Cyprus water security experience

Presentation to the Swedish delegation consisting of:

- National Food Agency (NFA) (Location Uppsala)
- Swedish Meteorological and Hydrological Institute (SMHI) (Location Norrköping)
- Swedish Civil Contingencies Agency (Location Stockholm and Karlstad)
- Swedish Geological survey (Location Uppsala)
- Swedish Board of Agriculture (Location Jönköping)
- Swedish Agency for Marine and Water Management (Location Göteborg)
- South Baltic Water District Authority (Location Kalmar)
- Göteborg Vatten och Avlopp, Drinking water producer (Location Göteborg)
- Municipality of Kramfors

Nicos Neocleous
Chief Water Officer
Water Development Department
Ministry of Agriculture, Rural Development and Environment
Republic of Cyprus

Water Development Department Nicosia
2 October 2017

Outline of Presentation

- OVERVIEW OF WATER SCARCITY AND USE
- WATER RESOURCES MANAGEMENT
- WATER SAVING MEASURES
- NON-CONVENTIONAL SOLUTIONS

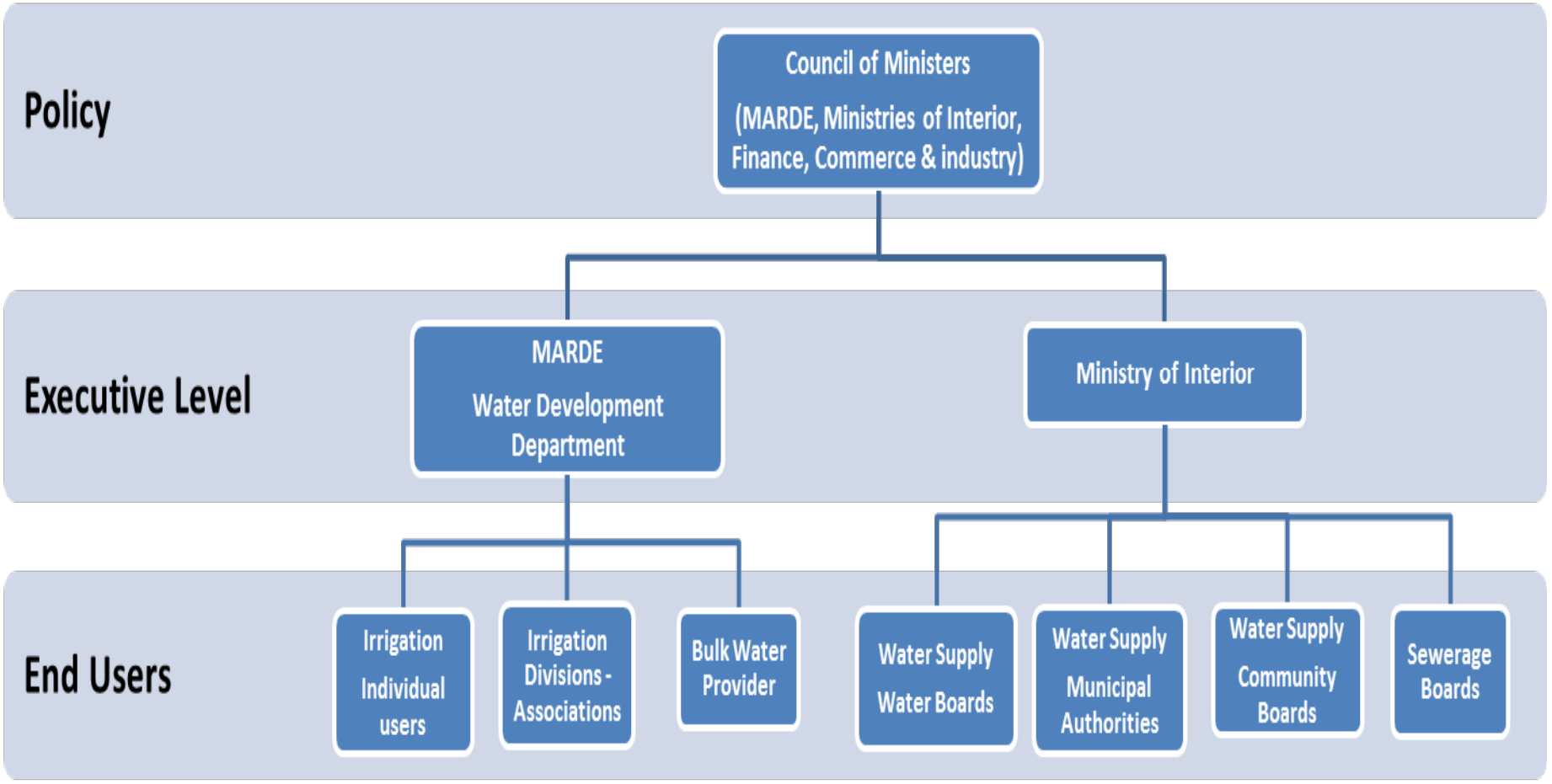
OVERVIEW OF THE WATER SCARCITY PROBLEM AND USE OF WATER IN CYPRUS

SHORT DESCRIPTION ABOUT CYPRUS

Cyprus is an island in the Mediterranean Sea

- Area: 9250 Km^2
- Population: 850,000 (under Government control)
- Year of Turkish invasion and percentage of the occupied area:1974 , 39%
- Year joined the EU: 2004
- Year joined the Eurozone:2008
- Year of the Financial crisis:2013
- GDP (per capita): 2016 €20.984

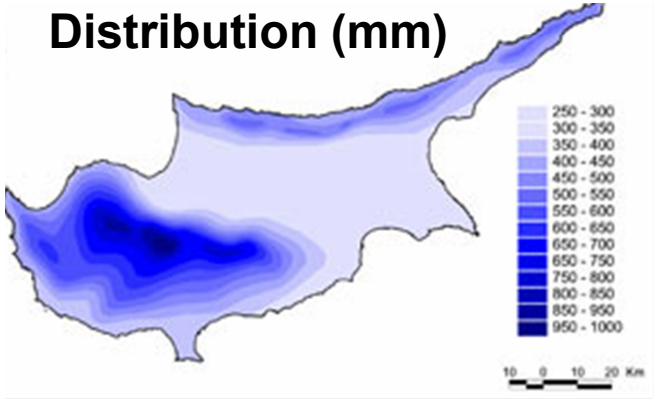
Institutional and Administrative Structure of the Water Sector in Cyprus



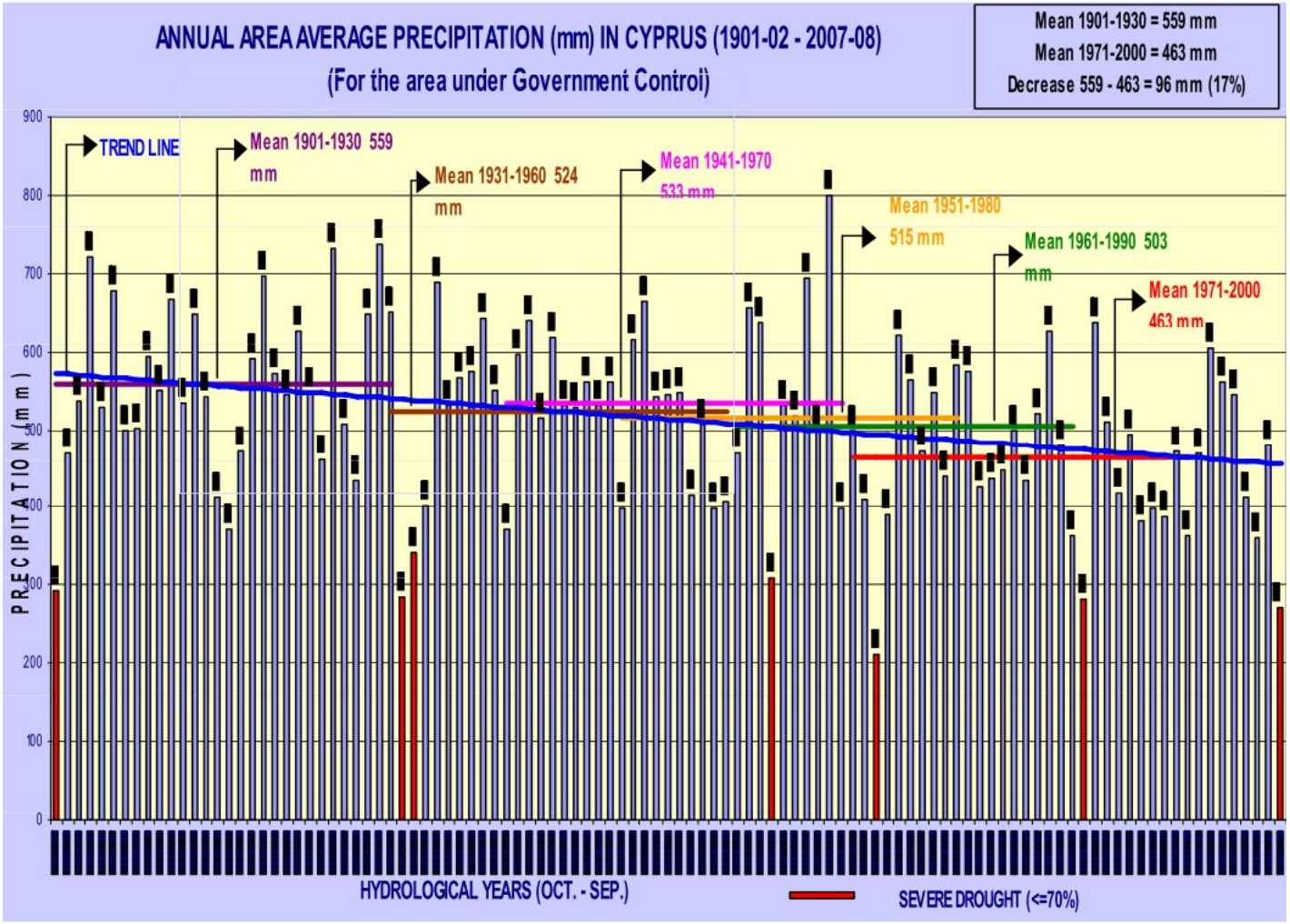
Water Situation in Cyprus

- Water scarcity has always been a very serious problem for Cyprus
  - Cyprus is one of the “water poor” countries of Europe
- Semi-arid climate
- Limited water resources
  - Depend mainly on rainfall
  - Scarce & expensive to exploit
- Unevenly distributed rainfall
- Frequent occurrence of droughts
- Many small catchments, but no perennial flow

