inspector, Larnaca Municipality.
George Theoklis, Architect, Municipal Special Projects, Larnaca Municipality.
Othon Theodoulou, Permanent Secretary, Larnaca Chamber of Commerce & Industry.

4.0 CYPRUS

Cyprus is the third largest Mediterranean island with an area of 9,251 sq km (3,355 sq km are occupied by the Turks). The coastline measures some 784 km which coupled with the warm, sunny climate, encouraged 2.2 million tourists in 1998.

Situated at the crossroads of Africa, Asia and Europe, the island has a long history of political upheaval culminating in the present unhappy partitioning of the northern part of the island.

5.0 LARNACA

Larnaca, "the town of Zenon" is the capital of Larnaca district and the is the third largest city in Cyprus, after Nicosia and Limassol. The town of Larnaca is the oldest inhabited town in Cyprus. It has a continuous history of over 6,000 years. Present day Larnaca was built over the ruins of the ancient City-Kingdom of Kition. It's name is derived from the word "Larnax", which means tomb or sarcophagus in ancient Greek.

The modern city is built on the shores of the Bay of Larnaca in the Southeast of the island, a few kilometres to the north of the ancient kingdom of Kition. It is characterized by low relief as no part of the city has an elevation of more than 50 metres.

The city of Larnaca is well-known for its picturesque sea-front which includes rows of palm trees, or finikoudes in the local Greek dialect. Much of the activity is centred around the city promenade during the major festivals. The most important of which is Kataklysmos or the Festival of the Flood, celebrated in early summer with a series of cultural events.

Apart from the attractions of the seafront, the city boasts numerous places of interest including the Archaeological Museum, the Pieredes Museum, Larnaca Fort, St. Lazaros Church, the Kition Acropolis, the Hala Sultan Tekke Shrine and the adjacent Salt Lakes.

CHAPTER 2 SUMMARY OF THE AUDIT FINDINGS

1.0 THE LARNACA ENVIRONMENT

Larnaca is an attractive, lively city with good beaches, a clean sea, a bustling centre and a wide range of facilities for residents and tourist alike. The city boasts a beautiful promenade, preserved old buildings and ruins, interesting museums, and spectacular birdlife on the Salt Lakes.

Health is generally good, there is little unemployment and the people mostly enjoy a high standard of living.

There are no serious environmental problems but a range of issues and concerns which caused the Mayor to request an independent audit of the local conditions with a view to developing a long term strategy for the sustainable development of the city and its surroundings.

The Audit Team discovered nothing new but hopefully is able, through this report, to convey an objective view of the environmental weaknesses and suggest what measures should be taken in order to ensure a more sustainable future for the residents of this historic city.

2.0 SCOPE OF THE AUDIT

The principal emphasis of the audit has been on the Municipality of Larnaca but has also included the surrounding parts of Larnaca District which lie within the Local Planning Area. Inevitably, in a small country with a fair degree of central control, many of the issues involve Central Government and, as one would expect, many of the solutions rest with that body. This report, therefore makes recommendation to the Municipality and to other bodies, as appropriate, which frequently includes the Government.

3.0 ENTRY INTO THE EUROPEAN UNION

Providing all goes well, Cyprus will be joining the EU on 1 January 2003. Accession means that all the EU legislation will then apply and will, of course, need to be enforced. An all-embracing environmental law is being drafted and once the law and priorities are established the national institutional structure will follow. The creation of a Minister for the Environment together with some kind of environmental agency have been discussed at Government level although there are constitutional difficulties which have to be overcome and any decision will probably be delayed until after negotiations with the Commission are completed.

This report also calls for the appointment of a corporate Environmental Co-ordinator with Larnaca Municipality as well as the other 3 principal municipalities. These local co-ordinators, who should operate across all departments, and liaise with other local organisations, should have special responsibility for the development of Local

4.0 PRIORITIES FOR LARNACA

4.1 The Oil Refinery and Distribution Depots

The refinery and the adjacent depots were originally located outside the city but development has now surrounded this industrial site. The result is a 3 km coastal strip of unsightly tanks and other equipment which gives rise to occasional smells, look totally alien and ugly on a tourist route to the new hotels, and which now has residential accommodation as very close neighbours.

The safety of such an arrangement concerns the Audit Team and it is recommended that a integrated quantitative risk assessment of the refinery, the six oil and LPG marketing depots, the underground pipelines and the road transport of LPG and distillates, should be carried out as a matter of urgency. The assessment must also take into account both the existing and future operation of the airport.

The visual impact of these facilities has a detrimental affect on tourism in Larnaca and is undoubtedly damaging the local economy. There needs to be a long term plan for the removal of this industrial development in order to ensure the future economic development of the city. A strategy for removal should be drawn up un consultation with the Government which sets out a time scale for the complete removal of the refinery and the depots returning 3 kms of coastline to public use and providing a long coastal front linking with the hotels north of the city. In the short term, this industrial strip should be landscaped and the visual impact of the industry reduced.

The problem may be solved if EU rules which require a minimum of 90 days storage of fuel in a country are applied. This site only hold 30 days supply and if space for an additional 60 days supply is required, the sensible answer would be to move the whole complex to another site somewhere on the island.

4.2 The Salt Lakes

4.2.1 Proposed De-salination Plant

The Larnaca Salt Lakes are a wetland of international biological importance for waterbirds and more especially flamingos and shelducks. The Government recently declared the Lakes the first Cypriot Specially Protected Zone and intends to ratify the Convention on Wetlands of International Importance (Ramsar Convention). Soon after the declaration, a separate Government department, apparently without any consultation with the Municipality or residents, decided that the Zone should be the site of a new de-salination plant. Whilst not underestimating the need for the emergency provision of such plants, the Team are dismayed that such an important wildlife site should even be considered for this construction after formally recognising the international importance of the area. This disregard of the island's first protected area status gives a completely wrong message. Alternative sites are available and should be used in preference to this protected area. Should the proposal be pursued, an independent environmental impact assessment should be conducted including a comparative impact assessment of alternative sites.

4.2.2 The Proposed Airport Extension The Lakes will also be affected by the extension to the airport. The airport dates back many years and extending it on the same site is the only realistic alternative. The planned new terminal building and other improvements are necessary but the need for an additional runway is debatable when one considers the projected passenger numbers and the island's carrying capacity. A perfunctory E.I.A. was conducted which did not include any investigation into potential noise and air pollution. A further survey should be carried including noise contours according to anticipated levels of traffic and the type of aircraft to be used, together with an investigation into the potential levels of air pollution and the impact of both on local residents.

Linked to the proposed new runway is a plan to fence off part of Lake Orphani. As this runway may never be constructed, the lake should not be fenced until it proves to be necessary.

A detailed wildlife management plan for the lake complex should be prepared aimed at habitat restoration for the protection of the birds which represent a major attraction to residents and tourists. Suggestions for the content of this plan are contained in Chapter 5.

4.3 The Port and Marina

A key part of the seafront tourist development is the marina and port which are situated between the promenade and the refinery.

The marina is an attractive feature which is well organised and provides city centre access to visiting vessel owners and as a result is very well used and overcrowded in summer. The facility is currently run by the Cyprus Tourism Organisation but the proposal is to privatise it and increase the capacity. At present public access is to one pier only and any future enlargement should enable tourists and residents alike to enter the major part of the facility to view the boats and enjoy a walk around the piers. A further consideration is that if this area is to be improved for tourists, the existing boat maintenance area should be screened or established in a separate area.

The port has gradually declined in use and its future as a commercial operation is in doubt.

It has been suggested that the port should be enlarged to provide an increased turning circle and deepened to allow for larger vessels. The aim being to encourage visiting cruise liners and their passengers who could tour the city and perhaps use Larnaca as a base for trips to other parts of the island. The cost of the required work has been estimated at C£60 million. A long term vision for this part of the city's seafront should be developed which will include the marina, the port, the refinery and the adjacent land. Whilst the conversion of the whole area would be expensive and is not without its difficulties, the ideal would be the continuation of the existing promenade to take in an enlarged marina, a cruise liner port (which could also continue with commercial trans-shipments), the reclamation of the 3 kilometres of coastline currently dedicated to oil and gas, new hotels and a shopping centre. Whatever is proposed for this very sensitive area there should be a process of local consultation and an environmental impact assessment must be carried out to consider the effect on the coastline, the marine environment, the impact of traffic, etc.

5.0 OVERLAPPING LOCAL AND NATIONAL ISSUES

5.1 Coastal Development and Carrying Capacity

It was suggested to the team that 50% of the non-occupied part of the island's coastline is developed. This is perhaps an exaggeration but nevertheless, coastal zone development is continuing at a fair pace even though slower than in the 80s.

Future coastal development is a cause for concern when one examines the reasoning behind the proposed Larnaca airport extension. The need is based on the current 4 million passengers/year growing to 6 million in the first phase, to 9 million in the second phase (2010) and 12 million in the third (2015). Last year 2.2 million tourists came to Cyprus, mostly by air, and Pafos airport is also to be extended to double the present 1 million/year. Even allowing for the fact that each tourist usually represents 2 passenger movements; the proposal to extend the tourist season; and that the fact that the figures include resident movements; it still begs the question of where all these tourists are going to stay.

There has to be a limit to the carrying capacity of the island. Not only in terms of accommodation and coastal zone development, but the provision of water, the effect on road transport, and the collection and disposal of liquid and solid wastes.

After 25 years of development, perhaps now is the time to decide on the maximum number of tourists that the island can 'carry'. The Cypriot Tourism Organisation is calling for quality rather than quantity. In Cyprus, a large measure of that 'quality' relates to the beautiful coastline and sea views. Without tighter control, the time may come when this asset disappears along with many of the tourists.

5.2 Demand Management

It has been common practice all over the world for local and central governments to attempt to meet public demand by expanding services such as water supply, energy provision and road construction. Whilst still maintaining these services, forward looking authorities are enlisting the cooperation of 'consumers' in managing the demand through reducing use/consumption in preference to expensive new facilities and infrastructures.

5.2.1 Water Supply

Cyprus faces a critical situation as a result of reduced winter rainfall and the over extraction of groundwater. The forecasted effects of climatic change in this part of the world is a northerly move of the North African desert conditions leading to even worse droughts in the future. In these circumstances the proposed de-salination plants will prove to be essential but their use should be restricted as much as possible because of their high energy demand and disturbance to the marine environment.

Some attempts have been made to manage demand but a concentrated campaign is needed coupled with a proper pricing structure and subsidised conservation measures, especially for agriculture which accounts for more than 70% of the

demand. Domestic consumers receive supply for only 2 days per week but this rationing of supply appears to have little effect on demand and leads to increased loss through network leakage.

5.2.2 Energy Use

Although a study has been commissioned into the introduction of energy efficiency measures, no serious efforts have been made to manage the demand. The often quoted example of the North American power company which found it cheaper to pay for the provision of low energy light bulbs and insulation measures for consumers rather than build a new station, could apply in Cyprus. Demand management is the key to reducing not only consumption but also the resulting air pollution and rising imports.

5.2.3 Traffic and Highways

The need to manage demand in terms of vehicle use and traffic flow should also have a positive effect of energy demand. Car dependency is high in Cyprus and so is urban congestion, especially in summer. In Larnaca, tourists struggle to keep on narrow pavements alongside solid traffic. Public transport is poor other than inter-city coaches.

Many countries have realised that traffic expands to fill the available road space and constructing more highways is not the solution. Plans are in hand in Larnaca, as in other cities, to 'improve' traffic flow by road widening and new junctions. More enlightened highway engineers in Northern European countries are introducing 'no-go areas' for cars, speed humps, 'pinch' points, etc, to reduce traffic flow.

Highways between cities in Cyprus are good and an essential part of the economy but cities like Larnaca, should be pedestrianising the centre, pushing private cars out to the peripheral car parks, encouraging walking and cycling, and permitting only taxis and minibuses into the town centre with restricted hours for commercial deliveries.

5.2.4 Comments

It is acknowledged that demand management measures such as given above are politically difficult, but the responsibility for the common environment is not purely that of governments.

Residents and visitors alike have a part to play in conserving resources and reducing pollution. Improving the quality of life for everyone is the goal and a some changes in lifestyle will be necessary to achieve that target.

National environmental management systems are being developed by the Cyprus Organisation for Standards and Quality Control within the framework of ISO 14001 and EMAS. Any such system adopted by industry, commerce, government departments or municipalities will entail the implementation of measures to reduce energy and water consumption and to minimise the environmental impact of transport whether that is business car use or the transport of goods, as well as other measures. If environmental management systems are widely adopted, demand management will become a standard part of business and government operations.

5.3 Integrated Waste Management

Larnaca, like most Cypriot municipalities, has an efficient refuse collection system but little waste is diverted for further use and virtually all ends up in a below standard landfill. EU legislation such as existing and proposed landfill directives, the Packaging Directive and other existing and proposed producer responsibility legislation will insist on the recovery and recycling of increasing percentages of packaging, the progressive removal of organic waste from landfills, as well as other moves away from current practices.

The team was specifically asked to propose some alternative ideas for handling waste materials which has been the subject of much discussion in government and municipal circles. Chapter 9 deals with this topic in some detail but the principle proposals are:

- to return the organic content of waste, including farm wastes and sewage sludge

- to agriculture land which presents numerous advantages not least being improving the water retention capacity of soil;

- the production of energy in the form of methane from the anaerobic treatment of some waste;

- the separate collection of specific recyclable material;

- the creation of new SMEs (small and medium size businesses) to manufacture products from 'secondary' materials and the refurbishment of 'White' goods, furniture, etc; and

- the central treatment of hazardous wastes including specified clinical wastes.

This extremely important subject, for so long the 'Cinderella' public service, illustrates the interrelated nature of environmental issues. The correct sustainable treatment of solid wastes can reduce air, land and water pollution, reduce dependence on manufactured fertilizers, provide energy, create new businesses and employment, and reduce transport whilst involving the general public both as consumers and waste generators.

6.0 OTHER FINDINGS

6.1 The Ecological Baseline

The importance of Cyprus as a bird migration route is marred by the continued hunting and illegal liming and netting. The legislation is considered to be comprehensive but enforcement is inadequate.

Beach erosion is a problem on the seafront between Larnaca castle and the Fishing Harbour probably as a result of the past construction of the sea wall creating a greater depth directly offshore and consequent increased wave action. The Report suggest

possible remedies to halt further erosion.

6.2 Land Use and Planning

The control of development is a serious issue in Cyprus. There is as yet no comprehensive national development plan and although a local plan exists its enforcement is not always simple being tied in with constitutional development rights and ruled by the Cypriot culture which regards land as an investment which one should be able to realise when required. The report proposes changes in the local plans, a national environmental sensitivity survey and a masterplan for tourism. Recommendation in relation to specific sites are also listed including those for development of the Port and Marina area.

6.3 Pollution Control

The potential for air pollution from the combination of the Dhekelia Power Station, the oil refinery, the airport and urban traffic is such that air quality monitoring stations should be established in the Larnaca area.

In addition, the sulphur content of both diesel fuel and the heavy fuel oil used at the power station and the refinery should be reduced. Although some unleaded petrol is imported most of the petrol used on the island is leaded and produced at the Larnaca Refinery. The necessary treatment plant should be installed to produce unleaded petrol and low sulphur fuel or all these products will have to be imported in order to comply with the European Standards. An assessment of the emissions from the hospital incinerator is recommended due to doubts about the ability of the existing plant to remove dioxins and other pollutants. It is also recommended that noise monitoring equipment is installed near to the airport.

6.4 Sewage and Drainage Management

Some 35% of the sewerage network which serves 65% of the population of Larnaca has been completed together with a newly constructed sewage treatment plant. The remaining part includes the less densely populated part of the city and will be proportional much more expensive. However, this should be completed as soon as possible as the absorption pits which are being replaced by the network will certainly be contaminating groundwater and may be affecting sea water quality.

CHAPTER 3 THE INSTITUTIONAL FRAMEWORK

1.0 THE AREA COVERED BY THE AUDIT

The audit focused on the Municipality of Larnaca but as the Area Plan extends beyond the Municipal boundaries (Map 1), it was agreed with the Municipality that the planning area (Map 2) would be the audit area. This also enables the audit to include the administrative areas covered by both the Larnaca Sewerage and Drainage Board and the Water Board of Larnaca.

2.0 THE NATIONAL FRAMEWORK

2.1 Government and Administration

Under the 1960 Constitution, executive power is vested in a President elected for a five-year term of office by universal suffrage and exercised through a Council of Ministers appointed by him. The House of Representatives is the legislative organ of the Republic. The administration of justice is exercised by the Judiciary, which is a separate and independent body.

The majority of organisations and bodies in Cyprus are national and operate locally through their branches or through the Municipalities. Decision making for issues of strategic importance takes place at a national level and Government policy is designed by the 10 Ministries and the relevant government agencies.

2.2 District Administration

Cyprus is divided into six administrative districts (Map 3). These are Nicosia (the island's capital and seat of government), Famagusta, Limassol, Paphos, Larnaka and Kyrenia. Each district is headed by a District Officer who is essentially the local representative or extended arm of the central government. The District Officer holds a position analogous to Prefect in France and Commissioner in other countries.

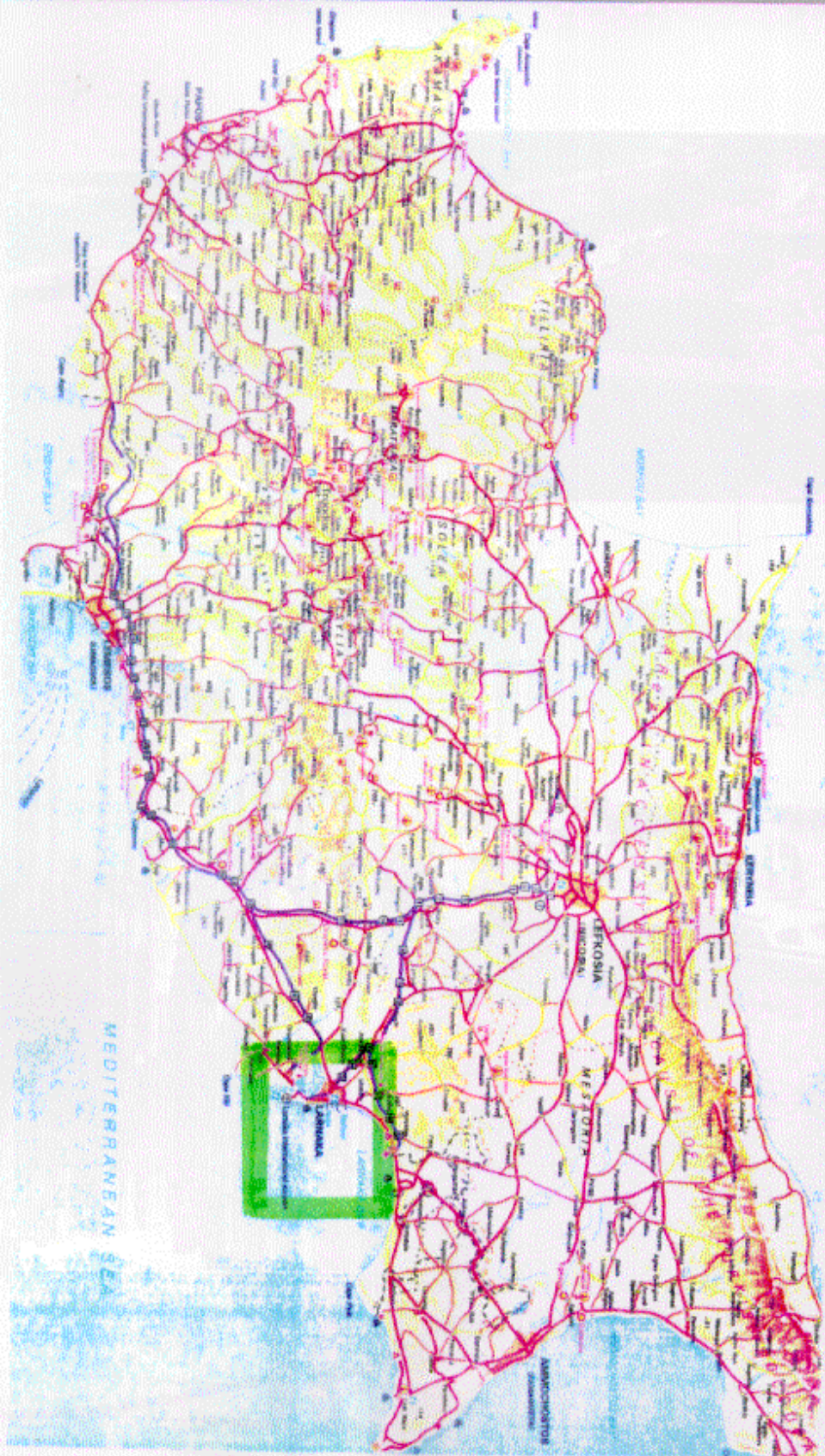
The District Officer acts as the chief co-ordinator of the activities of all Ministries in the District and is answerable to the Ministry of the Interior.

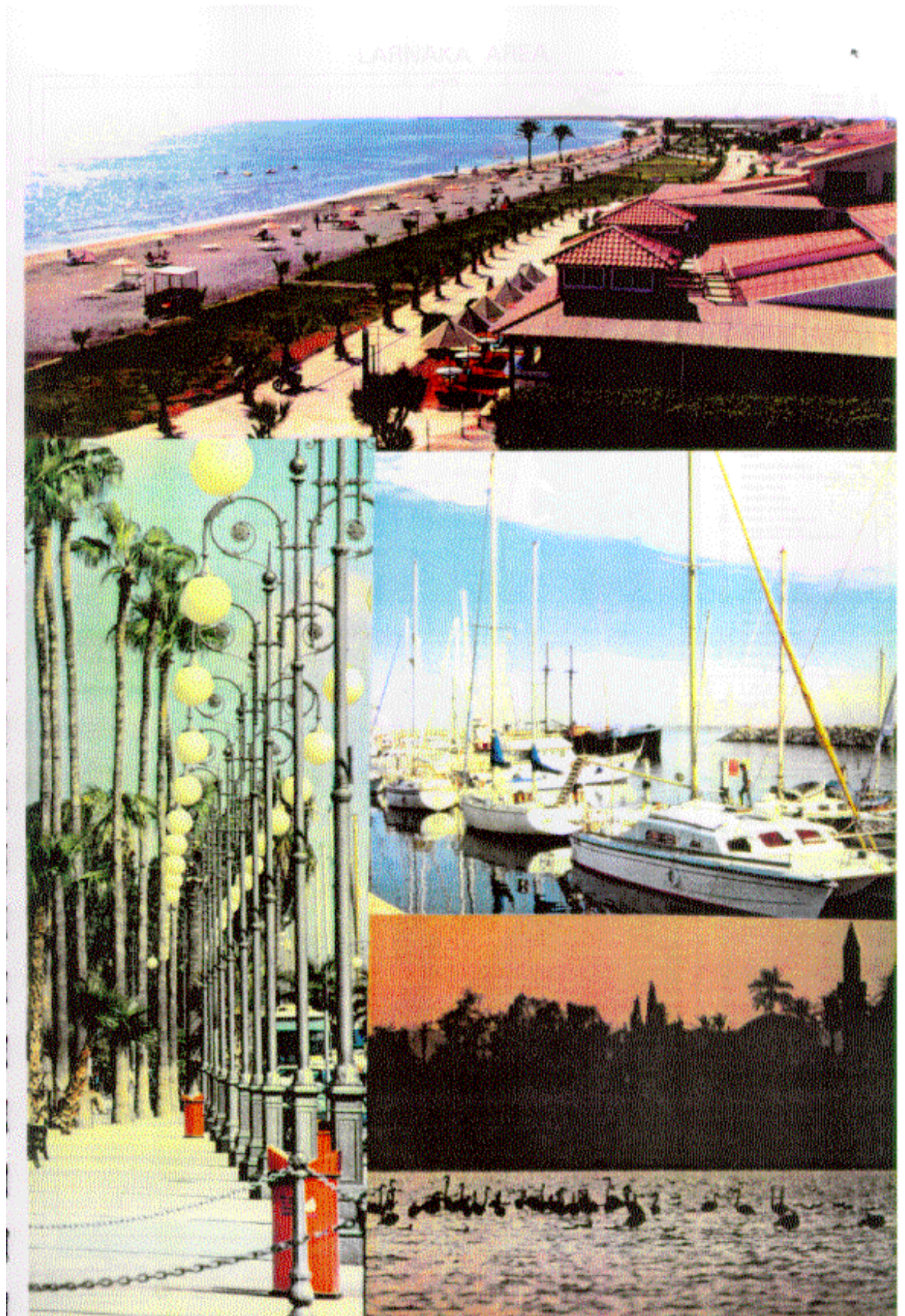
2.3 Local Government in Cyprus

There are three types of local authorities: Municipalities, Improvement Boards and Village Authorities. Municipalities account for about 60 per cent of the population, while 85 Improvement Boards and 352 Village Authorities cover the rest of the population.

The functions of Municipalities are determined by the Municipalities' Law of 1985. The corporate structure of municipalities is defined by the 1985 Comprehensive Law. Mayors are elected directly by the citizens for a term of five years and are the executive authority of the municipalities.

CYPRUS AND LARNACA

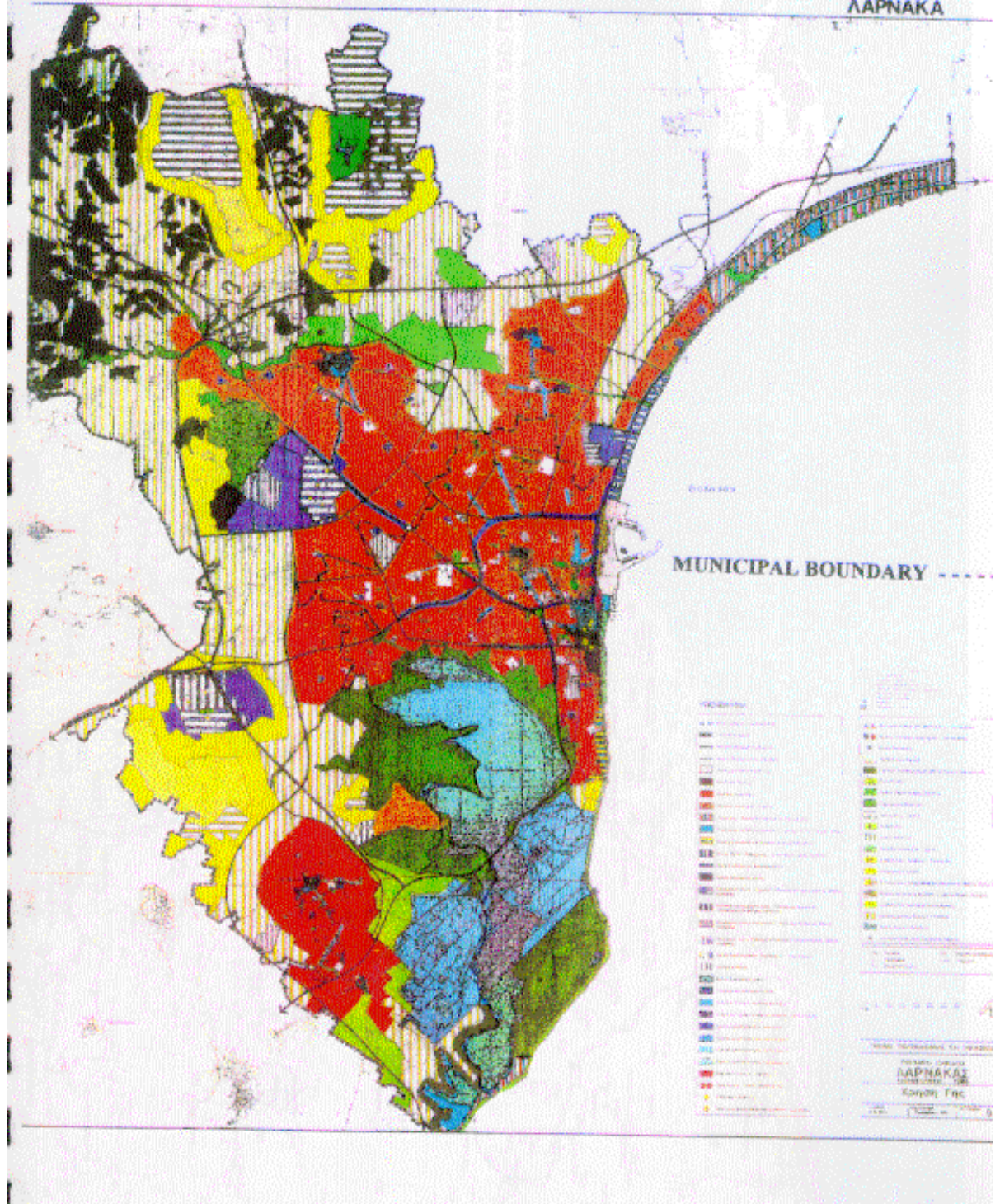


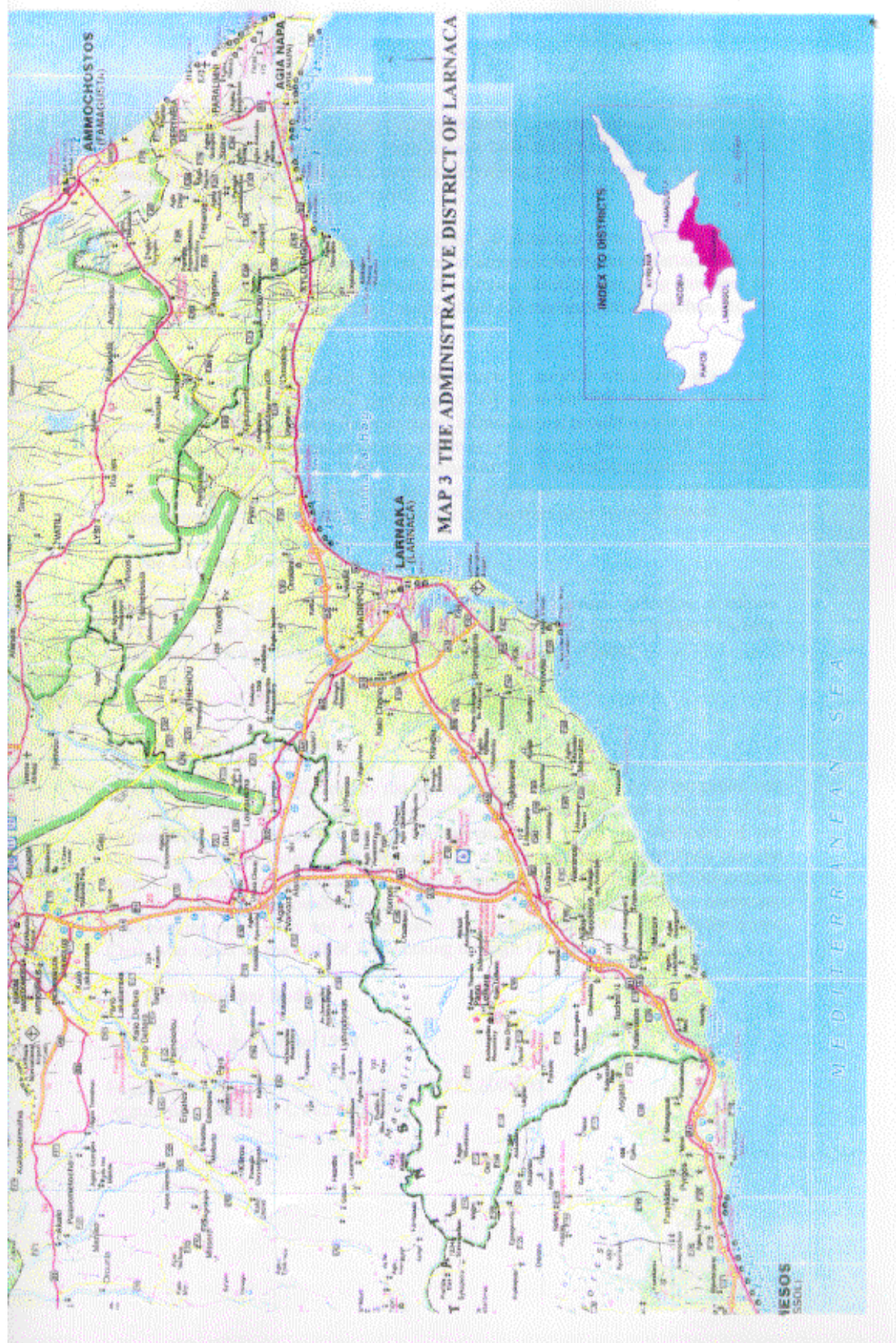


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MAP 2 THE LARNACA AREA LOCAL PLAN

ΛΑΡΝΑΚΑ





Under the provisions of the Town and Country Planning Law, the principal municipalities of Nicosia, Limassol, Larnaca and Paphos have been delegated the power to act as planning authorities, issuing planning permits authorising the development of immovable property and exercising planning control.

The main sources of revenue for municipalities are municipal taxes, fees and duties - professional tax, immovable property tax, hotel accommodation tax, entertainment tax, tolls, fees for issuing permits and licenses, for refuse collection, weighing fees, fees for water provision, rental income, fines, income from the management of beaches, etc, as well as state subsidies.

Taxes, duties and fees represent the major source of revenue while state grants and subsidies amount to only a small percentage of the municipalities' income. The central government, however, usually finances major infrastructural projects undertaken by the municipalities and this financial assistance depends very much on each individual project.

The latest amendment to the 1985 Law expanded the municipalities' autonomy and is expected to increase municipal revenue, as municipal Bye-laws concerning taxes and fees no longer need to be approved by the Council of Ministers prior to enforcement.

2.4 The Larnaca District

The Larnaca District (see Map 3) includes 4 Municipalities - Larnaca, Athienou, Aradipou and Lefkara; the 3 villages to the north which are included in the Local Plan - Livadia, Jorolini and Pyla; and several other improvement boards and villages.

3.0 THE LARNACA MUNICIPALITY

3.1 The Municipal Structure

The Municipality is administered by the Mayor who is elected directly by the public and a Council composed of 26 elected councillors. The current political make up of the Municipality is: 10 Members of the Democratic Rally Party, 10 Members of the Communist Party, 4 Independent Democrats, 2 members of the Socialist Party plus the Mayor, an Independent Democrat. The Mayor is supported by a coalition of the Democratic Rally Party and the Independent Democrats. The Mayor presides over meetings, represents the municipality and is responsible for implementing policy through the Town Clerk who heads up the staff of 300 working through 12 departments.

3.2 The Municipal Budget

3.2.1 Regular budget for 1999:

Expenses: - CY£ 6.200.000 Income: - CY£5,600,000
Accumulated deficit: - CY£2.800.000 .

3.2.2 Main expenses:

Wages: benefits, pensions, entrances etc. - approximately CY£4.000.000;
Administration costs: CY£1.200.000, repairs, maintenance, cleanup, gardening - approximately: CY£200.000;
Cultural events: CY£200.000 .

3.2.3 Main sources of income:

Professional taxes: CY£1.300.000;
Land taxes: CY£350.000;
Water fines: CY£360.000;
Rents, interest: CY£320.000;
Government grants: CY£275.000;
Refinery environmental compensation: CY£500.000.

3.2.4 Development budget

CY£8.500.000 No clear income sources other than up to 80% governmental participation in infrastructure funding .

3.2.5 Main expense items:

Sewerage system:
Main arterial road Leoforos Gkiani Timagia: CY£ 4,000,000 (per year for 5 years);
Other road building and maintenance: CY£250.000;
Parks and gardens: CY£150.000;
Plans for the city centre: CY£200.000;
Machinery acquisition: CY£100.000.

4.0 ENVIRONMENTAL MANAGEMENT AND LEGISLATION

4.1 The Framework for Environmental Policy and Management

The Council of Ministers has the overall responsibility for national environmental policy and management. The Minister of Agriculture, Natural Resources and Environment is responsible for the control and co-ordination of policies for the protection and preservation of the environment through the Ministry (MANRE) and particularly, through the Environmental Services section of the Ministry.

The Council for the Environment is chaired by the Minister and made up of representatives from governmental and non-governmental agencies, NGOs, the business and technical sectors and local government. The Council advises the Minister on issues relating to the environment and makes recommendations on environmental policy.

The Environment Committee is a cross-departmental policy co-ordination group which is chaired by the Permanent Secretary of MANRE and consists of representatives of the Ministries of Interior (responsible for Town and Country

Planning); Labour and Social Insurance; Commerce, Industry and Tourism; Communications and Works; and Education and Culture; plus the Planning Bureau, the Cyprus Tourism Organisation and the Department of Town Planning and Housing.

Each of the above Ministries and agencies have some statutory environmental responsibilities and although this coordination body exists, the management of the national environment inevitable suffers from a certain lack of cohesion in both policy development and law enforcement.

Currently, there is no 'internal' environmental management system in place within the Government. However, the Cyprus Standards and Quality Control (CYS) is preparing a national system for the international and European Standards for EMAS ISO 14001 and EN ISO 14001, Certification to ISO 14001 has been included in the Draft Bill for the Protection of the Environment. The application of ISO 14001 together with a more coherent approach to national environmental management through one environmental ministry served by an environmental agency, would undoubtedly lead to better coordinated and more efficient environmental performance.

4.2 Environmental Legislation

National environmental legislation has increased dramatically over the last 15 years and much of this is listed in the chapters which follow, however, it is generally piecemeal legislation which again lacks environmental cohesion. This is acknowledged by MANRE and an all-embracing Bill for the Protection of the Environment is currently being drafted which is designed to be compatible with EU legislation as well as incorporate existing national legislation and the most important international conventions. The Bill also includes provisions for the institutional and administrative framework for environmental management.

A study into Environmental Fiscal Instruments has been conducted which identified 16 economic instruments and a short list of potential instruments were analysed including pricing for water resources, an environmental development charge, transferable development rights, development completion bonds, and the establishment of an environment Fund. The basic suggestions of the Study have been incorporated in to the draft Bill.

4.3 Conventions/Agreements Ratified

Cyprus has ratified many international agreements including the: Long Range Transboundary Air Pollution, Biodiversity, Climate Change, Endangered Species (several), Environmental Modification, Transboundary Movement of Hazardous Wastes, Law of the Sea, Protection of the Mediterranean (several), Marine Dumping, Nuclear Test Ban, Ozone Layer Protection, Ship Pollution, Whaling signed, but not ratified.

4.4 Recommendations

4.4.1 Environmental Management

Although it is appreciated that the issue has already been considered, and that the Constitution currently permits only 10 Ministers, it is the opinion of the Audit Team that there should be a Minister for the Environment who has responsibility for all national environmental policy and coordination. It is also recommended that a sole agency should have responsibility for implementing and coordinating the development of policies for the sustainable development of the Republic.

The Team also recommend that each of the 4 principal municipalities should appoint a corporate environmental coordinator who would be the environmental 'supremo' for the Municipality and responsible for coordinating all environmental management and activity at the local level. These specialist officers would work closely with the central environmental agency and their local population. Part of their responsibility would be the development of a Local Agenda 21 for their administrative area.

4.4.2 Consultation and Delegation

In a small country it is inevitable that there should be a high degree of central environmental control and management and, indeed some in fields the Team feel there is insufficient central management, for example, in relation to solid waste. However, one of the basic tenets of sustainable development is local management and local participation even if within a centrally designed framework. Implicit in this approach is close consultation with local authorities and the general public and the impression is that there is frequently insufficient consultation with either the local authority or the public. It is recommended that formal lines of communication should be established at both political and officer level to ensure that consultation on any proposal or activity in any locality always takes place.

4.4.3 Managing and Monitoring Environmental Performance

It is recommended that a formal environmental management system should be applied to the national government and the principal local authorities. The system developed by the CYS will no doubt be similar to ISO 14001, or a modified version of the EMAS - the Eco Management and Audit System - and would have the effect of providing a structured approach to environmental performance across the board including establishing baseline indicators, targets and monitoring system to measure progress in environmental performance.

CHAPTER 4 SOCIO ECONOMIC BACKGROUND

1.0 POPULATION

1.1 Cyprus

The population of Cyprus at the end of 1997 was estimated at 657,900 an increase of 7% since the last census in 1992 and of 25.6% since the previous census in 1982, with an annual growth rate of 1.4%. The number of households in 1997 was 209,100 - a 10.1% increase since 1992. The average household size was 3.13, a decline from 3.24 in 1992, 3.51 in 1982, and 3.95 in 1976.

The annual population growth rate was estimated at 0.69% in 1998 and the net migration rate at 0.44/1000 population for the same year. The total fertility rate was estimated in 1998 to be 2.3 children born/woman.

The literacy rate, defined as those being over 15 years of age and able to read and write, was estimated in 1987 to be 94% - male: 98% and female: 91%.

1.2 Larnaca

Larnaca District had a total population of 110,000 inhabitants in 1997 (an increase of 9.7% since the '92 census). Inside the municipal area the total population was 43,586 in 1992. The population of the extended urban area of Larnaca, included in its local plan was 60,557 inhabitants.

In the Larnaca urban area (the Municipality and the surrounding settlements included in the local plan) there were in 1992 around 23,800 housing units, 17,350 of which were within the boundaries of the Larnaca Municipality. The population of the Larnaca urban area has increased from 14,772 in 1946; 19,608 in 1973; 48,330 in 1982 to; 60,557 in 1992.

These figures mask the sudden surge in population in 1974 when approximately 200,000 refugees migrated from the northern part of the island to the south. The population of Larnaca increased by 20,000 residents within a period of two weeks placing tremendous stress on the city's infrastructure. The immigration issue was one of the most serious ones facing Larnaca and Cyprus in general. The large number of Greek Cypriot migrants that fled from the Turkish occupied territory exerted pressure on the economy to provide them with adequate housing, jobs and services.

The sudden increase in the population-after 1974, led to the construction of refugee satellite towns around most cities. Larnaca's satellite towns were eventually absorbed within the municipal boundaries.