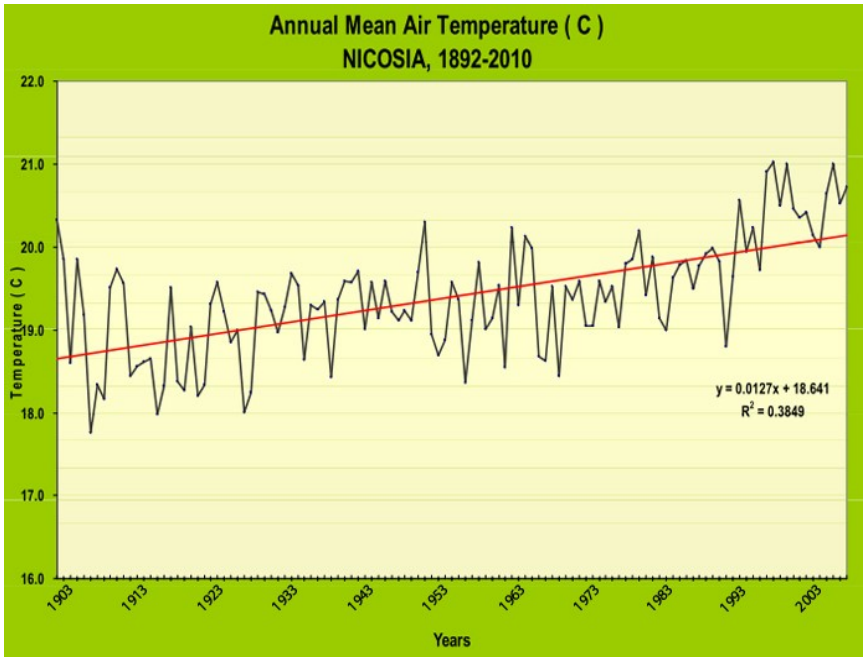
Annual Rainfall Distribution (mm)

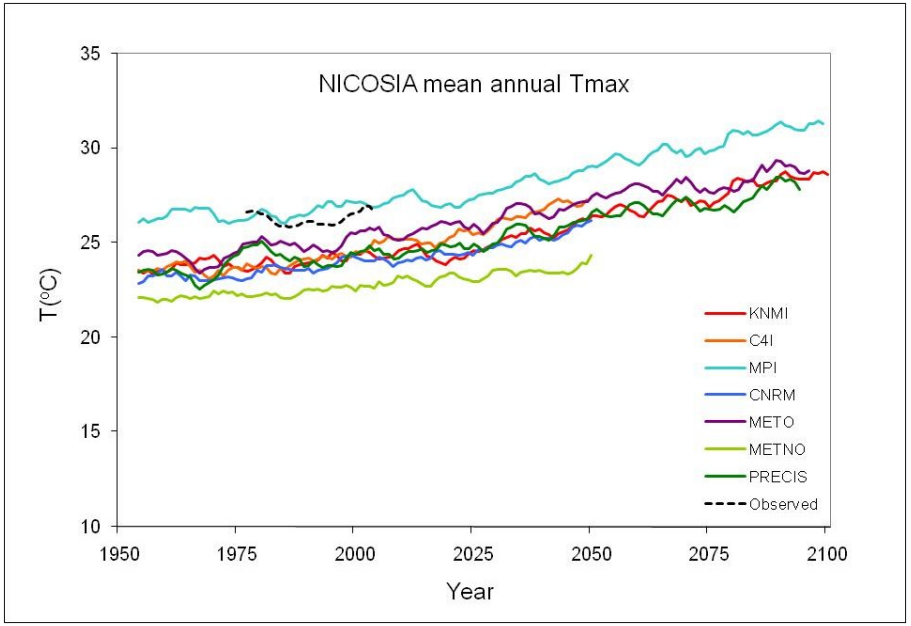


Declining Rainfall



Rising Temperatute



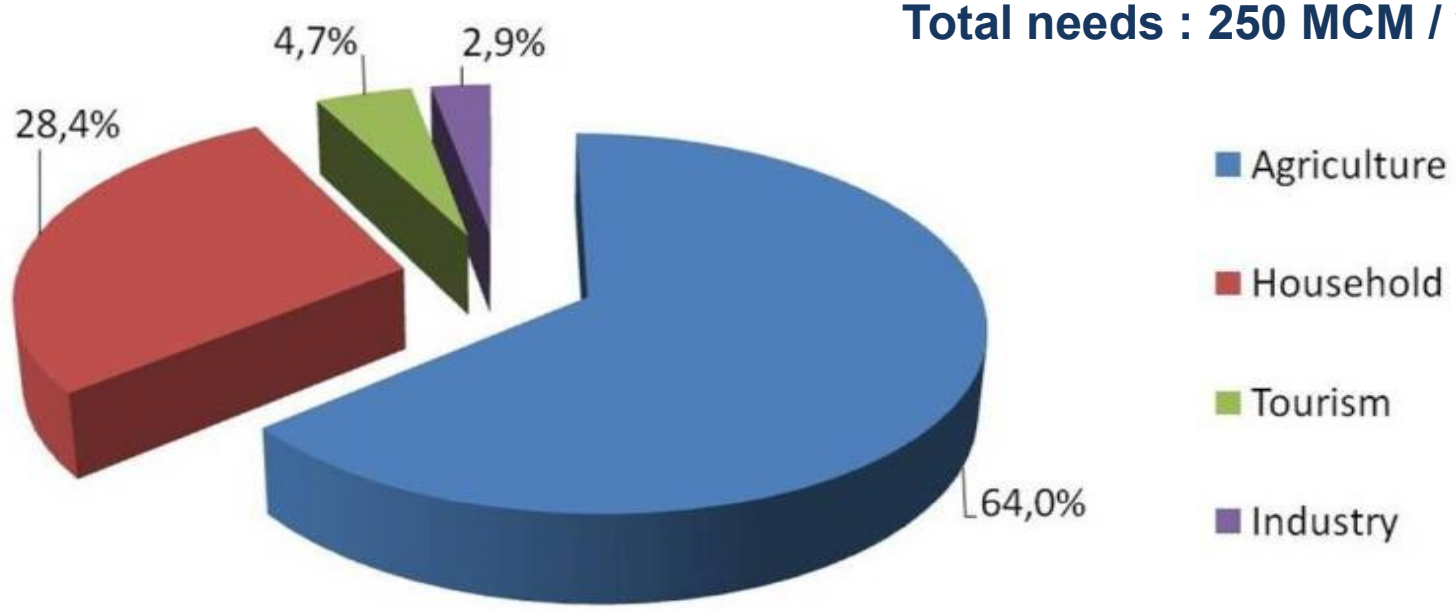


- Climate models predict rise in temperature and increase in the intensity and frequency of extreme drought events
- These conditions, coupled with increased water demands are worsening the water scarcity problem in Cyprus

WATER RESOURCES MANAGEMENT

Uses of Water

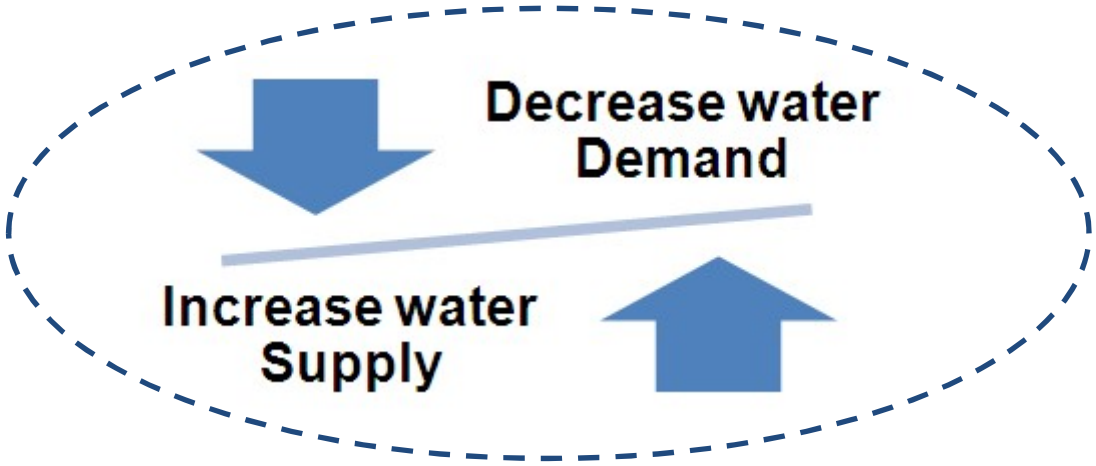
Total needs : 250 MCM / year



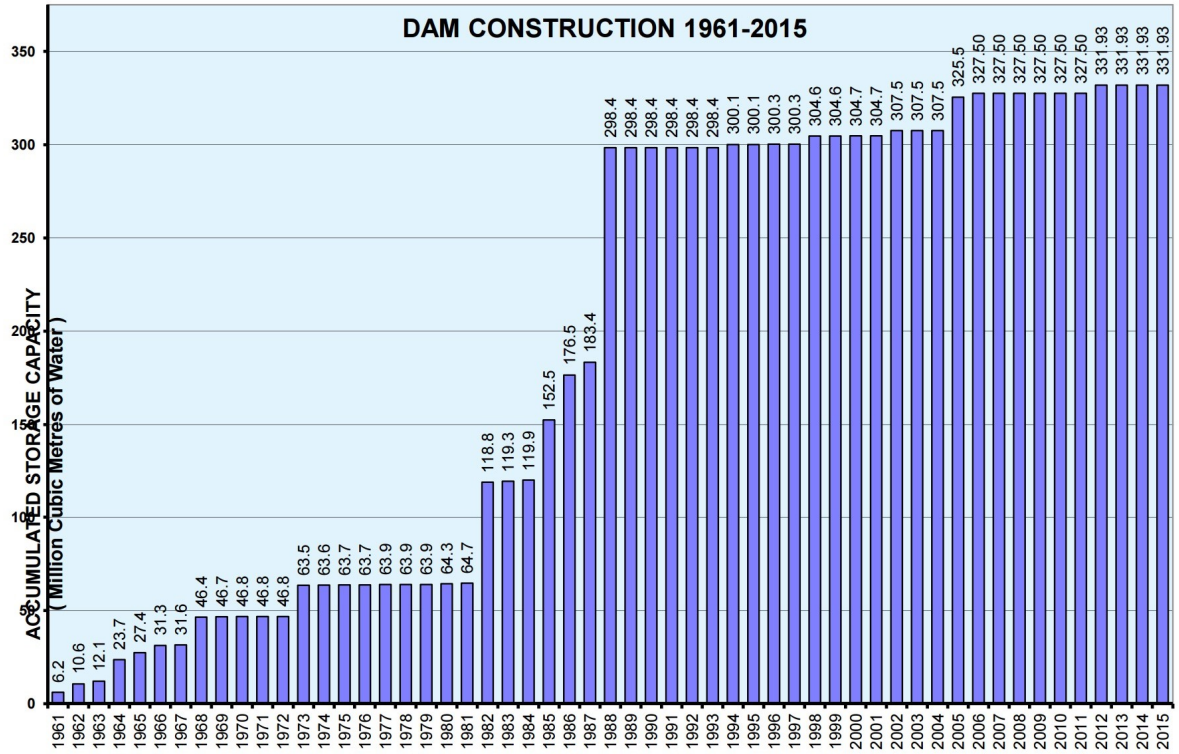
- Above figures approximate water consumption per use
- Total water demand is higher than availability and needs particularly for irrigation are rarely satisfied
- Average consumption per capita is estimated to: 150 litres/capita/day