1.3 Population Trends Nationally

The trends in population and household growth in urban and rural areas show marked differences signifying a definite trend of urbanization. Urban areas have much higher growth rates, with some rural areas actually declining in population, showing the

rural-urban migration pattern. The population pyramid shows a large economically active group providing a good dependency ratio (65% approximately are 15-64 years old, 24% under 15, and 11% 65 and over) but with time Cyprus might experience an increasingly ageing population, if current trends in improved health care, decrease in fertility rate (2.3 in 1998 compared to 2.4 in 1990), and increasing life expectancy, continue.

2.0 THE LOCAL ECONOMY AND EMPLOYMENT

2.1 Past Growth

Cyprus has experienced remarkable economic growth since independence through transformation from a rural to an urban based economy. Cyprus has overcome many serious constraints to reach its present state of economic development. The economy is no longer primarily dependent on natural resources, but has a commercial and industrial base. The contribution of natural resource based sectors (agriculture, forestry, fisheries and mining) has diminished considerably, giving way to the industrial and service sectors. The benefits of economic development are well distributed, and the people of Cyprus enjoy a relatively high standard of living. Scarcity of water and labour as well as pressures on prime agricultural land, are the main constraints to output growth.

The population is small and has attained a very slow growth rate. Educational levels are unusually high, with a very high per capita rate of university education (Cyprus ranks third in the number of university graduates per capita worldwide after the USA and Canada).

The tragic events of 1974 caused a severe recession - GDP fell by 30 Percent from 1973 levels, industrial output fell by almost 50 percent, and a third of the labour force was unemployed. However, the economy recovered rapidly, and by 1978 pre-war levels of output were regained and full employment was restored. The dislocation effects were also severe; more than one-third of the population became refugees, and the urban infrastructure was inadequate to receive the additional population.

2.2 The Current Situation

Cyprus is no longer a developing country. In 1996, Cyprus' per capita Gross Domestic Product was \$15,000. Real growth in GDP averaged 7.8 percent per year between 1976 and 1989. In the past years, the GDP has increased at about 3.5 % per year. The high growth in output and income has been combined with high levels of employment (3.3% of unemployment were estimated in 1997); and relative price stability has been maintained.

The inflation rate last year was 2.2%. The external debt was \$1.56 billion in 1997 and in 1996 the total value of exports (citrus fruits, potatoes, grapes, wine, cement, clothing and shoes) was \$1.3 billion and imports (consumer products, petroleum, food and feed grain) \$3.6 billion. The labour force totalled 299,700 divided by occupation into: services 62%; industry 25%; and agriculture 13%.

Indicators of the state of national well-being are a virtual lack of unemployment and a high adult literacy rate. Moreover, relatively few (less than 2%) people live in

substandard housing.

Although tourism accounts for approximately 29% of the local economy, the Larnaca area has a diverse economy which enables it to withstand a sudden drop in tourism as a result of "external" political factors, such as the Gulf War. The city boasts the Cyprus international airport, a large agricultural sector and diverse industries. Tourism has boosted trade in the retail, hotel, catering, recreational, and other service industries.

The total number of employed people in the study area in 1995 was estimated to be 24,442 and in the whole District 37,972. The current employment data indicates that the economic base of the city and district are similar to the national one, in most components save transportation. Hence the economic base of Larnaca (city and district) is diverse, and in rough terms, consists of tourist, financial and other services - about 60%, industry - about 15%, and construction - 10%. One major difference between Larnaca and its district to the rest of the island is its relatively large proportion of employment in the transportation sector- 16% in Larnaca and 11.75% in the District, compared with national average of a little over 7%. This difference is accounted for by the combination of airport, port and marina, and indicates their important role in the local economy.

One more notable fact is the relatively small increase in the number of new economic establishments in Larnaca in the years 1989-95 compared with the District and the entire island. Perhaps further investigation into the phenomenon and its sources may help direct economic development in the future.

3.0 TOURISM

3.1 History

After 1974, the main tourism destinations had become inaccessible and new areas had to be developed rapidly in order to restore economic growth. The construction of hotels, hotel apartments, and other accommodation took place very quickly, and continues to do so, in order to cater to the increasing numbers of tourists attracted to the island.

Prior to 1974, Larnaca was not regarded as a tourist resort. The popular resorts of Famagusta and Kyrenia were closed to tourists after the events of 1974, and many of the experienced hoteliers and caterers from those areas moved south to set up home in the Limassol and Larnaca area. The result was the rapid growth in all classes of tourist development over a short period of time.

The number of hotel/ hotel-apartment in the Larnaca area increased from a few hundreds in 1974 to over 9,000 in 1990. This rapid increase in tourism had a significant impact on the social, cultural and environmental fabric of the city.

3.2 The Issues Today

Despite the fact that tourism is part of the service sector, it merits separate attention in the current analysis, due to its importance for the economy of Cyprus in general and Larnaca in particular. Besides, tourism is the main land-use issue and a

prime environmental issue, both as a threat and polluter, and as a potential preserver.

Growth in the tourism sector, at around 10 percent per annum in real terms during the eighties and at around 8 % per annum in the nineties, has had a considerable impact on the economy accounting for 18% of GDP in 1990, and 17 % in 1997. Gross foreign exchange receipts from tourism amounted to CY£ 490 million (US\$ 995 million) or 50 percent of total export receipts in 1989 and CY£ 825 million in 1997 making it the largest foreign exchange earner. Tourist arrivals reached 2.22 million in 1998.

Despite its performance so far, the tourism sector is faced with a number of issues worth noting: The current tourism infrastructure is targeted mainly towards mass-type tourism. However, due to saturation on one hand and to the emergence of other popular tourism destinations in the Mediterranean on the other, Cyprus now has to offer services of comparable quality to those offered by Spain, Turkey, Egypt, Italy, etc. Such services have also to be offered at a comparable cost if it is to successfully operate at this market segment.

Larnaca is one of the island's popular tourist resorts, benefiting from its newly renovated promenade, the hotels and restaurants extending along the seafront, the modern amenities offered and its yachting marina. Its climate and Mediterranean landscape makes it a favourable tourist destination.

There are five types of tourist accommodation available in the study area with a total of 9,344 beds, of which 4,555 are Hotels (less than half - 2,100 in 4* and 5* hotels) and 3,430 in hotel apartments (the majority - 2,316 graded in class B). Compared with other sea resorts, Larnaca has few high rank hotels. The total number of beds has not changed over the last 10 years, while in other resorts it was doubled or even tripled.

While the total number of Larnaca tourists has increased progressively, its percentage share of the total arrivals in Cyprus has declined as other tourism venues have opened up in other parts of the island and because of environmental problems and constraints. In 1998, of the 2.22 million tourists who visited Cyprus, less than 10% stayed in Larnaca.

In 1998, the occupancy rate of visitors beds in Larnaca's 1 to 5 star hotels ranged from 60.1% for 4 star to 14.8% for 1 star with an average across all star ratings of 48% out of a total of 4,555 beds. The average occupancy in Larnaca's 3,430 Hotel Apartments beds was only 33% in 1998.

The bed occupancy rates for all 9,344 accommodation establishments, was the lowest when compared with all seaside areas (41% in Larnaca, 65% in Agia Napa and Pafos, 59% average for seaside areas)

3.2.1 Arrivals in Cyprus - Sea and Air

Arrivals	1995	1996	1997	1998
Travellers arrivals (thousands)	2,685	2,512	2,646	2,871

Tourist arrivals (thousands)	2,100	1,950	2,088	2,222
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3.2.2 Tourist Arrivals by Country

Country	1998	1997	% Change
United Kingdom	1,015,228	846,309	+19.98
German	208,309	250,053	- 16.68
Greece	70,762	67,749	+4.45
Nordic Countries	242,417	225,058	+7.73
France	28,598	32,356	-11.61
Switzerland	83,715	95,256	- 12.12
Netherlands	48,206	45,705	+5.47
Belgium	33,738	34,319	-1.69
Austria	27,443	26,841	+2.24
Italy	21,576	19,593	+10.12
Arab Countries	52,281	52,825	-1.03
Russia and other ex Soviet Union countries	197,482	221,854	-10.99
Israel	53,589	52,825	+2.12
Countries in Eastern Europe	44,304	40,842	+8.48
Ireland	21,926	20,141	+8.86
Other countries	73,048	56,666	+28.98
Totals	2,222,701	2,088,000	+6.45

3.3 The Environmental Impacts of Tourism

All of the environmental issues examined in this Audit Report are either caused by, accentuated by, or have an impact on growth of tourism in the Larnaca Area. Any plans for the town region in general, and those dealing with tourism in particular, should take into consideration the limits of the carrying capacity for tourists of the Larnaca area, and the possible means for increasing this capacity. The infrastructure, particularly in terms of water supply, sewage treatment, waste disposal and traffic, should not be subjected to any increased pressure until improved.

The hectic pace of growth since 1974 and (until 1990) the inadequacy of regulations to control the growth, has resulted in, random unprogrammed construction, unduly dense development of the sea front, and the destruction of many important examples of traditional architecture.

3.4 Future Tourism

Tourism is not a panacea for economic development and prosperity and the geopolitical location of Larnaca (and of Cyprus in general) makes it vulnerable to political instability in the area. For this reason, other forms of economic development should be pursued, through, for example, better exploitation of the existing dynamic small enterprise sector or diversification of other economic activities.

Improving the environmental quality while meeting the needs of both residents and tourists, and integrating sustainable industrial development and sustainable tourism, are the main challenges for Larnaca facing the third millennium.

The cultural sector and its potential to attract tourists has not yet been exploited. Larnaca is equipped with interesting cultural assets, currently under-utilised. Development planning for these would both preserve them and assign uses to them that benefit the tourist and the local community.

The yachting marina is another source of tourism with great potential, as witnessed by its current over-capacity (around 150%). The planned improvement in the provision of services has been delayed, with a potential negative impact on the quality of service and the marina's reputation. In addition, the expansion of the marina should be considered in order to address the problem of overcapacity.

The local community appreciates the economic value of tourism and their Cypriot hospitality is renowned. However, there is a general acceptance that mistakes have been made and that tourism has to be managed to prevent further possible damage to the very environmental and cultural assets on which it depends.

The Central Tourist Organization of the Cypriot Government has introduced a policy to discourage new tourist accommodation and the Local Authorities now have greater powers to control such development. The CTO (Cyprus Tourism Organisation) emphasizes that future tourism should concentrate on quality rather than quantity. A more diverse base is already being developed aiming at cycling, walking and water activities.

Efforts are being made to extend tourism outside the summer season and also to attract visitors to the island's archaeological and wildlife assets rather than the traditional 'sand, sea and sunshine' package.

The goal should be sustainable tourism which involves an integrated approach to development, resource consumption, the preservation of the natural and built environment, and the protection of the local culture.

This integrated approach can best be achieved through the development of a strategic plan by local groups which involves all sectors of the local community including local and central governments.

In the past, the pattern for tourism in the Mediterranean region has been dictated by the industries of the tourism-generating countries which have primarily sought to exploit the local culture and environment for short term financial benefits. Inevitably this has led to the typical 'boom and bust' tourist visitations which has left the less affluent 'host' communities to sort out the economic, environmental, social and cultural consequences.

In Cyprus, historical circumstances led to an 'open arms' policy towards tour operators and their clients. Both the host community and the tourism industry were guilty of maximizing short term economic gain at the expense of the environment.

The host nation and the tour operators are now developing a more environmentally enlightened approach to the needs of the tourist destinations. It is in both their interests to avoid the 'bust' phase which has followed similar 'booms' elsewhere. It would seem sensible for the industry and the Larnaca agencies to jointly contribute their resources and expertise to implement a strategic plan for much more sustainable tourism, to the benefit of both the 'home' and 'away' industries, the local population and future visitors alike.

CHAPTER 5 THE ECOLOGICAL BASELINE AND

CURRENT ISSUES

1.0 TERRESTRIAL ECOLOGY

1.1 Bio-geographical Situation of the Larnaca District

The Larnaca District belongs to the East-Mediterranean group of Thermo-Mediterranean Carob-Oleaster formation known as *Oleo-Ceratonion* (Natura 2000 code: 93.20). In altitude this thermo-mediterranean zone rarely exceeds 400 m and is replaced by an evergreen Holm Oak forest (*Andrachno - Quercetum ilicis*) associated with Aleppo Pine (*Pinus brutia*).

Today the natural woodland vegetation is rare in the coastal plane and is replaced by some cultivated woodlands on hill slopes (*Acacia sp.*, *Pinus brutia*), arable land and thorny garrigue scrubs known as “phryganea” (with such scrubs as Prickly Burnet (*Poterium spinosum*), Thorny Gorse (*Genista sphacelata*) and Lentisk (*Pistacia lentiscus*). Oleander (*Nerium oleander*) grows in the river beds and Juniper (*Juniperus phoenicia*) can be found in some isolated places such as Cape Greco in the easternmost part of the study area.

Because of insularity and its strategic geographical situation between three continents some 128 endemic plant species can be found in Cyprus. Most of these endemics survive in the mountain ranges of Troodos and Pentadaktylos as well as in the Akamas peninsula (Pantelas, 1993). Apart from the easternmost part of the Troodos massif the Larnaca district only shelters a few of these endemic plant species.

The faunistical composition of the island has also reached a high level of endemism. The Cyprus Pied Wheatear (*Oenanthe -pleschanka- cypriaca*) is the emblematic endemic which migrates to Eastern Africa. Its population is estimated at 3000 to 7000 pairs. The Cyprus Warbler (*Sylvia melanothorax*) is another endemic to Cyprus. In Autumn it migrates to the Levantine coast, Egypt and northern Sudan. Its population is estimated at over 4000 breeding pairs, mainly confined to Rockrose vegetation (*Cistus villosus*) in the coastal lowlands or to maquis and forests in the Troodos mountains. It is absent as a breeder in the dry agricultural plains found around Larnaca.

Various other birds are represented by endemic subspecies such as the Cyprus Coal Tit, the Cyprus Scops Owl, the Cyprus Short-toed Treecreeper and Glaszner's Jay.

Two small mammals (Cyprian Spiny Mouse and Cyprus Pygmy Shrew) as well as the Cyprian Mouflon are endemic to Cyprus.

1.2 Importance of Bird Migration & Protection

Spring and Autumn bird migration is very important all over Cyprus as the country is situated on one of the two Levantine migration routes. It is estimated that over 150 million migrants pass through Cyprus during Autumn, particularly such nocturnal migrating birds as Song Thrush, Robin and warblers as well as some diurnal migrants as swallows, Bee-eater, larks and pipits.

As on other East Mediterranean islands, hunting (liming, netting, shooting) of migratory birds is a widely spread tradition in Cyprus. There are about 35,000 licensed hunters within the Greek-Cypriot community.

At the eastern end of Larnaca district (region of Paralimni) it has been estimated that 50,000 to 84,000 birds were caught in 1980 (G. Sfikas, 1996). If every Cypriot hunter kills only 30 birds a year, then over a million are destroyed annually. Magnin (1987) calculated that up to 2.2 million birds are killed by liming and netting alone. According to Flint (1992) the total number of birds killed annually by liming, netting and shooting is around 6 million to which must be added 2 million killed in the North, making a total of around 8 million birds killed annually in Cyprus. Favourite prey are : Woodcock, Turtle-Dove, Bee-eater, Song Thrush, Robin and warblers. The eastern part of the Larnaca District as well as the South-East part of the country (Paralimni to Cape Greco) have perhaps the highest densities of bird trapping. Yet, bird trapping is not only confined to this area as Magnin (1987) reports that birds are caught also in the city centre of Larnaca as well as in the grounds of tourist hotels.

The halt of off-season shooting (late-Winter for waterfowl, Spring hunting for Turtle doves and passerines) and the implementation of the European Bird Directive (1979) are important issues for Cyprus wishing to join the European Union. Spring shooting has been banned from 1991 to 1993 and from 1994 onwards. Yet, many birds still perish from uncontrolled liming and netting which are illegal activities under the Cyprus law n° 39 of 1974.

Further shooting of such threatened species as Marbled Teal (*Anas angustirostris*), White-headed Duck (*Oxyura leucocephala*) and Ferruginous Duck (*Aythya nyroca*), both present in small numbers (A.E. and J.E. Sadler, 1998) may lead to their extinction. Hunting and illegal trapping constitute a serious conservation problem as already two species of breeding bird have disappeared in Cyprus: the Dipper (the endemic subspecies *Cinclus cinclus olympicus*) and the Lesser Kestrel (*Falco naumanni*). Shooting is also causing a decline in numbers of many other resident species including raptors (Alison J. et al., 1998). **Thus, although the hunting regulations can be considered comprehensive, the enforcement of the laws is inadequate.**

The creation of protected zones (nature reserves, Special Protection Areas as part of the NATURA 2000 network) is another prerequisite for Cyprus seeking European membership and wishing to comply with the international conventions.

Cyprus is a Contracting Party to the Mediterranean Barcelona Convention (UNEP) as well as to the Convention on the Conservation of European Wildlife and Natural

Habitats known as the Bern Convention (Council of Europe). All but four (3 lark species and the Bee-eater) of the species listed in Appendix 2 of the Bern Convention are legally protected in Cyprus.

Cyprus is also seeking membership of the Ramsar Convention and plans to designate the Larnaca Salt Lakes for inclusion in the Ramsar “List of Wetlands of International Importance”.

1.3 Biodiversity Conservation of the Larnaca Salt Lakes

1.3.1 Ornithological Importance

Cyprus hosts two major wetlands of international importance for birds: the Akrotiri Salt Lake West of Limassol and the Larnaca Salt Lake complex situated from 2 to 7 km South of Larnaca city.

The latter consists of four lakes (3 of them interconnected) of different sizes, respectively 24, 39, 166 and 449 ha. All lakes dry out in summer due to evaporation and lowering of the watertable. The main lake is merely 1 m deep during winter. It's believed that seawater reaches the lakes through a seeping underground flow. In early medieval times the main lake was apparently a lagoon with a connecting outlet to the sea south of the fishing port of Larnaca. Because of sedimentation the Venetians dug a canal to re-open the link between Aliko lake and the sea. Saltwort (*Salicornia fruticosa*) occurs commonly around a narrow strip between agricultural fields and the lake.

In winter the Aliko lake holds at least 1000 Greater Flamingos (A.E. and J.E. Sadler, 1998) every year which can easily be observed from the roadside. The lakes also hold in winter various thousands of gulls notably Black-headed Gull and Yellow-legged Gull and a few dozens of the Slender-billed Gull. An important population of up to 100 Stone Curlew can be seen during winter in the fields surrounding the airport. Various species of waders (Ruff, Kentish Plover, Curlew, Redshank, Marsh Sandpiper) as well as Common Cranes (max. 85 in 1998) can be seen there. The Larnaca Salt Lake complex is also an occasional stop-over area for the rare Demoiselle Crane (*Anthropoides virgo*).

The marshes of Spiro's Pool attract various species of ducks (up to 260 Shovelers and 340 Teals in 1998), Shelduck (up to 210) and White-fronted Geese (max. 260 geese : Barnus, 1991). Because of the absence of hunting, the ponds of the sewage farm host a few Flamingos and various dozens of ducks.

Among the breeding birds are found: Kentish Plover, Spectacled Warbler and Calandra Lark (P. Flint and P. Stewart, 1992) as well as a few pairs of Black-winged Stilt (if water-level suitable during Spring), the endemic Cyprus Pied Wheatear and Cyprus Warbler (max.10 pairs each).

The Larnaca Salt Lakes are considered of international ecological importance which led to the designation of the European status of Important Bird Area (I.B.A., Grimmett and Jones, 1989).

1.3.2 International Legislation

Ramsar Convention

The Convention on Wetlands of International Importance especially as Waterfowl Habitat, also known as the Ramsar Convention (1971), has been signed by 103 contracting parties including 32 European states. The objective is to stop further loss of wetlands and to ensure their conservation and wise use.

The Convention introduced the now widely used concept of “1% flyway population levels” for evaluating the international importance of wetlands. The Larnaca Salt Lakes reach this criterion as 1% of the Greater Flamingo population winters there. This percentage is even greater when the flamingos at Akrotiri are being disturbed. On such occasions the flamingos stationed at Limassol join the flock of Larnaca and form a population of up to 3,000 birds.

Exceptionally Lake Aliko hosts up to 10,000 flamingos for a short time when the Akrotiri salt lake is dried out or unsuitable because of hunting. This population leaves Cyprus for the Nile delta (and probably also Cyrenaica) or the Gulf of Iskanderun (Turkey) if both the Akrotiri and Larnaca lakes are made unavailable.

The Larnaca Salt Lakes also meet the Ramsar criteria for the Mediterranean population of Shelduck (*Tadorna tadorna*). The lakes hold up to 1,000 Shelduck (occasionally a maximum of 2,000 birds) for a Mediterranean “flypath” population of only 15,000 birds. Some Shelducks may also be seen at sea off the Larnaca coast (Flint P. & P. Sterwart, 1992).

At present the Cyprus Government is considering becoming a Contracting Party to the Ramsar Convention and will designate the Larnaca Salt Lakes for inclusion in the “List of Wetlands of International Importance”. Accordingly, the Larnaca Salt Lakes will be promoted to the status of a Nature Reserve. At present they enjoy the status of a Game Reserve where hunting is controlled.

Bern Convention

Cyprus signed the Convention on the Conservation of European Wildlife and Natural Habitats adopted by the Council of Europe in 1979. The contracting parties pledge to take appropriate legislative and administrative measures to ensure the conservation of the habitats of the wild flora and fauna, especially those specified in Appendices I (strictly protected flora species) and II (strictly protected fauna species). The Larnaca Salt Lakes host several of these strictly protected species such as the Stone Curlew, Common and Demoiselle Cranes, Greater Flamingo and various species of herons, waders and passerines.

1.4 Other Areas of Ecological Interest

1.4.1 Bird Areas

At least three other areas are identified to be important for birds:

Cape Greco is a rocky promontory at the extreme South-East of Cyprus with steep cliffs on the seaward side. The peninsula attracts many migrants (raptors, passerines) during both the Autumn and Spring passages. Breeding species include the endemic Cyprus Pied Wheatear and Cyprus Warbler, Blue Rock Thrush as well as Cretzschmar's Bunting (*Emberiza caesia*). Illegal bird trapping is a major conservation problem there although part of the promontory is closed off by a radio transmitter station.

The Akhna reservoir, 20 km North-East of Larnaca, attracts a variety of waterbirds such as Glossy Ibis, Coot, various species of duck and Black-winged Stilt.

The Dhiptamos Dam lies about 25 km West of Larnaca. Apart from several duck species it holds a number of rarities including White Pelican, Black Stork and Great White Egret. The fluctuating water levels do not attract any breeding birds in substantial numbers.

1.4.2 Sea-Turtles

According to the Department of Fisheries the beach between the southern airport boundary and the Army Beach Club (see map N• 2) and a few small sandy beaches West of Cape Kiti hold a couple of nests of Loggerhead Turtle (*Caretta caretta*). A complementary survey is required to evaluate the importance for sea-turtle nesting in the Larnaca District especially as several tourism development zones are anticipated in that area.

The nearest major sea-turtle (Loggerhead and Green Turtle) beaches are to be found in the Akamas peninsula (Lara beach), along the northern coast and in the North-East of Cyprus (Pachyammos and Galounopetra beaches near Cape Andreas).

Sea-turtles are protected under the Fisheries Law of 1971. They are considered endangered by development for tourism and recreational activities (Demetropoulos A. and M. Hadjichristophoru, 1995).

1.4.3 Coastal Flora

Some rare or endemic plant species can be found along the coastline of the Larnaca District such as *Anthemis tricolor*, *Carlina pygmaea*, *Odontites cypria* and *Onosma fruticosa*.

No phyto-ecological nor floristic surveys exist of the coastal environment. Yet, most of these plants are vulnerable to trampling and need protection before new tourist settlements are built.

It is recommended that such a vegetation surveys should be launched in accordance with criteria adopted by the European Habitats Directive (1992).

1.4.4 Terrestrial Herpetofauna

The Larnaca coast hosts at least 7 species of reptiles including Wall Lizard (*Podarcis*

muralis), Spiny-footed Lizard (*Acanthodactylus schreiberi*), Hardun or Starred Agama (*Laudakia stellio*), Chameleon (*Chamaeleo chamaeleon*), Kotschy's Gecko (*Cyrtodactylus kotschy fitzingeri*), Blunt-nosed Viper (*Macrovipera lebetina*), Montpellier Snake (*Malpolon monspessulanus*) and probably the Levant Viper or Whip Snake (*Coluber jugularis*) and Snake-eyed Skink (*Ablepharus kitaibelii*).

Two species of amphibians are identified: Green Toad (*Bufo viridis*) and Tree Frog (*Hyla arborea savignii*). Both the Hardun and Blunt-nosed Viper belong to the fauna of the Middle East biome. Very little is known about the status, distribution and population dynamics of terrestrial reptiles and amphibians in Cyprus.

Most species do not appear to be threatened although the Chameleon's territory has most likely become restricted in the coastal plain. The Spiny-footed Lizard (status unknown) may suffer from coastal urbanization. Yet, in other tourist areas such as on the Iberian peninsula (the only other European location where a similar species is present), the species is not endangered (Gasc J.P., 1997).

As is the case with other groups of biota it is recommended that a detailed census survey of the herpetofauna of Cyprus should be carried out so that conservation priorities can be identified on a scientific basis.

1.4.5 Paleontological sites

The caves and cliffs of Cape Pyla, at the eastern end of Larnaca Bay, contain various fossil remains of prehistoric fauna whereof: Elephant (*Elephas cypriotes*), Hippopotamus (*Phanuros minor*), bats, mice, terrestrial snails and various molluscs.

They can be found in the Miocene deposits of white chalky marl and limestone. A preservation order could be extended to Cape Pyla to ensure that tourists and commercial collectors do not take away the most significant witnesses of prehistoric life in Cyprus.

2.0 COASTAL AND MARINE ECOLOGY

2.1 Coastal Habitats

The coast of the Larnaca District is made up of at least two raised beach deposits resulting from the uplift forced up by the African tectonic plate. The first raised beach formed the promontories of Cape Pyla and Cape Greco.

The second raised beach is restricted to a low lying platform not exceeding 15 m as can be found in the depression occupied by Larnaca city. Larnaca is situated on a predominantly sandy coastline stretching from Cape Kiti to Dhekelia. The southern part is backed by a series of large salt lakes.

The beach is made up of sandy, and in places, pebbly sediments originating from river deposits. The seabed profile at Larnaca Bay is gently sloping and consists predominantly of fine grained sand. Even where the beach is covered by shingle, the seabed becomes sandy within 20 m offshore.

Sand and gravel have been extracted along the foreshore up to the 1960's leading to the disruption of the equilibrium of the sedimentary budget. Mineral extraction in coastal areas has now stopped in the Larnaca District.

The eastern part of Larnaca Bay consists of cemented marl outcrop and reef limestone. At some places a wave cut platform is formed with lower outcrops of beachrock at sea-level. This slows down erosion and protects some small sandy beaches secured by headlands (e.g. Potamos beach).

Further east a coralline reef is formed built up by dense aggregations of Worm Shells (*Vermetus sp.*) on beachrock just under the water surface. These wave resistant structures are made of stony coralline algal formations which grow by means of their cementing properties on an accretionary skeleton. This ecosystem enjoys a high rate of biodiversity especially at the exposed seaward side where the living coralline tissue forms a wave-washed platform known as entablature. These coralline reefs are typical for the Levantine coast (Israel, Lebanon). Crete and the adjacent islands is the only other Mediterranean region where this particular ecosystem is well developed. Elsewhere in the world only Bermuda is known to shelter similar entablatures.

2.2 Littoral and Offshore Drifts

Littoral drift is slow (less than 0.5 m/sec.) in the Larnaca Bay and travels along the coastline from West to East. Because of the lack of magnitude the coastal drift is dominated by wave action (Thomas R., 1981).

There is no major eddy effect within Larnaca Bay. Further offshore, in the high seas, two cyclonic eddies circulate during summer south-east of Cyprus and in the submarine Hecataeus Ridge (Zodiatis G. et al. , 1998). The absence of a coastal eddy effect may be explained by the small size of the promontories surrounding the bay which does not give enough protection from the south-westerly winds (the eddy at Limassol is created by the much longer Akrotiri peninsula).

Because of the gently sloping beaches in the Larnaca Bay the beach profile is considered in equilibrium. Offshore drift is thus insignificant except during stormy weather when steep waves induce transport of coastal sediments into the sea. This may lead to erosion if the same sediment is not being redeposited on the beach by onshore drift during calm weather.

The erosion created on the north-eastern side of the Larnaca harbour is created by blockage of the littoral drift and because of lack of suspended sediment. The lack of supply may be explained by the construction of dams for inland reservoirs. The Tremethios river dam has stopped the supply of an average annual quantity of 3,500 m³ of discharge at its estuary West of Cape Kiti. It has been estimated that the larger dams further east (Garryllis and Yermasoyia rivers) block every year an additional quantity of 21,000 m³ of sediment which used to feed the littoral drift along the southern coast of Cyprus (Thomas R., 1981).

2.3 Posidonia Meadows

Seagrass meadows (*Posidonia oceanica*) grow extensively along the coast of the Larnaca District especially in the shallow zone between -5 m and -30 m deep. *Posidonia* forms a dense mat of rhizomes which protect the leaves of seagrass from heavy swell. Seagrass meadows supply large amounts of oxygen which support

several species of herbivores (fish, molluscs). They offer the necessary shelter to spawning fish and constitute the essential habitat for many fish species preying on invertebrates which feed on seagrass.

The *Posidonia* ecosystem stabilizes infralittoral sediment and it absorbs the erosive swell of wave action.

Seagrass debris (mainly dead leaves) are deposited in quiet areas, e.g. in front of breakwaters and in coves. In the Larnaca Bay the main currents are wave induced since the magnitude of longshore drift (from west to east) is reduced by wind action coming mainly from the south and south-west. Thus plant debris from Cape Kiti and further west are deposited in Larnaca Bay and accumulate in front of piers, harbour walls and breakwaters. The marina harbour wall for example presents a significant blockage for dead *Posidonia* leaves which get amassed on the Town Hall beach. Similarly, dead sea grass accumulate south of the fishing harbour.

Despite the highly positive role of seagrass meadows, the accumulation of *Posidonia* debris have actually a negative impact, for example, on the tourist beach in the centre of Larnaca. The best solution is to remove the dead material mechanically, as is already done by the technical services of the municipality, which transport the debris at high costs to the city dump. An alternative solution consists of composting the dead material together with treated sewage sludge or agricultural soil. Some conclusive experiments are currently underway by Sassari University (Sardinia, Italy) which consist of recycling *Posidonia* litter as agricultural fertilizer.

2.4 Coastal Erosion

2.4.1 Existing Erosion and Accretion Patterns

The relative equilibrium between sedimentation and erosion in Larnaca Bay is explained by the following:

The gently sloping infralittoral beach profile reaching a state of balance between on-shore and off-shore wave action.

The west - east direction of the longshore drift transporting some suspended sediments from erosion in south-west Cyprus.

The absence of a counter clock-wise eddy effect.

and the existence of dense seagrass meadows.

This is not the case further West as the coastline of Limassol is facing fierce erosion.

Yet, because of the construction of river dams sediment transport has declined. Locally, the construction of harbour walls to protect the Larnaca port, marina and fishing shelter, has led to the blockage in the longshore supply of sand. Thus sediment deficiency and local blockage have caused erosion where development has taken place on the shorefront.

The Larnaca harbour and marina are two important obstacles and have led to the accretion of sediment further south resulting in the significant enlargement of the

Town Hall beach situated in the city centre. It has been estimated that a volume of 54,000 m³ of sand accreted there between 1968 and 1979 (Thomas R., 1981). Accretion continued there during the 1980's but has stopped today according to local observers.

Since the sediment load in the water column is limited in the Larnaca Bay, accretion occurs to the detriment of the downdrift area situated further north. Thus the beach north of the harbour where the refinery is situated has suffered from erosion. Between 1957 and 1973 erosion there was roughly 1 m per year of coast over a distance of nearly 3 km north-east of the harbour. This trend has been reversed by constructing some off shore breakwaters in order to protect the pipe track from being washed away.

Erosion further north towards the Larnaca tourist hotel zone was also important between 1957 and 1973 (Thomas R., 1981) but slowed down thereafter. First a groyne perpendicular to the coast was constructed at the Nautical Club north of the refinery which led to the classical pattern of updrift accretion and downdrift erosion. During the late 1980's some hotels started to build breakwaters lateral and close to the coastline in order to protect the tourist beaches in front of them. This led to the formation of a small tombolo or even a double tombolo forming an inner pool as in front of the Sandy Beach Hotel.

At present erosion is most visible on the seafront between Larnaca Castle and the Fish Harbour. The shorefront there is directly exposed to erosion by waves. The sea frontage has been protected by a vertical seawall to protect the adjacent road, restaurants and houses of the historical centre of Larnaca.

The reflecting waves on this small seawall seem to have changed the original beach profile creating a greater depth directly offshore which has led to increased wave-action whereas it is to be expected that waves previously were broken down on the infralittoral shore and were dissipated.

This increased offshore wave-action, with larger waves able to reach the coastline, will lead to further erosion south of the castle and is most likely also responsible for increased transport of sediment on the adjacent Town Hall beach. The beach accretion between the castle and the marina can thus be explained by a combined action caused by both the marina harbour wall and increased sediment transport originating south of the castle.

2.4.2 Towards a Sustainable Control of Erosion

The solution to halting further erosion between the fish harbour and Larnaca castle may consist either of the construction of a large concrete dyke, or metal sheet piling, or offshore breakwaters, or a stepped revetment structure with rubble or precast concrete blocks. The first two solutions are very expensive and may lead, in the long run, to further scour and deepening of the shore profile. The construction of a major dyke may even be impossible as the existing road and buildings are only at a few metres distance from the shorefront.

The combined action of offshore breakwaters and a rubble seawall may be the best

solution in this area. The breakwaters constructed at approximately 100 m distance from the coastline will reduce and dissipate wave-action. If enough suspended sediment is available they may even trap sand and stabilize the seabed in places devoid of seagrass. The rubble seawall, on condition the primary armour respects a gentle slope of min. 30°, will reflect the swell and protect the existing infrastructure from further scour.

Elsewhere in the Bay of Larnaca the golden rule for any future coastal development is, as elsewhere in the Mediterranean, a global retreat of any road or building structures at least 100 m from the shoreline. This is the main prerequisite for sustainable development in the coastal zone especially during a post-glacial period of global warming leading to sea-level rise and marine transgression.

Accordingly, the beach profile will remain undisturbed and may even be replenished if transport of sediment continues along the southern coast of the country.

A new source of sediment may consist of dredged material if the Larnaca harbour is to be deepened and extended to host berths for cruising ships. Harbour sludge may be dumped at the periphery of Larnaca Bay, on condition it does not contain any contaminants such as heavy metals, in which case it should be discarded in a well confined zone devoid of seagrass (dumping of sludge over *Posidonia* vegetation is contrary to the Barcelona Convention). A complementary analysis should investigate the quality of harbour sludge to be dumped and determine the most suitable dumping site.

It is to be expected that dumping of sludge will smother the seabed and thus modify locally the benthic biota. Compressing of dredged sediment will minimize such impact on the marine ecosystem. The dumping of uncompressed sludge released from the hopper would inevitably cause dilution and dispersion over a vast area in the sea resulting in increased turbidity of coastal waters at Larnaca. On the other hand, compression of sludge allows for a fast release of a cohesive mass. If dumped at a certain depth, for example, in the range of -30 m, the compacted harbour sediment will have a limited turbidity plume.

As a signatory to the London and Barcelona Conventions the Cyprus government has the responsibility to control dumping at sea and to grant any disposal license.

The Coastal Unit of the Public Works Department (Nicosia) plans to go ahead with the construction of three more offshore breakwaters. They are mainly designed to combat further beach erosion in the tourist hotel zone of Larnaca. Their design will be different from the existing ones as they will be submerged (“low crest breakwaters”) mainly for aesthetic reasons. It is not intended that these new breakwaters will form tombolos as the existing ones built in front of the hotels. Although these breakwaters create a pleasant looking inner pool, they create some negative impacts such as erosion on the downdrift side, pollution by windblown waste and lower water quality of bathing waters because of lack of longdrift circulation. The global aim should be to stabilize the existing coastline and, if possible, to widen it.

It is recommended that data related to coastal erosion and replenishment should be collected at least twice yearly. Monitoring the data should concentrate on sedimentology, wave and swell-action, coastal drifts and the depth of the beach

profile at each of the 14 breakwaters in Larnaca Bay as well as at some selective sample points undergoing erosion.

2.4.3 Artificial Beach Nourishment

To replenish sediments in areas where the coastline is transgressing one may consider artificial beach nourishment as practised in a few North-Atlantic countries such as Denmark, Great Britain, the Netherlands and the U.S.A. (Florida). Some 700 km of U.S. coasts have been nourished at a cost of over 8 billion Euro. Beach nourishment consists of the mechanical addition (normally by use of a boat) of sand in front of an eroding beach.

Nourishment projects may vary from rudimentary dry filling of sand by cranes or trucks on the beach to a large scale offshore unloading of sediment based on engineering experience, local geomorphology and computer modelling. Offshore nourishment is either carried out by hydraulic filling with a pipeline or by dumping using a hopper dredger in the nearshore area. When the borrow area is at some distance from the fill area the usual technique is hydraulic filling by making use of a “rehandle pit” and a stationary dredger.

In the Mediterranean, beach nourishment can provoke an important negative impact on seagrass meadows consisting mainly of the endemic *Posidonia oceanica*. As indicated above, *Posidonia* meadows support a highly diversified flora and fauna including various crustaceans and fishes of economic value. Seagrass meadows release 14 litres of oxygen/day/sq.m (comparable to a temperate forest), reduce the swell of currents by 60 to 70% and of waves by 30 to 40%, and protect the sediment on the infralittoral seabed from erosion. It has been calculated that any square meter of *Posidonia* vegetation destroyed corresponds to a reduction of 20 sq.m of beach. Thus the protection of seagrass meadows conditions the quality of the coastal ecosystem and the tourist economy. Any dumping and smothering of sea-grass meadows need thus to be avoided.

Artificial beach nourishment is thus considered inappropriate in the shallow coastal waters covered by seagrass. If in the long run artificial beach nourishment proves to be unavoidable to satisfy the demands of tourism, a small amount of experimental filling should first take place well behind the *Posidonia* vegetation line. Based on such an experiment a reliability analysis should define the quantitative design parameters so that all environmental criteria are being met.

Beach nourishment with an hydraulic pipe or hopper dredger is expensive and may cost up to 10 million Euro per km. The maintenance costs over a time span of 50 years requires another 15 million Euro per km for renourishment every 4 years.

The costs of removing dead *Posidonia* litter to maintain a clean tourist beach is thus much lower.

2.5 Fisheries

Traditional fishing is practised all along the Larnaca District coast and more especially South of Cape Kiti. The fishing fleet is based at the fishing shelter South of

Larnaca city centre. According to the Fisheries Department annual landings of fish caught in Cyprus are stable. Yet, local fish caught does not meet market demand especially during summer. Frozen fish is imported from various countries but especially Argentina while fresh fish is imported by plane from the Gulf region. Before the Turkish occupation, fish (for example Red Mullet) caught in northern Cypriot waters used to be consumed in Larnaca.

A fish farm is situated in the Liopetri Bay (east of Larnaca) where the Telia Aqua Marine Farm, which incorporates a hatchery, produces both sea bass and sea bream in off-shore cages. A land-based shrimp farm is operating in the Akrotiri peninsula South of Episkopi.

Fishing regulations prohibit trawling at less than 30 fathoms (55 m) because of important spawning and nursery grounds to be found in the shallow Posidonia prairies. Swordfish is being fished during summer on the high seas.

In order to control pollution at sea the Fisheries Department monitors several point sources four times a year according to criteria established by the Mediterranean Action Plan (Barcelona Convention). It also monitors biota and sediments for pesticides and heavy metals.

2.6 Microbiological Pollution at Sea

2.6.1 Algae as Bio-indicators

Nutrient enrichment by agriculture, aquifers polluted by absorption pits and sewage treatment units can threaten the quality of water at sea which is a major economic asset in Cyprus. Indeed the international tourist industry does not only require clean sandy beaches but also clean sea-water.

Organic pollution at sea can be monitored by analysing phytoplankton and algae especially macroalgae with rapid growth rates, as for example *Cladophora* and *Ulva* species, which proliferate in nutrient rich coastal waters.

The filamentous *Cladophora patentiramea*, a migrating algae originating from the Red Sea, has created blooms during the summers of 1990-91 in Liopetri Bay and the tourist area of Ayia Napa. M.Hadjichristophorou (1991) has attributed this proliferation to excessive nitrates from polluted groundwater seepage as well as to some environmental conditions such as the nature of substratum, light intensity and water temperature.

Marina A. and L. Loizides (1998) report that floating mats of *Cladophora* accumulated in the tourist beach area of Nissi creating a nuisance to tourists at the end of Spring last year. The same authors indicate that mass accumulation of *Cladophora* filaments (floating and attached to thalli of *Cystoseira*) was found last summer in coastal waters in front of the Larnaca sewage plant. The causes of this episodic bloom are probably due to leakages of sewage or to polluted effluent from adjacent tourist settlements.

The authors did not encounter the same phenomenon further west in 4 stations of the

Larnaca District where Cladophora was only sparsely distributed. Yet another algal outbreak was reported (summer 1997) at the sea outfall area in Moni Bay.

Increased outputs of phosphates and nitrates through seepage, and maybe by offshore fish farming, can thus create algal blooms and nuisance to the tourist industry. Further monitoring needs to be carried out to come to a better understanding of the dispersion of effluent and of the population dynamics of ephemeral macro-algae.

2.6.2 Blue Flag Programme

In the framework of the European Blue Flag Programme 25 flags were awarded to beaches in Cyprus during the campaign of 1998. The Blue Flag Programme is awarded to beaches which fulfill a number of criteria . One of them is the quality of the bathing water at sea which must be in accordance with the European Directive 76/160.

At Larnaca two beaches qualified for this award since the start of the campaign in Cyprus: Phinikoudes (Town Hall) beach and Mackenzie beach. The guide value for faecal coliforms and streptococci were complied with for all but one of the 18 periods of sampling during 1998.

A sample taken at check- point n• 41 (Phinikoudes beach) on 22nd September 1998 reached 5 times the allowable guide value. This was due to an unusual runoff after heavy rain which collected polluted seepage from sceptic tanks in the city centre. No such pollution was recorded in any other of the 32 sampling points of Larnaca District. One may hope that such a localized pollution won't repeat itself after the installation of the new sewage system in Larnaca.

It is proposed that the Fisheries Department (Nicosia) communicates its data for the other sampling points carried out on its own behalf. Indeed the Sanitary Engineer for Larnaca was unaware of a Cladomorpha outbreak in coastal waters in front of the sewage treatment plant of Larnaca.

Although the other coastal waters of Larnaca most likely comply with European standards it is difficult at present to extend the Blue Flag award to the other beaches in Larnaca District because of lack of finance. The Municipality will need to invest first in the appropriate infrastructure (toilets, showers, garbage bins, lifesaving and first aid equipment, free source of drinking water) and services (lifeguards to respond in emergency, access for the disabled, staff to clean the beach on a regular basis and daily during the peak season, etc.).

Yet it is recommended that the Municipality upgrades some of its beaches especially in the area of the tourist hotels east of the Oroklini road.

A management arrangement may be reached here between the hotel owners and the Municipality so that the general public may use some of the toilets and showers which already exist in the hotel compound and close to the beach. Another requirement not to be overlooked is to guarantee various signposted public access points between the Dekeleia road and the beach. In some cases this may prove to be difficult as some

hotels block off the public access to and from the road to the sea.

3.0 PORT FACILITIES AND POLLUTION CONTROL

There are four ports in the Larnaca Bay area: the commercial harbour with the adjacent petroleum facilities, the marina, the fishing shelter and the Dhekelia oil terminal serving the local power station. On the far western part of the Larnaca District is the industrial harbour of Vassiliko which is specialized in the export of cement and clinker produced locally by the Vassiliko Cement Works.

The main harbour of Larnaca as well as the Vassiliko harbour are managed by the Cyprus Ports Authority. Larnaca harbour used to be the main port in Cyprus after the occupation of the northern part of the island. Today, port handling activities have diminished since 1991 when the port of Beirut reopened (reshipments of petroleum to Lebanon were brought to a halt) and especially after 1997 when the container shipment company Evergreen switched its hub from Larnaca to South Italy.

At present, only a limited traffic is registered within the harbour compound, for example, the export of potatoes to Europe and of gypsum to Lebanon and Israel, and the import of agricultural fertilizer, cereals and bitumen.

The main cruising ships visiting Cyprus call at Limassol where most tour operators are situated and where part of the harbour can service ships requiring a 14 m draught (the maximum draught at Larnaca being 12 m).

Port movements are thus limited at Larnaca harbour and so are the environmental risks such as the overspill of bilge. Domestic waste from vessels is taken care after by the Port Authority and is incinerated within the harbour compound.

There is no contingency equipment in the main harbour but this equipment exists in the adjacent oil storage area and refinery (equipment privately owned) as well as in the fishing harbour (equipment belonging to the Department of Fisheries).

Only some limited pollution abatement equipment is present at Dhekelia (mainly booms but an absence of skimmers and dispersants). The waters in front of the power station are within the territory of the Sovereign Base. A satisfactory working relationship exists between the Fisheries Department and the British base. The latter has its own contingency plan and can make some equipment available (spray hoppers, helicopters). The Department of Fisheries has several crafts and patrols the sea on a daily basis.

The main environmental problem is linked to the offshore unloading operations of petroleum in front of the industrial areas which are situated in direct proximity of the city centre and the tourist beaches. Even if the big tankers are equipped with permanent ballast tanks and if sufficient contingency equipment is present on land, there remains an operational risk during unloading. There is no organizational management for small accidents and spillages during routine operations. Anti-pollution equipment at the refinery should be stocked close at the beach and not hidden in the refinery compound. At least one crew member of the subcontractor

responsible for contingency oil spills should be made permanently available.

Under the Fisheries Regulations the disposal of lubricating and other oils at sea is prohibited and as is the use of organotin based anti-fouling paints. Yet, one shop at Larnaca was found to stock such anti-fouling paint.

4.0 THE RISK OF POLLUTION AT SEA

Cyprus has ratified Annexes 1, 2 and 5 of the MARPOL Convention 73/78 (International Convention for the Prevention of Pollution from Ships). No port reception facilities for ballast exist but regulations on their establishment and operation have been prepared.

It is advised that the Port Authorities should apply the I.M.O. (International Maritime Organization) recommendations on the “Safe Transport of Dangerous Cargoes and Related Activities in Port Areas”, and more especially its chapter n°8 on liquid bulk dangerous cargoes including liquefied gas (I.M.O., 1995).

Cyprus is also signatory of the Barcelona Convention and takes an active part in the MEDPOL programme. A National Oil Spill Contingency Plan has been implemented using the “Medslick” numerical oil spill model. A programme of oil combating arrangements has been established on a regional scale with both Egypt and Israel. This has been carried out in close collaboration with REMPEC (UNEP Mediterranean Action Plan, Malta) and the European Commission. A trilateral training exercise took place off Larnaca during 1998 together with the collaboration of some specialized services on land (police, firemen).

Cyprus is to be congratulated for this exemplary trilateral co-operation to control oil pollution in the Levant Basin. It is hoped that the other Levantine nations can join this regional “Programme to Develop the Capabilities to Combat a Major Accident in the Eastern Mediterranean”. Lebanon and Syria have already formulated a demand to REMPEC to join this regional agreement.

It should be remembered that chemical dispersants into the water column may adversely affect some marine organisms which would not otherwise be reached by oil. Dispersants are not effective on all types of oil. A “Net Environmental Benefit Analysis” should determine in advance whether the use or non-use of dispersants will produce the greatest overall environmental benefit especially in such sensitive areas as Posidonia meadows, entablatures of coralline rock and fish farming. Damage can, for example, be minimized by spraying of the oil slick before it reaches an ecologically sensitive zone. It is also advisable not to use dispersants over seagrass prairies in shallow waters.

GIS cartography of infralittoral ecosystems in the coastal waters of Larnaca District would be an important asset and management tool for conservation.

5.0 THE AIRPORT EXTENSION

5.1 Site description

The existing Larnaca airport was constructed in 1975 after the upheaval leading to the closure of Nicosia airport. It was built on a former military airfield run by the R.A.F.

The master plan of 1991 for the extension of Larnaca airport foresees:

the extension of the existing runway,

the construction of a 2nd terminal with finger-type traffic islands to cater for 9 million passengers (instead of only 4.2 million passengers at present),

the creation of a commercial zone and freight area.

A second long-term phase foresees the construction of a second runway and further extension of the airport to accommodate 12 million passengers.

The main constraint of the airport and its extension consists of the fact that it is situated in the middle of the Larnaca Salt Lakes, a wetland of international biological importance for waterbirds and more especially flamingos and shelducks. The Cyprus government intends to ratify the Convention on Wetlands of International Importance known as the Ramsar Convention (1971). To ratify the convention it will submit the site of the Larnaca Salt Lakes for inclusion in the List of Wetlands of International Importance.

Contracting parties to the Ramsar Convention accept general obligations relating to the conservation and wise use of wetlands throughout their territory and special requirements pertaining to those wetlands which have been designated for the Ramsar List.

The lake complex consists of four lakes and a couple of ponds:

Lake Aliki (449 ha) is the main lake. It is assumed that it had a natural outlet to the sea in ancient times which gave birth to the ancient port of Kition. The marine regression since the early middle ages led to the formation of the lido and closed the lake off from the sea. Lake Alik holds the main winter population of Greater Flamingos as well as a few thousand gulls. It is the most visible part of Larnaca lake complex and it offers some picturesque landscapes as can be seen in the surroundings of the historical Tekke mosque.

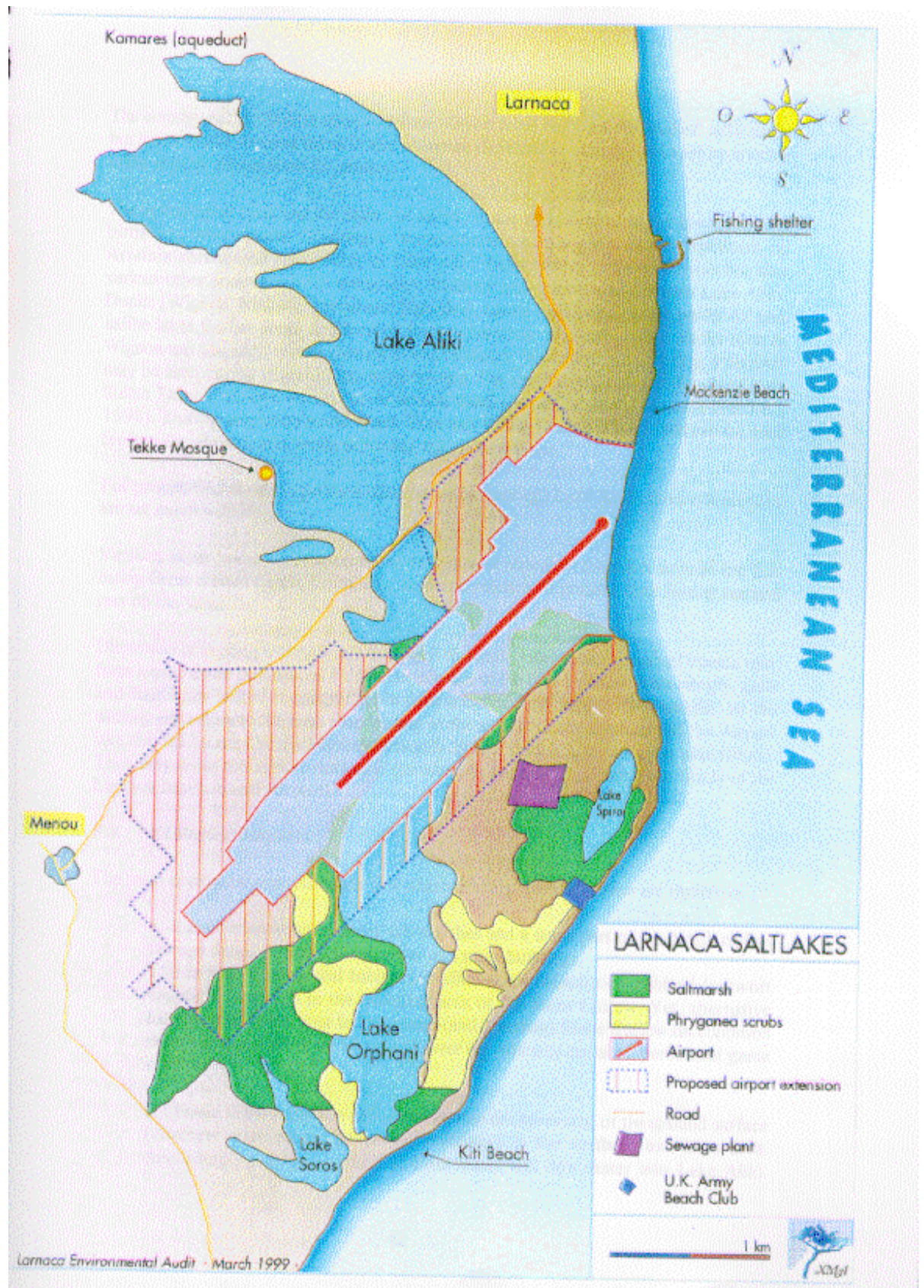
The southern part of Lake Alik is cut off by the Larnaca - Kiti road and forms the so-called '**Airport Lake**'.

Lake Orphani (140 ha) is intersected by the existing airport and will undoubtedly be further curtailed by the airport's proposed extension. The adjacent fields hold an important winter population of Stone Curlew (about 100 birds). Lake Alik, Lake Orphan and the Airport lake are interconnected by culverts under the road and the runway.

Lake Soros (40 ha) is separated from the other lakes by the road between Menou and Kiti beach.

Lake Spiro (20 ha) is situated in the vicinity of the sewage plant. It is separated from

the sea by some sand dunes. This small lake holds an important winter population of ducks, White-fronted Geese, waders. It attracts also various migrants during Autumn and Spring migration.



5.2 Ecological importance

The hydrology and salinity determine the biological importance of the lakes. Brackish during winter, the salinity increases while the water evaporates over summer leaving a thin layer of crystallised salt on the surface from July onwards. The salt used to be harvested up till 1986.

The abundance of the highly productive brine shrimp *Artemia salina* provides the food supply of the Greater Flamingo and some other specialized birds. This small shrimp feeds on unicellular algae known as *Dunaliella salina*, which proliferates in Spring when salinity increases (over 180 g/l, Sadoul N., J. Walmsley and B. Charpentier, 1998).

Brine shrimps have a dual reproduction cycle. They have eggs that hatch immediately and eggs, called cysts, that can survive when the lake dries up in summer. The conservation of the salt lakes ecosystem depends on the ecological equilibrium between fresh water supply (precipitation, runoff, groundwater) and salinity (seawater seepage, saline muds).

Because of increased runoff water due to the cut-off of an artificial channel after the construction of the airport runway some 30 years ago (Kypri D., 1976), the closed off Airport Lake as well as Lake Orphani are less salty than Lake Aliko where large salt deposits in the subsoil get diluted with rainwater during winter.

The ecology of the brackish lakes (Orphani, Airport lake) has not been studied sufficiently but it seems that *Artemia salina* is less abundant there and is partially replaced by another brine shrimp: *Branchianella spinosa*.

The hydrological cycle and the degree of salinity in the lakes determine the distribution of birds and invertebrates. Flamingos, for example, are to a great extent dependent on *Artemia* shrimp and feed mainly at Lake Aliko. Gulls (which capture *Artemia* but also various other organisms while swimming), Shelduck and Avocet also frequent Lake Aliko. Ducks (Wigeon, Mallard, Pintail and Shoveler), coots, waders and geese prefer the less saline lakes further south and feed on *Ruppia maritima* (for herbivorous ducks such as Wigeon and Mallard), worms (annelids) and molluscs. Some diving ducks (e.g. Pochard) may be seen during winter in the Airport Lake. The small vegetated pool South of Hala Sultan Tekke's mosque attracts up to several hundreds of Garganey (Sadler A.E & J.E., 1998). During migration some Black Tern and White-winged Black Tern can be seen feeding on invertebrates while skimming the water surface.

For unspecified reasons (perhaps disturbance by hunting) Lake Soros does not seem to attract much wildlife.

Various other water birds species are very rare or absent in the lakes such as the fish eating Great crested Grebe, Cormorant, terns and pelicans. If present, they feed at sea and rest on the lakes.

Dispersion of floating invertebrates is subject to wind. Artemia and larvae of insects may form locally dense populations if driven to one side of the lake by wind. Accordingly, gulls and flamingos will also congregate in such areas of food supply, for example, on the easterly edge close to the main road leading to the airport. Lake Orphani and the Airport lake also hold some Greater Flamingo (roughly 20% of the Larnaca wintering population). They may cross the airport runway if disturbed by hunting (Environmental Study of the Larnaca International Airport).

5.3. Ecological Impacts

The main ecological impacts of the first phase of the airport extension are threefold:

1. Land reclamation of some salt marshes and a small part of the North of fuel storage depot, a new control tower and some buildings.
The reduction of natural habitat will affect some halophytic scrubland (saltwort vegetation) as well as the wintering area of the Stone Curlew. Yet, alternative habitats exist in the area for wintering (and breeding) Stone Curlew on condition there's a strict control on hunting all over the officially declared 'permanent game reserve'.
2. Change in the water run-off regime due to the hardening of the ground surface (concrete slab, roads, pavement, buildings) in the northern extension area. Accordingly a larger amount of fresh water will flow faster into Lake Alik. Accidentally some water polluted by hydrocarbons may enter the lakes which would be detrimental to waterfowl.
3. A larger airport means more movements of aircraft and will thus occasion more bird strikes. According to the Larnaca Airport Authority, there are only a few minor incidents of bird strike principally caused by passerines during the Autumn migration. Some chukars and ducks may also be concerned. There is one case reported of an incident involving a flamingo.

5.4. Impact Mitigation

The following measures are proposed as recommendations for the consideration of the Municipality, or other bodies, as appropriate, in order to reduce the ecological impact in this sensitive conservation area:

- 1. Preparation of a detailed wildlife management plan for the lake complex aiming at habitat restoration for the protection of birds which represent a major attraction to residents and tourists at Larnaca.**

Such habitat restoration and creation may consist of :

the protection of the embryonic dunes south of Lake Soros,

the extension of the reedbeds to give shelter to warblers, ducks and herons,

the protection of some vulnerable plant habitats,

the deepening of some parts of the southern lakes to maintain some water during summer,

the pumping of seawater into Lake Aliko to maintain a stable *Artemia* population during summer and to attract some breeding birds such as Black-winged Stilt, Kentish Plover and possibly Greater Flamingo and Shelduck,

the creation of small islets in Lake Aliko to attract such breeding species as Slender-billed and Yellow-legged Gulls,

the strict protection of the natural habitats between Spiro's Lake, the beach and Lake Orphani. This natural coastal habitat attracts many species of waterbirds during winter, migrants and a few breeding species.

Habitat restoration and creation will lead to a greater biodiversity and more sedentary bird populations. The complete control of hunting in this future Ramsar site is another prerequisite for establishing more stable bird communities.

Birds fly up because they are disturbed by man and represent thus a greater risk for collision with aircraft.

Even if bird strike will be reduced by ecological management of the lakes it remains difficult to eradicate the risk of bird collision totally. The use of falconry, mowing of vegetation within the airport area and the dispatching of distress calls will need to be carried out in the vicinity of the runway and more particularly during Autumn migration.

2 Risk of oil pollution of the lakes by run-off or accidental spillage may be curtailed by the construction of a central settling basin (the existing airport does not have such a settling basin).

The future fuel depot, as well as the existing fuel storage tanks, should be surrounded by an impermeable landscaped mound in order to control any eventual spillage into the adjacent Aliko Lake. As foreseen the existing linkages between Aliko Lake, Airport Lake and Orphani Lake will be re-established after the construction of the airport extension. Yet, as it is difficult to predict how the modified hydrological regime will function during periods of heavy storm water, it is suggested that a monitoring programme be set up for Lake Aliko.

3 Although most modern aircraft make at present less noise than they used to do it is to be expected that the village of Menou will be affected by more noise pollution. Since aircraft create more noise during take-off than during landing operations it is recommended that most take-offs occur in an easterly direction (thus directly over the Mediterranean Sea) followed-up by a curve in a South-Eastern direction to avoid the

proximity of Larnaca. At present most of the landings come from the sea. This will reduce noise impacts over the village of Menou and neighbouring settlements.

The installation of double glazing of dwellings at Menou may prove to be essential if monitoring indicates that European acoustical standards for subsonic aircraft (Directive 80/51 of 20th December 1979) are not being met.

5.5 Impact of the Phase 2 Airport Extension

The construction of a second runway, taxiway and a 3rd terminal will infringe on a large part of Orphani lake and adjacent halophytic vegetation. The area to be reclaimed holds various hundreds of waterfowl (Wigeon, Mallard, Pintail, Shoveler, Coot and White-fronted Goose) and waders during winter and the migration periods. Stone Curlew can be seen in the adjacent scrubland.

Yet , it is difficult to imagine that Larnaca Airport will attract 12 million passengers by the year 2010 since the southern Cyprus coast has no capacity to host such a large influx of tourists. Further West, Paphos Airport intends also to double its capacity.

It is thus recommended that the reclamation of Orphani lake should not be carried out at this stage. The reclamation of Lake Orphani may also lead to the disqualification of the Larnaca lakes as a Ramsar site unless appropriate management and habitat creation elsewhere will guarantee the survival of the existing population numbers of waterbirds.

6.0 THE DESALINATION PLANT

The Cyprus Government is apparently going ahead with the construction of a second desalination plant (reversed osmosis type) to be installed close to the sewage treatment plant and in the vicinity of Lake Spiro. This will be within the recently declared protected zone and will be against both the letter and spirit of that declaration. The existing desalination plant is situated at Dhekelia at the other side of Larnaca Bay.

No environmental impact study has been prepared yet for this permanent facility in a future Ramsar site and very close to a lake of special scientific interest. Yet, the contract has already been awarded to two Israeli joint-venture companies. At present the tender is preparing the impact statement.

The Larnaca Audit team is unaware if such a study will include an environmental site assessment comparing various location possibilities including the extension of the existing desalination plant at Dhekelia and a possible location in the industrial zone.

A third desalination facility was planned at Petounda Point, some 16 km further east but it is understood that this proposal is now on hold.

Apart from the expected localized impact of the desalination plant on land and the accompanying new powerline, the principal environmental impact concerns the

dumping site of brine at sea. Brine bunkering will undoubtedly sterilize marine wildlife in an infralittoral zone covering various hectares, or within a radius of 200 to 250 m.

This may lead to the disappearance of *Posidonia* seagrass if the brine is dumped on a seagrass meadow. As planned the brine pipe will be designed to withstand movements in the wave-breaker zone located to a depth of 8 m, or approximately 500 m from the Larnaca coast where the beach profile is falling slowly.

It is important that the 'sea-fall' of this culvert is not only designed to suit the physical stability of the structure but takes into account the impact on sedimentation, flora (*Posidonia*, *Cystoseira* etc.) and fauna. It may well be possible that the length of the culvert needs to be extended so that brine will be dumped in a deeper zone.

7.0 LANDSCAPE CONSERVATION AND AMENITY

At present Cyprus hosts over 2 million tourists a year. 95% of them spend their holidays in one of the coastal resorts such as Larnaca, Agia Napa and Paralimni.

Tourist development spreads now to the eastern part of Larnaca District where such rural places as Cape Kiti, Perivolia and Petounda are being developed for the new east-European tourist market. Tourist developments there consist of indistinguishable housing blocks lacking both in local character and architectural composition.

A regional plan of the Larnaca District foresees at the East of Cape Kiti various tourist development schemes consisting mainly of a series of hotel apartments and housing blocks repeated at 1 km intervals. This development plan does not take into account the conservation of local landscape character nor the existence of sites of special ecological interest, for example, the presence of rare or endemic plants.

If no overall coastal landscape plan is approved by central government, it is to be expected that a continuous strip development of hotels, hotel apartment blocks and secondary houses will be built all over southern Cyprus.

In order to safeguard some stretches of coastal landscape for future Cypriot generations it is recommended to protect some stretches of natural coastline between Zygi and Cape Kiti.

Apart from the Akamas peninsula, this is the last stretch of 25 km natural coastline in Southern Cyprus.

The long term conservation of some specific sites such as Petounda Point, some embryonic dunes, the stream estuaries as well as some archaeological sites (late Minoan objects have been found at Maroni and Kiti: Mantzourani E. and A. Theodorou, 1989) would highlight the national heritage, the civic pride for the nation and the coastal beauty of Cyprus. The encouragement of wildlife tourism and of some limited hotel development in the hinterland (at least 500 m from the coast) and designed to the highest environmental standards (5 'green' stars category) would profit the Cyprus economy, diversify the tourist market and greatly uplift the international tourist image of Cyprus.

It would indeed be a pity for the world at large to imagine Aphrodite at a Cypriot beach .. in front of another unsightly housing development. There is here a unique opportunity to serve the long term interests of the nation at large.

A national Coastal Law, as existing in other European countries and the set up by a national organization such as the Conservatoire du Littoral set up in France and Tunisia or the National Heritage Trust in the U.K. is recommended in order to introduce a new policy for the protection of the coastal environment in Cyprus. This coastal conservation association would be able to buy up some strategic stretches of coastline for conservation and to manage them in the interest of the nation at large. Some more direct amenity operations are also recommended to uplift the present urbanized landscape in Larnaca Bay. The city of Larnaca has very few public green spaces such as parks, gardens and tree-clad boulevards. The new development zones towards the tourist hotels area need a major uplift especially in the vicinity of the harbour, the oil storage area and the refinery.

A major landscape scheme should identify these industrial eyesores and propose some dense screening, landscape design and tree planting.

The approaching year 2000 may be the ideal period to celebrate the change of the millennium by tree planting between Dhekelia and Kiti beach.

The industrial companies should be asked to plant 2000 trees each around their premises and in Larnaca city. All schools, associations, hotel owners and private entrepreneurs should also contribute in a concerted way.

It is needless to say that the image of the city of Larnaca will profit greatly from such a major green uplift. The municipality will need to co-operate closely with all participants to explain this landscape strategy for the city. The preparation of an overall landscape structure plan will help to identify priorities, to define the desired landscape design and to work out planting details for execution scheduled next winter.

To fund the above programme it is recommended that the CY£0.5 million environmental compensation provided by the refinery annually should be used.

CHAPTER 6 LAND USE AND PLANNING

1.0 BACKGROUND

1.1 Past Development

Current land use issues in Larnaca must be viewed in the context of the impact of the troubles of 1974, which generated over 200,000 refugees overnight, about 20,000 of which came to Larnaca, and the boom in tourism, which started a few years later. These events unleashed powerful forces for change that altered dramatically and permanently the function and character of the region

New houses, roads, schools, hotels, factories, hospitals, ports, and dams had to be constructed in very short time. New land was brought under cultivation and irrigation. Almost overnight, Larnaca grew from a small town to a centre of industry and tourism. Most of this development occurred with little regard to economic or environmental costs. In fact, few regulations existed to control land use and the environment. Still today, there is no specific legislation concerning the protection of the environment in Cyprus, although several environmental protection bills are pending.

The legacy of rapid settlement and accommodation of refugees and tourism boom is still being felt today in the form of the inadequate infrastructure, pollution of ground and surface waters, congested streets, deteriorating air quality, and a loss of the traditional character of parts of the town. Conflicting land uses cause irreversible damage to the environment. The coastal zone in particular has been subject to severe pressure from tourism, and industrial development as well as from the construction of hotels and apartments.

1.2 The Development of Larnaca

Larnaca's greatest asset, its beaches, have been treated roughly. On the north side of the town, approximately 3,000 Meters of the waterfront have been sacrificed to oil storage tanks, backed by the oil refinery. The commercial port nearby, distances the town from the sea shore for an additional kilometre. This industrial zone, is now located next to the residential area and next to the port with a threefold impact:

- ? ? on the living environment of the residents and tourists, due both to the perceived or real environmental hazards and to the aesthetic burden;
- on the future development of the port, as it raises questions about the potential co-existence of tourism (cruise-liners) and industrial activities;
- ? ? and on the image and tourist potential of the town at large.

On the southern side, the international airport restrains any possible urban development. It's planned expansion might cause nuisance to existing nearby neighbourhoods as well as damage to the Salt Lake natural reserve ecosystem.

Of the approximately 12,000m of waterfront within the municipality, almost a half is

devoted to Airport, industrial or harbour development and 3,000m consist of part of a nature reserve. More than 5,000m of the seafront at the north and more than 2,000m at the south, outside the municipal boundaries but inside the local plan area, is designated for tourism. On the northeast, along the waterfront high-rise hotels and apartment buildings were built. Most of the touristic accommodation is situated outside the municipal borders, and Larnaca municipality does not collect the professional or any other taxes. On the south, outside the local plan area, large amounts of residential and summer houses are built very close to the sea. Those developments do not take into consideration the need for an open shore both for the quality of life of the local public and for the sake of the future of the touristic industry.

Related to the above problem is the issue of the future of the refinery. This has raised significant controversy about the potential relocation of the refinery or its harmonic co-existence with the residential/touristic area guaranteed through adequate environmental monitoring and aesthetic improvements

Nonetheless, in comparison to many cities along the Mediterranean, Larnaka's environmental problems seem relatively minor. There are no signs of poverty and social disease, the town's shores and streets are clean, the existing green areas are maintained very well. The traffic congestion is tolerable in winter (worse in summer we are told) in spite of the characteristic high car ownership rate, and construction of a new sewerage system is underway to improve the collection and treatment of sewage.

2.0 TYPES OF LAND USE

The Larnaca Local plan Area, comprises about 80 square kilometres, approximately half urbanized and half non-urbanized or rural. Most of the land in the urbanized area is either used or designated for residential development. In the non-urbanized areas, about one half of the land is used for agriculture, which is gradually yielding to urban development.

Development in the Larnaca defined area does not fit neatly into individual land use categories. While some segregated areas exist for specific uses, many areas contain a mix of residential, commercial, and even industrial development. In general, the main land uses can be described as follows:

2.1 Residential

In the old part of town, small one and two storey houses are common. Apartment blocks and semi-detached houses, both for year-round residents and for tourists, have become increasingly common. Many flats in these large buildings are occupied for only a few weeks or more during the year.

In most residential areas in the city, construction of four and even eight story buildings is permitted. Actually, in many of the areas, there is a mix of single-family houses and high density construction juxtaposed in a completely random manner. The result is very unpleasant to the eye. The phenomenon is especially strident when high rise construction of low architectural quality appears adjacent to old structures, including structures designated for preservation.



In the new areas, and in infill areas, in the heart of the city or adjacent to veteran areas and the coast, and in the suburbs, there is no evidence of deliberate directing of the character of urban construction. The built pattern created is functional - residential structures, roads, public spaces - without the qualities required to support and encourage lively community life, the same qualities that may also contribute to the tourist image of the city.

In the suburbs, detached single family housing predominates, with the exception of refugee housing located in various government housing estates. New houses are being constructed primarily in the outlying areas of the city, repeating a pattern of suburbanization experienced in cities throughout the western world.

In the case of Larnaca, and actually in most of Cyprus, this situation is especially prominent, as a result of private ownership of most of the land and the right anchored in the Constitution to build on all private land. Others factors are the small area of the island, accelerated development of the recent years, and enforcement difficulties even in cases where development can be directed and monitored.

The environmental significance of the trend described here is in irreversible injury to land resources, and nature and landscape values. Additionally the cost of public infrastructure is very high due to spatial deployment and/or service to the residents and is of poorer quality than could have been in a system constructed in a more rational way.

2.2 Tourism and Commerce

Hotels, cafés, restaurants and souvenir shops can be found throughout the Larnaca local plan area, but are concentrated along the seashore, in the old town and along main and arterial roads. Small shops, catering primarily to tourists, predominate in the old part of town. The Local Plan designated six kilometres along the northern seashore, outside the municipal boundaries to be the main hotels and touristic area. Strips along the main roads (Leoforos Archiepiskopou Makariou III, Leoforos Grigori Afxentiou, Leoforos Gkiani Timagia, etc.) are designated as the primary areas for commercial uses. Public and private offices are located mainly in the centre of the town.

Modern infrastructure does not respect the traditional character of the city. Many hotels, restaurants and other tourist infrastructure suffer from aesthetic degeneration as a result of interventions such as, scale, design, and façades, signs and decoration which are not consistent with traditional styles.

2.3 Industrial

Most of the industrial facilities are concentrated in three industrial estates. Two - the Industrial Area and the Free Trade Zone are located just outside the urbanized area

and the Larnaca municipal boundaries within Aradippou village administrative boundaries. These two estates are relatively new, well designed and maintained and only partly occupied so far. The local and central authorities are interested in strengthening the industrial activity in those areas and encourage clean industries to join. Those areas include now manufacturers as well as food, and other industries. Hundreds of small industries (see tables) are located inside the inhabited area, some of them causing environmental hazards.

Number and Type of Small Industrial Units in Larnaca Municipal Area

Type of Unit	Number of Units	Percentage
Food Indust/Confectionery	38	6.6
Bakeries	28	4.6
Carpenters	73	12.0
Dry Cleaners/laundries	19	3.1
Car Mechanics	153	25.1
Clothing	42	6.9
Printing	25	4.1
Goldsmith	77	12.6
Workshop/warehouse	74	12.1
Other industries	79	12.9
	608	100

Location of Small Industries Within the Larnaca Urban Area

Location	Number of Units	Percentage
Central Business District	127	24.7
Activity Spines	67	13
Mixed Business Areas	23	4.4
Residential Areas	299	57.9
	516	100

Location of Small industries in Industrial Estates and Zones

Location	No of Units	Percentage
Industrial Estate	43	46.74
Inner City Industrial Zone	10	10.86
Light Industrial Park	39	42.4
	92	100

The third industrial area causes great controversy. It is located inside the Municipal boundaries. It includes the refinery in an area of about one square kilometre and a strip of oil distribution depots three kilometres long and less than 200 meters wide lying along the sea shore between Larnaca town centre and the region's main touristic area.

2.4 Mixed Development

Throughout the municipality, small industrial facilities or workshops intermingle with residential uses such as houses next to plastic manufacturers, apartments next to car repair shops. One area of the municipality in particular exemplifies this coexistence of workshops and houses. It is located close to the Turkish Quarter, and includes houses as well as workshops - furniture makers, metal works, tyre repair, dry cleaners, etc. Initially, there were few complaints from residents, but over time, as new residents move in, and as the occupants become more affluent and less tolerant of the noise and noxious fumes, residents have begun to object.

2.5 Parks and Open Spaces

The Larnaca area contains a large number of small parks. The local plan requires that when land (over 2,500 square meters) is developed, 15% must be set aside as a park. Combined, these isolated parks, along with other open areas such as stadiums, public gardens, comprise approximately 11% of the urbanized area.

Within the municipal area the Salt Lake and its surroundings have been declared a nature reserve. A plan for the preservation and development of the area has been prepared. The area has a large potential for both improving the quality of life of the residents and for the development of tourism.

The coast constitutes an important open space, for the use and welfare of the residents and tourists alike. In the summer season the use by tourists and residents is heavy, density on the coast is high, and the service to the user is impaired. The taking-over of space along the coast by uses that do not require proximity to the sea, such as the refinery and depots, and the difficulty in reaching some of the beaches located adjacent to the hotels is detrimental to the growth of tourism.

The lake of Oroklini and the Aliko park within the salt lakes area have great potential for tourism and local development.

2.6 Commercial Port, Marina and Fishing Harbour

These three facilities are located along the Larnaca municipal coastline. The port, in its actual position and shape was built in the eighties. It is operating now on a very small scale. The authorities consider designating it as a tourist port. The marina is a well located touristic site. Most of the yachts sailing in the region, enter this marina, which is the main one in Cyprus.

2.7 The Airport

The Cyprus main international Airport is located inside the municipal borders. It is

planned to expand the facilities and use more than four square kilometres in the Salt Lake natural reserve area (see pages 39 - 42 in Chapter 5).

2.8 Agriculture

Part of the local plan area is cultivated. In the Larnaca district potatoes, vegetables, orchard trees, flowers, citrus trees and dry-fed crops such as cereals, grapes, olives and almonds are cultivated. Stock farming is highly developed with significant cattle and pigs raising.

2.9 Historic Areas

Larnaca is rich in archaeology, history and architecture. The historic or traditional centre of Larnaca is located near the medieval castle in the old quarter of the town. The area is characterized by a network of narrow, winding streets and a mix of small workshops, stores, offices, houses and apartments, all built on a pedestrian scale. The area is popular with tourists, who come to marvel at the ancient buildings and to shop and browse in the stores.

The old part of town contrasts with the new. The older Larnaca neighbourhoods, which are consistent in scale and character and which exemplify Cypriot architecture, and modern development predicated upon new scales, different materials, different aesthetics, and an altogether alien character from the City's traditional development patterns.

Many old, traditional buildings were demolished to make way for new development. The Government Planning Authority is empowered to issue Preservation Orders to protect traditional buildings of architectural and historic significance. Since 1982, the Government has issued Preservation Orders covering 65 listed buildings in Larnaca. The Government also provides incentives, such as grants, low interest loans, and exemptions from rent control requirements, to protect historic buildings.

3.0 TOWN PLANNING

In 1972, the Cypriot Town and Country Planning Law, probably the most important piece of legislation regulating land development, was enacted.

The law offered, for the first time, the possibility to develop a framework for logical and consequent planning guidelines, strategies and policies on the island. Implementation of the Town Planning Law was delayed, however, until December 1990, due to the need to accommodate incoming refugees from the occupied areas of Cyprus, but also due to opposition by the large landowners. In the meantime, municipalities relied on an outmoded Streets and Buildings Regulations Law of 1946 whose primary purpose was to ensure the safety of buildings and the provision of proper amenities and sanitary facilities, to try to control and guide development. They were not very effective and the result was haphazard development and degradation of the natural environment.

The responsibility for physical planning in Cyprus lies primarily with the Ministry of Interior, through the Department of Town Planning and Housing. The Minister delegated the exercise of planning and development controls to the four main

municipalities: Nicosia, Limassol, Larnaka, and Paphos. Outside those areas, planning responsibilities were retained by the Government Town Planning Department, which maintains regional division offices in each of the four main cities.

The Government has prepared local plans, which apply primarily to urban areas, and policy declarations, which provide guidance to rural areas and villages.

In 1991, the local plan for the Greater Larnaca Area, which includes the Larnaca Municipality plus part of the small municipalities and improvement boards adjacent to Larnaca (see map 2 on page 13) was adopted. The plan determines the type, size, and location of development in the metropolitan area. It was developed by the Government of Cyprus, in consultation with the affected local authorities. The plan is updated every 5 years.

Occasionally, planning conflicts arise between local authorities and the Minister. Such conflicts may be resolved by the Council of Ministers, or, if necessary, by the Supreme Court.

The municipality issues construction permits in the area of the Larnaca local plan, when the site is within the municipal boundaries, and the district office issues them when the request concerns areas outside the municipal jurisdiction. The two offices hold frequent coordination meetings. Although it is possible to receive a permit for building almost anywhere, there is a severe problem of enforcement almost everywhere. Structures are sometimes built without, or contrary to, permit conditions, and the punishments for breaching the law in this field are light and do not deter developers.

The office of the City Engineer handles all planning and engineering issues of the city, and includes four departments. The first deals with planning and construction issues, including planning permits, subject to the 1990 town planning law. The second deals with issues of urban engineering, including the issuing of building permits and construction supervision.

The third deals with infrastructure and maintenance, and the fourth, the special projects department, deals with the planning and construction management of public buildings and other public projects.

4.0 URBAN SPRAWL

Larnaca is following the pattern of sub-urbanization that occurs in all westernized countries. Development migrates outward, away from the central core along radial streets, towards the villages that once seemed far away. In the last decades, the Larnaka urban area population has grown 3 fold, while the area occupied by housing has increased 10 times over and more.

Development is filling in the vacant land between the villages and the city. There is a trend for families with children to move out of the CBD to the suburbs.

Agricultural land is increasingly converted to urban, particularly residential development. The automobile makes this all possible and in Larnaka two and three car families are not uncommon. With an increasing dependence on the automobile,

comes the attendant traffic jams, air pollution, and the never ending construction of roads, and parking facilities. If current trends continue, more and more land will be devoted to the automobile, at the expense of open space, clean air, and clean water.

Controls on land use are few. Eighty percent of the land in the Larnaka local plan Area is privately owned, and private property rights are very strong in Cyprus. In fact, the right to build a home on one's property is guaranteed by the Constitution. The Government has imposed a number of restrictions on private property, however, most of them directed at new hotel construction. For example, it has imposed a de facto ban on the construction of new hotels. Since 1991, hotels may not be constructed on parcels under 20,000 square meters. In addition, approvals are required from both the municipality and the Central Tourist Office to construct tourist facilities, which includes hotels.

5.0 BEACH ACCESS

Ensuring that the public has adequate access to the beach is more an issue of equity than environmental protection, but important from the perspective of improving the quality of life in Larnaca.

In Cyprus, the beach is public property, private beaches are illegal. Land abutting the sea is held in the public trust, for all to enjoy. In the past, the construction of buildings along the seafront curtailed public access to the beach. Since the late 1970s, however, landowners must provide public access when constructing new buildings along the waterfront. For example, if a new hotel is constructed, the developer must construct a path alongside the hotel to allow the public to reach the beach.

In 1991, this requirement was challenged by a hotel owner and upheld in the Supreme Court of Cyprus. The court held that "Beaches are common goods, which must be at the direct disposal of the public. It is not acceptable or legally permissible for the hotel owners or owners of immovable property in the neighbourhood of the beaches to have the exclusive exploitation of these beaches and the public to be deprived and excluded from the use and enjoyment of something which is destined for common and public use".

6.0 CONCLUSIONS

6.1 Natural Values, Historical and Cultural Heritage, and Tourism Potential

On the state level, Cyprus is an island of natural values and a rich cultural and historical heritage. As an island, Cyprus enjoys a long coastline compared with its surface area, and prominent and abundant sea views.

The recent history of Cyprus is a remarkable story of success. The overcoming of the crisis of '74 and the management of the refugee problem in a most humane way are exceptional. The economic development in the years since shows that Cyprus has an enormous ability to direct energy and motivation towards growth.

There is a worldwide awareness of the island's tourist potential. Cyprus has succeeded in strengthening this awareness with speed and efficiency that probably has no match

in the modern world. However, this success might become a two-edged sword if it gets out of control.

This success can be understood in light of the joined effort of various levels in the central government, the local authorities and the wider public. All were harnessed to the mission of promoting the economy in general and tourism in particular, through largely short term, and sometimes long-term investment - financial, time and energy. This mission was often coordinated, although usually informally.

The main threat lies in over-exploitation of natural resources. This might undermine the very basis on which prosperity has hitherto thrived. An irreversible injury to the natural and historical attractions of the island will, in the nature of things, cause an irreversible injury to the residents and tourism.

The danger exists on the environmental and social level, and carrying capacity considerations should be applied in the planning process on both levels. The danger of ecological and visual destruction, partly irreversible, is very real. It threatens, naturally, most of all attractive areas.