Water Management Master Plan

- Implementation embarked in the late 60s
- **Objective**: to satisfy in a sustainable way the different users of water and safeguard human & other life
- **Measures implemented**: to increase water availability and decrease water demand

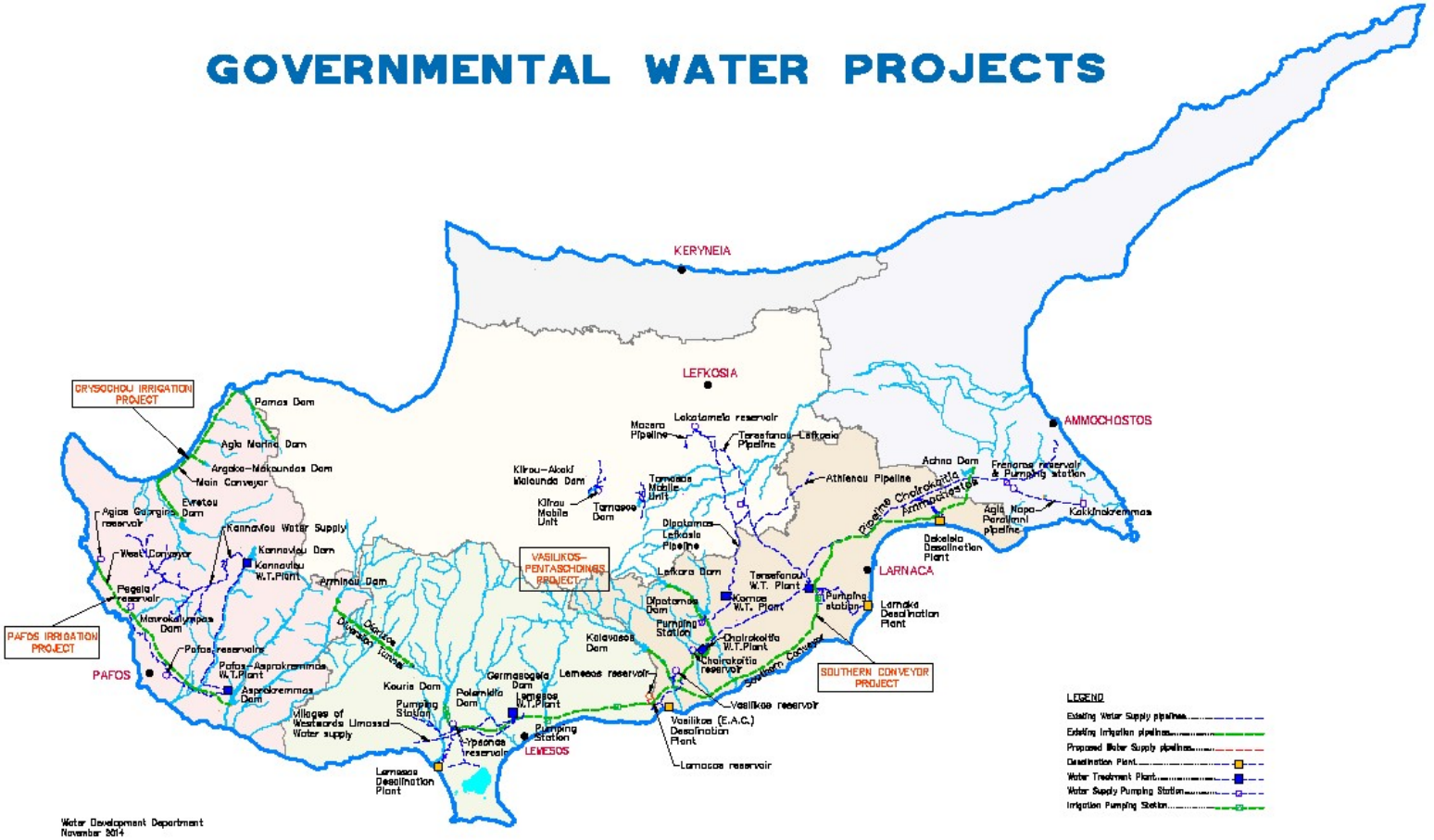


Supply Augmentation



- Increased storage capacity through dam construction
- Drilled boreholes for domestic and irrigation purposes
- Constructed several major water projects