The checks against deterioration are still weak. The system, establishments, laws and regulations, local mentality and other factors all contribute to this situation.

There is an awareness of the potential dangers if the current trends continue. If the success in the previous stage testifies to the potential for organization and perseverance, it is expected that it will be possible to develop and implement checks that will prevent the realization of the dangers. Part of these checks can be achieved through education at various levels and development of local awareness.

Part already exists in formal reports and declared policy of the ministries concerned, for example, upgrading of tourist services focusing on improving the quality of services rather than increasing capacity and transition from mass tourism to paying, more profitable tourism.

Despite awareness of the dangers, there exists a dynamics that leads to the continuance of destruction, as a result of plans underway, and a desire to continue the momentum and enjoy the fruit of success. This desire is common to public officials on the national and local levels and, of course, to the land owners and developers.

6.2 Human Potential

The general population has a very high level of education. There are excellent professionals who have acquired their education in very well known educational establishments in Europe. In addition, there is a significant public awareness and increasing involvement of NGOs with awareness and knowledge in environmental planning issues. These conditions constitute a good basis for the development and implementation of a sustainable development policy.

6.3 Institutional and Legal Aspects

The centralized system enables coordination, a directing hand, effectiveness and potential for operational efficiency. These are not usually realized in practicality yet.

Decisions are often taken at the central government level, without considering local needs.

6.4 Organizational and Ministerial Problems

In Cyprus the number of Ministerial government offices is limited by the constitution to 10. Urban and Regional Planning is dealt with by the Ministry of the Interior. The Ministry of Agriculture, Natural Resources and Environment apparently handles environmental issues. In reality, many of the ministries have units that handle various aspects of planning and environmental quality. Coordination and mutual completion appear to be lacking.

The taxation system does not provide the various authorities with sufficient monitoring tools for directing development, and does not enable reasonable balancing of costs and benefits. It appears that the private market is taking advantage of this situation. Development is often governed by considerations of costs to the developer, without a comprehensive environmental/economic view.

Thus, if, for example, a settlement wishes to reduce the injury to its coast, and limits residential construction in the vicinity, the neighbouring local councils which allow less considerate development "enjoy" the development pressures, this, in spite of the centralized method.

The characteristics of the taxation system and distribution of the burden, authority and responsibility between parties are responsible. However, a major share of the responsibility is due to inefficiency resulting in heavy costs to the public, the inefficient use of natural resources and an unnecessary and irreversible injury to landscapes and expendable resources.

This situation is not unique to Cyprus, of course, but accompanies organizational systems worldwide. Here this situation is especially prominent because the country's small size amplifies the sensitivities of the environment and the risk of injuring it. From here stems the need to give high priority to system improvement, despite the difficulties involved.

Some of the laws, regulations and procedures restrict the implementation of a policy of sustainable development. Due to the property rights anchored in the Constitution, the authorities are very limited in refusing to issue a construction permit. It is possible to confiscate land only with full compensation. In view of the fact, that a large portion of the land in all of Cyprus, and in the coastal regions in particular, is planned and subdivided, compensation can involve enormous costs.

6.5 The Planning System Nationally

Cyprus has no national plan and no comprehensive policy that can direct and monitor the situation in the field. After '74 a decision was made not to prepare such a plan, that should, naturally, relate to the area of the entire island, till the situation is resolved on the political level. Now, in view of the current trends and dangers, there are calls to prepare a national plan anyway, or at least some sectarian plans. As a result, heavy

damage to the environment and unnecessary costs might occur. One example is the question of desalination plants. Their size, number, location and relations to other land uses. These plants have long-range economic and environmental impacts that are not always considered in the process of decision making. The plan to expand Larnaka airport is another example of a lack of long-range policy. This plan was apparently formed without performing neither carrying capacity nor needs assessments.

The developer, towards the realization of real estate does detailed planning (subdivision, designation of land for public needs). This enables the execution of development in a manner saving time and costs to the public authorities. But there is a low level of coordination between neighbouring developments, and the detailed planning quality is poor.

7.0 LARNACA

7.1 The City Environment

Larnaca and its region have a very high environmental potential. The strengths of Larnaca include nice clean beaches and sea shore attractions, archaeological sites of interest and a cultural heritage, manifest in the living city of Larnaca. This potential is partly endangered by the unchecked development of recent years.

Within the limits of the city there are swimming beaches, one of them declared a "blue flag beach", and a unique nature reserve in the area of the Salt Lake. Along the coast runs a nice promenade that has been redesigned lately. Inside the town there is a small municipal park, and a few public gardens.

The level of development and maintenance have improved a lot in the last few years. In the vicinity of Larnaca there are additional beaches including another blue flag beach, an area designed as a regional park, forested areas and additional public areas.

The city has buildings designated for preservation. Some of them have been preserved in an admirable way, and now accommodate municipal, public and touristic users. A plan for preservation, renewal and development of the old city is under way. At the archaeological sites excavation continues, and the results gradually add to the touristic potential.

The city and its surroundings have many sites of attraction and a large potential to extend tourism beyond the summer season, as well as to new clientele.

However, the new development around most buildings designated for preservation is not well-directed and is not considerate. It lacks bearing to the preservation and definition of the urban pattern. In some cases archaeological sites have been irreversibly damaged.

7.2 The Port

Larnaca has the island's second most important port. It was built in 1983 and functioned as a cargo port but recently most of the activity that had taken place in it moved to the port of Limassol and other ports in the Mediterranean. The port does not function as a source of income for the residents and an important economic base as in

the past.

There is a plan to convert it to a tourism port. Its location in the centre of the city and adjacent to the marina make this port an important potential asset for the establishing and expanding tourism in Larnaca.

7.3 The Marina

Larnaca hosts the only public marina of Cyprus although others are planned. The marina is known to offer very good service for reasonable prices. It is operating with overcapacity and needs to be extended.

There are plans to expand the marina, but at the moment they are being held in abeyance due to proposals to privatise the service. The lack of coordination between the port authorities and the tourist authorities in charge of the marina still limit the realization of the potential of marine transportation and touristic development involved in it.

The marina is an attractive asset on the seafront and access for the public is currently restricted to only one small pier. It is hoped that when the facility is extended arrangements are made for people to walk round the whole area. Part of the marina is let to a contractor who carries out boat maintenance, painting, etc and this should be either fully screened or moved to a separate area if the extended facility is to be promoted as a tourist attraction.

7.4 Tourism Development

The touristic development of the city is blocked by the presence of the airport in the south and the refineries and fuel tanks in the north. The touristic image of the city and the quality of living of the residents are injured as a result of the environmental nuisances that accompany these installations. Moreover, in the north-east new resort areas were developed, with an emphasis on tourist attractions and entertainment.

Tourists are directed by travel agents to these places, especially to Limassol which has a greater quantity of hotel rooms and tourist attractions. Realization of the touristic potential of Larnaca is frustrated and delayed.

In the last few years there has been no new tourist accommodations developed in Larnaca, and there was a small decline in the occupancy in the hotels. There is a government policy that aims to improve the level and quality of the inventory of accommodation in order to reach higher quality and economically profitable tourism. This policy is being realized. In order to invest in the improvement and upgrading of the hotels and recreation resorts, the owners demand support in the form of permits to add rooms beyond the existing inventory, while the new policy allows no such flexibility.

The refineries and the strip of distribution depots constitute a nuisance and possibly a safety hazard. The tanks are deployed along 3 km on the coast front and constitute a

block and a visual nuisance that injures the touristic image of the city. In addition the tanks are accompanied by characteristic unpleasant odours.

8.0 PLANNING IN LARNACA

Existing planning presents a "final" picture without mention of the capacity, stages of development and dates for developing. Physical planning is not accompanied by budgeting (how much it will cost, to whom and when). Property rights, anchored in the Constitution enable development almost everywhere, and in consequence influence land value and increase pressures (the authorities usually resist) to develop engineered infrastructure over very large areas. It is accompanied by a lot of waste of natural and landscape resources. Directing is the link missing between comprehensive planning and detailed planning. The result is plans that are not coordinated, and thus the urban texture is badly damaged.

Directing and coordination may make the infrastructure more efficient and improve the quality of planning. Detailing in plans concerning local roads; squares; public buildings; public parks and other public spaces; character of construction; the nature of division and transition between common and private domain, can be useful to all parties concerned.

It is important to implement these to enable economizing on natural resources and financial expenses, and in order to cultivate and enhance the touristic character of the city (expansion of the attractiveness for tourism and travel beyond the classic touristic regions).

8.1 Industry

Larnaca has a diverse economic base and industry is strongly encouraged. The residents are not dependent on tourism alone for their living. There are three industrial areas, one of them is the first free trade zone in Cyprus.

Part of the industry does not pay taxes to the municipality, because it is situated outside its boundaries. Inside the urban area there are hundreds of small to medium enterprises, which increase the job availability and variety for the citizens, but cause nuisance and hazards as well.

8.2 The Oil Refinery

The city has grown, and the Refinery and distribution depots which have a great contribution to the town's economy are now a most strident enclave inside the urban pattern. Due to restrictions on construction development control, many residential buildings are very close to the refinery site. The site constitutes a serious aesthetic nuisance to viewers on the road and the sea, and an odour nuisance. These nuisances injure the tourist image of Larnaca. The survey of land and housing prices we conducted shows that the refineries strongly reduce the prices of real estate and housing in a large radius. It is reasonable to assume that the site as it is today is accompanied by the possibility of safety hazards.

In the community and the municipality there is great opposition to the continuance of the activity of the refineries in this site. In practice, plans for expanding and performance improvement are executed (though at a very slow pace) by decisions of

the central government, while partially bypassing the local authority.

For augmenting the amount of fuel stored for the state (for a period of 3 months instead of the existing one month), solutions for storage will have to be developed. Locating a site in the hinterland or anywhere else for storage of a fuel supply for 3 months can take into account the transfer of the tanks. This will return the beach or part of it to the use and pleasure of the residents and tourists.

The subject of the location and the actual existence of a refinery on the island is an economic, strategic and planning policy decision on the level of the central government. One of the possibilities that will be considered is that Cyprus will import distilled fuel only, instead of crude oil, and then will not need a refinery.

8.3 The Proposed Desalination Plant

The proposal will make joint use of the electricity infrastructure with the adjacent airport, and is close to the existing water pipelines. However, the Municipality and others including NGOs oppose the government decision, and indicate a few more feasible possibilities for increasing the quantity of desalinated water, which apparently have not been examined thoroughly.

It has been decided to locate the plant inside a nature reserve, immediately after the designation of the reserve. The decision was made before conducting an environmental assessment survey and apparently without any local consultation. It seems somewhat pointless to declare the first protected zone on the island and then immediately propose a construction in that zone, particularly as there are other sites available. By this means, the Government are conveying a message that the protection provided by their previous declaration is of little value.

8.4 The Airport

Larnaca, has the main international airport on the island, the second most important sea port and the largest and busiest marina. It is a gateway to Cyprus, and enjoys international and local accessibility as it is connected by highways to all the neighbouring cities.

As such, and being also a major city, Larnaca can be used as a base for tourists visiting the island. Highways now connect Larnaca with Nicosia (30 minutes ride) Limassol (45 minutes) and Agia Napa and other resorts in the southeast. This system creates a potential for developing the city as a focal point for tourism. Tourists can stay in a hotel in the city or near it and enjoy its beaches and attractions and make short trips to other nearby sites. At the moment this potential is not realized. It seems that tourists travel directly to other settlements, rather than to the hotels of Larnaca.

The excellent access from the airport can be an advantage to the economy of the city and to the quality of life of the residents. The airport already contributes to the economy of the city and its diversity. The expansion of the airport will add jobs and special commercial areas. The airport extension is planned for up to 12 million passengers per year, while the current number around 4 million a year.

There is another international airport at Paphos which is also to be extended to accommodate a forecasted increase in passengers per year. The declared policy is to check the increase in the number of tourists and it is not clear by what scenario the number of passengers was determined, and if the significance of the total forecasted passengers for the two airports for the carrying capacity of the island was assessed.

The airport is very close to the city, and especially to the settlements south of the runway. A perfunctory environmental impact assessment was conducted but even more questionable is the need for the proposed expansion. The environmental impacts assessment does not offer an answer to some of the main problems involved. For historical reasons, the airport was located on one of the most unique areas in Cyprus - the salt lake. There seems to be no alternative to this location, and the airport will be enlarged on this site. The fencing of the airport area for the final stage of development, that will be realized (if at all) in 30 or 50 years, will reduce the open expanse of the Salt Lake area.

The negative impacts of the airport need to be minimized, for two reasons. Firstly, its proximity to a populated area and secondly, its proximity to a nature reserve.

8.5 Traffic, Roads and Parking

Some of the arterial roads and most of the local roads are in bad repair in all aspects of the development level such as inadequate pavements, drainage systems and landscape development. This situation is especially striking in the road connecting the city centre to the tourist area in the north, which passes between the refineries and the fuel tanks. In some of the residential areas not only are the roads in bad repair, but they are situated badly, in a way that makes orientation difficult and the use of land less efficient.

The phenomenon stems from the lack of detailed planning and leaving the planning in residential areas in the hands of the developers, without sufficient coordination and direction.

In the last 3 years, many parking lots have been created mainly in the city centre. This is a very partial solution to the down town traffic problem. The existence of parking lots encourages people to reach the area with their cars, and cause a traffic load on the roads leading to the centre. The parking lots are not sufficient in traffic peak time hours. Nevertheless, with wise planning they will enable the preservation of the pattern of the old centre, and develop it as an area of tourism and commerce with priority to pedestrian traffic.

9.0 RECOMMENDATIONS

9.1 General

It is now time for Cyprus to protect and stabilize its achievements by promoting the sustainable development of the island. There is a need to conduct a comprehensive review of the strengths and potentials, weaknesses and constraints and threats in respect of the island's environment, and to develop and implement appropriate strategies for the sake of the environment and the people.

Responding to the challenge of assisting with the development of an Agenda 21 for Larnaca leading from this audit, the following recommendations aim towards the comprehensive sustainable development of the various aspects of Larnaka's growth.

Our recommendations relate to existing conditions at the various levels, from the entire system of the state (including external influences on which there is almost no control, such as global economic situation, political conditions in the country and region, etc.) to the specific site level. They focus on the level of the city with special attention to its relations with its environment and the need for coordination between the municipality, the neighbouring boards, district and state authorities.

Finally, the recommendations refer also to specific localized points of interest. It is recommended that priorities in implementing the recommendations take into consideration, among other issues, the degree of control the local level has over the various factors that require attention.

The discussion stems from the outlook that views city planning as an inter-disciplinary profession that includes spatial, physical and environmental aspects, as well as social and economic ones. The recommendations refer to general planning policy, coordination between and within organizations and various interest groups, and to legal and institutional issues.

9.2 Institutional Considerations ??

It is necessary now to find the balance between centralization which was suitable in times of crisis and when skills were lacking at the local level, and decentralization that enables efficient and effective responses to be made to local needs, aspirations, constraints and potential. This balance is essential if we take into consideration the actual trends in the western world regarding pluralism and democratization.

In the present situation, the central level is much stronger than the local level. The difference in power is expressed, among other things, by the fact that according to the planning law, projects promoted by the central government do not require planning and building permits. This is a dangerous situation. Branches of the central government sometimes make decisions and locate projects from considerations of feasibility and rapid execution, without sufficient awareness of local needs and constraints. Even when there is coordination, it is done out of a position of power of the central level. But it is the local government that has to face the impact of these projects later. The main issues on the present environmental agenda such as decision making regarding the future of the oil and gas tanks and the refinery, the airport expansion plans and the desalination project, illustrate this situation well. Problems are aggravated by an unsuitable, out-of-date institutional strategy, which might lead to undesirable situations for most stakeholders, and to environmental threats and hazards.

It is therefore, recommended that consideration be given by the Municipality, Central Government and other bodies, as appropriate, to :

A review of inter-organizational duties, relationships as well as authority and responsibility division.

The development of mechanisms of coordination, cooperation and of forecasting,

prevention and mitigation of conflicts between stakeholders in the national and urban arenas including.

9.3??Cost Benefit Considerations

Larnaca currently bears the burden of a some national facilities including the international airport and the refineries without benefiting from them, taking into consideration the costs and nuisance they create.

From this reason, the limitations of the taxation system and distribution of responsibility noted above, a change concerning the institutional-organizational issue is required in respect of both laws and regulations.

The decisions on the subject are naturally, on the state level, but due to the importance of the subject, the local authorities should initiate constructive rapprochement with the national level. Central Government will also benefit from the new arrangements due to the suitability of the new tools to be implemented, to the special needs and conditions in the towns and communities. Another important benefit will be an increase in motivation on the local level to promote issues important to the state, the citizens, tourists and developers.

Any improvement of the cash flow from tax revenues will enable the local authority to improve the services for the residents and tourists, and to upgrade the touristic product. As a result, revenues from tourism will increase, and so on.

It is, therefore recommended that consideration should be given to a revision of the taxation systems, with the aim of reflecting real costs, investments, benefits, and priorities at the local level.

9.4 Planning Policy and Decision Making

9.4.1 A Comprehensive National Plan

Cyprus needs a comprehensive national plan, in order to direct controlled development and increase the efficient use of limited and expendable resources. This decision should be made on the state level, but Larnaca should indicate and warn about the need for such planning, in view of the city's experience, for instance, the decision concerning the desalination plant.

The comprehensive plan should address the issue of desired population capacities in various stages and in various locations, and will consider also the costs of development and financing sources on the time axis.

9.4.2 Environmental Sensitivities Survey

Considering the small size of the Island, the sensitivity of its environment, and the irreversible damage that has already occurred, we recommend that a survey of Cyprus environmental sensitivities should be completed as soon as possible. Ecological, hydrological, landscape sensitivities, archaeological sites etc., should be mapped and analyzed in an integrative manner with the aid of a GIS system.

This survey will serve as a basis for planning and development control, both along the coast and inland. In this way, maximum benefit will be achieved from both development and preservation, since development will be done in the less sensitive places, with the least landscape and nature values and the least potential for tourism. Preservation will apply to areas with unique attributes and local attractions. These areas constitute a source of identity and pride to the citizen on one hand, and interest and a source of attraction to the tourist on the other. Preservation will replace investment in "new attractions" of the kind that can be found anywhere else in the world.

9.4.3 Limiting and Controlling the Use of land

There is a need to limit and control the use of land both along the coast and inland. The unlimited urban sprawl is a source of environmental threat to most natural resources, as it is accompanied with high infrastructure and energy costs.

The existence of undisturbed open spaces and agricultural contributes to the visual quality and uniqueness of the area, preserves picturesque views for the residents and next generations, and increases the tourism potential. The deployment of the tourism on a large expanse with a variety of attractions, not only on the beaches, and extending beyond the summer season will increase both the period of stay of tourists in the place, and the average number of tourists visits.

There is a need to develop and implement mechanisms and tools for building control and for limiting development without significantly encroaching on property rights, and without compensating landowners with sums that are unreasonably high from the state's point of view. In order to develop these tools, one can learn from the tools that have been successfully implemented in other democratic countries.

Transfer of development rights that was used in recent years in Cyprus, including Larnaca, for the preservation of historical buildings, and land consolidation that has been successfully implemented in agricultural areas indicate that the implementation of this kind of tool is possible.

Among the means for achieving this objective is differential taxation that encourages on the one hand construction development in defined areas and in desired densities (low taxation for desired density development, full taxation on undeveloped land). On the other hand, very high costs of taxation and development will deter those interested in building in low-priority areas.

This kind of strategy encourages land owners to develop, or alternately to sell the land on the free market, or to exchange their property with land of equal value in a non-priority area (possibly by establishing a "land bank" for this kind of purposes).

Others tools could include establishing mechanisms of land reparation and land exchange, and of purchase and sale of lands in a land "bank" encouraged and backed by the establishment.

There is also a need to extend the means of enforcement, and improve coordination with the judicial system in respect of deterring punishment.

It is, therefore, recommended that consideration be given to:

- 1. Commissioning an environmental sensitivity survey for the whole island as detailed above in 9.4.2.**
- 2. Placing greater emphasis on limiting and controlling the use of land, including developing and implementing mechanisms and tools such as the transfer of development rights, differential taxation measures, land reparation, land exchange and land 'banks'.**
- 3. Extending the means of enforcement and providing punishments which will act a deterrent.**

9.5 Planning for the Future of Larnaca

9.5.1 The Local Plan

While updating the Larnaka local plan, problems and opportunities mentioned in this report should be taken in consideration. The updated version should include recommendations for development phases, and point out prioritized infill and development areas. Fiscal, participatory and innovative means, designated to fit the local characteristics, should accompany the planning and implementation processes.????

It is proposed that the local authority initiate the preparation of detailed plans and levy the costs on the developers when they realize the development. This procedure should replace the existing one. Presently, the landowners or developers prepare detailed plans whenever they are interested in development, with very poor coordination with previous and future development. The planning should address the needs of the city, the neighbourhood, the community, the developer and each inhabitant and try to impart to the city the charm and uniqueness of the kind we view in towns for residents and tourists alike. This is additional to increased land use effectiveness and improved functioning of the urban scheme.

For selected areas in the city, that have special potential, urban design, and architectural and landscape schematic plans should be prepared previous to development in order to direct the various landowners, architects and engineers regarding the particular sites.

Regulations concerning design of structures with consideration of adjacent urban patterns should be development and enforcement.

It is, therefore, recommended that consideration be given to the inclusion of the recommendations of this report in drawing up the revised local plan, in particular:

The initiation of detailed plans for development,

The preparation of architectural and landscape schematic plans for

selected areas of the city,

The development and enforcement of regulations governing the design of structures.

9.5.2 A Masterplan For Tourism

A comprehensive masterplan for tourism in Larnaca and its surroundings should be prepared, which will consider existing sites, will be based of local strengths and weaknesses, will indicate possible connections between existing attractions, and will identify new ones. This masterplan will integrate with the findings of the sensitivity survey mentioned above and with the comprehensive and detailed planning of the city. It is desirable that the city and its surroundings will become one large tourist region, so that both the tourist and the resident will enjoy the increase in opportunities and improved development.

Tourist tracks or routes should be developed which will direct the tourist to places inside the city and on its outskirts, in order to raise their awareness of the uniqueness of the city. The tour tracks that connect focal points of interest will receive special design and landscaping care. The expansion of tourist infrastructure will be done in a way that emphasizes Larnaca's uniqueness as a vital and diverse city all year round, unlike other settlements that specialize in tourism, where one meets in the street mostly other tourists and they become "ghost -towns" out of season.

The City's potential for attracting international conferences and seminars should also be investigated. Mediterranean conferences are common but usually held in the larger western cities. Cyprus in general, and Larnaca in particular, have a great deal to offer and should be promoted. As little space remains for seafront hotel development, a new generation of inland hotels should be considered which could be within reach of the newly modernised airport, and the beaches, and provide high class conference facilities.

Suggested development will include tracks for pedestrian touring, bicycle paths and public transportation. In any case, effort will be made, to integrate the needs of tourists and residents.

It is, therefore recommended that consideration should be given to the preparation of a sustainable tourism masterplan for the city which examines existing tourism and details proposals for the future, including the following:

The development of tourist routes or tracks to highlight the city's attractions.

Proposals to develop 'inland' hotels and to capture a share of the international conference market.

Proposals to improve the road infrastructure and public space development.

The promotion of a public transport system integrated with other planning and enforcement rules, such as the control of urban sprawl.

9.5.3 Site Specific Recommendations

The following recommendations should be considered in respect of specific sites in the Larnaca area:

The City Centre

The promotion of plans for preserving and improving the sight and function of the city centre.

The Refineries Area

A risks assessment and an integrative assessment of environmental impacts should be carried out and their conclusions should be implemented. In the short term, measures to reduce the visual impact of the area should be undertaken including a special landscape design of the frontal roadside. In the long term, a plan to transfer the facilities to another site should be developed together with proposals for the alternative use of the beach that will be vacated.

? ? ?

The Port and Marina

The conversion of the port to a passenger port and the expansion of the yachting marina should be planned and developed including the expansion of the existing promenade, opening vistas to the sea, high quality hotels, and adjustment of adjacent uses to the character of a tourist area. The marina should be opened to the public the boat maintenance yard should be separated from the public area.

?

The Salt Lake

The area preservation plans should be implemented, and integrated into the proposed touring routes.

?

The Proposed Desalination Plant

This plant should not be located in a recently declared protected area. Alternative locations should be considered including the expansion of the existing plant at Dhekelia or enlarging the proposed plant at other locations.

The Airport

An updated needs assessment and environmental impact assessments should be completed before implementation of the airport expansion.

The fencing of the airport should be completed to the boundary of the intermediate stage only, while preserving the area of the nature reserve for as long a period as possible.

The Voroklini Lake

Imaginative plans for the creation of a quality recreational facility should be developed for this site.

9.5.4 Monitoring and Stakeholders Participation

The following recommendations are made for the consideration of the Municipality and other bodies, as appropriate:

A system of follow-up and monitoring of the environmental planning issues should be established.

Educational programs on the subjects of environment, planning and tourism should be developed including the involvement of pupils in the local events in town.

Specific programmes for tourists who are interested in the city in the fields of environment, planning, research and education should be developed including meetings with local professionals, study tours and participation in local activities and projects.

Mechanisms for public participation in planning and environmental management should be developed including the integration of NGOs and other citizens groups into policy forming and in monitoring of policies and project implementation.

Mechanisms of conflict management among and inside groups, organizations and communities should be developed including training professionals and laymen to act as mediators between sides in conflicts in their occupation and in their neighbourhood.

CHAPTER 7 HOUSING AND HEALTH CONDITIONS

1.0 HOUSING

1.1 General

Few people in Cyprus are without decent housing. At least since 1974, the Government's policy has been to ensure that everyone has access to adequate housing. As a result, only about 5% of the population live in substandard housing, mostly in rural areas. There are virtually no homeless people.

Houses are expensive in Larnaca, for a number of reasons. Firstly, land speculation has driven up the price of houses. In Cyprus, people traditionally invest in land rather than in bank accounts or stocks and shares. Secondly, most building materials are imported, which drives up the cost. Thirdly, many foreign residents buy vacation houses and apartments in Cyprus, a phenomenon that increases demand in the housing market, and prices rise as a consequence.

However, while housing prices are high, rents are low, due to rent control. Rents can be raised no more than 14% every two years. According to the 1992 Census, there are 23,800 households in the Larnaca Area. Most of these houses are in good condition.

1.2 Refugee Housing

In 1974, nearly 20,000 refugees arrived in Larnaca. Many came with little more than a car and some clothes. Housing the refugees became a top priority for the government. Refugee camps were established throughout Cyprus, several in the Larnaca region. With financial assistance from the United Nations, the United States, and elsewhere, the Government built houses for refugees.

Initially, the government provided the refugees with tents. Later, refugee estates with permanent houses were established. Construction started in the late 1970s and continued through the 1980s and early 1990s. Priority was given to those who were poorest. Some were given plots of land and small grants to build their own houses. Others were given houses built by the government. In other cases, the government subsidized the purchase of flats.

There are 7 government housing estates within the Larnaca municipal boundaries: Kokkines, Agioi Anargyroi, Tsakilero, Agios Georgios, and Agios Ioannis estates in the north, Kamares and Zinon estates are in the west part of the town. Most of the refugee houses are less than 15- 20 years old. Nonetheless, many need to be upgraded

1.3 The Construction of Houses and Apartments

Cyprus is undergoing an accelerated process of development and construction for

housing and vacation residences. The rate of housing units built is much higher than required by the slow growth of the population. The reason for this is the constant increase in the standard of living. Next to construction for young couples purchasing their first home, part of the new construction is designated for improving housing conditions of older residents. A notable phenomenon is of established refugees living in government flats, buying lots adjacent to the old buildings they had lived in, and building new houses on these lots, based on the existing social-community pattern. Many refugees tend to buy land for construction or flats for their children in the same area.

In Larnaka and its surroundings a rapid process of residential construction is taking place. A phenomenon unique in its scope is the construction of vacation houses (a second apartment) for the local population and for tourists.

The basic land unit is 520 sqm, and the custom is now to construct on it one or two apartments. The area of these is 150-200 sqm and more. In most parts of the city and especially near its centre, there is also construction of buildings 4-8 stories high, on joined lots.

The areas considered prestigious are north of the salt lake and the area near the hotels in the north of Larnaka bay. The less preferred areas are those around the refineries, and adjacent to the refugee residences in the northwest of the city.

Towards the end of 1998 a recovery in the real-estate market was apparent. Land values were between 40-50 CY£ per sqm in the refinery area and 60-80 CY£ in the north-west (an area characterized also by odour nuisances caused by animal farming in nearby villages), to 100-150 CY£ per sqm in the more prestigious areas. In the main streets, where land can be used for commercial uses, its value reaches 250 and even more CY£ per sqm. The values of apartments range from 13,000 CY£ for a studio flat to 50,000 CY£ and more for a 3-bedroom flat with an area of 100-120 sqm.

2.0 HEALTH CONDITIONS

2.1 General

The Cypriot people generally enjoy good health and are offered 100% access to health care. The life expectancy is given as 75.01 ('98). The infant mortality rate is 7.89 deaths/1000 births ('98) and the child mortality rate is 8 per 1000.

2.2 Causes of Death - Cyprus

Out of 4956 deaths in 1996, the cause was not stated in the mortality list in the case of 2272 deaths, however, of the remainder the following principal causes were identified:

Diseases of the circulatory system	1557
Neoplasms	450
Diseases of the respiratory system	385

Diseases of the digestive system	59
Diseases of the genitourinary system	36
Septicaemia	24
Endocrine, nutritional and metabolic diseases	22
External causes	108
Of which - transport accidents	76
- accidental drowning & submersion	17

2.3 Road Traffic Accidents - Cyprus

Deaths in road accidents per 100,000 population:

1985 - 21.4
1990 - 17.4
1997 - 17.5

CHAPTER 8 TRANSPORT AND ENERGY USE

1.0 TRANSPORT IN CYPRUS

1.1 Car Dependency

Poor public transport systems coupled with increasing affluence has resulted in Cyprus having one of the highest car ownership rates in the world. This car culture has, in turn, led to urban congestion, and a consequent mind set amongst some local and central government officers and elected representatives which calls for more roads and widening schemes to meet the demand.

In addition, most of the petrol used is leaded and the diesel has a high sulphur content (See Chapter 10), and in total road transport is consuming 47% of the country's available energy. The resulting air pollution is rarely visible and is monitored only in Nicosia, but localised pollution is present and must be particularly high in some urban areas on sunny, still, summer days. The natural ventilation of the coastal cities reduces the impact but it exists and is a risk to the health of residents, particularly the children.

1.2 Reversing the Trend

It is becoming recognised in many parts of the world that more and wider roads simply increases the amount of traffic and its speed. Whilst some nations are still laying out new roads to 'improve' traffic flow, the more enlightened ones are deliberately restricting flow through the introduction of exclusions zones, pinch points, sleeping policemen and other obstructions designed to slow traffic down. The argument is similar to the one for water supply or energy use. Should the responsible authorities always set out to meet the public demand, no matter what the environmental consequences, or should they aim to control the demand? The modern thinking in respect of traffic is the latter for sound environmental, health, safety and (usually) economic reasons.

There will always be some urban road improvement which are necessary for safety reasons but generally the highway engineers should aim to improve flow only between cities. Urban areas, like Larnaca should be aiming to reduce traffic, particularly in the centre, by means of peripheral parking linked to public transport, pedestrianisation, traffic restrictions and calming measures in residential areas. In time, the only traffic allowed into the centre should be buses/mini-buses and taxis with special arrangements for the disabled.

Efficient, clean, attractive public transport is required in the urban areas and inter-city if people are to be dragged out of their beloved cars. However, the achievement of such a target will not only lead to cleaner safer and more commercially viable city centres but also, in time, to a re-think of urban planning so that the car is not an essential prerequisite of urban life.

1.3 Vehicle Data (Cyprus)

Type	1985	1990	1997
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Vehicles in circulation			
(licensed at end of year)	220,383	316,437	402,586
Saloon cars	126,010	178,602	234,695
Taxis	1,557	1,732	1,860
Available for rental	2,597	2,597	5,695
Buses	1,503	2,308	2,000
Goods conveyance vehicles	45,802	74,325	105,652
Mechanised cycles	40,002	50,953	63,264
Tractors	5,964	8,517	11,913
Other categories	1,102	1,732	2,190
New registrations of vehicles in the year	24,563	38,768	31,857
Persons per private saloon car	3.8	3.1	2.5

1.4 Highways

The 1996 estimate reported that there were 10,415 km of highways in Cyprus of which 5,947 were paved and 4,468 unpaved.

1.5 Air and Sea Traffic

	1985	1990	1997
Aircraft landings	14,193	18,713	22,840
Ship arrivals at ports	4,793	5,638	4,593

2.0 RECOMMENDATIONS

Recommendations in respect of air pollution and monitoring are given in Chapter 10 and those relating to urban planning in Chapter 6.

It is appreciated that restricting car use is an extremely difficult political area and that car users are very resistant to any measures which appear to be aimed at removing their independent mobility and perceived 'freedom'.

However, it is recommended that consideration be given to a range of measures to reduce the resource use, pollution, safety and land use implications of the current excessive use of private motor vehicles in Cyprus, including:

The use of economic instruments to encourage the greater use of unleaded petrol, leading to an eventual ban on leaded fuel, and the use of smaller, more fuel efficient vehicles.

A complete cessation of new road construction and road widening schemes in urban areas other than those designed to improve pedestrian safety.

The development of long term plans for Larnaca, and other urban areas, to restrict the flow of traffic within the city centre and to institute traffic calming measures to all residential areas.

The development of an efficient, clean, smart system of suburban public transport including minibus routes linked to peripheral car parks in Larnaca and other urban areas.

3.0 ENERGY USE

3.1 The Current Situation Nationally

Energy is provided through the use of conventional fossil fuels and solar sources used almost entirely for domestic and hot water heating. Electricity is provided by 2 oil fired power stations at Moni and Dhekelia and the construction of a new plant is planned. The existing power stations impact on the environment through the attendant air pollution and thermal marine pollution. The high sulphur content of the fuel is a particular concern - see Chapter 10.

3.2 Managing the Demand

The developing national economy and higher standards of living are bringing about a growth in energy demand of around 4% per year. Once again part of the issue is proper demand management which requires the introduction of energy efficiency measures across all sectors and a pricing structure which penalises excessive use.

3.3 Solar Energy

There can be few countries in the world which are better placed to take advantage of the potential for the use of solar energy. The technology is improving and although some research has been undertaken by the Government no definite plans appear to

have been developed. Solar and wind energy would appear to be much more environmental sound solutions to the growing energy demand than another fossil fuel plant.

3.4 Research

A study has been commissioned by the Government, 'Preparation for an Action Plan for Improving the Efficiency of the Energy Sector' which is financed under the SYNERGY Programme of the EU. Measures for the reduction of CO₂ emissions and energy efficiency measures in all sectors have to be given particular attention as Cyprus has ratified the Climate Change Convention.

4.0 RECOMMENDATIONS

Recommendations relating to air pollution from the Dhekelia power station are included in Chapter 10 and those in respect of more fuel efficient vehicles are discussed above.

Meeting the future energy demand in Cyprus is a subject which has been well aired and studied in Cyprus. However, even though managing the demand to ensure the more efficient use of energy will not ensure future supplies on its own, experience in other countries has shown that substantial savings can be achieved and it is hoped that the Study will produce some tangible results.

It is therefore recommended that consideration be given to a long term policy for energy supply to the island in which both demand management and renewable resources must play a prominent part.

CHAPTER 9 SOLID WASTE MANAGEMENT

1.0 BACKGROUND: PREVIOUS STUDIES, BASIC DATA AND PLANNING

1.1 Municipal Solid Waste

At the end of 1992, the Ministry of Interior of the Cyprus Government granted to the consultants Carl Bro (Denmark) and NV Consultants (Cyprus) the "Feasibility Study for Recycling of Municipal Solid Waste (MSW) in the Main Urban and Tourist Centres of Cyprus". The study was finished at the end of 1994, hereinafter referred to as MSW94 Study.

The MSW94 Study consists of two parts:

Survey and evaluation
Recommendations

The MSW94 Study gave basic data about MSW generation and composition at both National and District level and this is the only data available for the Audit development, since Larnaca Municipality neither identifies nor registers MSW generation.

1.1.1 Generation in 1993

In order to carry out the MSW94 Study, field analysis on waste amounts and composition were performed. From the results of these analysis, MSW generation was estimated, as shown in table 1.

Table 1
Estimate on MSW generation in Cyprus, 1993 (t/y)

District	Residential	Tourist	Other	Total
Nicosia	118.300	600	26.200	145.500
Limassol	74.900	6.300	14.600	95.800
Larnaca	49.600	3.000	11.100	63.700
Paphos	25.000	5.900	5.500	36.400
Paralimni	13.200	10.200	4.000	27.400
Total Cyprus	281.400	26.000	61.400	368.800
Per capita generation (kg/y)	468	670	102	

Source: MSW94 Study (Carl Bro as (Denmark) y NV Consultants (Cyprus))

1.1.2 Forecast of the generation in 2007

Due to the growth in population, tourism and economy in general, the anticipated MSW generation for 2007 has been estimated as shown in table 2.

Table 2

Forecast on MSW generation in Cyprus, 2007 (t/y)

District	Residential	Tourist	Other	Total
Nicosia	139.400	1.200	47.200	187.800
Limassol	94.300	14.200	26.300	134.800
Larnaca	54.900	6.400	20.000	81.300
Paphos	30.300	22.400	9.900	62.600
Paralimni	17.800	38.700	7.200	63.700
Total Cyprus	336.700	82.900	110.600	530.200

Source: MSW94 Study (Carl Bro as (Denmark) y NV Consultants (Cyprus))

1.1.3 Composition

In July 1997, an additional study was carried out to complete and update the MSW94 Study data about MSW composition. The results are given in table 3.

Table 3
Average MSW composition in Cyprus (% W)

Glass	Paper	Card-board	Metal	Plastics	Textiles	Wood	Garden waste	Food waste	Other
1,2	18,8	9,7	2,3	12,1	6,7	1,0	9,3	32,3	6,2

Source: MSW94 Study (Carl Bro as (Denmark) y NV Consultants (Cyprus))

1.1.4 Disposal planning in 2007

As indicated in table 4, the MSW94 Study proposes that future MSW management in Cyprus should be based on recycling and incineration:

Recycling/composting:	40 % of MSW
Incineration:	60 % of MSW

The Cyprus Government considers this solution only as a proposal, and it has not taken a final decision yet, remaining willing to evaluate other solutions.

Table 4
Proposed MSW management system, 2007

Waste fractions	Potential amount (t/y)	Recycling efficiency (%)	Collected amount for recycling (t/y)	Remaining amount for final disposal (t/y)

Glass	6.363	65	4.136	2.227
Paper/cardboard	151.107	55	83.109	67.998
Metal	12.194	65	7.926	4.268
Plastic	64.154	25(1)	16.039	48.115
Garden waste	49.308	70	34.516	14.792(2)
Food waste	171.254	40	68.502	102.752
Combustible	50.370			50.370
Non-combustible	25.450			25.450
Total	530.200		214.228	For incineration: 301.180 For landfilling: 14.792

(1) Only PET bottles are collected for recycling

(2) It is assumed that garden waste will be disposed of at landfills

Source: MSW94 Study (Carl Bro as (Denmark) y NV Consultants (Cyprus))

1.2 Hazardous Waste

In 1994, the "Hazardous Waste Management Study" (HW94) was carried out to assist the Government of Cyprus with selecting a cost effective solution to the management of hazardous waste (HW). The HW94 Study was performed by the Swedish consulting group SWECO, and was financed by the European Investment Bank through the Mediterranean Environmental Technical Assistance Programme (METAP), administered by the World Bank.

The HW94 Study relates to waste classified by the European Union as being hazardous, according to the Directive 91/689.

1.2.1 Generation in 1994

The HW94 Study reassesses the types and quantities of HW that are generated in relation to a previous study on industrial waste and waste water carried out in 1986.

The amount of HW generated by private enterprises, public establishments and households is estimated in table 5.

Table 5
Hazardous waste generation in Cyprus, from all sources

Type of waste	Generated amount (t/y)	Quantities for treatment after existing internal reduction or pre-treatment (t/y)	Quantities for treatment after suggested internal reduction or pre-treatment (t/y)
Flammable substances	450	450	450
Pesticides	750	750	750
Medical waste	7.380	4.428	216
Waste containing certain heavy metals	39.654	39.654	20.020
Ashes and cinders	80	80	80
Miscellaneous	296.600	119.870	9.492
Total	344.914	165.232	31.008

Source: SWECO (Swedish consulting group)

The total generation of HW amounts to some 345.000 tons, of which approximately 8.000 tons are solid. The liquid HW is diluted by non-hazardous effluents, in accordance with current industrial practices.

The largest quantities of effluents containing hazardous compounds are generated at the bleaching and dyeing plants (286.000 m³/y), tanneries and at metal plating and aluminium anodizing plants.

Solid hazardous waste is generated at pesticide manufacturing plants, hospitals and at bleaching and dyeing plants. The generation of hazardous household waste is estimated to be 1,5 kg per inhabitant per year, based on experience gained in other countries.

1.2.2 Disposal planning

According to HW94 Study, after internal reduction or pre-treatment, some 30.000 t/y must be disposed of. Since most Cypriot industries are small, central treatment and disposal is considered to be the most effective solution. Two treatment and disposal facilities will receive the 30.000 t/y of HW:

Vathia Gonia Central Wastewater Treatment Plant: this facility has been in operation since 1998 and treats some 20.000 t/y of metal HW. The Vathia Gonia facility also treats 600.000 m³/y of domestic sewage and more than 100.000 m³/y of industrial non-hazardous liquid waste and sludges. Adjacent to the plant, there is a landfill cell to dispose of the hazardous sludges resulting from treatment.

A central HW treatment and disposal facility is planned to be located at Kotsiatis, 18 km South from Nicosia, close to the Nicosia municipal landfill. It

is proposed that this facility should have the following main parts:

- Storage area for chemical waste
- Refrigerated storage area for hospital waste
- HW incinerator (planned capacity: 2.000 t/y)
- Landfill cells for HW

The total investment in this facility is estimated at 4,2 MCY£.

1.3 Waste Management Legislation: Draft Bill for the Protection of the Environment

There is no specific legislation about waste management in Cyprus, but the main provisions on this matter are scattered throughout a number of national Laws:

- Water Pollution Control Law (No. 69/91)
- Atmospheric Pollution Control Law (No. 70/91)
- Roads and Public Areas Pollution Prevention Law (No. 19/92)
- Municipal Corporations Law (Cap. 240)
- Village Law (Cap. 243)
- Public Health Law (Cap. 259)
- Forest Law (No. 14/67)
- Public Roads Law (Cap. 83)
- Public Rivers Law (Cap. 82)
- Mines and Quarries Law (Cap. 270) and Regulations

MSW is managed by the various municipalities, which are responsible for the collection, transport and disposal.

The Ministry of Agriculture, Natural Resources and Environment (MANRE) has prepared a draft Bill for the Protection of the Environment, aimed at creating the basic legal text for the adoption of the bulk of the European Union's environmental legislation, including that relating to the most important international environmental conventions.

The whole issue of integrated waste management is proposed to be comprehensively covered in the draft Bill for the Protection of the Environment, which includes a wide range of provisions concerning the management of solid waste, packaging waste, deposit-return schemes, responsibilities for the management of solid waste, sanitary landfills, licenses for sites, responsibilities of licensees, keeping of records, waste management strategy, import of waste, responsibilities of waste generators, etc.

In respect of the waste management strategy, terms of reference have been issued to contract a specific study on this subject.

2.0 CURRENT SITUATION OF WASTE MANAGEMENT: DESCRIPTION AND DIAGNOSIS

2.1 Municipal Solid Waste

2.1.1 Generation

According to the MSW94 Study, in 1993 the MSW generation in Larnaca District was 63,700 tons. Since there is no registration of data, neither of the amount nor of the source of the MSW entering the Larnaca landfill site, it is not possible to know how much waste is produced in Larnaca Municipality and in the rest of the District. But, taking into account that:

About 45% of the Larnaca District population belongs to the Municipality,

About 65% of the industrial activity is located in the Municipality,

Municipal services estimate the increase in waste generation in Larnaca Municipality at 7% since 1992,

The current (1998) MSW generation in Larnaca Municipality can be estimated at some 35,000 tons.

This figure includes: ordinary and bulky MSW from households, commerce, hospital and clinics and industry; household hazardous waste; hazardous waste from clinics, and some hazardous waste from small businesses (most hazardous waste from Larnaca Hospital is incinerated at the premises in a pyrolysis kiln, so that it is diverted from the MSW flow).

2.1.2 Collection

The collection of MSW in Larnaca has the following characteristics:

There is no separate collection of recyclables. Only some aluminium cans (less than 5%) are collected separately by a charity NGO.

Apartment buildings must buy their own 1.100 litre containers, either of metal or plastic, and place them at the backyards so as to avoid garbage bins in the main streets. The occupier of the building is responsible for cleaning the containers to preserve hygiene and avoid odours.

In areas with single family homes, residents store their MSW in 62 litre plastic bins belonging to each family. The use of plastic bags by households to store garbage is common practice. Garbage bags are sometimes left on the side of the road (not in the containers or bins), but this occurs relatively rarely.

Single MSW generators (big supermarkets, fast food, Marina, some industries, etc.) have their own skips, generally without compaction, except for two cases:

McDonalds: 11 m³ compactor

Catering - Cyprus Airways: 24 m³ compactor

General collection frequency is three times a week (every two days, excepting Sunday).

From May to October, MSW collection from certain generators (hotels, restaurants, the hospital, dustbins on the beach and on the sea promenade, etc.) is carried out daily.

Once per year, for two weeks, the municipality places a skip to collect bulky MSW (beds and mattresses, appliances, furniture, etc.) in every one of the areas Larnaca is divided into for collection purposes. The rest of the year, this service has to be hired from the Municipality, provided that there is a significant quantity of bulky waste to be deposited in the skip.

For collection purposes, the Larnaca Municipality owns 12 lorries:

8 lorries of 16-19 m³ (10-12 t) for collection from bins and containers, plus 2 spare ones. During collection time, each lorry makes 2 trips to the landfill site.
2 skip collecting vehicles.

2.1.3 Disposal

Municipal solid waste generated in Larnaca Municipality is disposed of at the landfill site located next to the road between Klavdia and Tersefanou.

The landfill is built in a hollow and has no liner. However, according to the municipal services, the site is on a 40 meters clay geological barrier. Despite the fact that there is no leachate collection, during the site visit by the Audit Team no leachate escape nor superficial pollution could be observed.

Leachate eventually will infiltrate the soil until it reaches the water table. But, according to the ground water services of the Central Government, there is not any aquifer formation at the site and the local ground water is not connected to any ground or superficial flow of water that might be polluted. There is no monitoring of ground water quality around the site.

The landfill has no gas (methane) collection, but no accident nor fire has been reported.

Tractors spread and compact the waste, which is not covered with soil every day. Site access is not controlled during out of work hours, so that there is some illegal dumping of waste over the fence.

Municipal experts believe that the landfill will be full within 5 years under present waste generation and management conditions.

2.1.4 Collection and disposal costs and charges

The costs incurred in 1998 by Larnaca Municipality to keep the city clean are as

follows:

Collection and disposal of waste;	600.0000 CY£
Streets cleaning:	200.000 CY£
Other (beach cleaning, plot cleaning, etc.):	200.000 CY£

Larnaca Municipality is allowed by law to recover those costs by charging residents and businesses for the service:

Household:	50 CY£ (poor people: 25 CY£, elderly people don't pay)
Skip for household cleaning:	12 CY£ trip
Skip for business:	20 CY£ trip
Disposal at landfill for private users:	12 CY£ vehicle

The total income from those charges amounts to 800.000 CY£ in 1998, so there was a deficit of 200.000 CY£ in 1998.

2.2 Medical Waste

2.2.1 Classification

Before describing and evaluating current medical waste (MW) management, it is necessary to define it precisely.

MW is the waste generated by health care centres: hospitals, clinics, first aid health services, etc. From all these sources the following MW types can be distinguished:

a. MW equivalent to MSW

Waste non-specific to health care activity, which does not have any specific type of contamination. It comes from offices, cafeteria, storage rooms, waiting rooms, gardens, etc. It can be collected and disposed of together with **MSW**.

b. Biomedical waste (BMW)

Waste specific to health care activity, which is characterised by its potential biological contamination.

b.1 Special BMW (SBMW)

BMW that, because of operational or infection risk conditions, cannot be collected and disposed of by the same means as MSW, but it requires additional precautions.

b.2 Non special BMW (NSBMW)

BMW that can be collected and disposed of by the same means as MSW, but

that requires special management precautions inside health care centres.

c. Citostatic waste (CW)

Hazardous waste specific to health care activity, characterized by its contamination by citostatic drugs (used to treat cancer).

d. Non citostatic chemical waste (CHW)

Hazardous waste non-specific to health care activity, characterized by its contamination by chemical substances different from citostatic drugs.

e. Radioactive waste (RW)

Waste contaminated by radioactive substances.

f. Anatomical remains of relevance (AR)

Corpses and anatomical remains from abortions, mutilations or surgical operations. They have to be handled in accordance with the specific legislation, normally through incineration or being buried.

2.2.2 Disposal at Larnaca Hospital

Larnaca Hospital is owned by the Cyprus Government, it has 250 beds and is located in a residential area. Hospital waste waters are treated in its own treatment plant, with tertiary treatment by means of filtration and chlorination. Treated waters are used to irrigate some sports fields nearby, which have storage tanks. Sludge is digested aerobically and taken by tanker lorries to the Vathia Gonia treatment plant. During the Audit Team visit no operational problem was noticed at the hospital waste water treatment plant.

Solid waste (or liquid waste in containers, such as blood tubes) generated by Larnaca Hospital is classified and managed as follows:

Black bag: non-hazardous waste, which is accumulated in 1.100 litre containers, is collected by the municipal service and disposed of at the landfill together with the rest of the MSW.

Blue bag: waste which cannot be managed as MSW, according to the criteria established by the persons responsible at the hospital. This waste is incinerated in a pyrolytic kiln, located in the central services area of the hospital.

Liquid waste from analyzers is poured into the drain. The Audit Team was unable to obtain information on how the other chemical liquid wastes are being managed. Some of these are very hazardous: etide bromide, osmium tetroxide, xylene, etc.

The incineration facility (see annex 3, Chapter 10) of the hospital has the following characteristics:

Pyrolytic kiln with a treatment capacity of 75 kg/h. Two air tubes are embedded in the concrete bottom of the pyrolytic chamber, each having holes for the primary air (forced draft). There is also an auxiliary burner for the ignition of the material.

Post-combustion chamber (thermal reactor), where gases from the pyrolytic chamber are burned with a surplus of air, at a temperature from 800 to 1.300 °C (according to the provider).

To have a good destruction of the contaminants in the pyrolysis gases, the post-combustion chamber design must assure that the gases remain for at least 2 seconds at a temperature not less than 850 °C. During the hospital visit, fulfilment of these conditions could not be checked, since measurement equipment is not available at the facility.

From the post-combustion chamber, exhaust gases are evacuated to the atmosphere through a chimney stack which rises about 5 m over the terrace roof of the hospital. There is no gas treatment before it enters the stack.

Bottom ashes from incineration are managed as MSW. There is no fly ash generation as a secondary waste (there is no energy recovery).

There are also a number of small private clinics (10 to 30 beds). According to the waste municipal services, no clinic has its own incineration device, and all solid waste from clinics is collected and disposed of as MSW.

2.3 Hazardous Waste

2.3.1 Sources and disposal

The main sources of hazardous waste (HW) in the Larnaca Municipality are the following:

Small quantity generators:

Householders: batteries (Hg, Cd, etc.), pesticides, fluorescent (Hg), paints, etc.

This waste is not collected separately and is disposed of together with MSW.

Small businesses and industries. Table 6 summarizes the number and type of those units in Larnaca municipal area. The main HW from those sources are: solvents (some of them chlorinated), metal-containing liquids and sludges (some of them could have Cr⁺⁶ or CN⁻) and mineral oil and other car liquids.

Some organic or metallic sludges are taken to Vathia Gonia treatment plant. The remaining small quantities are disposed of as MSW or waste water (most of which is disposed of by absorption pits).

Refinery: the main HW is oil sludge resulting from the treatment (centrifugal) of bottom tank sludges. At the moment, those sludges are being treated by land-farming at the premises. The refinery intends to incinerate those sludges in a cement kiln, if it

can gather all necessary agreements and permits.

Until now, the refinery has hired external companies to treat centrifugally the tank bottom contents, though it is also considering building its own centrifugal facility.

Coastal tank farms for oil-derived product storage: these facilities also generate bottom tanks sludges, but much smaller quantity than the refinery, since finished products are being stored, with a low content of impurities. Until now, this HW has been stored on-site. Its future treatment could be subcontracted to the refinery (centrifugal treatment + cement kiln).

Table 6
Number and type of small industrial units in Larnaca municipal area

Type of unit	Number of units	%
Food industries/confectionery	38	6,2
Bakeries	28	4,6
Carpenters	73	12,0
Dry cleaners/laundries	19	3,1
Car mechanics	153	25,2
Clothing industries	42	6,9
Printing	25	4,1
Goldsmith	77	12,7
Workshops/Warehouses	74	12,2
Other industries	79	13,0
Total	608	100

Source: Larnaca Municipality

2.4 Conclusions

The MSW collection system at Larnaca Municipality works efficiently in terms of the prevention of the accumulation of waste and the cleaning of the urban and tourist areas. Thanks to the low-cost, or free of charge, municipal skip service to collect bulky MSW, illegal dumping in the municipal area hardly exists. If there is some, the response of the municipal cleaning service is fast and effective.

A portion of the MSW is collected in 62 litre garbage bins, or garbage bags which are sometimes left on the side of the road and could cause low efficiencies in the collection system and represents a certain risk for the collection workers.

Nearly 100 % of MSW is disposed of at a sub-standard landfill, without any kind of pretreatment. The only separate collection is carried out by a charity NGO and is limited to a very small percentage of aluminium cans. That represents a waste of precious resources: organic matter, raw materials and energy.

Despite the fact that the landfill has no liner, nor any leachate or gas collection, no significant ecological or human health risks have been reported to or detected by the Audit Team.

MSW landfill tipping fees charged by the Municipality to private hauliers or other municipalities are too low and not related to weight, since there is no registration or control on who delivers waste. This is a barrier to the reduction and valorisation of MSW.

There is not a clear definition of the real risks associated with the management of each type of medical waste and how to prevent them. According to the international experiences and knowledge, the waste may cause a significant risk of infection inside the hospital and clinics, specially to health care and cleaning staff.

Special biomedical waste and some solid hazardous waste from the Larnaca Hospital are being incinerated in a pyrolytic kiln with a post-combustion chamber which is too small and without any gas treatment system. In this way, the Larnaca Hospital incinerator becomes a important source of air pollution as several toxins may be emitted in the particulates and vapours, as follows:

- Dioxins (there is a lot of chlorine in medical waste)
- Heavy metals
- Acid gases
- Mercury
- Particulates

All special biomedical waste from private clinics is being collected and disposed of as MSW. This represents a low but significant risk for collection and landfill workers.

There are no special collection systems for urban hazardous waste. An important part of the hazardous waste in Larnaca municipality is generated in small quantities (by households, laboratories, other services, small businesses and industries) and disposed of at the landfill together with MSW. This represents a low but significant risk for collection and landfill workers.

Landfarming at the refinery of bottom tank oily sludges represents a very significant risk of pollution of ground water which could be connected to Kokkinokhoría aquifer or reach the sea.

The legislation about waste is fragmented into several national and local laws, incomplete and not very precise, and it does not comply with international standards, in particular those of the European Union. However, the Ministry of Agriculture, Natural Resources and Environment (MANRE) is working on a Bill for the Protection of the Environment to adopt the bulk of the European Union's environmental legislation.

3.0 PROPOSAL OF WASTE MANAGEMENT MODELS AND SOLUTIONS

Because of technical and economic factors, waste valorization cannot be undertaken by Larnaca Municipality alone. To look for economies of scale and technical

synergies, solutions with a wider territorial scope are advisable.

In this section the basic characteristics of those solutions are discussed. In section 4, recommendations for Larnaca Municipality to foster and develop those solutions are made.

3.1 Municipal Solid Waste

3.1.1. Mass management versus integrated management

Mass management essentially consists of:

The mass collection of MSW (that is, without previous separation into fractions), in containers of different sizes which are unloaded mechanically into lorries with a compacting box.

The disposal of MSW in sanitary landfills or through incineration, in infrastructures designed and operated to comply with legal rules.

This model, which is currently applied in Larnaca and in the whole Cyprus, is still being applied (with few, not very significant modifications) in some European Regions.

The modern approach "integrated MSW management", fostered by the European Union Directives, is basically characterised by two concepts:

a) The application of the different management options in a level approaching the environmental and economic optimum:

Prevention (reduction of the quantity of waste generated).

Valorization of MSW: material recycling, composting, energy valorization, that is, using waste as a secondary type of fuel.

Disposing of the rest (that is, waste not being valorised) and the refuse from recovery facilities by landfilling or incineration, or secondary valorization of the remainder by state-of-the-art technologies: advanced thermal treatment, anaerobic digestion, etc.

In an integrated MSW management system, prevention is a priority, but the key option in the short run is recycling. However, recycling is not a goal in itself, but just one more management option, among others, suitable for certain materials and up to certain levels, from which it is not economically and environmentally feasible.

Most prevention implies changes of product and packaging design, which in turn depends on variations in the habits and environmental conscience of the consumers. By nature, really effective measures to foster prevention require a

national approach and, occasionally, extend even further. Maintenance in the short run of the current per capita generation levels should be considered an ambitious goal.

As far as recycling is concerned, its goals depend on diverse economic and environmental considerations which are difficult to assess. These are tempered by socio-political factors, the involvement of the population, and the lobbying of economic and ecological groups. It is considered that a net diversion from disposal of around 40% of waste is an ambitious goal, but it is economically and environmentally appropriate. Through secondary valorization of the residue, that percentage can be significantly increased. To reach such high rates of recycling it is essential to obtain secondary materials of quality, price and regular supply as demanded by the market. In particular, it is considered that the quality of the recovered materials is a decisive factor, in a competitive but growing market.

Moreover, the recovery of dirty materials with a large proportion of contraries becomes more complex and expensive as it is more difficult to classify and requires more stringent labour security and health measures, larger facilities, and more energy. In this sense, so-called "recycling and composting facilities", which produce recyclable materials and compost from mass MSW, are not considered to be a viable solution.

Therefore, virtually all European countries, which apply integrated management systems consider that separate collection is essential as a prior step to the valorization of MSW. This is also the opinion of the Audit Team

.b) The active, responsible involvement of all the agents concerned is required:

Producers, wholesalers and retailers, because the products that they place in the market become waste.

Citizens and companies generating MSW after consumption, on whom separate collection depends.

The Administration responsible for a public service.

For the integrated MSW waste management to achieve its goals, a constant effort in organization is necessary. Most of this effort should be carried out through a set of promotion and coordination instruments, which are technical, administrative, legal, economic, and informative. It is also vitally important that the necessary resources should be dedicated. The systematic development and implementation of those instruments are an essential characteristic of a true "MSW integrated management system". As an example, we mention some instruments which should be borne in mind:

Legal rules that make it compulsory for industrial and service generators to separate recyclable waste for collection.

An office to certify the quality of the compost and foster its use. In particular it is necessary to define compost quality standards.

An optimal design of the separate collection containers and their area of influence.

A door to door information and awareness campaign for the population, to be devised in a professional way.

The provision of internal means of waste separation in homes.

Institutional measures and support to develop the market for recycled materials.

3.1.2 Factors conditioning MSW management in Larnaca.

A number of general and local conditions justify setting up a MSW integrated management model in Cyprus and, in particular, in Larnaca, and they entail the optimization of its specific design:

The strong contribution to the greenhouse effect by the methane generated in the poorly designed landfills.

The opposition of the population to the setting up of certain waste disposal facilities, particularly MSW landfills and incineration facilities.

The importance of recycling as a self-esteem and identity element for the population.

The importance of the separate collection and recycling for the international image and tourism.

The opportunity to develop local industries to take advantage of the recycled materials.

The appearance of new, more efficient, flexible and economic technologies such as the automatic sorting of recyclables, wet anaerobic digestion, etc.

The major advantages that the large scale use of compost made from good quality organic waste can bring to Cyprus:

Increasing the organic matter content of the agricultural soils in Cyprus, which are generally deficient.

Decreasing the use of inorganic fertilizers and pesticides, a non-point source of superficial and ground water pollution.

Increasing the water retention capacity of the soil which is especially important for water saving, since more than 70 % of the water demand in Cyprus is for agricultural purposes.

The opportunity of obtaining new financial resources by the application of the principle of producer responsibility, which states that companies responsible for placing in the market products or packaging which will become waste must bear the cost of managing that waste. Through this principle, MSW management is eventually paid for by the consumer and not by the tax-payer. The Directive on packaging and packaging waste is the first European law which applies this principle, and other directives of the same type are being developed covering electronic and electrical goods, end of life vehicles, tyres, batteries, and others.

Engagement with the principle of sustainable development, which is incompatible with the destruction of natural resources and energy implied by the disposal of waste in landfills and even its incineration.

3.1.3 Proposal for the design of MSW integrated management in Larnaca

As explained in paragraph 1.1.4, the Government of Cyprus has planned the setting up of a MSW integrated management over the next few years, based on recycling and composting from separate collection and the incineration of the remaining fraction. In accordance with the conditions outlined above, some basic aspects of the system are specified in detail and some important modifications are proposed.

3.1.3.1 Separate collection

In view of the composition of the MSW (see paragraph 1.1.3), separate collection should concentrate on three main fractions:

Organic matter; paper and cardboard; light packaging (plastic, metal, cartons)

Since there is such a small amount of glass in the MSW (1,2 %), its separate collection is not recommended, at least at an early stage.

The quality of the separate collection materials should prevail over quantity. That is why the following measures should be considered as appropriate:

To give priority to single generators, that is, those able to easily separate large quantities of high quality recyclables; for example: office buildings (paper and cardboard) or hotels, restaurants, catering services (organic matter).

Not to implement separate collection in isolated or low population density areas, at least at an early stage.

In that sense, planned separate collection objectives (see paragraph 1.1.4) could be considered slightly overvalued, especially if separate collection cost are to be maintained at reasonable levels.

Bulky waste is the main cause of uncontrolled dumping which may damage the city's image. The current system of collection on predetermined days has two important limitations:

Citizens want to get rid of a waste that is bothering them immediately and they are not willing to wait for days or weeks to have it collected.

Waste collection without separation by type of material makes valorization difficult.

That is why it is necessary to equip permanent points for bulky waste delivery, the so-called "Recycling Parks" (see figure 2).

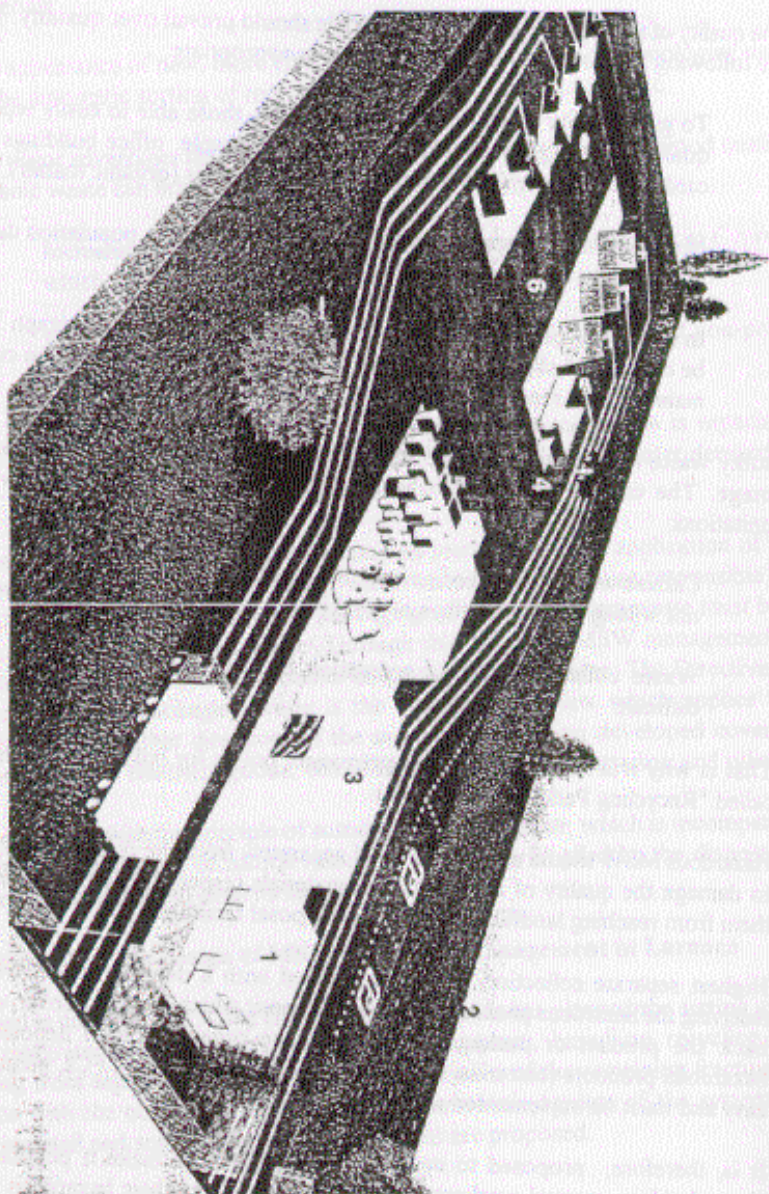
Hazardous MSW should also be collected separately from the rest of MSW, in order not to damage the quality of the valorisable materials (especially compost) and to prevent them from reaching landfills or other final disposal facilities.

Highest separate collection levels are reached with a deposit system where the user receiving the hazardous product must leave a deposit which he will recover when he takes back the product or packaging. However, the organization of deposit systems for hazardous products (batteries, fluorescent, refrigerators with CFCs, paints, etc.) is not easy and must be implemented at a national level.

It is, therefore, proposed to equip Recycling Parks to make it possible for citizens (householders, manual workers, shops, etc.) to deliver their hazardous waste free of charge. This municipal service could be extended to small quantity generators of HW (see paragraph 3.3).

Ordinary recyclables (paper, plastics, organic matter, etc.) would be also collected at Recycling Parks. Table 7 shows proposed separate collection levels.

Figure 2
Recycling Park



1. Information and reception desk
2. Perimeter fence
3. Domestic hazardous waste storage. This building could be extended as a transfer station for HW in small quantities from industries and services.
4. Lanes and big containers for bulky waste delivery
5. Containers for separate collection
6. Lane for loading lorries

3.1.3.2 Valorization and disposal

The incineration of the remaining fraction is not considered a viable solution for Cyprus for several reasons:

Energy recovery would be low, since there is hardly any possibility for heat recovery.

Most organic matter (60 % according to separate collection goals) would be lost.

In view of the strict gas emission limits that are going to be in force in Europe in the future, the economic feasibility of incineration will demand high capacity facilities (250.000 to 300.000 t/y), which is incompatible with the proposal to set up two incineration sites.

Incineration can generate up to 30% secondary waste, some of which (fly ash) is classified as hazardous.

Incineration is in practice a barrier to reaching the prevention and valorization levels that integrated management demands.

An Ecopark as an alternative

As an alternative to incineration, The Audit Team proposes the Ecopark concept: - an integrated treatment centre for waste from different sources, which gives rise to the technical synergies and the economies of scale which are necessary to optimize material valorization and energy recovery.

In its most encompassing design, an Ecopark has the following waste valorization lines (see figure 3):

Valorization of the MSW organic fraction, together with other organic waste which are generated within the area of influence of the Ecopark, such as:

- Industrial organic waste (food industry)
- Sludges from urban wastewater treatment plants.
- Green waste
- Pig manure
- Sea grass (waste from beaches)

Organic matter can be subject to two different treatments according to its quality and physical state:

Composting (aerobic) of the best quality solid organic matter: organic matter from MSW separate collection, industrial waste, sea grass, green waste, solid manure. The output product is a high quality compost with a remarkable content of fertilizing substances.

Table 7

Proposal of MSW separate collection levels

Collection method	Type of generators	Collected fractions	Collection frequency	Maximum distance citizen has to travel
Door to door	Single-family houses	Food and garden waste (hotels and restaurants)	Daily	0 m
		Paper and cardboard (offices and shops)	Periodically	
		Bulky waste	Daily	
		Food and garden waste	Twice a week	
		Remaining waste	Periodically	
Recycling banks	Backyard of buildings	Paper, packaging and textiles (clothes and shoes)	Daily	100 m
		Food and garden waste	Periodically	
		Paper and cardboard	Periodically	
		Light packaging	Twice a week	
		Remaining waste	Periodically	
Recycling Parks	Group of houses	Bulky waste	Periodically	3-4 km
		Paper and cardboard		
		Light packaging		
		Bulky waste		
		Bulky waste		
Recycling Parks	Households, manual workers (and maybe small businesses)	Recyclables	Periodically	3-4 km
		Hazardous waste in small quantities		

Source: Audit Team

Anaerobic digestion of the organic matter mechanically separated from the MSW remaining fraction and liquid manure.

Sorting and recovery of recyclables from MSW separate collection: paper/cardboard and light packaging.

Sorting and recovery of recyclables from the MSW remaining fraction

Sorting and recovery of bulky MSW

The refuse from all Ecopark treatments can follow two main lines:

Preparation of fuel loads for industrial kilns (i.e. cement). Some refuse (5 to 15 %) would remain and have to be disposed of at landfill.

Advanced thermal treatment (pyrolysis/gasification). These technologies are not yet proven and it is considered that at least 5 years will elapse before low cost, small or medium units have proved to be satisfactory. These technologies generate little refuse so that the landfill needs would be very low.

Ecopark outputs

The Ecopark would produce:

High quality compost to be used in high value added applications: gardening, green houses, irrigated land, vines, fruit trees, etc.

Medium quality compost for landscaping, land remediation, landfill covering, etc.

Biogas to produce electrical energy and heat, or as a fuel for public transport vehicles.

Recyclable materials: different types and qualities of paper, cardboard, plastics, metals, etc.

Depending on the refuse treatment:

Fuel loads for industrial kilns

Electric energy, heat and inert material for road construction, or other less conventional uses, if the refuse is treated by gasification.

Finally, MSW valorization would be completed with the development of small and medium sized businesses using 'secondary' materials to generate added value from Ecopark outputs (materials and energy).

Ecopark location

Economies of scale and the location of farms and food industries point the way to the location of the Ecopark between Larnaca and Nicosia, on the site proposed for one of the planned MSW incineration facilities.

To confirm this location, a detailed study about the quantities and points of generation of the different waste to be treated at the Ecopark should be developed. However, from an exclusively technical and economic point of view, the Audit Team considers that combining the waste from Larnaca and Nicosia areas is the logical option.

Concentrating MSW treatment and valorization facilities entails a certain increase of the transport needs, but, in return, important advantages can be obtained:

- A fewer number of sites and locations

- Flexibility: adaptability of qualitative or quantitative variations of waste input, due to the different types of treatment available. This allows a progressive implementation of the separate collection.

- Common process areas: waste reception, pre-treatments, etc.

- Strong scale economies and technical synergies for waste valorization.

However, a detailed study might conclude the need for a separate location of a facility (for example, paper/cardboard or light packaging sorting plants).

Advantages of the proposed solution (Ecopark) over incineration

The Audit Team considers that the Ecopark solution has decisive advantages over incineration:

- Integral profiting of organic matter to produce compost and energy.

- Smaller investment and operation costs.

- Higher MSW material and energetic valorization.

While incineration is a capital intensive technology (purchasing foreign technology), the Ecopark is a labour intensive technology which develops a diversity of economic activities around it. This in turn, induces a greater modernization of the country, since it is an integrated solution with a number of economic and social agents involved.

- Much better acceptance by population.

- Better international image.

3.2 Medical Waste

3.2.1 Biomedical waste: traditional management versus advanced management

Biomedical waste (BMW) is by far the main problem for waste management at health care centres, because of the large quantity (about 40% of a hospital total waste generation) and because of its strong psychological burden derived from its infection potential, its nature and look.

The appearance of AIDS in the early 80s resulted in a strong public sensitivity about hospital hygiene and, in particular, about waste, especially among health and cleaning staff. As a response, many hospital extended the application of "universal precautions" to waste management, so that any biomedical waste (BMW) was considered as infectious. This fact, together with generalization of one-way health material, caused hospitals to generate large quantities of BMW.

In the late 80s, faced with more and more complex waste management and with a high cost for the health sector, several countries (Canada, Netherlands, Germany, USA, among others) began a research process into the biological contamination of BMW and its repercussions for public health. The conclusions of this process were consolidated in 1990 and 1991 and were decisive:

Traditional BMW management practices, that respond to perceived risks, do not have either a microbiological or a epidemiological justification. It is necessary to go towards a BMW management which is not essentially based on psychological or emotional reasoning, but has a scientific coherence and confronts the real risks associated with BMW:

Health risk by infection inside health care centres.

Environmental risk by air pollution from sub-standard incineration.

Only a small percentage of BMW (between 3 and 5%) should be classified as being special (SBMW).

As a consequence of these basic conclusions, two BMW management criteria are now co-existing in the most advanced countries in this field, as it is shown in table 8.

Table 8
Basic models of medical waste management

	BASIC DESCRIPTION	REPRESENTATIVE COUNTRIES
Traditional management	Most or all BMW are classified as special	United Kingdom, France, Belgium.
Advanced management	Only a small percentage of BMW are classified as special	Germany, Netherlands, Austria, Canada

Source: Audit Team

In countries such as the USA or Spain both types of management are still coexisting, depending on the State or Region. In Catalonia and, in particular, in the metropolitan area of Barcelona advanced management is applied.

SBMW generation also depends on size (number of beds) and specialization of hospitals and clinics. In Cyprus, the Audit Team has not succeed in obtaining this basic information. However, in order to reflect how far the management model selection affects the dimension of a central disposal facility, table 9 shows an estimate of the generation of SBMW in Cyprus.

Table 9
Sensibility of Special BMW generation in Cyprus to the BMW management model

Total number of beds in Cyprus	Average unitary SBMW generation (kg/bed/day)		SBMW to be incinerated (t/y)	
	Traditional management	Advanced management	Traditional management	Advanced management
2.000	1,1	0,14	800	100

Source: Audit Team

3.2.2 Proposal for the development of medical waste management in Cyprus

The Audit Team is aware of the likely opposition of the population to incineration and that disinfection technologies are a partial alternative that is being applied in some European countries¹. Despite that, the Audit Team considers that the best way to dispose of most hazardous MW is incineration in a central facility which gives service to all health care centres in Cyprus, as the Government has planned (see paragraph 1.2.2), for the following reasons:

Incineration has been the solution traditionally applied by many European hospitals. This is the current solution at the Larnaca Hospital. However, on-site incineration facilities are not at all appropriate for compliance with the strict gas emission limits which environmental protection demands². These limits (according to the state-of-the-art combustion and pollution abatement technologies) are especially justified in urban residential areas where hospitals and clinics are normally located.

To comply with these limits it is necessary to equip the last generation kiln and post-combustion chamber with a high efficiency gas treatment system. In these conditions, an incinerator becomes a technically very sophisticated installation, that requires specialized operation and maintenance which is difficult to address in a health care centre (whose mission is to improve patients' quality of life and not to incinerate waste).

Besides, operational and capital costs would be very high because of the lack of economies of scale which one hospital alone, with limited waste generation, would have to bear³. The greatest efficiency of gas treatment systems is reached with a non-stop

¹ Especially, thermal disinfection in autoclaves (pressurized steam), which is applied in a decentralized way (for example, in Germany) or in a centralized way (for example, in Spain).

²The proposed new European Directive on the incineration of waste (COM(1998) 558 final), will regulate MW incineration to very high standards.

operation (24 hours a day), which is also incompatible with the operation of an incinerator by only one hospital.

This explains why, in the European Union, most of on-site incinerators have been closed down.

Consequently:

It is strongly recommended not to install on-site incinerators at hospitals and clinics. It could be said that, facing the pressing need to minimize the emission of toxic compounds contained in the combustion gases, this method of treatment belongs in the past.

According to the information given to the Audit Team by the Ministry of Agriculture, in Cyprus there is no significant waste incineration facility in operation. Strategically, Cyprus should have available an incineration plant, where waste or products which for any reason must be destroyed, such as certain pesticides or reagents, drugs or other confiscated materials, can be treated.

Obviously, this plant would also be used to dispose of some MW:

Certain chemical waste (mostly generated at the pathological anatomy laboratory)
Experimental drugs
Cytostatic waste
SBMW

However, to design the complete MW management cycle (internal management, transport and disposal), it is necessary to carry out a detailed study with the following minimum contents:

Decision about traditional or advanced management. Besides the radical discrepancy concerning SBMW definition, both models adopt quite different internal management and external transport practices, which have to be evaluated in detail in order to reach a final decision.

If advanced management is chosen, landfill sites and disposal practices for NSBMW.

The possibility of managing certain biological and chemical liquids as waste waters (into the drainage system). Conditions that have to be fulfilled by the sewage system.

Packaging, storage, collection and external transport practices for the different MW types.

On the other hand, to guarantee the rigour and the continuity of the implementation of the finally selected technical solutions, it is recommended to develop some complementary organizational measures:

To develop a specific piece of legislation at the national level about MW management.

To develop an "Internal MW Management Guide", to ease the practical interpretation

³Only centralized incineration facilities, which receive waste from a number of health care centers, can be of sufficient size for economic feasibility.

and application of the legislation adopted.

To establish a training program for the persons responsible for the health care centres. This training should also be received by municipal inspectors in charge of controlling waste management practices at health care centres to ensure that they do not pose a significant risk to the waste and waste water municipal services (occupational and environmental risks).

To develop an informative leaflet addressed to the cleansing staff, about good practices in the prevention of infections.

It has to be taken into account that sound MW internal management, especially its segregation, is essential for the efficiency and safety of the whole system. It is not worth the application of the best MW packaging, collection and treatment technologies, if internal management is deficient or the criteria on which it is based are not accepted. The health staff is the main executive for internal management and therefore they must be fully informed as well as trained about the basic practices required by them.

3.3 Hazardous Waste

3.3.1 Specific solutions for small quantity generators

As explained in paragraph 1.2.2, hazardous waste (HW) generated in Cyprus will be treated at two central facilities: Vathia Gonia plant which is in operation, and the planned plant in Kotsiatis.

By means of these centralised plants, medium and large quantity generators in Larnaca will be well served. After a certain storage period, the length of which will depend on the quantity and available space, they will be able to hire a licensed transporter to take the waste to the central plants.

Citizens in Larnaca will be able to take their HW to a Recycling Park (see paragraph 3.1.3.1), where it will be classified, grouped and transported to the central plant.

But a number of small quantity generators (industries and services that generate HW in small quantities, such as workshops, laboratories, printing facilities, dry cleaners, small industries, etc.) would be out of the system. Due to the lack of economies of scale and technical difficulties in the transport and treatment of small quantities, as well as the lack of space to store HW disposal in central facilities, their inclusion would not be feasible. This waste would not be admitted in a Recycling Park either except by special arrangement as the service is free of charge designed for domestic users.

It is because the quantities are small as in the case of domestic HW, that this HW is often easily disposed of through a sewage system (if there is a connection), or into the MSW containers, causing serious environmental problems to the city of Larnaca :

Toxic leachate at MSW landfill.

Health risks for MSW staff and for sewage system maintenance staff.

Contamination/pollution of the compost produced from MSW.

Disruptions in the biological processes for waste water treatment. Chemical pollution of resulting sludges or treated water.

Polluting emissions (mercury and other heavy metals), if there is MSW incineration.

That is why, it is proposed to develop a specific service for this kind of generator, which consists of:

Giving advise about HW identification, segregation, packaging, labelling and storage.

Routine collection.

Storage at a transfer station, where HW would be classified and grouped to optimize its transport to the central disposal facilities.

It is proposed to extend the HW area within the Recycling Park and equip it with human and technical means to operate that commercial service.

Small quantity generators and the types of HW they are generating should be inventoried. Then, the service staff in charge should send a legal-commercial letter to them, informing about the new service and their obligation to use it and avoid any consequent pollution.

4.0 RECOMMENDATIONS

The following recommendations are proposed for the consideration of the Municipality, Central Government and other bodies, as appropriate:

1. Adopt a proactive waste policy, which foster and, when necessary and feasible, leads the attainment of four essential goals:

To contribute to the modernization of strategic economic sectors and develop economic activity around recovery and valorization of recycled materials and renewable energy.

To strictly protect ground and superficial water quality (including sea water).

To improve the organic soil structure, save water and decrease non-point source pollution, through the utilization of organic waste in true Mediterranean style.

To contribute to the improvement of the Municipality' international image, and development of greater self-esteem and identity within the population.

2. That Larnaca Municipality leads the development of a MSW integrated management system, following the scheme proposed in paragraph 3.1.3 and fig.3.

2.1. Larnaca should foster a cooperation agreement between local authorities in a Larnaca-Nicosia Waste Management Council (LNC) composed of the following:

**Larnaca Municipality
Nicosia Municipality
Other Municipalities in Larnaca and Nicosia Districts
Federation of Villages and Improvements Boards in Larnaca and Nicosia Districts.**

2.2 The LNC should develop a study into the economic feasibility of the integrated system and its detailed design. In particular, the following areas should be studied:

Implementation stages of the separate collection. For each stage the following should be defined: geographic area, involved generators, separate collection methods and logistics to minimize local government's costs.

Institutional measures to foster separate collection not only in quantity, but above all in quality involving the following considerations:

National or local legislation which make it compulsory for industrial and service generators to separate recyclable waste for collection.

An optimized design of the separate collection containers.

A door to door information and awareness campaign for the population, to be devised in a professional way and including periodical follow-up campaigns.

Provide homes with internal means of waste separation.

A deposit system for some particular domestic hazardous waste.

Quantitative and qualitative characterization of non-municipal organic waste that will be treated at the Ecopark, and identification of the generators (food industries, pig farms, etc.).

Location of the Ecopark and the advisability of placing certain facilities outside the Ecopark.

Costs of the MSW integrated management system and financing options.

Administrative management of the construction and operation of the Ecopark. It is recommended that at least the three following options should be considered:

Direct operation by the LNC.

The contracting out of the operation to a private company.

Construction and operation by a mixed company formed by a private civil works company, non-municipal waste generators, the LNC and the Government of Cyprus. The private company, (which could be the main partner), should be selected by a public contest.

Development of special industrial areas for the location and support of SMEs that utilize the output products from the Ecopark as a raw material. The following stimulating measures could be considered in these areas:

To provide the plot of land at zero or low cost.

To simplify administrative procedures.

Economic aids to launch the companies.

Technical and commercial advice free of charge.

The goal is to develop a market for recycled materials that brings the highest possible added value and fosters competition to maintain prices.

The closing down of current landfills, the monitoring of groundwater quality and the underground migration of landfill gas. The opening of adjacent cells complying with the new European Directive on waste landfilling.

3. As a main industrial and services centre, it is recommended that Larnaca Municipality develops a hazardous waste (HW) in small quantities management service, as it has been defined in paragraph 3.3 (HW transfer station).