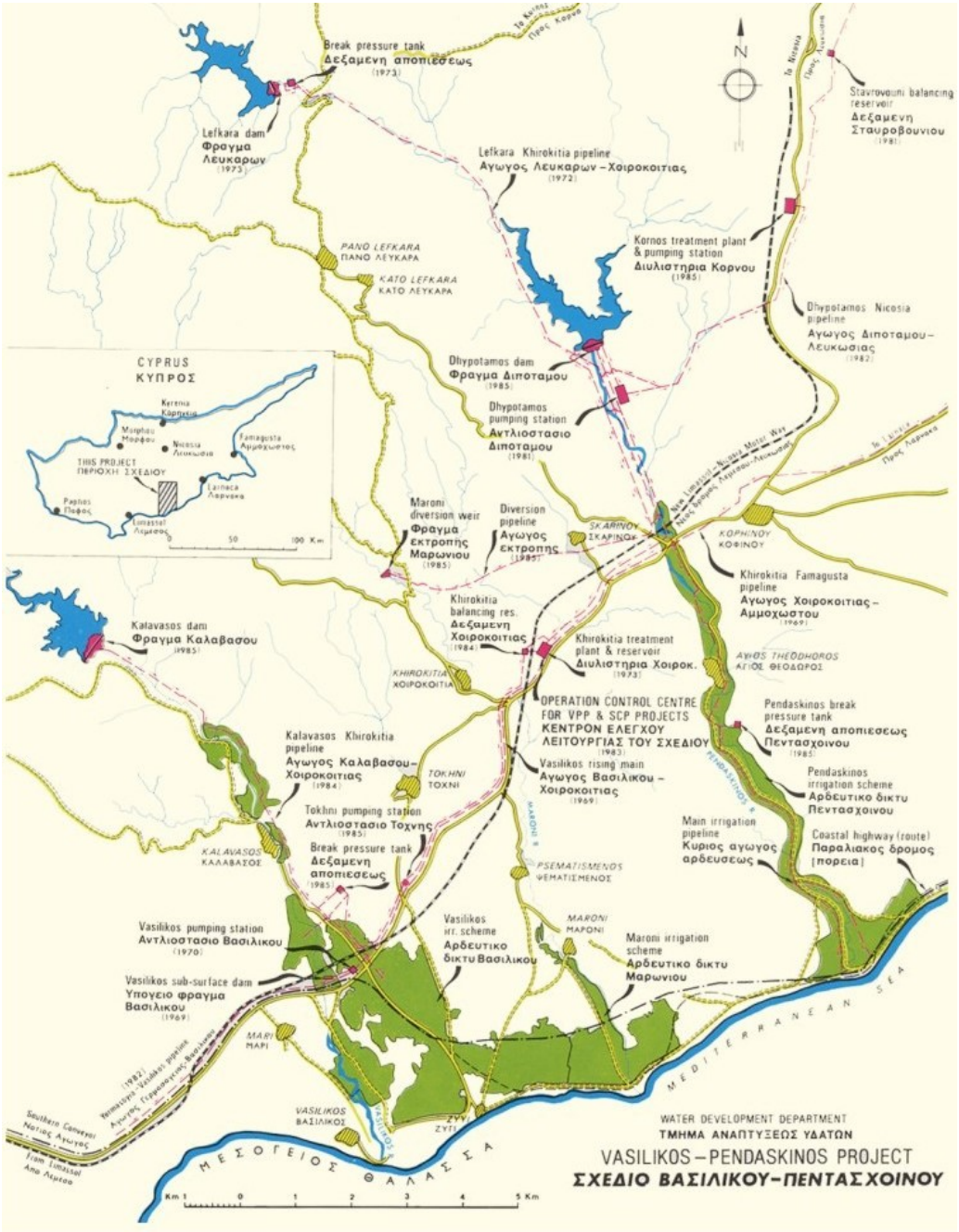
GOVERNMENTAL WATER PROJECTS

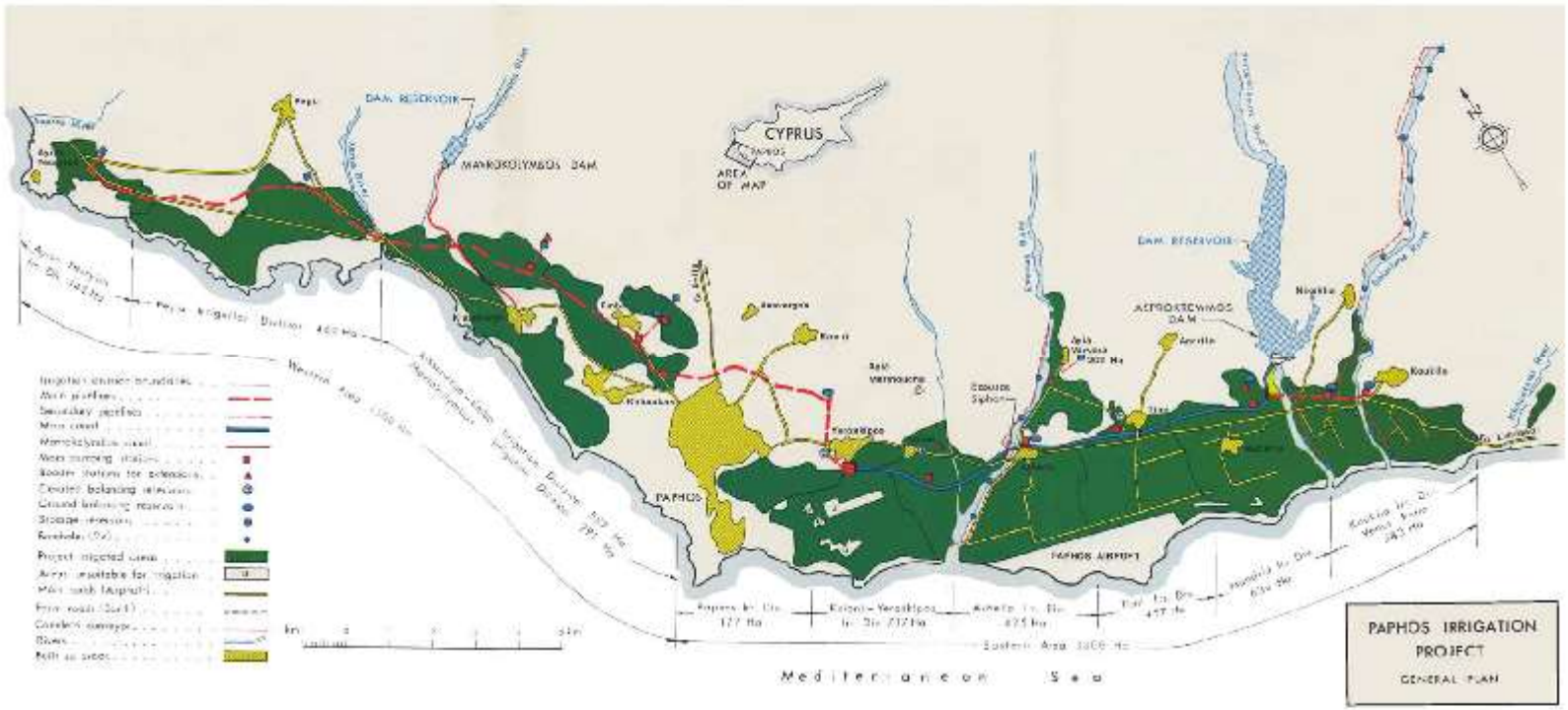


Water Development Department
November 2014

SOUTHERN CONVEYOR PROJECT

KOURIS DAM


Break pressure tank
Δεξαμενή αποπίεσεως
(1973)
Lefkara dam
Φραγμα
Λευκαρων
(1973)
Lefkara Khirokitia pipeline
Αγωγος Λευκαρων – Χοιροκοιτιας
(1972)
Stavrovouni balancing reservoir
Δεξαμενη
Σταυροβουνιου
(1981)
Kornos treatment plant & pumping station
Διυλιστηρια Κορνου
(1985)
PANO LEFKARA
ΠΑΝΟ ΛΕΥΚΑΡΑ
KATO LEFKARA
ΚΑΤΟ ΛΕΥΚΑΡΑ
Dhypotamos Nicosia pipeline
Αγωγος Διποταμου – Λευκωσιας
(1982)
CYPRUS
ΚΥΠΡΟΣ
Kerynia
Κερυνεια
Morphou
Μορφου
Nicosia
Λευκωσια
Famagusta
Αμμοχωστος
THIS PROJECT
ΠΕΡΙΟΧΗ ΣΧΕΔΙΟΥ
Larnaca
Λαρνακα
Paphos
Παφος
Limassol
Λεμεσος
50
100 Km
Dhypotamos dam
Φραγμα Διποταμου
(1985)
Dhypotamos pumping station
Αντλιοστασιο
Διποταμου
(1981)
Maroni diversion weir
Φραγμα
εκτροπης
Μαρωνιου
(1985)
Diversion pipeline
Αγωγος
εκτροπης
(1985)
SKARINOU
ΣΚΑΡΙΝΟΥ
KOPHINOU
ΚΟΦΙΝΟΥ
Khirokitia Famagusta pipeline
Αγωγος Χοιροκοιτιας – Αμμοχωστου
(1969)
Kalavasos dam
Φραγμα Καλαβασου
(1985)
Khirokitia balancing res.
Δεξαμενη
Χοιροκοιτιας
(1984)
Khirokitia treatment plant & reservoir
Διυλιστηρια Χοιροκ.
(1973)
KHIROKITIA
ΧΟΙΡΟΚΟΙΤΙΑ
AYIOS THEODHOROS
ΑΓΙΟΣ ΘΕΟΔΩΡΟΣ
OPERATION CONTROL CENTRE FOR VPP & SCP PROJECTS
ΚΕΝΤΡΟΝ ΕΛΕΓΧΟΥ ΛΕΙΤΟΥΡΓΙΑΣ ΤΟΥ ΣΧΕΔΙΟΥ
(1983)
Pendaskinos break pressure tank
Δεξαμενη αποπιεσεως
Πεντασχοινου
(1985)
Kalavasos Khirokitia pipeline
Αγωγος Καλαβασου – Χοιροκοιτιας
(1984)
Vasilikos rising main
Αγωγος Βασιλικου – Χοιροκοιτιας
(1969)
TOKHNI
ΤΟΧΝΙ
Tokhni pumping station
Αντλιοστασιο Τοχνης
(1985)
Pendaskinos irrigation scheme
Αρδευτικο δικτυ
Πεντασχοινου
Main irrigation pipeline
Κυριος αγωγος αρδευσεως
Coastal highway (route)
Παραλιακος δρομος (πορεια)
KALAVASOS
ΚΑΛΑΒΑΣΟΣ
Break pressure tank
Δεξαμενη
αποπιεσεως
(1985)
PSEMATISMENOS
ΨΕΜΑΤΙΣΜΕΝΟΣ
Vasilikos pumping station
Αντλιοστασιο Βασιλικου
(1970)
Vasilikos irr. scheme
Αρδευτικο
δικτυ Βασιλικου
MARONI
ΜΑΡΩΝΙ
Maroni irrigation scheme
Αρδευτικο δικτυ
Μαρωνιου
Vasilikos sub-surface dam
Υπογειο φραγμα
Βασιλικου
(1969)
MARI
ΜΑΡΙ
(1982)
Southern Conveyor
Νοτιος Αγωγος
From Limassol
Απο Λεμεσο
VASILIKOS
ΒΑΣΙΛΙΚΟΣ
ZYGI
ΖΥΓΙ
ΜΕΣΟΓΕΙΟΣ ΘΑΛΑΣΣΑ
MEDITERRANEAN SEA
Km 1 0 1 2 3 4 5 Km
WATER DEVELOPMENT DEPARTMENT
ΤΜΗΜΑ ΑΝΑΠΤΥΞΕΩΣ ΥΔΑΤΩΝ
VASILIKOS – PENDASKINOS PROJECT
ΣΧΕΔΙΟ ΒΑΣΙΛΙΚΟΥ–ΠΕΝΤΑΣΧΟΙΝΟΥ


DAM RESERVOIR
MANDROLYMBOS DAM
CYPRUS
AREA OF MAP
DAM RESERVOIR
AKROKTEMVIOS DAM
PAPHOS
PAPHOS AIRPORT
Mediterranean Sea
PAPHOS IRRIGATION PROJECT
GENERAL PLAN

ASPROKREMMOS DAM


ΚΥΠΡΟΣ
ΤΕΡΙΟΧΗ ΣΧΕΔΙΟΥ
ΣΧΕΔΙΟ ΧΡΥΣΟΧΟΥΣ
ΦΡΑΓΜΑ ΠΟΜΟΥ
ΦΡΑΓΜΑ ΠΥΡΓΟΥ
ΦΡΑΓΜΑ ΑΓΙΑΣ ΜΑΡΙΝΑΣ
ΦΡΑΓΜΑ ΑΡΓΑΚΑΣ – ΜΑΚΟΥΝΤΑΣ
ΦΡΑΓΜΑ ΕΥΡΕΤΟΥ
ΦΡΑΓΜΑ ΕΞΟΥΣΑΣ
(Προτεινόμενο)
ΑΡΔΕΥΤΙΚΟ ΣΧΕΔΙΟ ΧΡΥΣΟΧΟΥΣ
ΓΕΝΙΚΗ ΔΙΑΤΑΞΗ

Water Balance

(mean values in Mm3 for period 2000-2011)

Rainfall:	476 mm
• Inflow into groundwater	201
• Outflow to the sea	62
Groundwater Balance [GW]	139
Inflow into surface storage [SW]	82
TOTAL Available (SW+ GW)	**221**
SW Releases	60
GW extraction (Pumping)	146
TOTAL Releases/ Extractions	**206**
DEMAND	**250**
DEFICIT	**– 44 (+33*+8**)**

*Desalinated **Reused

WATER SAVING MEASURES

Policy, legal and Institutional aspects

Legislative measures

- Water Saving Law adopted in 1991

Institutional changes

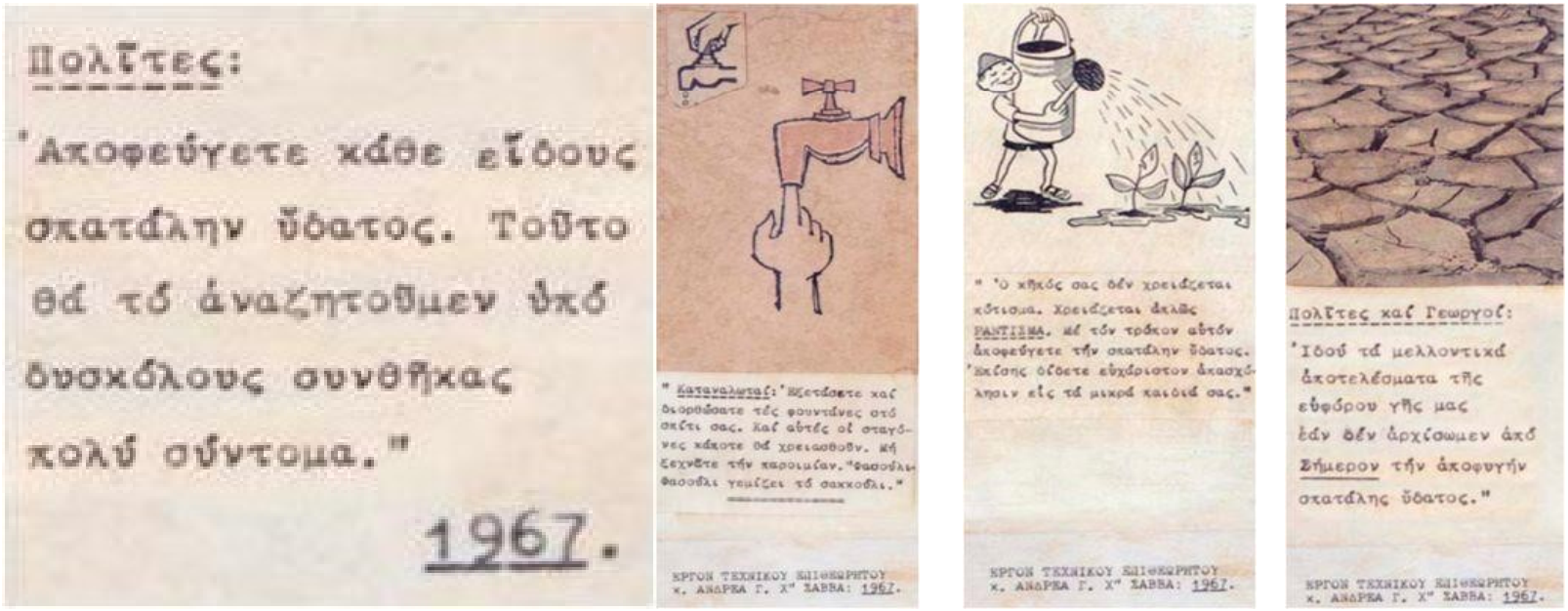
- For years water legislation evolved on an ad hoc basis – Numerous complex laws with fragmented responsibilities
- In 2010 an Integrated Water Management Law (Law N. 79(I)/2010) was established giving the responsibilities of water management to the Water Development Department (WDD)

Water Saving Law 1991

Any person using a hose for the washing of pavements, or verandas, or roads or vehicles is guilty of criminal offence and could be ***imprisoned for up to 3 months*** *OR be* ***fined up to €513****, or both (Extrajudicial fine is €51)*

Demand Management: Integral part of water policy

- Water saving is of particular importance for Cyprus
- Water saving measures have been a long time tradition of the water authorities