The operating company, together with the local Administrations, should:

Identify all potential costumers for the service.

Remind them of the fact that they are obliged to manage their HW correctly, given the vital importance of preserving water quality as well as the quality of waste water treatment sludges, treated water quality and compost quality.

Inform potential customers about the scope of the service, its rates and means of contact

This service, should either be a part of a Recycling Park or not but should accept domestic HW free of charge.

4. Larnaca Municipality should create a Recycling Park for citizens to deliver bulky waste. Once MSW separate collection was in place, the Recycling Park would be supplied with containers for the delivery of recyclables. The transfer station for HW could also be integrated within the Recycling Park or be located separately.

5. Larnaca Municipality should press the Government of Cyprus for it to:

Clarify the management of all types of medical waste (MW).

Draft a specific piece of legislation for this kind of waste as soon as possible.

Start the planned hazardous waste incineration plant, which is necessary to dispose of HW collected by municipal services.

- 6. Larnaca Municipality should foster this integrated waste management system, with the previously mentioned goals and strategies as a basic system for Cyprus which as such should be taught at schools and universities, and be subjected to a continuous monitoring and improvement process.**

CHAPTER 10 POLLUTION CONTROL

1.0 INTRODUCTION

There are three industrial areas in Larnaca. Two of these are in the city and the third is the oil refinery including the petroleum and LPG storage farm of six companies. The residents of Larnaca have registered many complaints against the oil refinery and have petitioned the Municipality to relocate this installation.

Within the Larnaca urban area are located 516 small industries, 299 (58%) of which are in the residential area (see Annex 1).

Other sources of industrial pollution which are discussed below are the National Airport, the seaport, the hospital incinerator, the sewage pumping stations, the sewage treatment plant, vehicular pollution and that from the power station outside Larnaca.

1.1 The Issues

The issues discussed below are

- air pollution
- industrial waste water treatment
- hazardous waste
- hazardous materials storage
- problems due to odours
- noise
- radiation

2.0 AIR POLLUTION

2.1 Air Pollution Sources

2.1.1 The Oil Refinery

The Cyprus Oil Refinery is the only petroleum refinery in Cyprus. It is owned by the Government of Cyprus (35%), the Oil Marketing Company division of the British Petroleum Co., Ltd. (30%), Socony Mobil Co., Inc. of the U.S.A. (20%) and Petrolina (15%).

The Cyprus Refinery consists of the following units: (see Annex 2)

- Crude distillation
- Hydrotreatment
- Platforming

LPG treatment
High vacuum distillation
Bitumen blowing

The refinery distils 3800 tons/day of crude and 1.2 million tons/year. Their energy source derives from 90 tons/day, of which 45 tons/day are heavy fuel oil containing 2.2 - 2.5% S and 45 tons/day of gas containing 2% S.

According to their permit, SO₂ and NO_x are monitored continuously and their limitations are:

Smoke test	(Baharain scale)	Below 3
CO	(mg/Nm ³)	200
SO ₂	(")	1700
NO _x	(")	450
Particulates [dust]	(")	100

The results presented to us were within the permit limits, though data pertaining to particulates [dust] were not given.

There are no restrictions relating to the emission of volatile organic compounds (VOC) from the storage tanks.

The flare is designed for a smokeless capacity of 10 tons. In a major failure 50 tons of gases will burn in the flare with dark smoke.

The main complaint of residents living close to the refinery relate to obnoxious odours. These arise mostly from the oil-water separator, the sludge storage area, VOC emissions and leakages.

2.1.2 Power Station

The Power Station is located at Dhekelia and supplies 360 MW of electricity from six units of 60 MW each. The fuel used is the same as that used by the refinery, containing 2.2 – 2.5% S, and an imported fuel having 2% S. The asphaltene content of the latter fuel is 4.42 (the tender specification calls for 7%).

The pollution emitted from the power station is much more serious than that from the oil refinery. Wind from the power station reaches the area of Larnaca 12% of the time, according to the distribution of wind directions in the region. The influence of the power station on the ambient air quality must be investigated.

2.1.3 Larnaca Airport

No data is available relating to air pollution deriving from the Larnaca airport. The environmental impact analysis (EIA) prepared for the airport did not examine the potential problem of pollution from either the existing nor the proposed airport extension.

2.1.4 Hospital Incinerator (Hoval Pyrolyse System) see Annex 3

(250 hospital beds)

Hospital waste is incinerated in a unit having a small thermal reactor and no additional equipment for minimizing emissions. Because the hospital is located in the centre of the town, an assessment of its operation is urgently required. The incinerator must be shut down if its emissions are found to be dangerous.

2.1.5 Transportation

The contents of lead in the gasoline (0.35%) and sulphur in the Diesel fuel (1%) and its use in Cyprus constitutes a source of high levels of these pollutants. The number of older cars also aggravates air pollution emissions.

2.1.6 Petroleum Storage Companies

The petroleum storage facilities are a source of VOC emissions.

2.1.7 Sewage Treatment Plant

The sewage treatment plant *per se* is not an air pollution problem. However, problems can arise from the sludge, from the malfunction of the biological treatment and from an over-capacity (for consideration in the future), giving rise to obnoxious odours.

2.1.8 Sewage Pumping Station

Since these are located in populated areas, they constitute a potential odour problem if the activated carbon used is not changed according to the producer's instructions.

2.1.9 Manufacturing Plants in the Industrial Area

The two meat processing industries, the dairy and the vegetable oil production plant can be sources of obnoxious odours if the waste water treatment units do not operate efficiently or if sludge or solid waste are not carefully treated and disposed in approved places.

The grain storage silos are sources of dust pollution from the industrial area.

2.2 Ambient Air Quality

There are no monitoring stations in the Larnaca area. Therefore, no data is available. In view of the presence of a power station, an oil refinery and the national airport in the vicinity, it is very important that an ambient air quality monitoring system be installed in the future.

Air monitoring units should be located near the oil refinery and near the airport. An additional monitoring station should measure pollution from transportation. In every monitoring station, meteorological data should be collected in order to correlate the pollution measured with the sources.

The location of the monitoring stations must take into account nearby population centres,

prevailing wind directions and the various pollution sources.

2.3 Legislation

The relevant pieces of national legislation are:

Control of atmospheric pollution from industrial sources law (No. 70/91)
Motor vehicles and road traffic law (No. 86/72) and motor vehicles regulations (No. 66/84)
The 1992 regulations under the petroleum products law of 1975
Criminal code law (CAP. 154)

2.4 Enforcement

Industrial activities which are classified as registerable processes require a permit for operation and a license must be obtained. Regulations based on the law provide for the setting of atmospheric quality objectives and for emission standards of a case-by-case examination. The local municipality is not involved in the licensing process nor in its supervision.

2.5 Summary and Conclusions

There are no available measurements of the air quality in the Larnaca area for the purpose of comparison with the limiting values set by the Cyprus air quality objectives and the relevant EU directives.

The air quality in Larnaca is influenced by a mixture of pollutants from the oil refinery, the power station, the airport and road traffic.

The hospital incinerator must be checked immediately for the possible emission of hazardous gases.

The sulphur content of 2.5 % in the heavy fuel oil used in the refinery and in the power station is very high.

The sulphur content of 2% in the gas used in the oil refinery is also very high.

The Diesel fuel used has a very high sulphur content (1%).

The lead content of 0.35% in the gasoline is very high.

Odours emanating from the oil refinery are a serious problem.

2.6 Recommendations

The following measures are recommended for the consideration of the Municipality and other bodies, as appropriate:

1. Establish an air quality monitoring network consisting of four monitoring stations and a central computer centre. One of these should be intended to measure road traffic pollution.

2. The sulphur content in the heavy fuel oil should be reduced to 1% and that in the gas, to 0% sulphur.
3. The sulphur content of the diesel fuel should be reduced to that of the European standard.
4. Produce unleaded fuel and phase out the use of leaded gasoline.
5. Minimize the emission of VOC from the storage tanks.
6. Minimize odour emissions from the oil refinery.
7. Establish a local environmental management to supervise the industries with respect to their compliance with the requirements set by the permits, to coordinate between the local municipality, the ministries and the industries, and to be responsible for the air monitoring network.
8. Improve the smokeless capacity of the oil refinery flare.

3.0 INDUSTRIAL WASTEWATER

3.1 Sources

3.1.1 Oil Refinery

The oil refinery wastewater treatment system for the cooling water which comes from the sea, the process units and rain water are described below. (see Annex 4)

The requested limiting contents of pollutants in the refinery's effluent are as follows:

Zinc	(μ g/kg)	below 100
Copper	(")	below 100
Cadmium	(")	200
Mercury	(")	50
Chromium	(")	-
Lead	(")	-
BOD	(mg/l)	below 30
COD	(")	below 30
TSS	(")	below 30
pH		6-9
Oil content	(")	5
Phenols	(")	below 0.5
Conductivity		-

Because the cooling water and the industrial process waste water are mixed together after oil separation, the holding basin outfall data are below the required limits. The sludge

produced in the oil separator and from storage tank cleaning are stored in unlined, open ponds. Starting in April-May of this year, the sludge will be incinerated in a cement kiln.

3.1.2 Petroleum Storage Companies

Sludge from the storage tanks are currently treated in drying beds and stored in ponds. In the future, the sludge will be treated as described above for the oil refinery. The wastewater must be treated.

3.1.3 Factories in the Industrial Area

Each of the two meat processing plants, the dairy and the vegetable oil industry has its own biological treatment plant and individual permit limits which are unique for each effluent. These limits are negotiable.

For example, the requirements for the effluent of the Lambrianidis meat processor are:

Temperature	below 30°C
pH	6.5-8.5
BOD	100 mg/l
COD	300 "
TSS	50 "
Oil (as fat)	10 "
Conductivity	9000
B	1 mg/l
NaCl	1400 "

These components are checked by the Ministry monthly. The treated effluent is discharged into the surrounding area where it permeates into the ground. The permit requests are related to the underground water quality, which in that vicinity is very poor. The data we received were:

pH	7.68
TDS	6736 mg/l
Cl ⁻	1914 "
SO ₄ ⁼	2350 "
HCO ₃ ⁻	281 "
NO ₃ ⁻	75.9 "
NO ₂ ⁻	6.0 "
Na ⁺	1294 ""
K ⁺	63.8 "
Ca ²⁺	766 "
Mg ²⁺	171 "
B	2.1
Hardness	2620 " (as CaCO ₃)

According to this company's permit, this effluent is not intended to be connected to the

municipal sewage treatment plant even in the future.

3.1.4 Airport

The airport has no effluent treatment facility. One is intended to be built to handle the maximum designed flight volume of 12 million passengers per year.

3.2 Legislation

Water pollution control law (No. 69/91) and relevant regulations

The sewage system law (No. 1/81) and relevant regulations

The fisheries law (cap 135), the fisheries (amendment) reg. of 1981, 1989, 1990

Petroleum law

3.3 Enforcement

3.3.1 A permit is required for every industrial effluent. These permits may be granted under terms and conditions with regard to the relevant effluent standards, the quantity concerned, the site and the intended manner of disposal.

3.3.2 Industrial effluents are currently managed by each industry and disposed of in absorption pits. A small number of industries, such as the meat processing plant, the dairy and the vegetable oil industry in Larnaca already have wastewater treatment plants installed. For other small industries there is no supervision.

3.4 Summary and Conclusions

Treated effluents from the small scale industries and the food industry are discharged to absorption pits and thus permeates into the ground.

The oil refinery effluent is diluted with the sea water emanating from the cooling system.

There are no requirements nor supervision of the wastewater from small scale industries.

3.5 Recommendations

The following measures are recommended for consideration by the Municipality and other bodies, as appropriate:

- 1. Treated effluents from the small scale industries and the food industries in Larnaca must be connected to the municipal sewage treatment plant (MSTP) and not discharged to absorption pits. After the additional treatment in the MSTP, it can be recycled for irrigation.**
- 2. All effluents treated within the industries must be supervised by the MSTP. The major sources must install on-line recorders.**
- 3. The oil refinery effluent must be treated according to the best available technology and not diluted with sea water as is the current practice.**

4.0 HAZARDOUS MATERIAL

Though hazardous materials in the Larnaca area do not comprise an obvious or continuous pollution problem, they are potentially the most dangerous environmentally.

4.1 Storage of Hazardous Material

4.1.1 Storage of Distillates

The five companies, BP, Esso, Lina, Mobil and Petrolina, all store large quantities of distillates. Their sources of supply are the local oil refinery and the importation of unleaded and Jet A-1 fuel. The storage capacities are given in Annex 5.

4.1.2 Storage of LPG

The three companies, Mobil, Petrolina and Intergas store huge quantities of LPG in large 700 ton spheres. The total storage capacity of LPG is 5000 tons.

4.1.3 Storage of Hazardous Materials in the Oil Refinery

The oil refinery is a 1.2 M t/yr crude refinery and produces 3800 t/day of distillates, operating 340 days per year. Its supply of crude oil is the responsibility of the five oil marketing companies - BP, Esso, Lina, Mobil and Petrolina - which purchase crude oil and transport it to the refinery site. The refinery processes the crude for these companies, charging them for this service.

At all stages, the crude and products remain the property of the supplier. The refined products are delivered to the companies, which are responsible for their marketing. The LPG storage capacity consists of only two tanks of 20 tons each.

The tetramethyl lead (TML) used to produce the 0.35 g/l lead content gasoline is stored in the refinery complex. This material is very dangerous and both the quantities and location must be carefully checked.

4.1.4 Chlorine Storage in the Municipal Sewage Treatment Plant

The effluent of this plant is chlorinated before being supplied for irrigation. In this connection, four tons of chlorine will be stored at the Municipal Sewage Treatment Plant. This material is very dangerous, and because of the proximity of the MSTP to the airport and nearby Salt Lake tourist area, the risk must be checked very carefully.

4.1.5 The Transport of Hazardous Materials

The following transportation systems of hazardous materials must be checked:

Pipelines from the oil refinery to the oil marketing companies

Pipelines from the sea to the oil marketing companies and to the oil refinery

Down-loading of crude tankers

Down-loading of LPG ships

Down-loading of distillates

LPG tank truck loading and transport

Distillate tank truck loading and transport

TML and chlorine handling systems at the port as well as their road transport.

4.2 Legislation

The broader issue of risks and accidents relating to industrial sources is to be dealt with by regulations under the Health and Safety at Work Law, which is in line with the ILO Safety and Health Convention and the relevant legislation of the European Union.

A major hazards control system is about to be established.

4.3 Summary and Conclusions

The oil refinery, the six oil and LPG marketing companies, the underground pipes and the road transport of LPG and distillates must be checked in an integrated quantitative risk assessment (QRA) since no risk assessments are available. Some risk assessments for the oil refinery are in existence, but not in accordance with integrated risk assessment methodology.

In the risk assessment, both the existing and future airport must be taken into consideration. In the EIA of the airport there are no available data with respect to risk assessment.

The QRA must also relate to the subject of chlorine use in the MSTP and its import as well as that of TML.

4.4 Recommendations

The following measures are recommended for the consideration of the Municipality and other bodies, as appropriate:

- 1. Considering the area in which are found the oil refinery, oil marketing companies (see Annex 6) and an increase of airport activities on the one hand and the increasing number of people on the other, a risk management policy is required to avoid exposure of the public to unacceptable risks.**
- 2. For a clearer insight into the risks due to both the present and future activities, an integrated QRA should be performed with the following objectives:**

(i). To analyze the individual and societal risk presented by the airport and the oil refinery, the storage of LPG, chlorine and distillates, underground pipelines and the transport of chemicals by road tankers. Individual risk is defined as "The frequency per year that a hypothetical person will be lethally affected by the consequences of possible accident during an activity with hazardous materials". The individual risk is a function of the distance between the exposed person and the activity, regardless of whether people actually live in the area.

(ii). Societal risk is defined as "The cumulative frequency that a minimum number of off-site people simultaneously will be killed due to possible accidents during an activity". In this case, the actual presence of people in the surroundings is taken into account.

(iii). To compare the determined risk with the Dutch and British risk acceptance criteria, and to indicate possible areas where a serious risks exists.

(iv). To recommend measures to reduce the risks

(v). To assess the consequences of both a worst case scenario and a most probable case scenario for emergency planning purposes

(vi). To indicate the sensitivity of the calculated risks with respect to the input data.

3. The results of this QRA study should be used to identify activities of high risk in public areas. It is recommended that for these activities a detailed external safety report should be requested, including recommendations for risk reduction.

5.0 NOISE

5.1 Noise Sources

5.1.1 Airport

There are no available data or noise measurements. Neither is noise considered within the environmental impact assessment of the new airport.

5.1.2 Small Scale Industries in Residential Areas

Industries such as automobile mechanics' garages, bakeries, carpenters, clothing industries and workshops are potential sources of noise (see table on page 50).

5.1.3 Restaurants and Bars

Restaurants and bars located in residential areas and which open evenings into the early morning are a potential source of objectionable noise, especially in the tourist season.

5.1.4 Pumping Stations for Sanitary Sewage

Such stations located in residential areas must be designed so as not to produce objectionable noise.

5.1.5 Road Traffic

Heavy vehicles and motorcycles are the major source of objectionable noise from traffic.

5.1.6 Construction Activities

Earth-moving machinery and compressors are the major sources of noise from construction activities.

5.2 Legislation

Motor vehicles and traffic law (No. 86/72) and regulations (No. 66/84)

Protection of common peace law (No. 27/74)

Aerodromes law (CAP. 300)

Air navigation (aircraft noise) reg. of 1988

Health and safety at work law (No. 89 [1] 96)

Civil wrongs law (CAP. 148)

Criminal code (CAP.)

The draft bill for the protection of the environment will empower the competent authorities to issue mandatory abatement notices (orders). It also includes provisions for ambient noise exposure levels, programs for the reduction of noise exposure, the establishment of noise abatement zones and the control of noise emissions from various activities and uses.

5.3 Conclusion

There are no available data regarding noise measurements nor statistics of complaints from the public.

5.4 Recommendations

The following measures are recommended for the consideration of the Municipality and other bodies, as appropriate:

- 1. Initiate the continuous measurement of noise in one of the air monitoring stations.**
- 2. Empower the competent authorities to issue mandatory abatement notices.**
- 3. Control the noise emissions from various activities and uses by the Health and Hygiene Department.**

6. RADIATION

6.1 Radiation Sources

Local TV stations
Local Radio stations
Cellular phone antennas

6.2 Radiation Measurement

No radiation measurements were available.

6.3 Recommendation

The following measure is recommended for the consideration of the Municipality and other bodies as appropriate:

Initiate a radiation measurement survey in the vicinity of TV, radio and cellular phone antennas. Compare the results with the IRPA standards if no other national standard is available.

7.0 SUMMARY AND TIMING OF RECOMMENDATIONS

7.1 Recommendations for the First 18 Months

7.1.1 Establish an air monitoring network of four monitoring stations and a central computer centre.

7.1.2 Prepare an integrated QRA for all hazardous materials.

7.1.3 Start the continuous measurement of noise emanating from the airport.

7.1.4 Establish a local environmental management unit.

7.1.5 Assess the operation of the hospital incinerator.

7.1.6 Control noise emissions with the Health and Hygiene Dept.

7.2 Recommendations for the Next Four Years

7.2.1 Reduce the sulphur content in the heavy fuel to 1% and in the gas to 0%.

7.2.2 Reduce the sulphur content in the Diesel fuel to 0.035%.

7.2.3 Produce unleaded gasoline.

7.2.4 Minimize odour emissions from the oil refinery.

7.2.5 Minimize VOC emissions from the oil refinery and from the oil marketing companies.

7.2.6 Implement the QRA report requirements.

7.2.7 Unite the treated effluents from all of the industries, except that of the

oil refinery, to the MSTP.

7.2.8 Treat the oil refinery wastewater according to the Best Available Technology principle.

7.2.9 Reduce the LPG storage capacity.

7.2.10 Issue mandatory abatement notices for noise pollution.

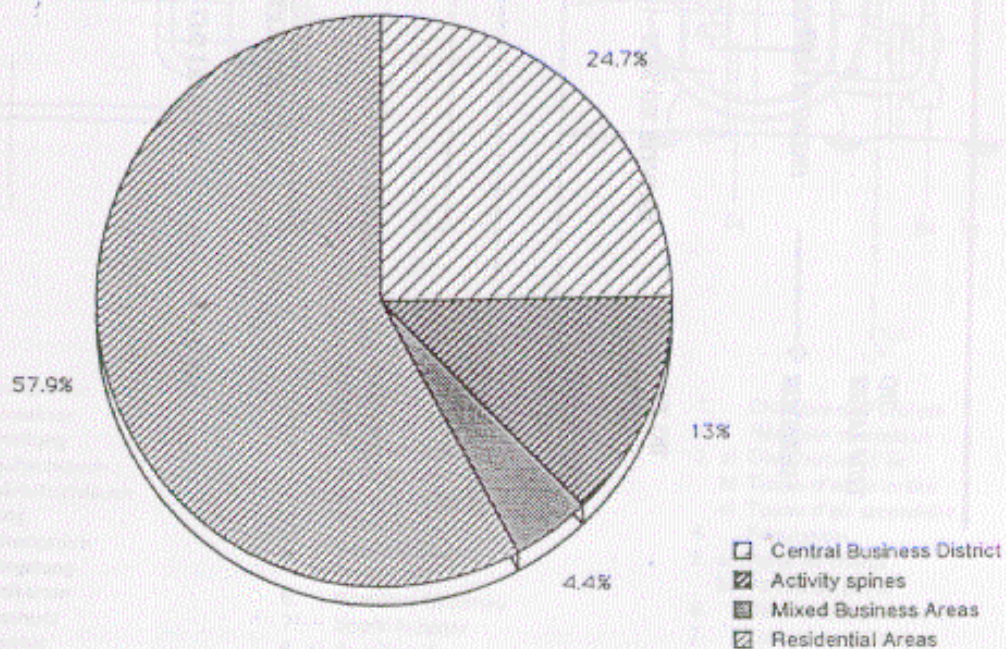
7.2.11 Relocate the small industries which at present are in residential areas.

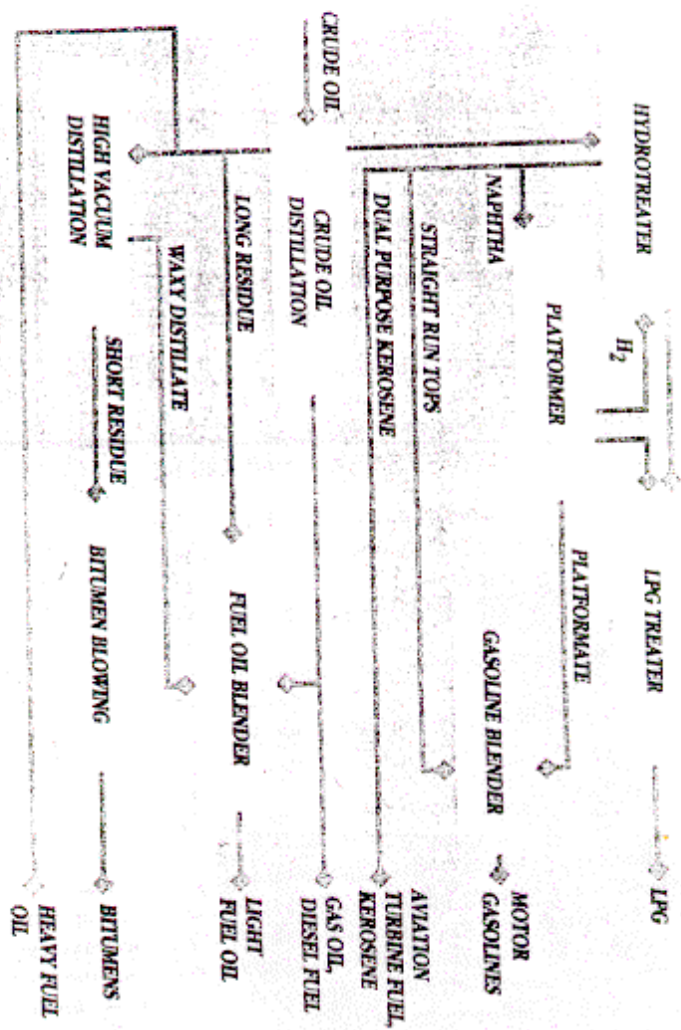
7.3 Recommendations for the Next Ten Years

The policy regarding maintaining the 90 day storage of crude oil or distillates, and the present situation of only 30 days storage must be decided upon by the government. If the decision be that Cyprus will import all of its distillates and no refining processes will be performed locally, then all of the 90 day storage capacity should be designated for distillates and the storage tanks of the refinery and those in the Larnaca area can be removed elsewhere. If the decision be that the oil refinery will maintain its on-site storage tanks, those of the refinery, as well as those of the oil marketing companies which are found to be dangerous should be removed to the new storage area.

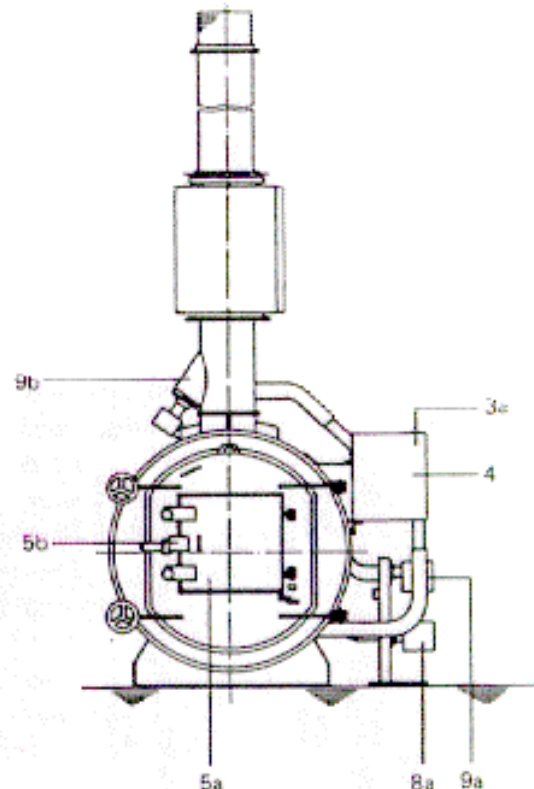
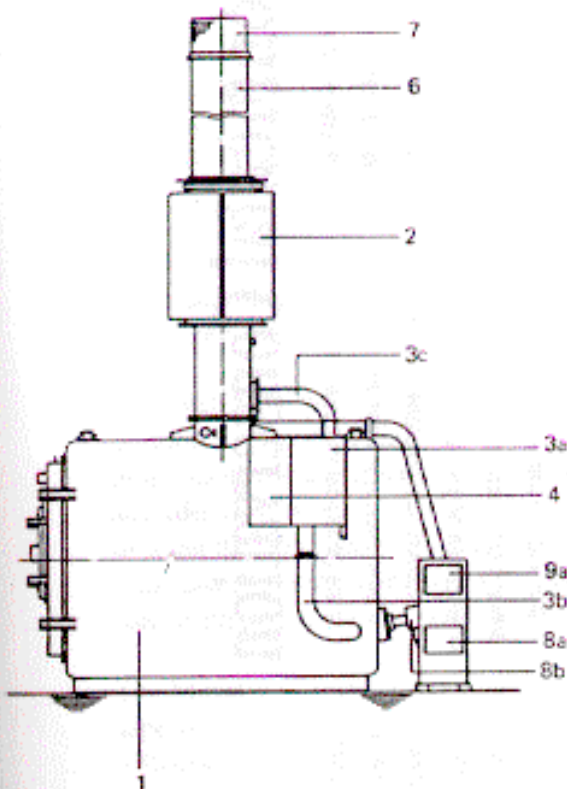
Location of Small Industries within the Larnaca Urban Area

Location	Number of unit	%
Central Business District (CBD)	127	24.7
Activity spines	67	13
Mixed Business Areas	23	4.4
Residential Areas	299	57.9
Total	516	





THE PURPOSE OF OPERATING AN OIL REFINERY IS TO PROCESS



1. Pyrolysekammer
2. Thermoreaktor
3. a) Luftverteilung
b) Primärluftschlauch
c) Sekundärluftschlauch
4. Steuerung
5. a) Beschickungstüre
b) Türverriegelung
6. Standardkamin
7. Funkenschutz
8. a) Stützbrenner
b) SB-Kopf
9. a) Pilotbrenner
b) PB-Kopf

1. Pyrolytic Chamber
2. Thermal Reactor
3. a) Air distribution
b) Primary air hose
c) Secondary air hose
4. Control
5. a) Feeding Door
b) Door Lock
6. Standard Chimney
7. Spark Arrestor
8. a) Auxiliary Burner
b) AB-head
9. a) Pilot Burner
b) PB-head

1. Chambre de Pyrolyse
2. Réacteur thermique
3. a) Distribution d'air
b) Tuyau d'air primaire
c) Tuyau d'air secondaire
4. Régulation
5. a) Porte de charge
b) Verrou de porte
6. Cheminée standard
7. Protection étincelles
8. a) Brûleur d'appoint
b) Tête BA
9. a) Brûleur pilote
b) Tête BP

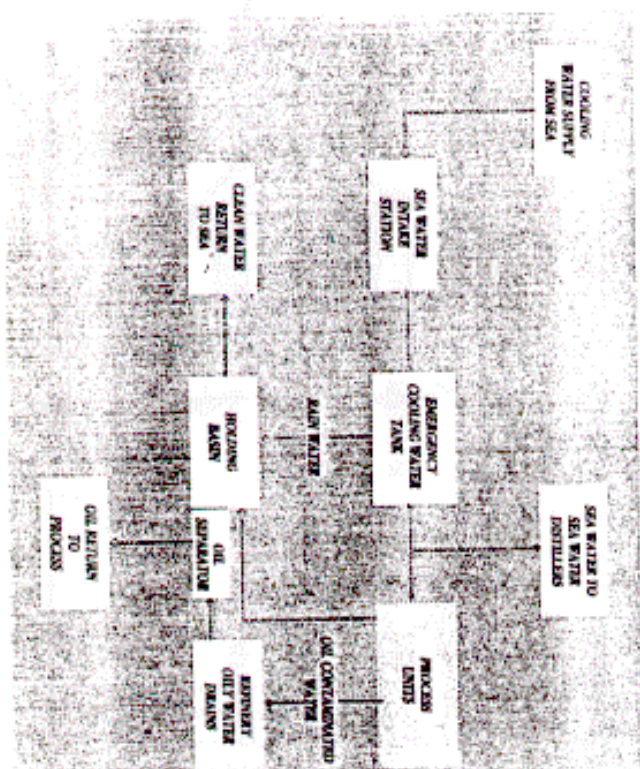
Environmental Conservation

The utmost care is taken to avoid pollution of the environment. Any harmful gases that emanate from refinery processes are burnt away in heaters and in the flare stack - the landmark of every refinery. The flare stack, with its pilot flame permanently visible, also acts as a safety valve. In the event of an operational upset it may be necessary to reduce pressure quickly by relieving the unit of large quantities of gases which are then led to the flare and completely burnt off high above the ground.

The 60 m. flare gas stack ensures that flue gases are disposed of high in the atmosphere to ensure efficient dispersion. Ground level measurements are taken frequently to ensure that traces of sulphur oxides that may be present are below internationally accepted limits.

Rain-water as well as all water used in the plant is treated in an ingenious water effluent system incorporating special oil interceptors which ensure that the water flowing from the refinery site to the sea is clean. The water effluent is frequently

checked so that immediate remedial action can be taken in case of system malfunction. In addition the Fisheries Department analyse spot samples which so far have always been found within internationally acceptable limits.



CHAPTER 11 WATER SUPPLY

1.0 WATER RESOURCES

1.1 Introduction

Cyprus, has an area of 9.251 square km, but its arid Mediterranean climate is quite varied due to the diversified topography of the island. Hot and dry summers lasting from June to September and rainy winters extending from November to March, are separated by the rather short duration season of Autumn and Spring.

Water is the most constrained natural resource in Cyprus and the correct development of it is one of the highest priorities for the country. The Government is responsible for the planning and management of this resource nationwide (both surface and underground water).

The Ministry of Agriculture, Natural Resources and Environment (MANRE), has been responsible through the Water Development Department (WDD), for the major projects that have been implemented in order to have the maximum availability of water.

The WDD, as the predominant technical agency in the water resources field, is in a position to provide a high degree of overall integrated management of water resources in an institutional framework in which local authorities are responsible for distribution and sales to consumers. In addition to the planning, design, construction and maintenance of water development works, the WDD is also responsible for bulk sales of potable water (including providing treatment where it is needed) to water boards, besides its traditional role of supplying surface water to villages and irrigation systems.

The Ministry of Interior has a largely administrative role. It is concerned with the legal aspects of water resources planning, development and management, and has, in its district officers, legal authorities concerned with the irrigation and domestic water supply projects.

Water supply depends mainly on the storage of surface water in reservoirs and groundwater recharged from the infiltration of rainfall. In the hilly areas other water resources are the springs which are numerous and have been a traditional source of irrigation water and village water supply.

The agricultural sector is by far the largest user of water, accounting for about 75% of total water available from surface and groundwater sources. The largest proportion of this water is pumped from groundwater aquifers (in 1991 at least 65%).

Domestic and industrial use account for the rest (19% and 6% respectively in 1991).

Finally, due to the drought of recent years, the water problem has intensified and the

desalination of sea water has been undertaken to ensure sufficient supplies.

1.2. Surface Water

Rainfall is the only source of water in Cyprus and is highly variable from year to year. The last two years have been a period of drought (as in the 1989-1991 period). The rainfall has been less than 300 mm, compared to the long-term annual average of 500 mm. In certain areas, however there has been perhaps twice the average level of snow, at heights above 1000 m on the Troodos Massif.

Sunlight intensity and low clouds result in very high rates of evaporation, estimated at 80% of the total precipitation.

There are no perennial streams. Runoff occurs only during the rainy season (about 85% of the total rainfall) from about November to March.

The WDD has put a particular emphasis on the construction of dams, mostly in the mountainous area of the South and West, and the conveyance of water from the dams to other parts of the island.

Currently, the number of dams constructed for the WDD is approx. 100, but the greater part of these are small reservoirs. Their reserve capacity is 300 million cubic metres.

At present, due to the drought over the last few years, the water reserve in the major 17 dams which store a major part of the country's water resources, was 38,800,000 cubic metres in January '99 whilst in January '98 the stored quantity was 33,600,000 cubic metres. The current situation is therefore, slightly better than last year, but in any case still very critical.

With the exception of very small surface reservoirs, no more significant surface storage sites remain to be developed. The water supply system is thus virtually complete included several water treatment plants for bulk urban water supply. Only treatment plants for water reuse remain to be constructed or started up.

The Government is actively promoting efficiency in water use (e.g. water saving campaigns and rationing), and MANRE is promoting the use of irrigation systems which are very efficient in terms of economy of water and use of fertilizers (e.g. drip irrigation system)

1.3. Underground Water

The main aquifers are associated with the coastal plains built up of gravel, sand and calcareous sandstone. Generally a rapid vertical and lateral variation is noted due to intercalation of silt, clay layers and lenses.

The main aquifers, together with values of estimated annual replenishment, pumpage and losses to the sea (unfortunately, part of the data is based on 1974 conditions), are shown in Fig. 1.

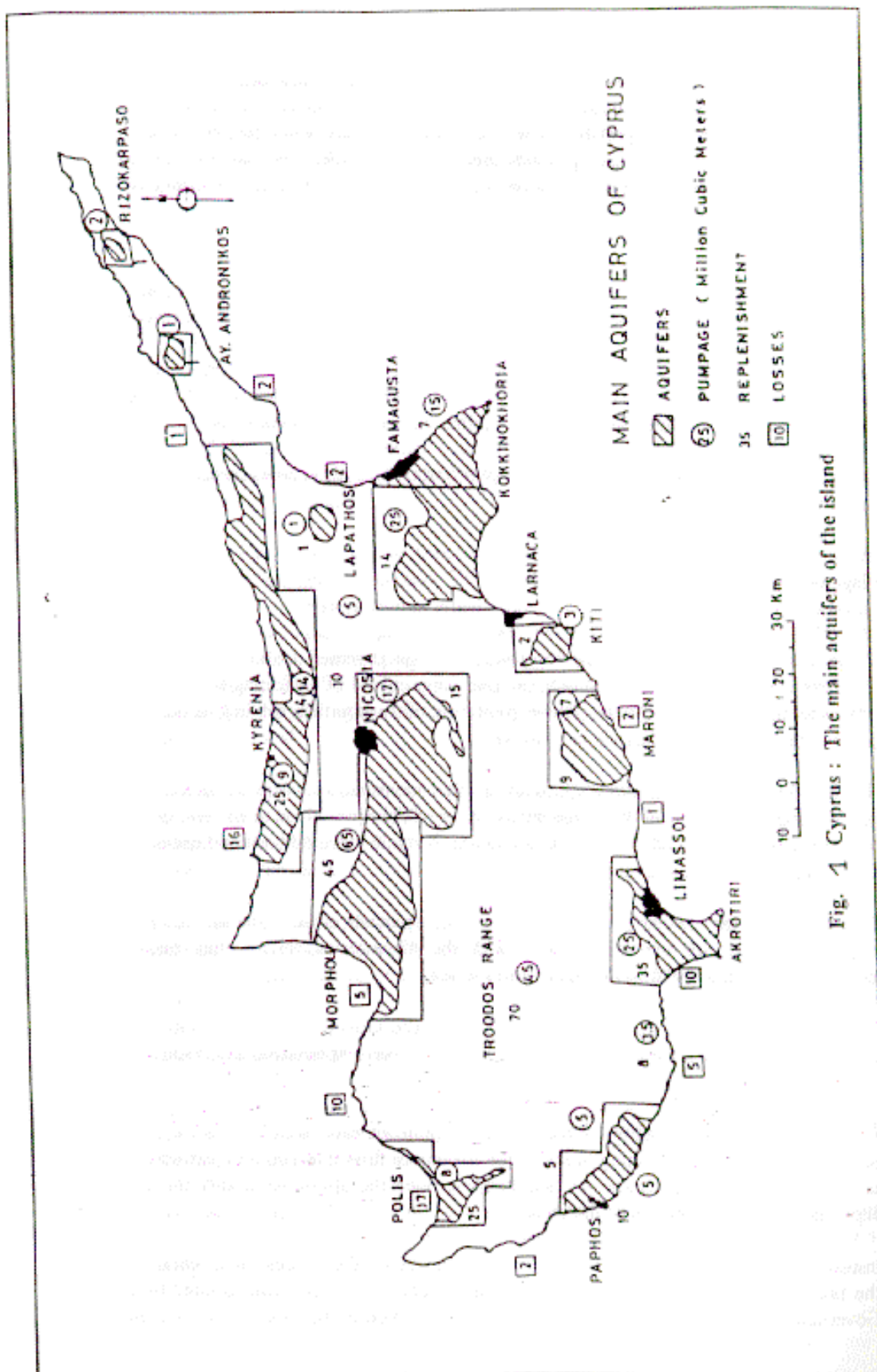


Fig. 1 Cyprus : The main aquifers of the island

Most of the groundwater resources are being exploited. However, due to the rapid growth of water demand, groundwater quality is affected by salinity, the chemicals in fertilizers, and in some cases, pollution from absorption pits where aquifers are close to populated areas. The principal groundwater quality problem is salinity due to overpumping, although in some cases, concentration of nitrates up to 200-250 ppm have been recorded in irrigated areas.

The WDD work to optimize the joint use of surface and groundwater throughout the region and is also monitoring a scheme which subsidizes the drilling of new boreholes, in areas where groundwater is not suitable for drinking but suitable for watering gardens.

The monitoring of groundwater levels and water quality is extensive. All boreholes must be licensed. Use is monitored through interviews particularly with irrigators. Computer models have been developed for the major aquifer systems in Southern Cyprus.

Groundwater development in Cyprus is complex and includes boreholes developed and maintained by:

private domestic and industrial users,
village and municipal authorities,
central government as part of the public bulk water supply system.

In the years of favourable climatology with enough dammed water available, the Government obliged the municipalities to use this water instead of exploiting the aquifers. In this way they tried to avoid the over-exploitation of the aquifers, refilling as much as possible the hydrological balance in those years.

This could become a continuing approach if other measures to avoid the draining or contamination of the aquifers by saline intrusion, specially those close to the sea, do not exist or are not introduced. To recover an aquifer is much more difficult and expensive than preventing its contamination.

For the last few years the exploitation of many wells, specially close to the sea, has been stopped. Due to its over-exploitation and the absence of reload they became contaminated by the invasion of water from the sea.

Obviously, and being under its exclusive domain, the Government must control the extraction from all the aquifers, especially those whose over-exploitation has resulted in, or will result, in saline intrusion.

The quantity and the quality of the water taken from each well should be under permanent control, establishing limits to the maximum flow that could be extracted in each case under normal conditions, and keeping open the option to modify this flow depending on the conditions of the aquifer.

Instead of paying a single yearly tax to the Government for the concession of each well, the tax should be proportional to the amount of cubic meters per year granted by the Government to the owner of each well regardless of whether they are extracted or not.

The tax should be independent of the use given to the water in order to avoid subsidizing any particular sector (agriculture, industry, tourism, etc.).

With such a system, the Government would not know the amount of water extracted from each well, although they could obtain an estimate if the basic technical details and the consumption of energy is known for each exploitation.

Bearing in mind the critical water situation in Cyprus, it would be better if the Government charged proportionally to the real extraction effected (with the limit of the concession), by installing meters at each well.

The system could be managed (installation, maintenance, control, charges, etc) in accordance with the most efficient technical, strategic and economical alternative (ie: having a structure created 'ad hoc' by the government, giving the concession to a private company by means of an agreement). Obviously the tax must cover all these expenses.

To take this step and control all the aspects related to the extraction of underground waters, each well should be geographically located with all the relevant data as to years of concession, name of the owner, etc. This data would be introduced into a GIS (Geographical Information System) providing an effective compilation and utilization of groundwater data which would be updated regularly.

1.4. Sea Water Desalination

In view of the continuously increasing potable water demand by the population, tourist and visitors, to the non-occupied areas of the island, MANRE and its Water Development Department decided in the late 80's to implement a new potable water policy. This resulted from feasibility studies into new water works to cover the potable water shortages resulting from the decreasing annual rainfall.

The feasibility studies indicated that a desalination system would be the suitable and in 1996 a contract for a 20,000 m³/day Desalination Plant, Phase I, was awarded.

On April 1, 1997, Dhekelia Desalination Plant (DDP), Phase I, was started up and Phase II, which also has a production capacity of potable water of 20,000 m³/day, begun its activity on June, 1, 1998.

DDP, Phase I and II, utilize the Reverse Osmosis Process to produce an average of 40,000 m³/day of potable water in accordance with EU Drinking Water Standards, EEC Council Directive n° 80/778/EEC.

Daily water analysis is carried out to measure of certain ion concentrations as well as the physical parameters of the drinking water. Every hour, the plant laboratory facilities and Government alternately analyse the water quality.

After final remineralization and disinfection, the treated water is then delivered to supply the non-occupied area of Famagusta district (directly), part of Larnaca, and part of Nicosia town (both, through the potable water storage tanks at the Government's surface raw water treatment plant).

The plant comprises of the following general treatment process steps:

Seawater Intake System
 Pre-treatment System
 Reverse Osmosis System
 Product Water Unit

The operation team, includes a chemical engineer to control the quality of the treated water. The basic parameters of the raw water and the product water are:

Raw Water Source	Mediterranean Sea Water
Intake System Type	Open Sea
Raw Seawater Total Dissolved Solids Content (TDS)	39.200 mg/L
Seawater Temperatures	16 °C to 24 °C
Plant Recovery	50%
Product Water Quality TDS	<500 mg/L

DDP is located approx. 800 m. east of Dhekelia Power Station Plant within the boundaries of the Dhekelia Sovereign Base area, and was constructed in accordance with the Cypriot Environmental Protection Legislation relating to construction works and/or operational conditions that will not unfavourably affect the environment, public health, the leisure pursuits of people living in the area, pollution of the atmosphere or the coastline.

Although, in general, the recommendations of the Environmental Impact Assessment Study have been implemented in the construction of the plant, there are more negative impact problems to be tackled. For example, the noise from the external pumping stations and the negative visual impact of the facilities. The latter could be resolved with the planting of vegetation and trees. (See photo 1)

According to the agreement between the DDP and the Government, the DDP must produce 73,000,000 cubic metres in 10 years for each Phase, and the Government must buy this quantity, at an agreed price.

In addition, the Government may buy the facilities of each Phase after 2 years of production at an agreed price (with 6 months notice). In any case, after 10 years of production of each Phase, the facilities will become the property of the Government with the payment of compensation to the owner. At present (February 1999) the sale price to the Government of water produced at the DDP is CY£ 0,55/m³.

Following its policy of looking for alternatives sources to the traditional system of water supply the Government has decided to build a new desalination plant with a production capacity of 40,000 m³/day. The drinking-water produced will be sent to the storage tanks of the government owned potabilization plant at Thersepanou.

The area selected to locate the new plant is in the municipality of Larnaca next to the sewage treatment plant and between this plant and the airport (see fig 4 Chapter 12). The area where the new plant will be located is a protected area due to its high ecological value as it includes several wetlands and salt lakes. For this reason, the location selected has turned out to be controversial, creating very active public opposition in Larnaca, especially within the Municipality.



Photo 1: A view of Dhekelia Desalination Plant



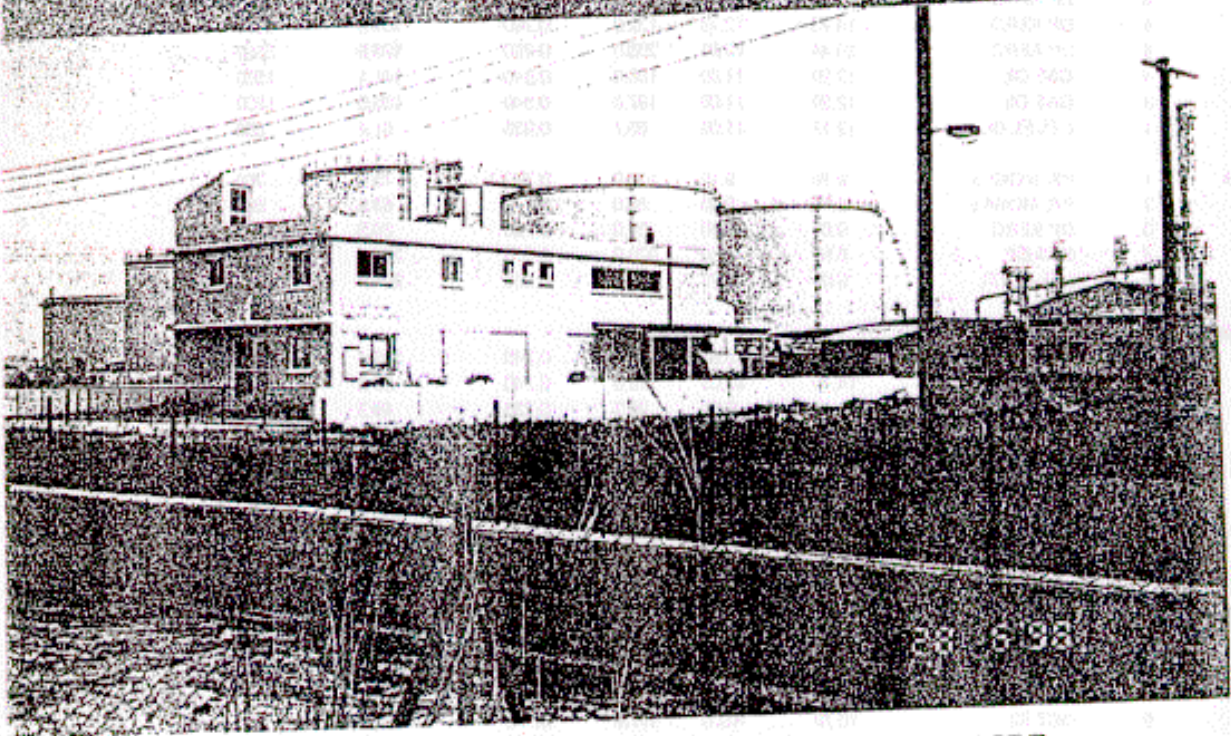
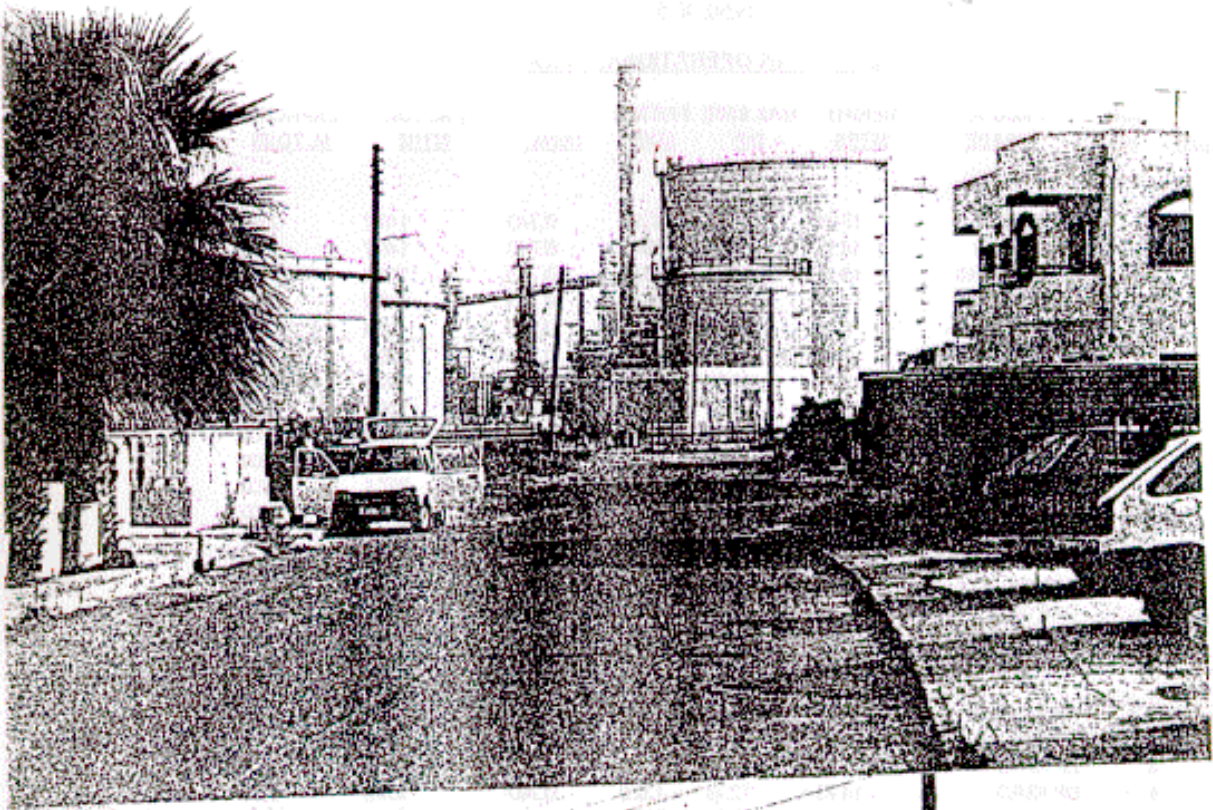
Photo 2: Available non-constructed area in Dhekelia Desalination Plant

ANNEX 5

USERS' TANK OPERATIONAL DATA

COMPANY	TANK NO.	PRODUCT GRADE	HEIGHT MTRS	MAX SAFE DEP	FACTOR MTM	DENS.	FACTOR MTM	CAPACITY M.TONS
BP								
	13	PR. MOGAS	15.24	15.00	201.0	0.740	148.7	2300
	16	PR. MOGAS	14.13	12.50	201.0	0.740	148.7	1800
	6	UNLD MOGAS	13.13	12.45	177.0	0.733	129.7	1800
	3	UNLD MOGAS	13.13	12.45	254.0	0.733	189.2	2000
	7	ILL. KERO	6.75	6.70	28.4	0.750	22.4	150
	8	ILL. KERO	6.50	6.50	28.4	0.750	22.4	150
	12	ILL. KERO	13.72	12.50	177.0	0.750	139.8	1800
	4	DP KERO	13.13	12.45	177.0	0.750	139.8	1800
	5	DP KERO	13.13	12.45	177.0	0.750	139.8	1800
	9	DP KERO	13.13	12.45	177.0	0.750	139.8	1800
	15	DP KERO	15.45	15.25	452.0	0.750	357.1	5200
	10	DP KERO	14.45	14.40	188.7	0.750	133.3	1850
	11	DP KERO	14.45	14.40	188.7	0.750	133.3	1850
	1	GAS OIL	13.13	12.45	254.0	0.840	213.4	2800
	2	GAS OIL	13.13	12.45	255.0	0.840	214.2	2800
	18	GAS OIL	15.29	17.50	299.0	0.840	251.2	3400
	17	GAS OIL BOND.	15.29	17.50	299.0	0.840	251.2	4500
	19	L FUEL OIL	15.29	17.50	229.0	0.935	214.1	3500
ESSO								
	2	PR. MOGAS	18.28	13.00	132.0	0.740	97.7	1250
	7	PR. MOGAS	7.12	5.82	37.2	0.740	27.5	150
	5	DP KERO	10.55	10.20	119.0	0.750	89.3	600
	6	DP KERO	14.73	12.78	132.0	0.750	104.3	1335
	8	DP KERO	20.44	19.30	258.0	0.750	199.9	3900
	4	GAS OIL	12.20	11.00	188.0	0.840	141.1	1550
	3	GAS OIL	12.20	11.00	187.0	0.840	165.5	1800
	1	L FUEL OIL	12.17	11.00	85.7	0.935	61.4	650
LINA								
	1	PR. MOGAS	9.70	9.10	108.0	0.740	79.9	700
	2	PR. MOGAS	9.70	9.20	95.0	0.740	69.6	600
	3	DP KERO	9.03	8.20	58.0	0.750	68.5	600
	4	GAS OIL	8.59	8.80	328.0	0.840	275.5	2400
	5	L FUEL OIL	9.03	8.78	219.0	0.935	204.8	1800
MOBIL								
		LPG						1050
	6	PR. MOGAS	14.64	13.50	183.0	0.740	135.4	1800
	7	PR. MOGAS	14.45	13.00	113.0	0.740	83.8	1100
	3	ON B2	10.67	9.50	26.3	0.733	19.3	200
	9	DP KERO	15.00	13.50	290.0	0.750	221.2	3100
	5	DP KERO	14.64	13.50	368.0	0.750	282.9	4000
	8	ILL. KERO				0.750		60
	2	GAS OIL	14.64	13.50	183.0	0.840	153.7	1800
	4	GAS OIL	18.20	17.50	183.0	0.840	153.7	2800
	1	L FUEL OIL	14.64	13.00	113.0	0.935	105.7	1300
PETROLINA								
		LPG						2770
	6	PR. MOGAS	5.20	4.30	47.5	0.740	35.4	180
	13	PR. MOGAS	13.41	12.00	298.0	0.740	221.9	2650
	5	UNLD. MOGAS	6.50	5.50	229.0	0.740	169.5	1000
	9	OCT B2	10.70	10.00	117.0	0.733	85.6	500
	8	ILL. KERO	7.24	6.50	69.0	0.750	78.2	500
	4	GAS OIL	6.95	5.50	230.0	0.840	93.2	1100
	7	GAS OIL	6.13	5.70	87.5	0.840	38.9	200
	11	GAS OIL	12.90	12.00	488.0	0.840	391.4	4600
	2	GAS OIL	8.47	7.50	283.0	0.840	237.7	1800
	3	AGC BONDED	8.44	8.00	283.0	0.840	237.7	1800
	12	AGC BONDED	13.40	12.70	299.0	0.840	251.2	3150
	14	AGC BONDED	13.46	12.00	299.0	0.840	251.2	3000
	1	L FUEL OIL	8.49	8.00	283.0	0.935	284.8	2200
WATERGAS								
	10	WH TE SPIRIT	10.70	10.00	117.0	0.740	85.6	900
		LPG						1200

H R S
30-JUL-87



ANNEX 6 - From LARNACA PROGRESSIVE MOVEMENT REPORT

DATE	TIME	LOCATION	TYPE	STATUS	REMARKS
01/01/98	10:00	01-01	01-01	01-01	01-01
02/01/98	11:00	02-01	02-01	02-01	02-01
03/01/98	12:00	03-01	03-01	03-01	03-01
04/01/98	13:00	04-01	04-01	04-01	04-01
05/01/98	14:00	05-01	05-01	05-01	05-01
06/01/98	15:00	06-01	06-01	06-01	06-01
07/01/98	16:00	07-01	07-01	07-01	07-01
08/01/98	17:00	08-01	08-01	08-01	08-01
09/01/98	18:00	09-01	09-01	09-01	09-01
10/01/98	19:00	10-01	10-01	10-01	10-01



Photo 3. Water storage tanks on the roofs of houses



Photo 4 Tank Truck with fresh water from the Iarnaca mountains for the hotels

An Environmental Impact Assessment of the different alternatives for the new plant should have been carried out in which all the parameters would be objectively considered, including the strategic ones but this apparently has not been done.

One of the alternatives to be considered is the enlargement of the number of units in the existing desalination plant in Dhekelia, especially as there is sufficient space and that some of the installations already built could be used for the new plant, lowering the costs. (See photo 2). Also for strategic reasons it seems easier to control desalination plants with higher capacities than a smaller number of scattered plants.

Additionally, it should be pointed out that if Government want to have independent installations to avoid possible failures within the common areas, a new plant could be built totally independent from the actual installations of Dhekelia, including, if it was necessary, a new sea outfall and its corresponding diffusers, to dispose of the residual brine.

It is easy to understand that the emergency water supply situation in Cyprus has resulted in urgent decision taking in respect of the construction of new sea water desalination plants. The proposal was to install a mobile plant next to the airport for 20,000 m³/day and it finally ended with the construction of two permanent units with a capacity of 20,000 m³/day. This kind of installations involve a high capital cost and high energy consumption, thereby producing very expensive water.

The development of an integral plan for the management of the hydrological resources of the country should be considered in which the desalination plants would be considered as emergency sources of water to guarantee a minimum supply, but they should be planned in number, size, location, in consultation with the local authority and the community.

In this Plan all the alternatives to save water would be considered. Consideration should be given to the point that although the shortage which brings the highest social drama and most political pressure is the one which interrupts the supply of domestic water, agriculture is the most important and most demanding consumer.

More than 75% of the water is used in irrigation and there are several different options to optimize its use. These range from changing the irrigation systems, to the application of compost from organic wastes to the soil to improve its water retention. The latter would also improve the soil quality and reduce the need for manufactured chemical fertilisers which contaminate the underground waters as well as producing organic (more marketable) crops.

In any case, the water situation at present in Cyprus is still critical, despite the winter rains, with only approx. 38 million m³ in the dams. Annually, 137 million m³ are needed to meet the island's needs.

For this reason, the desalination plant could be vital in meeting the demand this summer. Any possible crisis could be resolved by building a new unit of 20,000 m³/day within the boundaries of the Dhekelia Desalination Plant facility (see photo 2).

2.0 WATER SUPPLY TO LARNACA

2.1. Management Organization

The distribution and sale of potable water to the municipalities for domestic, industrial, and other services is the responsibility of each municipality. Larnaca Municipality is a part of the Larnaca District, and these functions are realised by the Water Board of Larnaca (WBL).

WBL is a non-profit, semi-public, independent organization. The president of the WBL is the District Officer who represents the Government and receives general instructions about water policy.

The Board represents different departments of the Government (MANRE, Ministry of Finances, Ministry of Interior, etc.), the Municipality (the Mayor of Larnaca) and private organizations (selected by the Government).

In the case of Larnaca, the WBL not only supply water to the municipality but also to external areas, like the hotels on the northern coastal strip, and the industrial zones, such as the Free Zone Area (See map 1, Chapter 3).

The supply of these specific areas was dictated by the Government, for economic-strategic reasons (tourist and industry) and the ability of WBL to supply potable water, rather than the municipalities where they are located.

WBL has 3 basic departments: Accounting, Technical and Administrative. These departments are directed by a manager. The WBL depends on the Government (District Officer) to defend the interest of the Municipality of Larnaca in important water issues related to quantity, quality, prices, etc.

2.2. Sources of Water Supply to Larnaca

The sources of water supply to the WBL are the following:

bulk purchase of potable water from the Government (WDD),
underground water from WBL boreholes,
others sources of potable water in small quantities,
and reused water for garden irrigation

2.2.1. Potable Water from Government Facilities.

Water Quantity

The Government transport and sell potable water to WBL in a quantity which depends on existing reserves.

Due to the drought, in 1997 the Government sold the WBL only 3.511.990 m³. In less restrictive years this quantity would be 30% greater and in years of normal rainfall would be 50% more.

The acute shortage is primarily managed in the form of deliberate interruptions in supply.

Water Quality

The potable water (chlorinated) which the Government supplies to WBL (currently a mix of surface water and desalination water) is in accordance with the EU Drinking Water Standards, EEC Council Directive n° 80/778/EEC.

The physio-chemical and bacteriological parameter standards in 1998 were as follow:

Physio-chemical parameters

Conductivity us/cm	1130
pH	7,5
Chloride (Cl ⁻)	145 mg/l
Nitrate (NO ₃ ⁻)	3 mg/l
Nitrite (NO ₂ ⁻)	<0,003 mg/l
Hardness (CaCO ₃)	395 mg/l

Bacteriological parameters

Escherichia coli/100 ml	0 in all samples
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However, in a 1990 study by the Geological Survey it was found that nearly all samples of water from reservoirs and ponds contained chlorinated pesticides, and 23% of the samples contained more pesticides than the higher permissible value set by the EC, samples from water wells, however, were free of any pesticide contamination.

2.2.2. Potable Water from WBL Boreholes

Water Quantity

The WBL would like to obtain the maximum quantity of water from boreholes for supplying the Larnaca Municipality. The reason is that this source of water is cheaper than the potable water from the Government. Unfortunately for the WBL, at present the amount of water produced from its boreholes is very low.

10 years ago, 50 % of the water the WBL supplied to Larnaca Municipality was from its boreholes. Due to the climate conditions, and overpumping, some aquifers were contaminated by sea water intrusion, thus decreasing each year the quantity of water supplied from these sources.

In 1997, the water supply to the WBL from its boreholes was 279.520 m³ but it is not as easy to extract the quantity and quality of water from boreholes as it was 10 years ago.

If the climate conditions over the last two years continue and the abstraction of water from boreholes follows the same pattern, the water supply from this source will continue to decrease.

When rainfall conditions are normal and the quantity of storage water in the Governmental reservoirs is sufficient, the Government require the WBL and the other

Municipal Water Boards which have underground resources to cease underground water abstractions, and to buy all potable water from the Government.

Water Quality

The water from the WBL boreholes is of good quality and is in accordance with EU Drinking Water Standards, EEC Council Directive n° 80/778/EEC.

2.2.3 Other Sources of Water

The oil refinery has a relatively high consumption of potable water, and can be considered as a "singular point" of consumption.

Obviously it is an industry with a high strategic and economic value, and cannot be dependent on the potable water resources of the WBL. For this reason, and with the relevant permits from the Government, the refinery has 2 small desalination units with a capacity of 160 and 60 m³/day respectively, to supply water to its industrial processes.

The rest of the water supply for the consumption of the refinery services (bar, restaurant, toilets, showers, etc.) is from the WBL.

Another source of small quantities of potable water is the private wells which exist in the mountain areas. This water is bought by many coastal hotels and transported by tanker trucks. (See photo 4)

Also the small villages which are not connected to the WBL water supply network have their own wells for potable water consumption.

Finally, Larnaca Municipality and the adjacent northern coastal strip hotel area have a special network to distribute treated water from the sewage treatment plant, after tertiary treatment, which will be reused for the irrigation of the municipal and hotel gardens and other landscaped areas.

2.3 Water Consumption

Water supply was distributed from WBL in 1997 as follow:

SECTOR	QUANTITY m ³	PERCENT (%)
Industrial	599.441	19
Domestic	2.594.480	80
Others	32.234	1
Total	3.226.155	100

There is a difference between the quantity of water that the WBL managed in 1997, which was 3.791.510 m³ (3.511.990 m³ from the Government and 279.520 m³ from boreholes) and the real water consumption (water billed) which was 3.226.155 m³.

The difference is the 15% that corresponds to the losses that the WBL's distribution infrastructure has of between 12% and 18%, depending on whether the network is working or is cut off to limit supply.

With this percentage of losses the WBL have an enviable record of very low unaccounted-for water. Naturally, the WBL is very interested in controlling and minimizing the losses as it pays for all the water received from the Government.

Larnaca Municipality have had restrictions to the supply for 10 years, depending on the year and month. But in the last two years restrictions has been continuously and very drastic.

The WBL currently supplies water for domestic and hotel consumption only two days per week. The days of supply are different for each sector of the network, e.g. one sector receives water Tuesday from 8 pm to 3 am and Saturday from 7 am to 16 pm.

The WBL is actively promoting efficiency in water use and, in general, the public campaigns have a great impact on users' behaviour (flow diminution in showers, toilets)

Today, the domestic consumption average is 118 /capita/day (lcd), that is higher than should logically be expected, but less than the designed water consumption, which is approx. 180 lcd.

Obviously, with these drastic restrictions, consumers seek to satisfy their need by investing in storage facilities, which are located on the roofs of houses. These create an ugly image of the houses and buildings producing a negative visual impact. Together with the water storage tanks there are other tanks for storing hot water which are heated by

solar panels.(See Photo 3)

The two industrial areas which the WBL supplies with water, are of economic importance and, therefore, receive water continuously.

Another alternative for the consumers, such as the hotels, is to purchase groundwater from water vendors at a higher cost. All these solutions are indications of the consumers's considerable willingness to pay.

It follows, therefore, that if water prices to users are not affected, the demand for water will remain unchanged at a level that exceeds supply.

The impact of rationing the supply is similarly limited and temporary. It may help in water source replenishment and system pressure maintenance for a while, but it does not help in expanding the available supply. Nor does it generate any additional financial resources for investment to expand supply, and to the extent that it succeeds in curtailing demand, it further reduces revenues.

Thus, although rationing may be useful as a short-term measure, it does not alleviate water shortages and may, in fact, exacerbate the situation by encouraging privately undertaken initiatives that may be detrimental to the quantity and quality of water resources in the long-run.

2.4. Infrastructures

Although, the water which the Government sells to the WBL is chlorinated bulk potable water, it is transported long distances and the residual chlorine is very low. For this reason the WBL must re-chlorinate the water in its facilities.

The re-chlorination is realized in the WBL facilities with chlorine gas, automatically and proportionally to the flow. This operation is controlled by a computer.

The chlorine gas is stored in bottles of 75 Kg. The consumption of gas is approx.150 kg/week in winter and in summer is logically more because of the number of tourists. The stocking area for the chlorine gas meets security conditions and contains a stock 2,250 kg, in bottles of 75 Kg, which is less dangerous than having all the gas stored in a tank.

After chlorination, the potable water goes to the storage area which is close to the chlorination facility. In this area, there are 7 storage tanks, 6 small cylindrical and 1 large square tank. The capacity of the storage tanks is 11.500 m³ and in the next few months another large tank will be constructed (with a capacity of approx. 10.000 m³) alongside the existing large one. (See photo 5)

This new tank is essential, because summer consumption, in non restricted periods is 14,000 m³/day which is more than the current maximum stock. With the present restrictions, the consumption in the summer is approx. 11.500 m³/day which is the current maximum stock capacity.

However, the Government has constructed a new treatment plant to produce bulk potable water near the WBL water storage area, and its water storage tanks will also be available

to the WBL. This facility is currently not working, because of the restrictions (see photo 6).

The WBL distribution network is currently constructed in asbestos-cement, and the connections from the secondary pipes to the flow meters of the houses are polyethylene. The pipes to the houses are made of PVC and polyethylene, and special heat resistant plastic is used for hot water.

Water is transported from the WBL storage area to Larnaca by gravity. The diameters of the distribution network are:

15 inch (375 mm) for the main pipe

12 inch (300 mm) for the secondary pipes.

However, the WBL has begun to change the main pipes for a new 700 mm diameter pipe to allow for the future enlargement of the network. The objective is change all the main pipes up to the coastal hotel area outside of Larnaca Municipality, which the WBL also serves.

The present number of households with Piped Water Supply (House Connection) is 26,934.

The distribution network has no problems and the losses are a maximum of 18%. It is divided into sectors which are monitored continuously with electronic controls which report all incidents to a computer that is allocated in the WBL central offices. If an incident occurs, the sector supply is shut off so that the leak can be repaired. The current restrictions, make it more difficult to detect problems because whole sectors are without water during the day.

So far no bacteriological, organic or industrial contamination has been detected in the water supply during the most restricted periods when water remains in the pipes during the day. However, there is a risk of contamination entering the supply network whilst the supply is interrupted and the pressure is low. There should be a joint WBL and Municipality study into the potential contamination from this practice as well as from underground storage tanks (gas stations, etc.), septic tanks, absorption tips, etc, especially if they are near to the distribution network pipes.



Photo 5 Potable water storage tanks



Photo 6 New governmental facility to potabilize raw fresh water

2.5. Water Accounting

The WBL is a non-profit organization, which must cover its costs to finance water development and distribution expenses. The price of water for domestic and commercial use is determined by the WBL which are empowered to generate sufficient revenues to compensate for their expenses.

2.5.1. Water Distribution Network Connection Fees

Fees paid to the WBL by the developer for the right of water supply in case of the division of land into building plots are:

Up to 2 building plots	CY£ 100 each
From 3 to 4 building plots	CY£ 300 each
From 5 to 10 building plots	CY£ 500 each
More than 10 building plots	CY£ 600 each

Fees paid to the WBL by the developer for the right of a water supply by the Water Board in the case of development (construction of a building) on a piece of land which is not a building plot, are calculated by dividing the area of the land by 8000 ft² to find the number of building plots equivalent to the size of the piece of land and then applying the above formulae. The current fees are reasonable and it is not necessary to increase them (except for inflation). However, before 1994 these fees were unrealistically low. The WBL has sensibly increased the fees to the real cost.

2.5.2 Average Recovered Costs (Tariffs)

The WBL purchase water from the Water Development Department of the MANRE, which seeks uniform price up to the point of supply to all the Water Boards. The

current price paid by the WBL for potable water is CY£0,335/m³. However the WBL pays the Government only CY£ 0,275/m³ because they do not have sufficient funds to meet full price. The problem is that the sale price of the WBL to consumers is too low to cover all the costs of the organization. This situation began a few years ago and the WBL asked the Government to increase the tariffs to compensate for the costs of the organization, including the real cost of the water sold by the Government. Price increases need approval by the Council of Ministers. Increases have been approved but not confirmed by Parliament and the WBL have not been able to increase the prices.

The WBL have their own sources of supply from boreholes at a very low cost of CY£ 0,005/m³ (only energy cost). Unfortunately, the boreholes now only produce a small percentage of the total consumption water. The quantity in the underground sources of other Water Boards is much greater. This results in substantial water price variations in different parts of the country, which is in itself inefficient.

It is easy to observe that differences exist between groups of users. Households are charged at a higher rate than businesses including tourism and industry.

An inappropriate pricing and subsidy policy tends to encourage the inefficient use of water, produce excessive quantities of wastewater, thus adding to the potential for pollution and reducing incentives for reuse.

Water must be costed at its real price for all sectors, included tourism. Businesses and

industry can pay the real price of water without any problem, because it is an insignificant part of the costs of the services or products. In contrast to water, petrol is not subsidized but taxed. Electricity prices are also raised above the marginal cost of supply through surcharge to cover the cost of its distribution.

Prices charged for agricultural use, reflects only a small proportion of the cost of producing the water from the sources available. These policies (inappropriate pricing and subsidies) have contributed to increased demand and discouraged conservation measures.

Clearly, the WBL together with the Municipality of Larnaca, should insists that the Government, through Parliament, take measures to finalise a political agreement designed to increase the price of this scarce product. This agreement by the Parliament should be accompanied by an acceptance by the Government that a plan for the use of national hydrological resources needs to be drawn up, emphasizing the saving of water, especially in agriculture.

The current water prices to domestic, industrial, tourist, etc, users are as follows:

RECOVERED COST PAYABLE EVERY TWO MONTHS (m ³ for payment in CYP)									
A. Domestic									
m ³	CYP	m ³	CYP	m ³	CYP	m ³	CYP	m ³	CYP
	3,15*								
1	3,30	21	6,50	41	13,70	61	27,05	81	45,05
2	3,45	22	6,65	42	14,25	62	27,95	82	45,95
3	3,60	23	7,20	43	14,80	63	28,85	83	46,85
4	3,75	24	7,55	44	15,35	64	29,75	84	47,75
5	3,90	25	7,90	45	15,90	65	30,65	85	48,65
6	4,05	26	8,25	46	16,45	66	31,55	86	49,55
7	4,20	27	8,60	47	17,00	67	32,45	87	50,45
8	4,35	28	8,95	48	17,55	68	33,35	88	51,35
9	4,50	29	9,30	49	18,10	69	34,25	89	52,25
10	4,65	30	9,65	50	18,65	70	35,15	90	53,15
11	4,80	31	10,00	51	19,40	71	36,05	91	54,05
12	4,95	32	10,35	52	20,15	72	36,95	92	54,95
13	5,10	33	10,70	53	20,90	73	37,85	93	55,85
14	5,25	34	11,05	54	21,65	74	38,75	94	56,75
15	5,40	35	11,40	55	22,40	75	39,65	95	57,65
16	5,55	36	11,75	56	23,15	76	40,55	96	58,55
17	5,70	37	12,10	57	23,90	77	41,45	97	59,45
18	5,85	38	12,45	58	24,65	78	42,35	98	60,35
19	6,00	39	12,80	59	25,40	79	43,25	99	61,25
20	6,15	40	13,15	60	26,15	80	44,15	100	62,15

* Minimum

B. Hotels and industries

Minimum every 2 months	CY£ 13,65/m ³
1-200 m ³	CY£ 0,35/m ³
201-400 m ³	CY£ 0,40/m ³
>400 m ³	CY£ 0,60/m ³

C. Government and semi-governmental institutions, benevolent and local authorities:

Minimum every 2 months	CY£ 65,65/m ³
1-1000 m ³	CY£ 0,40/m ³
>1000 m ³	CY£ 0,55/m ³

D. Sale of water to ships: CY£ 0,60/m³

E. Sale of water to tanker trucks: CY£ 0,50/m³

Note: E only without restrictions

2.5.3. Other Water Source Costs

The price of potable water transported from the mountains in tanker trucks, generally to hotels in restriction periods, is approx. CY£ 1,00/m³, and they would pay more, if it were necessary, to give the required service to their clients. The water costs for the tourist are an insignificant part of total hotel and service expenses.

Consideration could, therefore be given to the provision of small desalination plants to supply the hotel areas in high occupancy time of the year which coincides with those of highest restrictions (June, July, August). To improve the water supply situation, perhaps the touristic village would require an independent water supply based on a village-wide desalination plant. It seems reasonable that the Government should subsidise such plants provided that all the technical, urban and environmental requirements are fulfilled.

By the end of 1999, all the water produced at the sewage treatment plant will be reused, after a tertiary treatment (filtration and chlorination). Treated water will be delivered by pipes to irrigate municipal and hotel gardens. The tertiary treatment and the treated water network for reuse is owned by the Government, who will sell this water at CY£0,15-0,20/m³.

3.0 LEGISLATION

Over twenty different laws exist for the development, distribution, pollution and management of water resources in Cyprus, and many more regulations have been adopted pursuant to these laws.

Different agencies are responsible for the implementation of different laws and the end

result is inconsistent and disorganized management of the island's most scarce natural resource.

Various departments are using standards set by WHO, FAO and the EC with no clear legal endorsement of one set of standards over another. Currently, standards are being developed under the provision of recently enacted specific environment laws.

The Fisheries Law (Cap 135) and its Regulations (no. 273/90) prohibit the pollution of marine waters, dams, rivers, lakes and any other natural or artificial reservoir with aquatic life.

Relevant water legislation

- * Water (Development and Distribution) Law (Cap. 348)
- * Government Waterworks Law (Cap.341)
- * Public Rivers Protection Law (Cap. 82)
- * Public Health Law (Cap. 259)

4.0 RECOMMENDATIONS

The following recommendations are made for the consideration of the Water Board, Municipality, and other bodies as appropriate:

4.1. Sustainable Demand Management

Whilst the construction and use of additional desalination plants may be essential as a standby in times of severe water shortage, the implication in terms of air pollution, including CO₂, from their massive energy use and the disturbance in respect of marine life, dictates that they should only be used in times of emergency.

Although it is acknowledged that some efforts have been made to reduce demand, the approach both nationally and locally appears to be largely one of obtaining supplies to meet the demand rather than managing the demand. New resources, such as additional desalination plants, can only be justified when all other demand management related options have been explored. Managing the demand through intensive campaigns together with the use of modern conservation measures and a proper pricing structure should be the prime strategic objective of the Government and the Water Boards.

The following measures are recommended for inclusion in a National Demand Management Strategy:

4.1.1 Develop a pricing structure for all consumers which penalises excessive water use and encourages conservation measures.

4.1.2 Conduct a large scale and continuous campaign aimed at bringing about a change in the attitude of consumers including informing visitors of the need for conservation.

4.1.3 As the agricultural sector is by far the greatest consumer, the use of irrigation systems which are very efficient in terms of economic use of water,

particularly low energy sprinklers and drip irrigation system, should be promoted. Grant aid to farmers to assist in the application of such measures should be available.

4.1.4 Encourage the use of water efficient appliances such as domestic and commercial washers including the support of grant aid

4.1.5 Encourage the use of waterless urinals, dual flush toilets, low pressure shower heads and other equipment designed to reduce consumption with the support of grant aid.

4.1.6 Study the possibility of the covering of swimming pools when not in use to reduce evaporation.

4.1.7 Develop programmes for the use of recycled or 'grey' water for toilet flushing, car washing and other uses where treated water is not necessary. Legislate for the use of 'grey' water systems in new houses and other buildings.

4.1.8 Design gardens and landscaping using plants, etc which require the minimum of water.

4.1.9 Conduct a study into demand management measures in use in those countries and regions with scarce water resources with a view to learning from the experience gained in these areas. The study should include designing a specific programme for managing the demand in Cyprus.

4.1.10 Establish a 'Water Saving Trust', or similar body, which is adequately funded so as to offer grant aid to encourage physical alterations to premises and equipment.

4.1.11 Establish pilot experimental areas in Larnaca the supply to which is monitored and within which different measures to reduce consumption are introduced and the results measured. Control areas should also be monitored, without any experiments, against which improvement can be compared.

4.2 The Control of Aquifers

The extraction from all aquifers, especially those whose over-exploitation has led, or will lead, irremediably to a sea water intrusion, should be controlled. The quantity and quality of the water taken from each borehole should be monitored including establishing limits to the maximum flow each case and retaining the option to modify this flow depending on the conditions of the aquifer.

4.3. The Use of Financial Instruments

4.3.1 Boreholes

The use of a tax based on the amount of permitted annual consumption in cubic meters should be levied on the owner of each well regardless of whether they are extracted or not. The tax should be applied regardless of use to avoid subsidizing any particular sector (agriculture, industry, tourism, etc).

4.3.2 Pricing Structure

It is appreciated that water costs are a difficult political issue but water conservation is directly related to cost. Most consumers would prefer to pay more than suffer the inconvenience of constant interruptions to the supply. Provided that any increase is part of a package of measures designed to reduce consumption all round, the support of the Cypriot people, who are aware that there is a crisis, can surely be anticipated.

The current inappropriate pricing and subsidisation policy tends to encourage inefficient use and produce excessive quantities of wastewater thereby adding to the potential for pollution and reducing the incentives to reuse.

The price paid for water by all sectors, including tourism, should reflect the true cost of its collection, treatment and distribution including the cost of demand management.

4.4. Potential Contamination

The WBL and the Municipality of Larnaca must realize a study into the potential contamination from underground storage tanks (gas stations, etc.), septic tanks, absorption tanks, to the distribution network whilst the supply is interrupted.

CHAPTER 12 SEWAGE AND DRAINAGE

MANAGEMENT

1.0 MANAGEMENT ORGANISATION

The management of sewage and stormwater for the Larnaca Municipality is the responsibility of the Larnaca Sewerage and Drainage Board (LSDB). The LSDB is an organization which is closely related to the Municipality, and its president is the Mayor of Larnaca. The LSDB is structured into 3 basic departments which are, Maintenance, Development and Accounting.

The management include the sewage collection pipeline network, the sewage treatment works, the effluent irrigation system and the stormwater drainage system.

The LSDB is presently developing the sewerage and drainage network for the Larnaca Municipality and other strategic zones outside the municipality (the same zones to which the WBL supply potable water).

The area which will be served once the network is constructed is a low-lying coastal strip running from the boundary of the Sovereign Base, Dhekelia in the north to Larnaca Airport in the south. The area, about 13 km long and up to 1,5 km wide, including parts of the town which are generally less than 5m above sea level and the hotels strip which extends to the north of the town. (See map 1, Chapter 3)

2.0 NETWORK DEVELOPMENT

2.1 The Sewerage Network

Only 25% of the projected sewerage network is constructed and 35% will be finished by May '99, including the sewer that will serve the northern coastal strip.

The 35% of constructed sewerage network serves approx. 65% of the Larnaca population. There is no specific schedule for the construction of the remainder of the network which is dependent on the availability of funds. The present sewage network has been developed in the last few years at a cost of approx CY£ 30,000,000, including the existing drainage network.

The cost of constructing the remainder of network will be approx. CY£ 80,000,000, and will cover the remaining 65% of the network area. This high investment will be to serve only 35% of city's population and LSDB are under less pressure to finish the network which will probably be within 5 years.

The rest of the sewage collection pipeline network should be constructed as soon as possible as the town of Larnaca predominately relies on absorption pits, or in some cases on septic tanks, and it is likely that the groundwater is contaminated. The distribution network design and size also needs to relate to the shortage of building space and the

tendency to construct higher buildings.

Obviously, to implement the total network will have numerous benefits for the town of Larnaca and the surrounding area, and the production of treated wastewater, will be beneficial in a country facing water shortages.

The pipeline network is comprised of gravity sewers and force mains. The pipes are constructed below existing roadways and public land to a maximum depth of 3,5 m and a minimum depth of 0,9 m.

The area which the network serves to date is very flat, and it is necessary to pump the sewage to transport it from the town and the northern coastal strip to the treatment works which are located in the south, near the international airport.

With the present 25% of the sewerage network constructed, a total of 16 underground pumping stations are in operation located in different parts of the town and the Municipality (see fig 3). The external parts of this facility, the access to the underground system and the ventilation of pumping stations are planned correctly (security, odours filters, etc.) but the visual impact of some pumping stations should be improved. (See photos 7 & 8)

The pumping stations, which are the weakest part of the sewerage network, are monitored continuously with electronic controls which notify all incidents to a computer located in the central offices. If there is an incident, the LSDB have a maximum of 45 minutes to repair the problem and for this reason all pumping stations materials and equipment are of high quality and the maintenance is very good. The LSDB have mobile pumping equipments which can be rapidly brought into operation.

The network has had no problems up to now, except some small obstructions due to household oils and fats which cause a reduction in the diameter of the pipe connections.