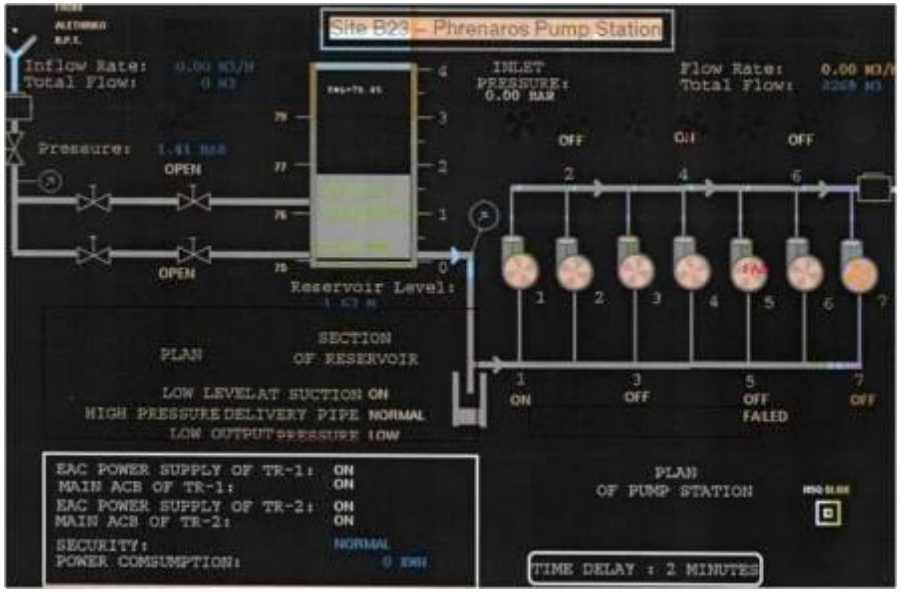


Education and Awareness Campaigns

- Public awareness campaigns
- Weekly television and radio programs for the farmers
- Establishment of Water Week
- School visits
- School drawing and essay competitions
- Distribution of information on water saving
- Daily updated web-site with information on water issues

Leakage Reduction in Distribution Networks

- A systematic effort is made to reduce water losses
  - Efficient conveyance and distribution systems
  - Leakage detection methods
  - Real time tele-monitoring and tele-control on most important projects to optimise operation & maintenance
- The unaccounted water for the Water Boards is reduced the last two years to 12% - 20%
- In villages and small municipalities it is still high (up to 50%)



Economic incentives

- Drilling of private boreholes for garden irrigation with low grade water
- Connection of private boreholes to toilet tanks
- Installation of grey water recycling systems
- Installation of hot water circulating pumps for immediate hot water supply
- Installation of systems to collect rain water from greenhouses roofs

Subsidisation stopped temporarily in 2013 due to the economic crisis in Cyprus

Water saving devices

- Water saving measures are promoted through the National Green Public Procurement Action Plan
- Measures include use of tap and toilet water saving devices in public buildings

Cropping patterns

- Many irrigation projects were under study and implementation during 1970 – 1994
- At planning stage, a cropping pattern was selected and proposed to land owners to ensure efficient utilisation of water at farm level
  - Selection criteria: water supply reliability, project economics, land resources, climatic conditions
- Nevertheless certain crops were not profitable & were replaced with higher profit but more water consuming crops

Improvement of Irrigation Efficiency

- Water Use Improvement Project initiated in 1965 to provide farmers with technical & financial assistance
  - Installation of improved on farm irrigation systems
  - Application of proper irrigation schedules

- Improved irrigation systems currently cover 95% of total irrigated area (annual water savings are of the order of 75 MCM)
- Irrigation water in government schemes distributed through modern & highly efficient systems (closed pipes, drippers, sprinklers)
- Conveyance efficiencies: 90-95%, field application efficiencies: 80-90%

Quota control

- Water allocated to agriculture using a quota system and penalty charges for over-consumption
  - Allocation to farms depends on crop & area irrigated
  - Over-consumption fee is double of the usual tariff
  - The Water Development Department is entitled to interrupt water supply in cases of over-consumption
- Measure applied every year with the exception of some rare years of satisfactory rainfall-inflow

Water Pricing and Metering

- Metering applied to all water uses
- Water billing is based on actual consumption metered at each individual water supply point
- Charges usually comprise a fixed and maintenance charge and a series of block charges (rising block tariffs)
- For irrigation water, charges are established on a volumetric basis and are uniform for all schemes

PRICES FOR DRINKING WATER

Water Framework Directive – Reporting Sheets on Economics – Republic of Cyprus

Table 7.1.1-1 Price of Drinking water from Governmental Drinking Water Supply Systems

Price of Water (per c.m.) \ Period of validity	1984 - 1985	1986 – 1989 (from 1/11/1985)	1990 – 1993 (from 1/01/1990)	1994 – 2004 (from 1/1/1994)	2004 – today (from 1/1/2004)	2017
GWCB of Limassol, Nicossia, Larnaca-Famagusta	0,1812 C£ 0,31 €	0,217 C£ 0,37 €	0,27 C£ 0,46 € *	0,335 C£ 0,57 €	0,45 C£ 0,77 €	0,82 €
GWCB of Pafos				0,16 C£ 0,27 €	0,33 C£ 0,56 €	0,64 €

** This price is valid since 01/01/1994 for the GWCB of Nicosia and Larnaca-Famagusta and since 01/01/1994 for the GWCB of Limassol, which is the date of start of operations for the Water Distillery of Limassol.*

PRICES FOR IRRIGATIONAL WATER

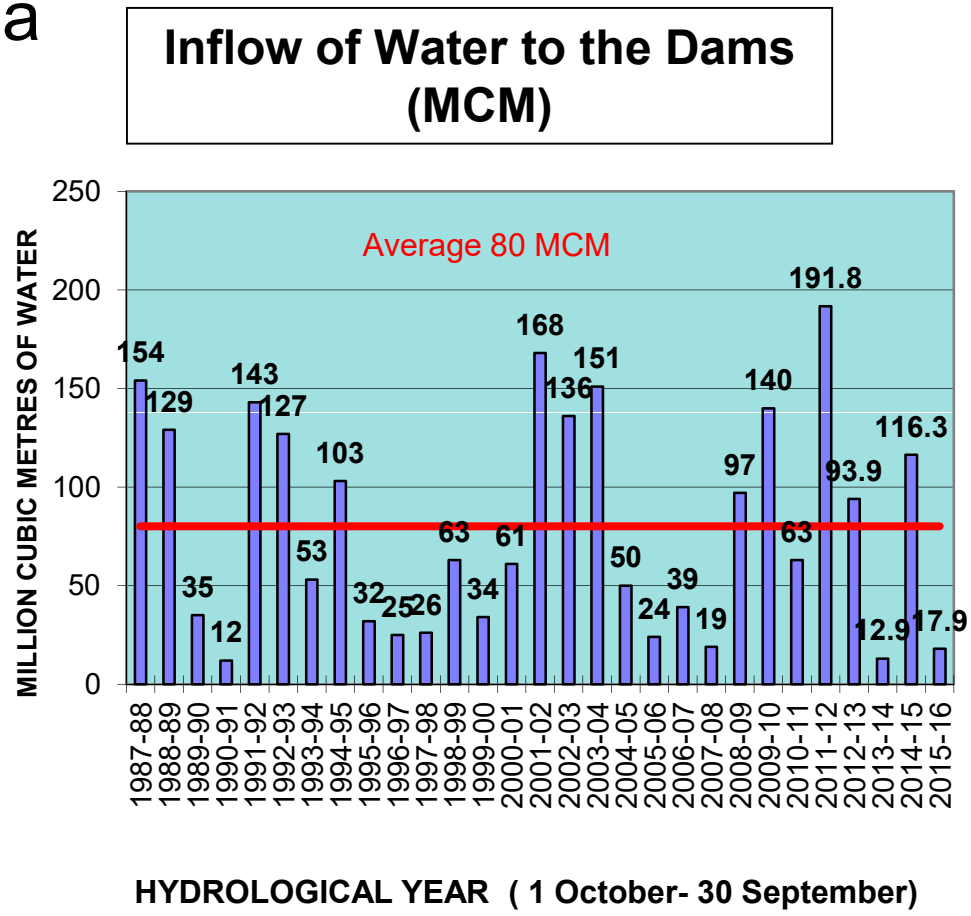
Table 7.2.1-1 Prices of irrigational water from the Water Development Department (€/m^3)

Description / Use	Unit	Unit Price	UNIT RATES FOR 2017
To Agricultural Organisations for agricultural production	€ /m^3	0.15	0.12
To individuals for agricultural production	€ / m^3	0.17	0.17
For industrial consumption	€ / m^3	0.19	0.25
For animal husbandry consumption	€ / m^3	0.17	0.17
For consumption after overflow	€ / m^3	0.05	NOT APPLICABLE
For irrigation of football and golf courses	€ / m^3	0.34	0.36 private- 0.23 public
For irrigation of other sports places, hotels and house gardens	€ / m^3	0.34	0.36 private- 0.23 public
For fish breeding	€ / m^3	0.17	0.17
For over consumption	€ / m^3	0.56	0.45 for irr. & double for other uses
Other prices/ rates			
Fixed yearly rate	€/hectare	1.71	2.40
For connection (once)			
(α) Water meter	€ /meter	68.00	200.00
(β) Filter	€/ hectare	5.00	5.00
For reconnection	€	25.50	20.00

Actual cost of irrigational water: 0.45 €/m3

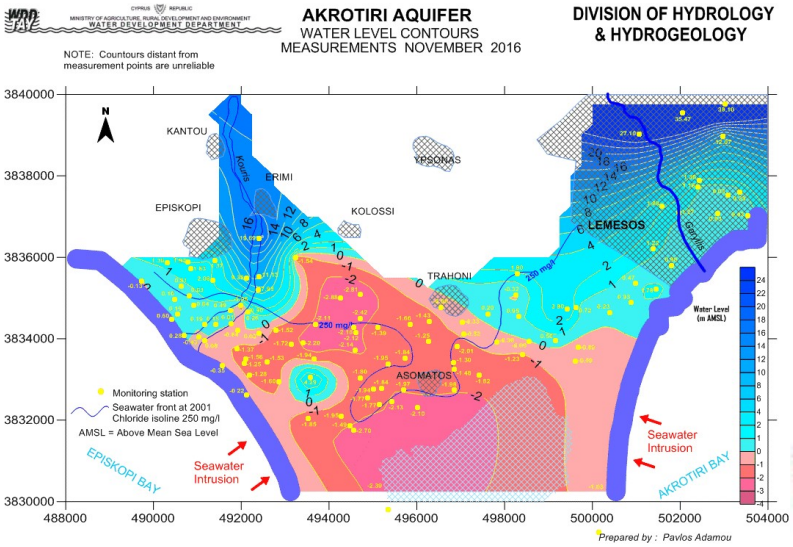
Despite the significant measures, available water was not enough