Users are subject to legal requirement not to dispose of oil and fat in the sewerage network. Unfortunately, many owners, specially in small services like restaurants, disregard the requirement. The LSDB is taking measures to solve this problem.

2.1.1 Industrial Effluent

The effluent from industries which are connected, or will be in the future, is covered by Regulations to control the quality of effluent discharged to the sewers (A.G. No 35/1969 (1)): "A law to Provide for the Establishment and Construction of Sewerage and Drainage Works, Their Control and Management, For the Treatment and Disposal of Sewage and For Matters Connected Therewith". In summary the law prohibits the discharge of fatty materials, inflammable materials, acid or alkaline substances, toxic metals and phenols, and excessive quantities of suspended sediments, dyes and materials with high BOD's.

The law also requires the monitoring and control of the chemical content of industrial waste discharges to the sewerage system as this can limit the reuse of the sewage effluent for irrigating crops.

Fig. 3

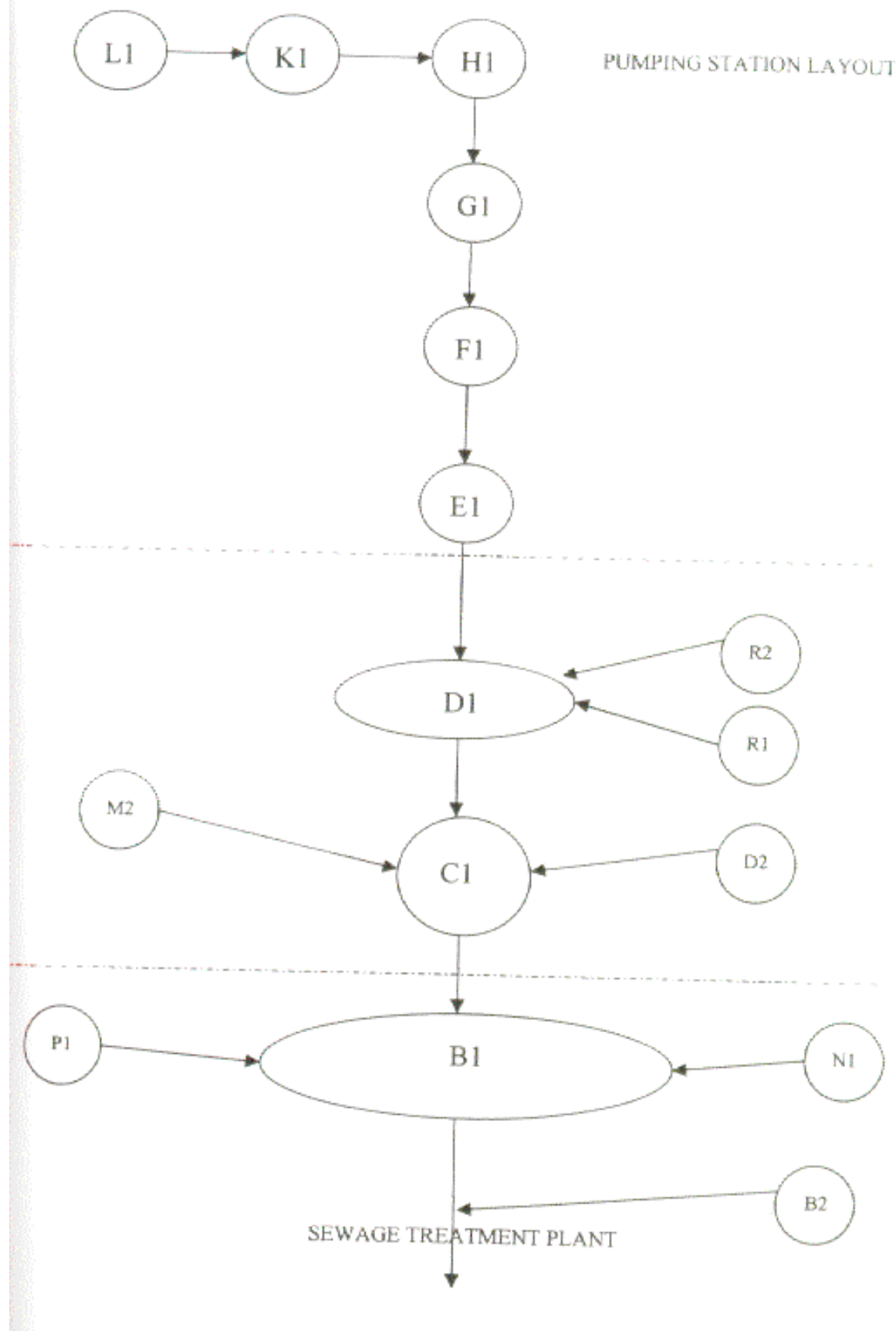




Photo 7. Facility area of the sewage pumping station with plants to improve the environment an visual impact



Photo 8 Facility area of the sewage pumping station without measures to improve the environment and the negative visual impact

Permits to discharge are specific to each industry. However, the LSDB can decide if an industry can be connected and if so, the permitted effluent characteristics. Currently, the LSDB do not permit any industrial connections, even if the effluent is organic and has been adequately pre-treated. This is fine if the industrial effluent contains inorganic compounds, heavy metals, or hazardous wastes (organic or inorganic), because of the need to produce a quality sewage, without contamination.

The treatment works needs to produce a high quality, uncontaminated sludge, if the LSDB wishes to recycle it for landscaping, agriculture, etc. However, when the effluent has similar characteristics to normal sewage, the connection to the sewerage network should be permitted, as in the case of the many food industries located in the Industrial Area which have secondary biological treatment.

The industries can obtain Government permits to discharge their effluent in absorption pits (where the network is not yet constructed) if the characteristics after treatment (generally secondary biological treatment) are as follows:

Temperature	30 °C
BOD	100 ppm
COD	300 ppm
SS	50 ppm
Oil & Fat	10 ppm
Conductivity	9000 us/cm (this value varies according the industry)
Cl (salts)	1400 ppm

The permitted conductivity and chlorine is due to the underground water in this area being salinated because of the intrusion of sea water, as a result of overpumping in the past. The Government permits absorption pits with a depth of 1.400 ft, in the case of the meat industry.

2.2 The Stormwater Drainage Network

The stormwater drainage network is being constructed at the same time as the sewerage network. At present the completed part of the network collects the stormwater from 20% of the city.

The constructed network has 7 pumping stations, and the stormwater is pumped directly to the sea. The drains discharge through a series of outfalls along the seashore.

The remainder of the network will be constructed at the same pace as the sewerage network. However, it is very important to finish the stormwater drainage network as soon as possible as stormwater produces small floods in many areas of the city and the municipality during heavy rain. (see photo 10). Some sectors of Larnaca town will in the future be connected to a channel which needs some improvement to prevent flooding. The current pipeline network is comprised of a parallel pipe to the coastal line and 7 more pipes which are perpendicular to this line. Stormwater is not treated before discharge to the sea, and probably will contain oil and heavy metals, especially after long dry periods, from surface traffic areas such as roads and car parks.

Although rainfall is generally in the winter period, which is a low tourism period, water

containing oil will be flowing from all the storm drains, resulting in an oily sheen on the sea. Stormwater should not, therefore, be pumped directly to the sea, but to a reservoir to be treated and reused for the irrigation of landscapes, golf courses, etc, or used to recharge the coastal aquifers which are contaminated by sea water intrusion. Water could be stored in water butts or sealed ground tanks where evaporation losses are minimised.

The LSDB may request the Government to handle the construction of this infrastructure and, as with the tertiary treatment of sewage, they could sell the treated stormwater.

3.0 THE SEWAGE TREATMENT PLANT

The sewage treatment plant is on an 11 ha site located about 2,5 km south of the city near to the international airport and one kilometre from Larnaca Salt Lake. It is surrounded by agricultural land and undeveloped scrubland which is a halophytic (salt-loving) plant community with three salt lakes (see fig 4).

The plant is designed to treat a maximum flow of 17,500 m³/day (2,5 x the average peak flow which in Summer will be 7,000 m³/day). Currently the flow is low as the sewerage network collects only a part of Larnaca municipality and, therefore, the facilities do not work as efficiently as they would with a full load. The process for the sewage treatment is extended aeration (biological secondary treatment by activated sludge). The treated effluent is sent to 2 storage lagoons which are near the treatment facilities. (see Fig. 5 & photo 11)

By the end of 1999, the treated effluent will pass from the settlement tanks to tertiary treatment. Modular sand filter units will be used to remove fine suspended sediments with pre and post chlorination. The treated effluent will be stored in the lagoons prior to use for landscaping irrigation within the municipality, at hotels, etc.

The 2 lagoons are constructed with a polyethylene lining and each one has a capacity of 500,000 m³. However, the surface of the lagoons is too large (approx. 100,000 m² each one) and in the summer periods (from 15 May to 15 September), the evaporation losses are 1,500 m³/day. During the rest of the year, the evaporation is less but in any case, very significant. (see photo 9).

Water resources are a major problem in Larnaca as in all of Cyprus. Such evaporation losses should, therefore, be avoided and the storage of all treated water in only one lagoon should be considered thereby reducing the evaporation by half. The other lagoon would contain salt water to maintain the stability. When the network is completed and the second lagoon is required, it will be necessary to empty and clean it before filling it with treated water.

Treated sewage, after tertiary treatment, will be distributed to Larnaca Municipality and the hotels in the northern coastal strip by a pipeline network, to be reused in landscaping, etc. Both the tertiary treatment and the pipeline network, has been paid for by the Government who will sell treated water at CY£ 0,15-0,20/m³.

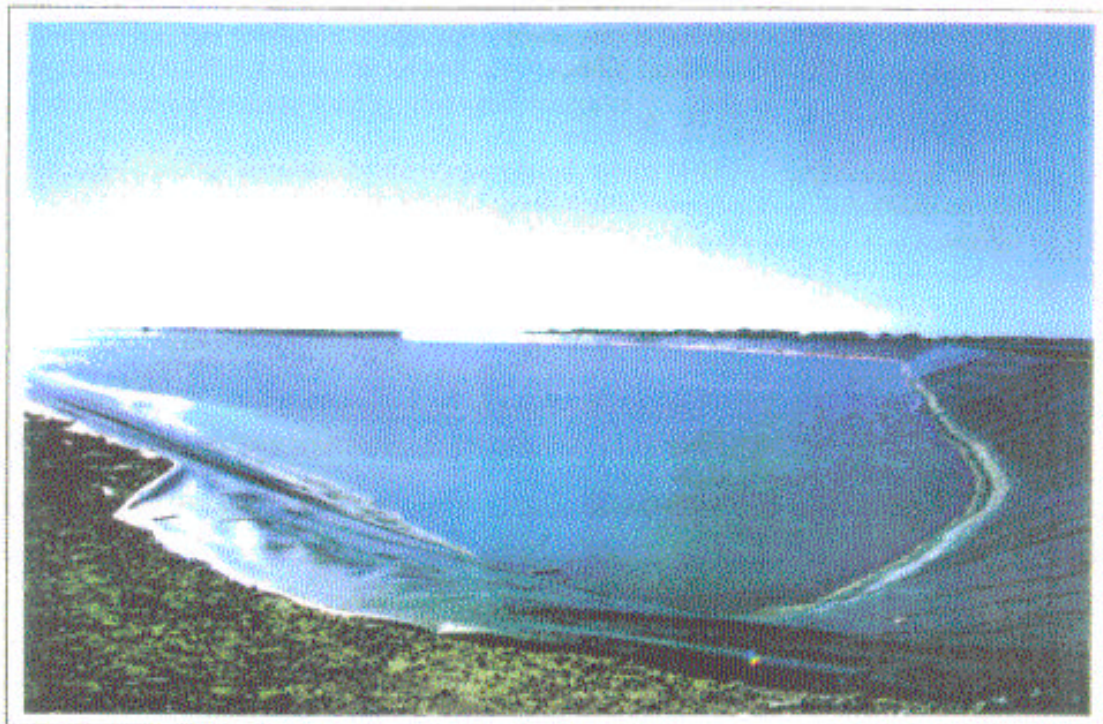


Photo 9 Storage pond of sewage treated water



Photo 10 Area of Larnaca Town without stormwater drainage system, after rainfall

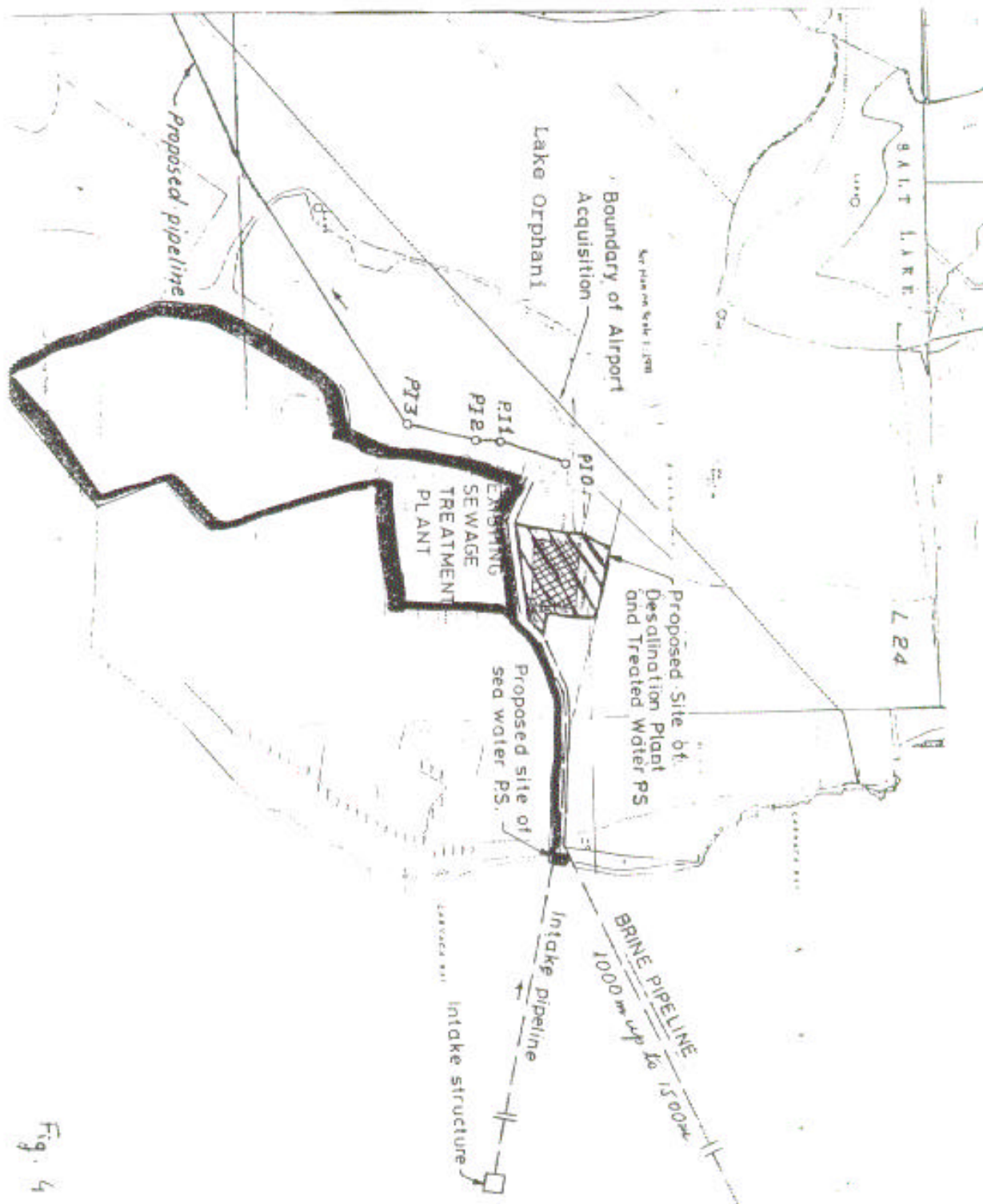


Fig. 4

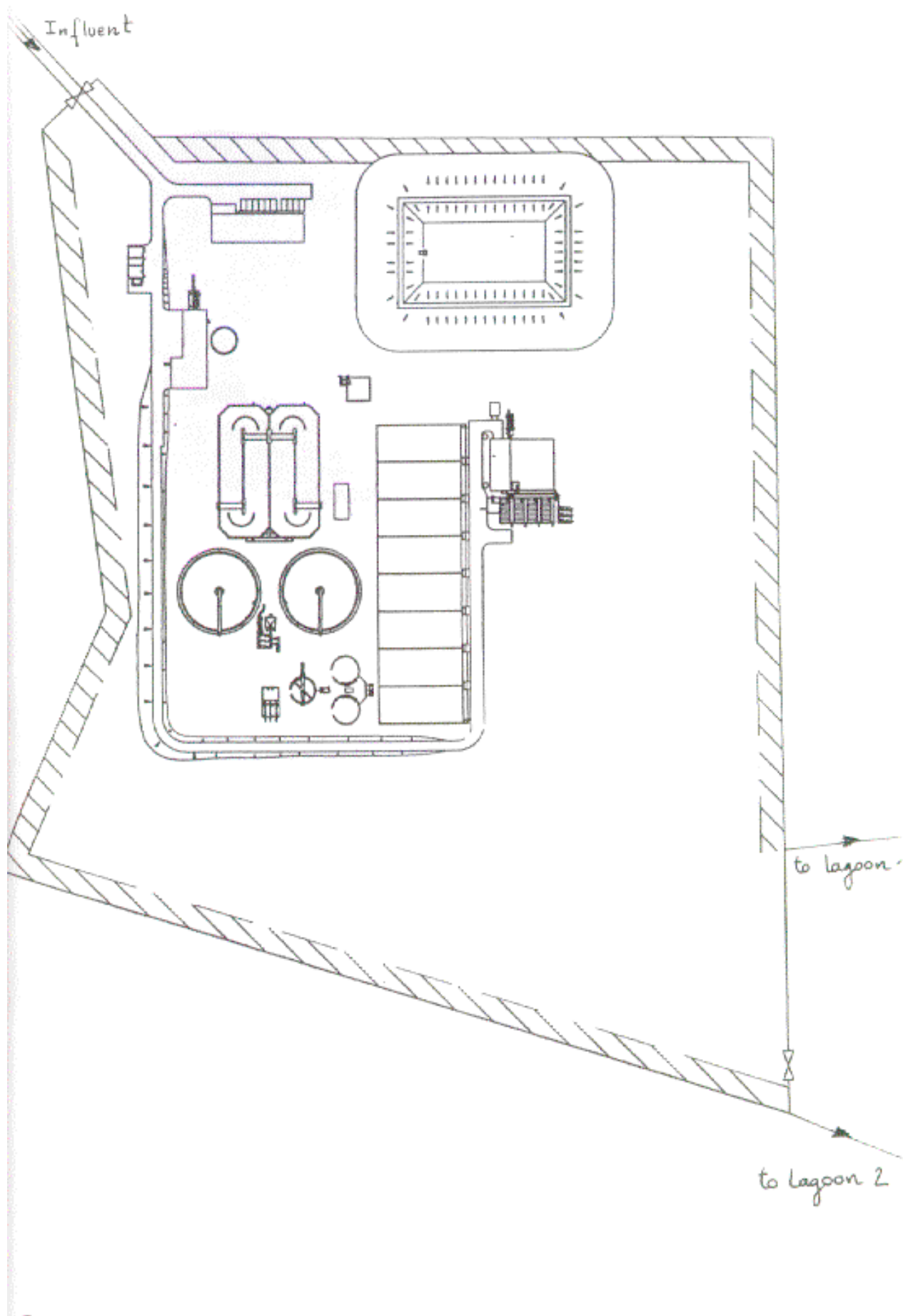




Photo 11 A view of the Sewage Treatment Plant

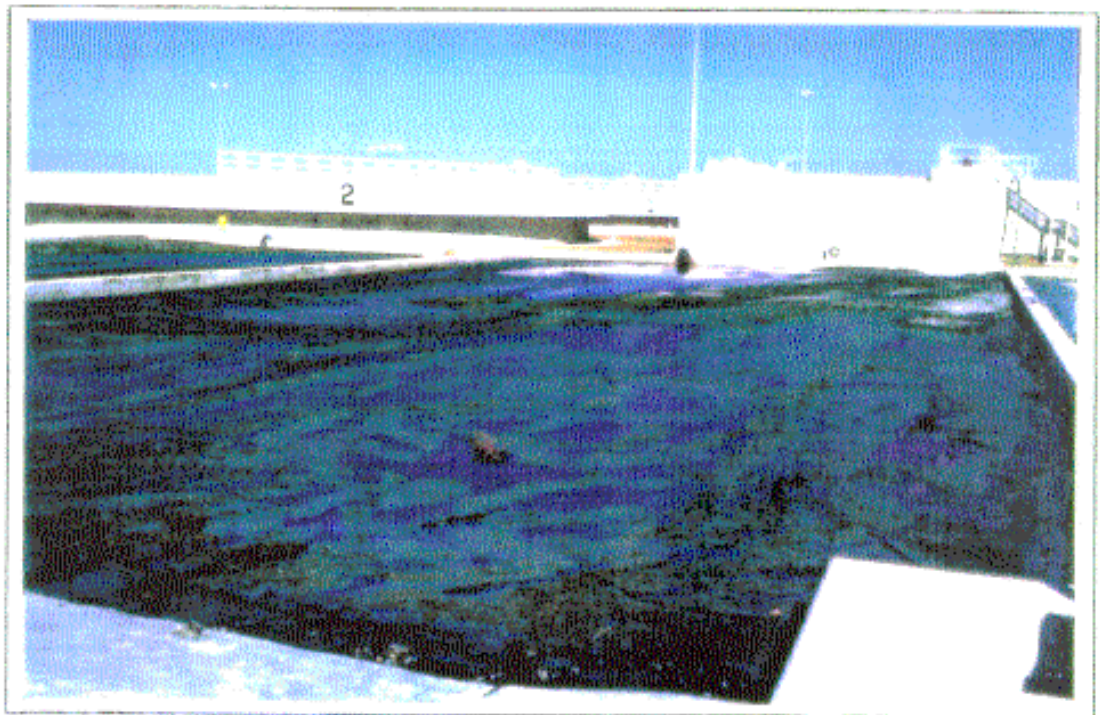


Photo 12 Sewage Treatment Plant: drying beds

The sludge passes from the settlements tanks to the sludge thickening tank. After thickening, the sludge is held for 15 days in an aerobic digestion tank with an aerator. After digestion, the sludge is dried for at least 3 months in 10 drying beds (total surface area of 5,400 m²). The sludge is then removed from the drying beds by tractor and stored for up to 12 months on site prior to disposal or reuse as a soil conditioner (see photo 10).

The current production is low, because the sewerage network collect only a part of the Larnaca population. However, an annual production of 900 m³ dried sludge is anticipated once the plant is running at maximum capacity.

The drying beds are a simple, cheap and ecologically sound system of drying the sludge, and do not have problems with odours or flies, etc. They are, however, working inefficiently at present. The current problems with the drying bed will be increased when the treatment plant works at maximum flow and it will be necessary to analyse why the drying beds do not work efficiently and to seriously consider the alternative of a belt press system.

3.1. Sewage, Effluent and Sludge Characteristics

3.1.1 Raw Wastewater Flow

The incoming flow is currently very low and variable, because the sewerage network is not completed. The following table shows the quantity and variation of the flow from Larnaca, over the last 3 years:

SEWAGE TREATMENT PLANT RAW WASTEWATER FLOW (m ³)				
	1996	1997	1998	1999
JANUARY	23.499	31.196	42.867	27.701
FEBRUARY	26.825	34.261	35.814	
MARCH	23.826	38.029	39.197	
APRIL	42.324	37.230	32.182	
MAY	38.730	36.094	30.779	
JUNE	37.677	39.221	34.167	
JULY	41.403	43.870	35.625	
AUGUST	54.381	45.085	39.952	
SEPTEMBE	45.561	43.121	32.529	
OCTOBER	42.535	39.727	29.127	
NOVEMBER	31.028	37.018	29.127	
DECEMBER	36.491	37.840	33.304	
TOTAL	444.280	462.692	415.30	

3.1.2 Treated Effluent

In the Larnaca community, the sewage will be a mixture of the water supply, which acts as a carrier, domestic and commercial waste, but not industrial waste. For this reason the sewage has very good characteristics as shown by the following table (2 sample days in February 1999).

The characteristics of the effluent from the secondary treatment are very good, but the facility is only working on low flow and the retention times in the tanks, including the aeration tank, is higher than it would be in normal conditions. However, the facility is very well designed and likely to work adequately when the sewerage network is completed. The effluent characteristics in February 1999 (2 sample days) are shown in the following table.

FEBRUARY 1999				
		LIMIT	Monday	Tuesday
INLET WORKS	(m ³ /d)		1077	908
	BOD ₅ (mg/l)	110-400		
	COD (mg/l)	250-1000		
	Nitrogen as NH ₃ (mg/l)	<100		
	Suspended Solids (mg/l)	100-500		
	Conductivity (ms/cm)	1,0-2,5	1,898	
	pH	6,5-8,5	7,921	
FINAL EFFLUENT	BOD ₅ (mg/l)	<20	7	
	COD (mg/l)	<70	17	21
	Nitrogen as NH ₃ (mg/l)	<3	0,39	0,46
	Suspended Solids (mg/l)	<30	1	7
	Conductivity (ms/cm)	1,0-2,5	2,22	2,37
	pH	6,5-8,5	7,684	7,531

Effluent to be reused for the irrigation of amenity areas in Larnaca

The required effluent standards are that 80 % of effluent samples shall be equal to, or better than, the following:

After Sand Filtration (Tertiary) Treatment:

BOD	10 mg/l
SS	10 mg/l
Ammonia	3 mg/l

After Chlorination

Faecal Coliforms not to exceed 100 per 100 ml

At present, the treated sewage effluent (secondary treatment) is stored in the lagoons, and will be subject to tertiary treatment at the end of 1999. Currently, the storage time is very long and the characteristics of the stored effluent change, depending on this timespan. The present, characteristics are as follows:

LAGOONS		LIMIT	SAMPLE 1	SAMPLE 2
	BOD ₅ (mg/l)	<30		
	COD (mg/l)	<150	88	71
	Nitrogen as	<3	0,46	0,55
	Nitrate (mg/l)	<3	0,0	0,0
	Suspended	<160	32	25
	Phosphorus	<3	0,01	0,05
	Sulfate (mg/l)	<500	950	850
	pH	6,5-8,5	9,687	9,110
	Conductivity	1,0-2,5	4,10	4,01
	Chloride	<800	1100	1050
	Boron (mg/l)	<0,5		

3.1.3 Sludge Characteristics

The sludge characteristics after treatment by aerobic digestion are:

Bacteriological analysis

Eggs	0 in all samples
Parasites	0 in all samples

Sludge heavy metal content

	<u>mg/Kg</u>
Cadmium (Cd)	2,20
Chromium (Cr)	30,50
Copper(Cu)	101,40
Zinc (Zn)	620,00
Nickel (Ni)	25,30
Mercury (Hg)	0,50
Lead (Pb)	21,75

Nutrients contents. Typical Analysis

pH	7,0
Nitrogen (N)	3,65 %
Phosphorus (P)	1,29 %
Potassium (K)	0,34 %

The quality of the sludge is very good, due to the absence of industrial wastewater and this quality permits the use of sludge on gardens or in agriculture without any problems.

The maximum concentration of heavy metal permitted in sludge to be applied in agriculture, (U.E. Directive) is:

SLUDGE	
Heavy Metal	__mg/kg mg/kg
Cadmium (Cd)	40
Copper (Cu)	1750
Nickel (Ni)	400
Lead (Pb)	1200
Zinc (Zn)	4000
Mercury (Hg)	25
Chromium (Cr)	1000

4.0 TAXES AND COSTS

Since 1980 taxes have been as follow:

Non-connected houses/buildings	CYP 0,70/CY£ 1000th of house value
Connected houses	CYP 2,99/CY£ 1000th of house value
Connected hotels	CYP 9,79/CY£ 1000th of hotel value

The LSDB is considering a new tax, which will be based on the cubic meters of water consumed (approx. CY£ 0,10/m³).

The actual cost of sewage treatment is CY£ 0,45/m³ of sewage, and when the treatment plant works to full capacity, the cost will be CY£ 0,20-0,25/m³ (including the pumping costs).

5.0 WASTEWATER LEGISLATION

The bulk of environmental protection legislation is contained in laws and regulations on natural resources preservation and management.

The Control of Water Pollution Law (69/91) and special Order (no. 45/96), prohibit the dumping of substances or materials in lakes and rivers, the release of untreated industrial effluent, the dumping of industrial waste on soil, of dangerous substances in any water and of waste in wells.

Although there are wastewater discharge regulations, there are no effluent charges, and thus no direct application of the "polluter pays principle". The Sewage and Drainage Law (no. 35/69), prohibits the release of specific substances and industrial waste to public sewage, unless treated.

In respect of rural areas, central sewerage systems have been constructed in a number of villages and more such systems are under construction. Funds have been secured from EIB, for the preparation of a study for the treatment and re-use of sludge from treatment plants and a code of practice for its use as fertilizer (soil conditioner) has been prepared.

Provisions in Regulations approved under the Sewerage Networks Laws, impose conditions concerning the nature and characteristics of wastes discharged into a public sewer, as well as effluent standards for industrial wastes to be allowed into them.

Treated effluent of high quality is produced from such plants, and the Government's policy is to utilize it to irrigate agricultural crops, green spaces and sports ground and for aquifer recharging.

The MANRE has prepared final regulations on the establishment of a registry for water pollution licenses and for the adoption of ambient water quality standards, as well as draft texts for a Code of Contact for Good Agricultural Practices and Quality Standards for the Re-use of Treated Effluent.

Industrial effluent is currently managed by each industry and disposed of in absorption pits, but a small number of industries have already installed wastewater treatment plants. A special grants scheme is in place, to support the installation of pollution control equipment and, recently a new grants scheme was approved, addressed at the mining and quarrying industry.

The relevant wastewater legislation is as follows:

- * Water Pollution Control Law (no. 69/91)
- * Municipal Corporation Law (Cap. 240)
- * Public Health (Villages) Law (Cap. 259)
- * Public Rivers (Protection) Law (Cap. 82)

6.0 RECOMMENDATIONS

The following recommendations are made for the consideration of the Sewage Board, the Municipality and other bodies, as appropriate:

6.1 Sewage Network

Although 35% of the city (65% of the population) will be covered by the sewage network in May of this year, the remaining part should not be delayed and a target should be set for the completion of the whole network within 5 years.

6.2 Industrial Effluent

Where industrial effluent has similar characteristics to normal sewage, as with the many food industries, a connection to the sewerage network should be permitted by LSDB.

6.3 Stormwater Drainage

Stormwater should not be pumped directly to the sea, but to a reservoir to be treated and reused for irrigation purposes and approaches should be made to the Government to fund this work and recover the cost from the sale of the irrigation water.

6.4 Sludge Drying Bed

The cause of the problem with the sludge drying bed should be investigated and alternatives such as the use of a belt press should be considered if the problem cannot be solved.

6.5 Treated Water Storage

To reduce the evaporation losses by half, all treated water from the wastewater treatment plant should be stored in only one lagoon.

CHAPTER 13 RECOMMENDATIONS AND

FINANCIAL IMPLICATIONS

1.0 INTRODUCTION

The recommendations highlighted in the text of this report are summarised below by chapter.

2.0 SUMMARY OF RECOMMENDATIONS

2.1 The Institutional Framework - Chapter 3

Accession to the EU will result in a greater emphasis on environmental management, legislation and control. The framework and structure should include a Minister for the Environment, an operational environmental agencies and the appointment of local environmental co-ordinators within the 4 principal municipalities.

Improved lines of communication and consultation should be established between central and local government.

Environmental management systems should be applied to government departments and local authorities once they are established.

2.2 The Ecological Baseline and Current Issues - Chapter 5

The legislation in respect of the hunting, liming and netting of birds should be enforced more rigidly.

A vegetation survey and a detailed survey of herpetofauna should both be conducted.

Data on coastal erosion and replenishment in Larnaca Bay should be collected and studied twice yearly.

Steps should be taken to upgrade more beaches towards the Blue Flag standard especially those off the Oroklini Road.

A detailed Wildlife Management Plan should be prepared for the Salt Lakes area.

The reclamation of Orphani Lake should not be carried out at this stage.

Some stretches of the natural coastline between Zigi and Cape Kitti should be protected.

The introduction of a National Coastline law is recommended including the establishment of a coastline conservation association.

Urban amenity operations such as more green space and trees are proposed which should be funded from the CY£0.5 compensation provided annually by the refinery.

2.3 Land Use and Planning - Chapter 6

A review of inter-organisational duties and mechanism for coordination and forecasting is proposed.

Consideration should be given to a review of the taxation system with the aim of reflecting real costs, investments, benefits and priorities at the local level.

An environmental sensitivity survey is recommended together with placing greater emphasis on limiting and controlling land use and expanding the means of deterring transgressors.

The revised local plan should include provisions requiring more detailed plans, schematic plans for selected areas, and also govern the design of structures.

A masterplan for tourism for the city should be drawn up to include tourist routes; the development of 'inland' hotels, capturing a share of the international conference market; improved road and public space development; better public transport; and the control of urban sprawl.

Plans should be promoted to improve the city centre.

The visual impacts of the refinery area should be improved through landscaping. and a long term plan should be developed for the eventual removal of the refinery and depots including alternative use for the recovered beach area.

A plan for the development of the Port and Marina area should be developed including public access to the extended marina.

An alternative site for the de-salination plant should be determined which is not within the declared protected zone.

An updated EIA should be carried out for the proposed airport extension.

The fencing to the airport should be completed to the boundary of the intermediate stage only.

Imaginative plans for Voroklini Lake should be developed.

Systems should be developed for the monitoring of planning applications; educational programmes, and mechanism established for greater public participation in planning and environmental management.

2.4 Transport and Energy Use - Chapter 8

The use of economic instruments to encourage the use of unleaded petrol and smaller fuel efficient vehicles.

Aim for a cessation of the construction of new roads and widening schemes.

Plans to restrict traffic flow in Larnaca centre should be instituted including the provision of efficient public transport linked to peripheral car parks.

Demand management measures should be introduced to control the use of energy.

2.5 Solid Waste Management - Chapter 9

Adopt a proactive waste policy including the development of an integrated waste management system through a collaborative group of local authorities.

Carry out a study into the feasibility of the integrated system and its detailed design as set out in the Report.

Develop a management service for hazardous wastes in small quantities.

Create a 'recycling park' in the Larnaca area for the delivery of bulky waste by householders.

Review and clarify types of hazardous wastes and their correct treatment.

2.6 Pollution Control - Chapter 10 (see page 117/118 for the timing of recommendations).

Establish an air quality monitoring network for Larnaca.

A quantitative risk assessment of the refineries and distribution depots should be carried out as a matter of urgency and the requirements of this assessment must be implemented..

Reduce the sulphur content of diesel fuel and produce unleaded fuel.

The management of the refinery to reduce VOC from storage tanks, minimise odour emissions and improve the smokeless capacity of the flare.

Assess the operation of the hospital incinerator.

Connect treated effluent from small scale industries to the sewage network and major sources must instal on-line recorders.

The oil refinery effluent should not be diluted with sea water before discharge.

Control noise emissions from various activities, monitor noise levels, and empower the appropriate authority to issue noise abatement notices.

Initiate a radiation measurement survey in the vicinity of TV, radio and cellular phone antennas.

2.7 Water Supply - Chapter 11

Develop a national demand management strategy including consumer campaigns; aid for water efficiency measures; the use of grey water; the use of plants requiring

the minimum amount of water; and establish a pilot scheme in Larnaca to determine public response to different measures.

Undertaken a study to examine demand management measures in use throughout the world.

Control the use of aquifers to prevent their over-exploitation.

Conduct a review of the pricing policy to develop a new charging system which does not encourage the excessive use of water.

Review the whole system of rationing supplies and, in particular, study the potential for cross-contamination from other underground systems to the water supply network whilst the supply is interrupted.

2.8 Sewage and Drainage Management - Chapter 12

Complete the sewage network for Larnaca within a minimum of 5 years.

Stormwater drainage should not be pumped directly into the sea without some preliminary treatment.

Investigate the cause of problems with the sludge drying bed at the Sewage Treatment Plant.

Reduce evaporation by halving the treated water storage area.

3.0 COSTING THE RECOMMENDATIONS

Most of the above recommendations relate to policy, staffing or administrative provisions which cannot be realistically costed. The cost of some environmental improvements could be met by the CY£0.5 environmental compensation paid to the municipality by the refinery. It is understood that this annual sum is taken into the municipal general funds and we believe that this should be used for air monitoring, a general greening of the city, and other projects.

Other major proposals such as the development of the port and marina area, the removal of the refinery and storage depots, and proposals for the city centre would require detailed estimates. The following are an idea of the costs involved in specific recommendations:

3.1 Chapter 5 - Collecting data on coastal erosion **CY£10,000 per year**

3.2 Chapter 5 - Upgrading beaches - according to funds available.

3.3 Chapter 9 - Integrated Waste Management Proposals

Larnaca Municipality, together with other municipalities and villages in the area may wish to develop an Ecopark independent of Nicosia. In that way the average transport costs could be reduced but a small 'park' would have dis-economies of

scale. Below is a very raw estimate of the costs taking into account the technical and feasibility of an Ecopark restricted to the Larnaca area.

Estimation of MSW treatment cost for Larnaca (*)		
	Investment (MCYP)	Total cost (CYP/t of MSW)
Larnaca-Nicosia Ecopark	16	12 to 18
Larnaca Ecopark	10	25 to 30
Larnaca-Nicosia incineration plant	30 to 40	25 to 30
Larnaca Recycling Park	0,15 to 0,20	Included in Ecopark cost
Larnaca transfer station for SQG	0,40 to 0,50	SQG should pay

(*) Very raw estimation, because of dependence on non-municipal waste quantities and fees.

3.4 Chapter 10 - Establishing an air quality network CY£200,000

3.5 Chapter 10 - Sulphur content and unleaded petrol CY£40 million

3.6 Chapter 11 - Demand management worldwide survey CY£60,000

3.7 Chapter 12 - Complete the sewage network CY£80 million

CHAPTER 14 DEVELOPING THE LARNACA LOCAL

AGENDA 21

1.0 CONTINUING THE PROCESS

1.1 The Local Agenda

In the Introduction to this Report it was stressed that the Audit is only the first part of the process leading to the development and implementation of a Local Agenda 21 strategy for the sustainable future of Larnaca. This report highlights the existing environmental strengths and weaknesses of the area but sustainable development is concerned with more than environmental conditions. Inevitably, an environmental audit overlaps into economic, social and cultural conditions and any strategic approach to the future which is developed from the results of this audit has also to take these factors into account as well as the needs of the environment.

A 'green' strategy which simply sets out an idealistic environmental programme without considering the economic, social and cultural implications has little hope of succeeding. The reality is that very few, if any, political (or other) decisions are made on purely environmental grounds. Usually, the driving force behind such decisions is economic and occasionally social or cultural but only very rarely is it purely environmental.

The strategy, therefore, has to be a 'vision' for the sustainable development of the area, the primary ingredients of which is for it to be both environmentally and economically sustainable. Above all, the vision must aim for the continuing improvement of the quality of life for present and future residents.

Agenda 21 is a programme for action towards sustainable development at a global level which was agreed at the 'Earth Summit in Rio. Local Agenda 21 is the adaptation of this Agenda for use at the local level which calls for the production of a plan or strategy for sustainable development which is produced in consultation with the local community. The international Agenda seeks the collaboration of all local authorities, throughout the world, in producing their Local Agenda 21.

1.2 Involving the Whole Community

The prime mover in requesting the audit and a strategy has been the Mayor and, through him, the Municipality. However, it is essential that the strategy involves as many people as possible from all walks of life. It is the local community who can best decide the strategic programme for the future based on their local knowledge and understanding of the area, its people and culture.

The key is participation as well as consultation. This Report aims to provide the basis for discussion but it is not exclusive, and to take the recommendations of this report as a 'draft' strategy and circulate it for consultation is not sufficient. Different sectors of the community, such as the fishermen, young people, or the farmers, have different priorities and their views should be sought together with those of Government, both local and central.

The strategy and the subsequent programme for its implementation should be managed by a co-ordinating body, or Environmental Commission, composed of members of the public bodies, all parts of the business community, non-governmental organisations and interested individuals.

1.3 Integrating the Approach

Too often environmental, economic and social issues are pursued in isolation by different public bodies. A further essential ingredient of the production and implementation of the strategy is that these subjects are integrated through an approach which accepts that sustainable development is in fact an overarching umbrella which encompasses a whole range of topics. Central and local government officers concerned with specific topics and services often find this difficult. Their training and work practice has encouraged some to think only, for example, in terms of water supply, or solid waste.

As discussed previously, an environmental co-ordinator should be appointed whose role is to ensure the integration of the strategic programme into existing and future plans and actions working through all the separate sectors. Clearly this is no easy task and it calls for a sympathetic but dynamic individual who may be employed by the Municipality but who works for the whole community through the Commission.

2.0 IMPLEMENTING THE STRATEGY

Once the strategy is agreed by all sectors it should be implemented through a series of Action Plans produced by each of the participating bodies. Each business, NGO, the Municipality, and District Government Departments should produce their action plan which defines how the organisation intends to carry out their responsibilities under the Strategy and in what time scale. Action plans can even be produced by individual schools, shops and households as an important part of raising public awareness and involving the community.

3.0 THE AIM OF THE STRATEGY

Taking into account the comments above, the aim of the strategy should be to structure a vision of future economic, social, and environmental sustainability which involves the community, seeks to integrate all policies, and addresses the priorities.

This report attempts to set out the priorities in the Summary of the Audit Findings (Chapter 2). However, this is only as the Audit Team see them and local people may not agree and priorities should be subject to local and national discussion starting with the Draft Local Agenda document.

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