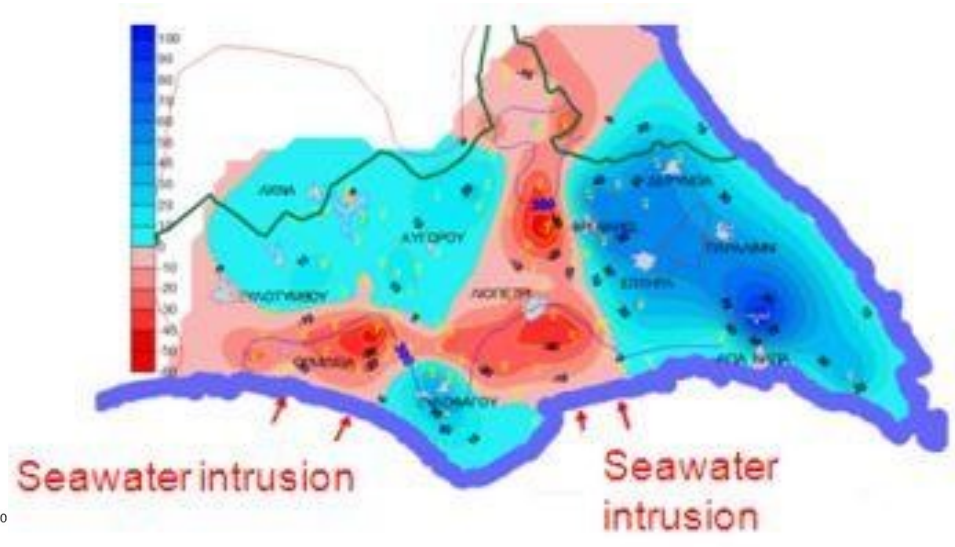
- Climate change caused a drop of 20% in precipitation resulting to a 40% reduction in surface runoff
- Experienced more frequent occurrence of extreme drought events
- Rapid increase in population and tourist arrivals



….Groundwater Deteriorated…

- Groundwater resources have been the most obvious & easily accessible sources of water for many years
- In the attempt to meet the increasing water demand or to mitigate drought effects, they have been heavily over-pumped:
  - Led to seawater intrusion into coastal aquifers
  - Deteriorated both quality and quantity



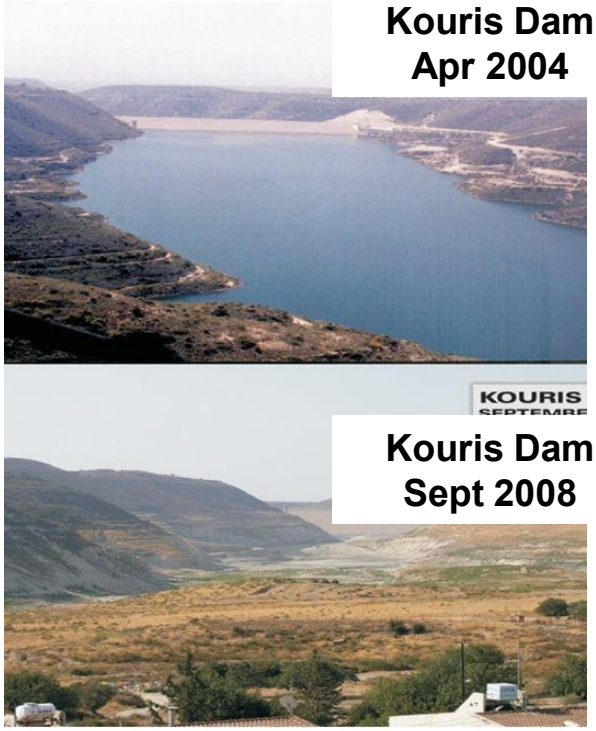


Water rationing

Rationing measures implemented during periods of droughts with priority given to domestic sector

- In 2008, Cyprus was faced with one of the most acute and prolonged droughts in the recent years

- A Drought Mitigation & Response Plan was applied in response
  - Almost 100% ban on water supply to agriculture
  - Strict restrictions on drinking water supply to households (36 hours/week)



Facing water crisis in 2008

Transportation of water from Athens to Limassol with tankers in August 2008 :

35.000-50.000 m^3/day

8.0 MCM of water – cost €56.0 M

NON-CONVENTIONAL SOLUTIONS

Non Conventional Water Supply Sources

- About twenty years ago the Government in order to eliminate the dependency of the water supply on annual rainfall, decided:

- To proceed with the construction of sea water desalination plants to use for domestic water supply

- To replace part of the fresh water used in agriculture by treated effluent.

In 1997 Desalination was Introduced

Public-Private Partnerships (PPP)

- By developing partnerships with private-sector entities, the governments can use the private sectors' knowledge, experience and financing capacity to improve the quantity and quality of basic public services.
- Such Public-Private Partnerships, if properly designed and implemented, can present a number of advantages.
- In Cyprus all desalination plants operate under **B**uilt, **O**wn – **O**perate, **T**ransfer (BOOT) Contracts, where private companies using their own funds, undertake the design, construction and operation of the Plants over a fixed period.
- The Government has the obligation to buy a minimum quantity of desalinated water each year over that fixed period.

Desalination Plant – Contractual Obligations

- The Contractor produces desalinated water of a specified quality and quantity and delivers it to the Water Development Department's storage reservoirs
- The water quality is checked every 2 hours. Additional quality test are carried out on a daily and weekly basis
- The Water Development Department is obliged to receive a specified minimum quantity every 3 months
- Payments to the Contractor are made every 3 months
- The Contractor submits 3-monthly reports on:
  - Quantities of water delivered
  - Quantities over and above the minimum 3-monthly quantity
  - Volume of water which did not comply to the specification
  - Quantities which were not delivered by the Contractor for reasons beyond his direct control

Pricing of Water Purchased

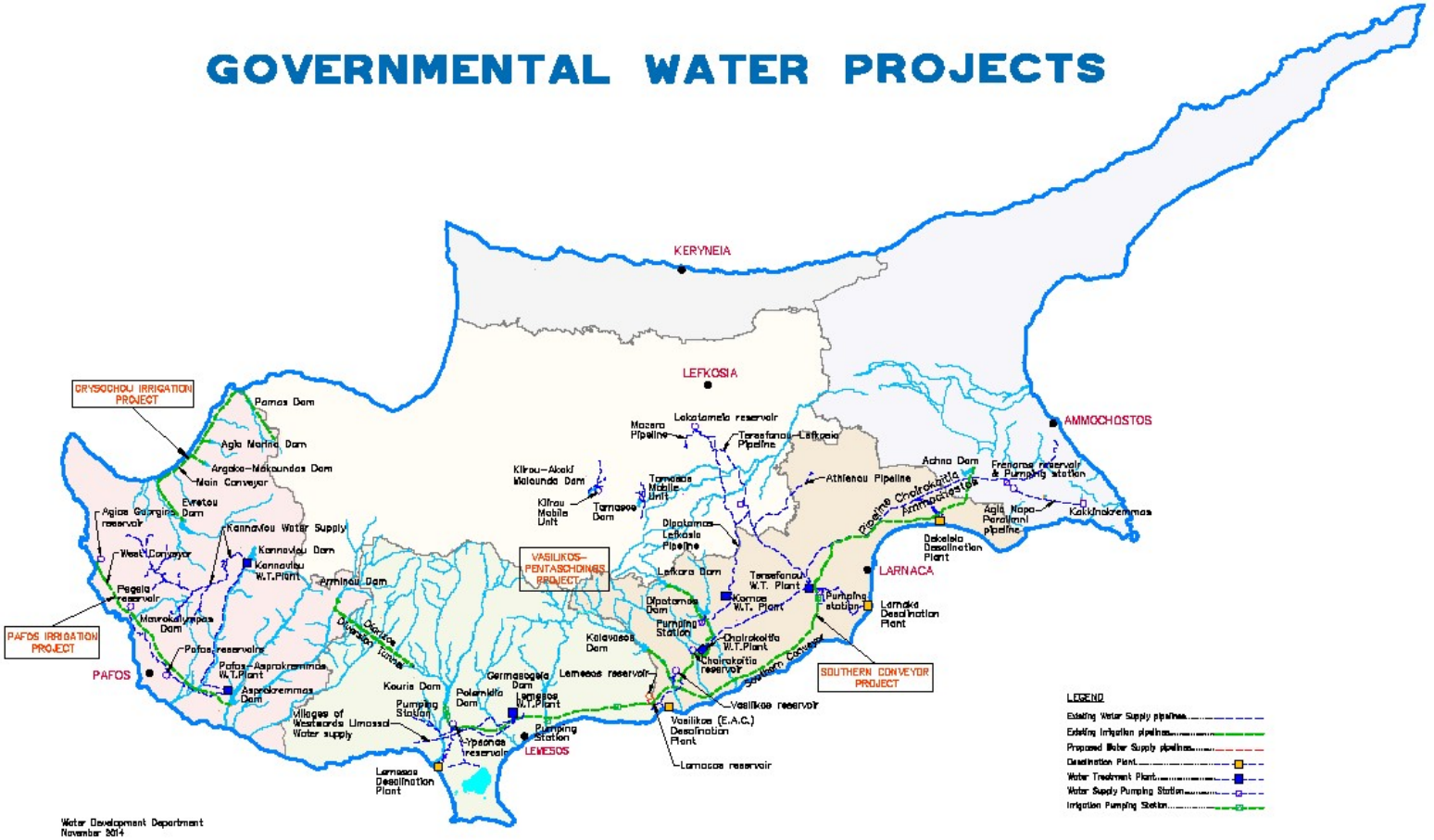
- **The Unit Price** is made up of four components:
  - C: Capital Expenditure
  - OM: Operation and Maintenance
  - E: Energy
  - SOM: Standby Operation and Maintenance

- **Different Unit Prices** are applied:
  - Unit Price for operation: C + OM + E
  - Unit Price for Stand-by : C + SOM
  - Unit Price for additional quantities: OM + E

Operational Conditions

- The Water Development Department has the option to purchase the desalination plant before the end of the Contract
- The Contractor will indemnify the Water Development Department for quantities of water which he was not able to deliver
- The Contractor has the option to produce and deliver the above quantities within the next 3-montly periods
- If he fails to do this a penalty is imposed
- The penalty is equal to the current purchase price of desalinated water times the quantities of water which were not delivered.
- The penalty is applied once a year.

GOVERNMENTAL WATER PROJECTS



Water Development Department
November 2014

DESALINATION PLANTS IN CYPRUS

	DHEKELIA	LARNACA	DHEKELIA REFURBISHMENT	DHEKELIA EXTENTION
CONTRACT TYPE	BOT	BOT	BOT	BOT
START OF PRODUCTION	1st April 1997	12th July 2001	20th May 2007	18th July 2008
PERIOD	10 Years	10 Years	20 Years	
CAPACITY	40.000 m^3/day	52.000 m^3/day	40.000 m^3/day	50.000 m^3/day
MINIMUM DAILY PRODUCTION (m^3)	-	46.500 m^3	36.000 m^3	45.000 m^3
MINIMUM YEARLY PRODUCTION (m^3)	-	**16.972.500 m^3**	**13.140.000 m^3**	**16.425.000 m^3**
CONTRACT PRICE	€0.92/m^3	€0.68/m^3	€0.64/m^3	€0.82/m^3 *
ADJUSTED PRICE (ELECTRICITY TARRIFF AND LABOR INDEX)	-	-	€1.31/m^3	

* For the extra 10.000 m3/day

DESALINATION PLANTS IN CYPRUS

	MONI	GARYLLIS	PAFOS	LIMASSOL
CONTRACT TYPE	BOOR	BOT	BOOR	BOT
START OF PRODUCTION	22nd December 2008	2009	22nd November 2010	1st July 2012
PERIOD	3 Years	5 Years	3 Years	20 Years
CAPACITY	20.000 m^3/day	13.000 m^3/day	30.000 m^3/day	40.000 m^3/day
MINIMUM DAILY PRODUCTION (m^3)	18.000 m^3/day	11.700 m^3	27.000 m^3/day	36.000 m^3
MINIMUM YEARLY PRODUCTION (m^3)	**6.570.000 m^3**	**3.482.592 m^3**	**9.855.000 m^3**	**13 .140.000 m^3**
CONTRACT PRICE	€1.39/m^3	€0.29/m^3	€1.219/m^3	€0.8725/m^3
ADJUSTED PRICE (ELECTRICITY TARRIFF AND LABOR INDEX)	-	€0.35/m^3	€1.70/m^3	€1.27/m^3

DESALINATION PLANTS IN CYPRUS

	LARNACA REFURBISHMENT	VASSILIKOS
CONTRACT TYPE	BOT	Purchase contract
START OF PRODUCTION	Summer 2014	Summer 2013
PERIOD	25 Years	20 Years
CAPACITY	60.000 m^3/day	60.000 m^3/day
MINIMUM DAILY PRODUCTION (m^3)	54.000 m^3/day	54.000 m^3/day
MINIMUM YEARLY PRODUCTION (m^3)	**19.710.000 m^3**	**19.710.000 m^3**
CONTRACT PRICE	€0.59/m^3	€0.813/m^3
ADJUSTED PRICE (ELECTRICITY TARRIFF AND LABOR INDEX	€0.82/m^3	€1.10/m^3

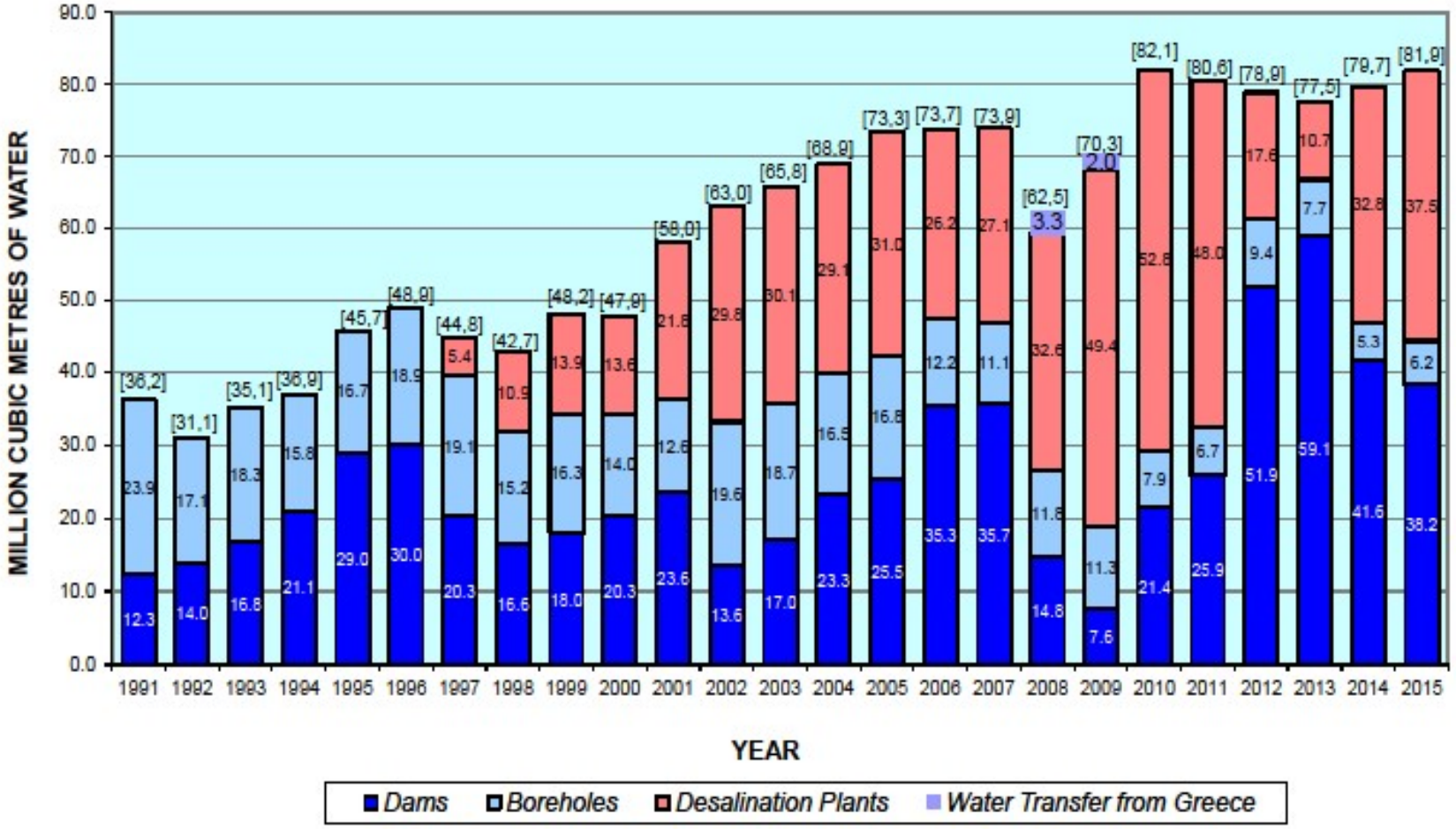
Desalination Plants at 2017

DESCRIPTION	DHEKELIA EXTENSION	LARNACA REFURBISHMENT	LIMASSOL	VASSILIKOS
CONTRACT TYPE	BOOT	BOOT	BOOT	Purchase Contract
START OF PRODUCTION	18 July2008	Summer 2014	1 July 2012	Summer 2013
PERIOD	20 Years	25 Years	20 Years	20 Years
CAPACITY	60.000 m3/day	60.000 m3/day	40.000 m3/day	60.000 m3/day
MINIMUM DAILY PRODUCTION	54.000 m3	54.000 m3	36.000 m3	54.000 m3
MINIMUM YEARLY PRODUCTION	19.710.000 m3	19.710.000 m3	13.140.000 m3	19.710.000 m3
PURCHASE PRICE OF WATER	€0.69/m3	€0.59/m3	€0.87/m3	€0.81/m3
ADJUSTED PRICE FOR 2016 (ELECTRICITY TARIFF AND LABOR INDEX)	€0.83/m3	€0.47/m3	€0.92/m3	€0.77/m3

Desalinated Water Production

YEAR	TOTAL COST/YEAR (M €)	PRODUCED QUANTITY (M.C.M.)
2008	65,28	32,6
2009	63,56	49,6
2010	62,36	52,8
2011	74,98	48,7
2012	49,98	17,6
2013	35,24	10,7
2014	36,92	32,8
2015	43,83	38,1
2016	39,27	62,6
TOTALS	**471,4**	**345,5**

GOVERNMENT WATER WORKS - DOMESTIC SUPPLY SOURCES
(1991 - 2015)



Desalination Pros and Cons

Pros	Cons
■ Coverage of drinking water needs of large urban and touristic areas – Dependence on rainfall eliminated ■ Availability of additional quantities of surface water for other uses – Irrigation – Environmental Flows – Recharge of heavily over-pumped aquifers ■ Economic and social benefits ■ Safety and reliability of drinking water supply	■ Energy-consuming process – Emission of Greenhouse gasses ■ Slight impact on the Marine Environment – Increased salinity at the point of brine rejection ■ High production cost

Desalination Plants

- The inevitable choice to built Desalination Plants in Cyprus has proved particularly beneficial for the agriculture and salvation for the water supply of urban areas.
- It is imperative to continuously seek of ways to increase the efficiency of the existing desalination technologies in such a way so as to reduce the energy consumption, and
- To seek for new methods to produce drinking water by utilizing renewable energy sources.

Water Reuse


ΤΜΗΜΑ ΑΝΑΠΤΥΞΕΩΣ ΥΔΑΤΩΝ
ΥΠΟΥΡΓΕΙΟ ΓΕΩΡΓΙΑΣ, ΦΥΣΙΚΩΝ ΠΟΡΩΝ ΚΑΙ ΠΕΡΙΒΑΛΛΟΝΤΟΣ
ΜΗ ΠΟΣΙΜΟ
NON POTABLE

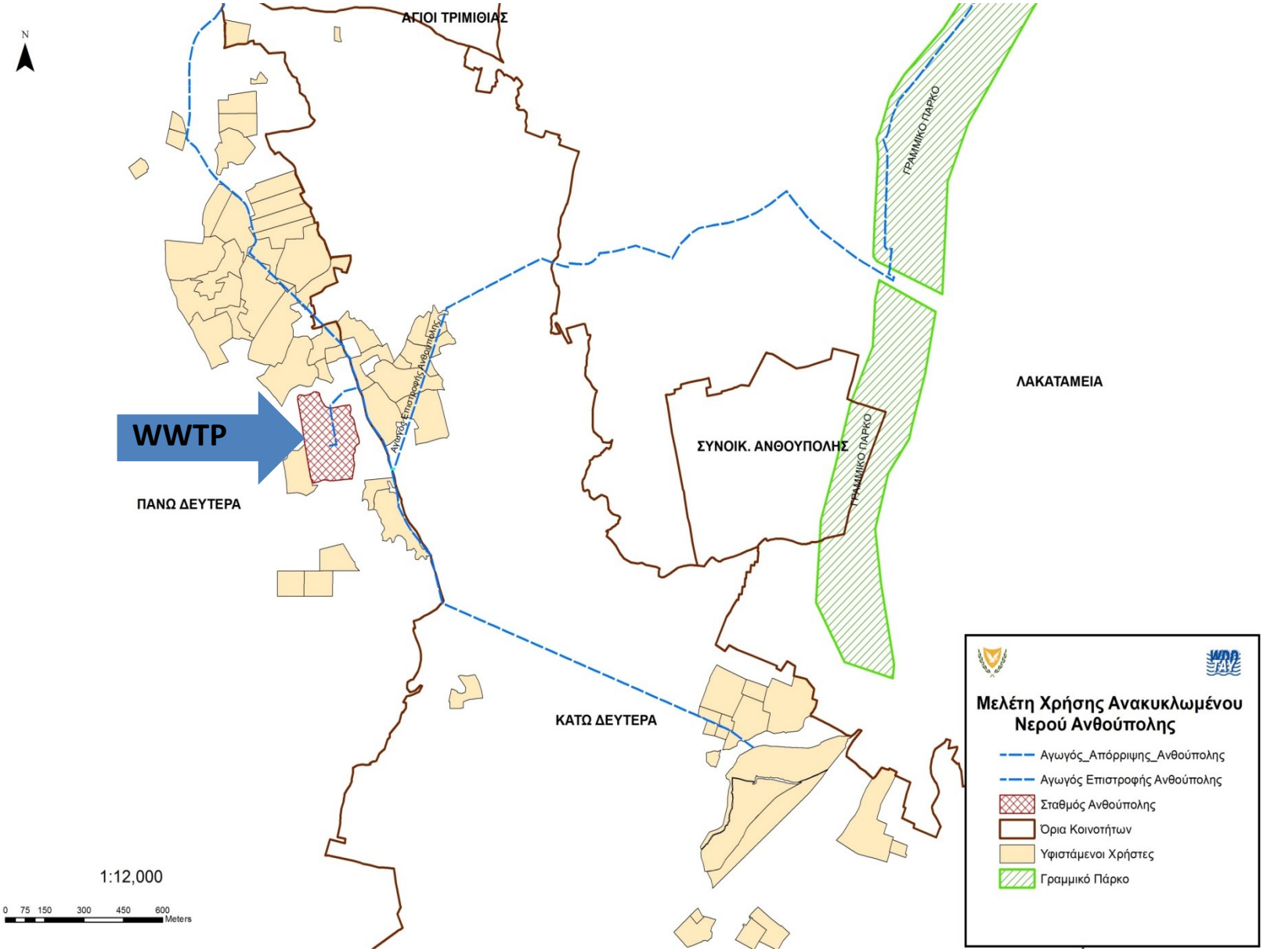
Reuse of Treated Effluent

- In Cyprus the treated effluent from the Urban Waste Water Treatment Plants is used for irrigation and recharge of aquifers
- Aquifers are used as storage reservoirs mainly in winter. The water from the aquifers is extracted and used for irrigation.
- Irrigation is done under the Code of Good Agricultural Practice
- During some winter months some quantities are discharged into the sea, as a temporary solution which will end after the implementation of the reuse projects

Existing Wastewater Treatment Plants (WWTPs)

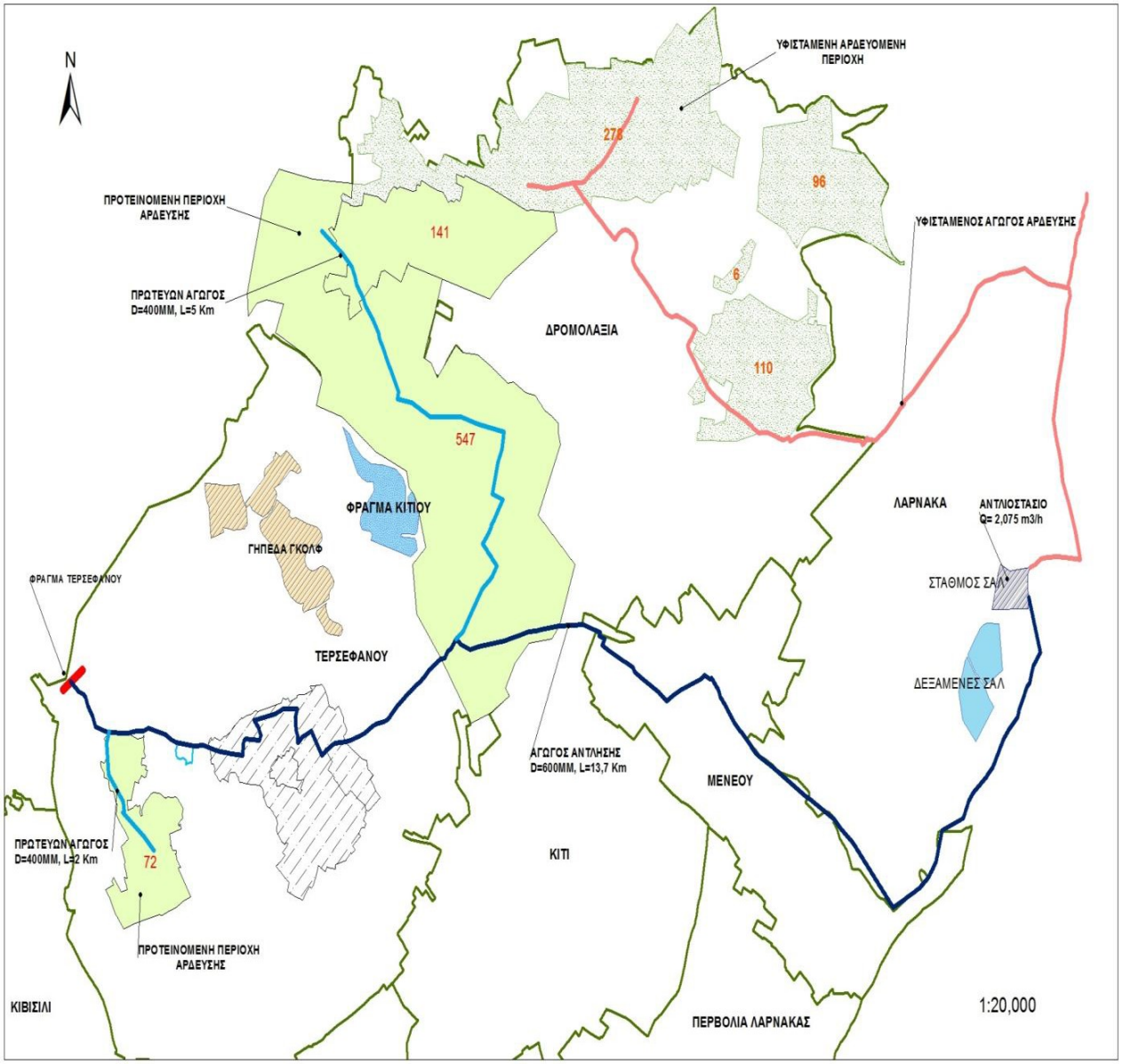
	Categories of WWTPs	Number of WWTPs	Total Capacity (m^3/day)
1	Existing Urban WWTPs (>2000 p.e.)	8	165.700
2	Existing Rural WWTPs (> 2000 p.e.) (Type of treatment : Extended Aeration/ Moving Bed Bioreactor-Tertiary Sand Filters-Chlorination with liquid hypochlorite)	6	2.101
3	Existing Rural WWTPs (< 2000 p.e.) (Type of treatment : Extended Aeration-Tertiary Sand Filters-Chlorination with liquid hypochlorite)	6	574
4	Existing WWTPs for Refugee Housing (Type of treatment: Extended Aeration-Tertiary Sand Filters-Chlorination with liquid hypochlorite)	3	560
5	Existing WWTPs for Hospitals (Type of treatment: Extended Aeration-Tertiary Sand Filters-Chlorination with liquid hypochlorite)	3	1.280
6	Existing WWTPs for Military Camps Type of treatment: Contact Stabilisation/Extended Aeration-Tertiary Sand Filters-Chlorination with liquid hypochlorite)	9	684
	TOTAL	35	170.899

IRRIGATION NETWORK FOR ANTHOUPOLIS WWTP

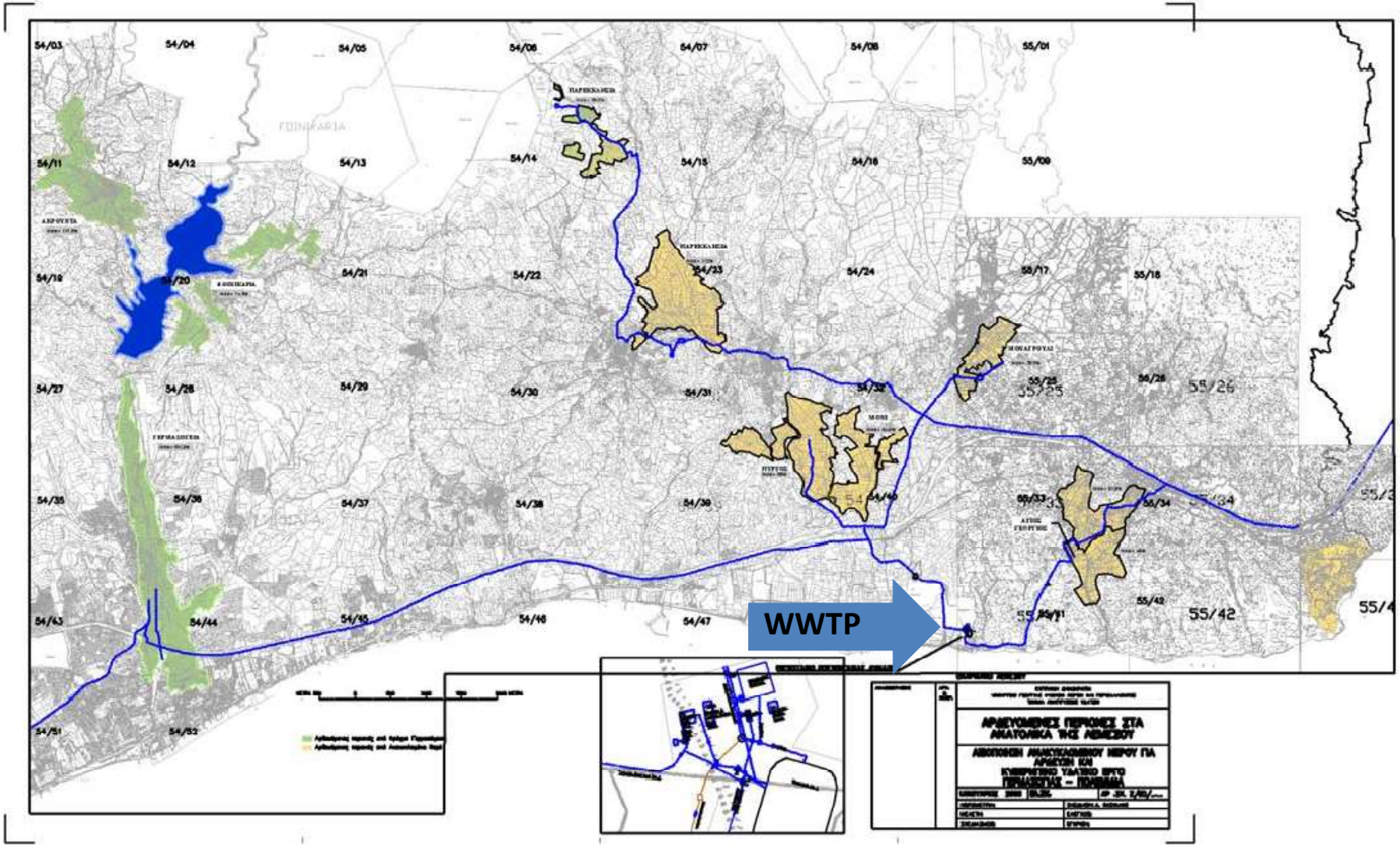


LARNACA AREA TREATED EFFLUENT IRRIGATION SCHEME

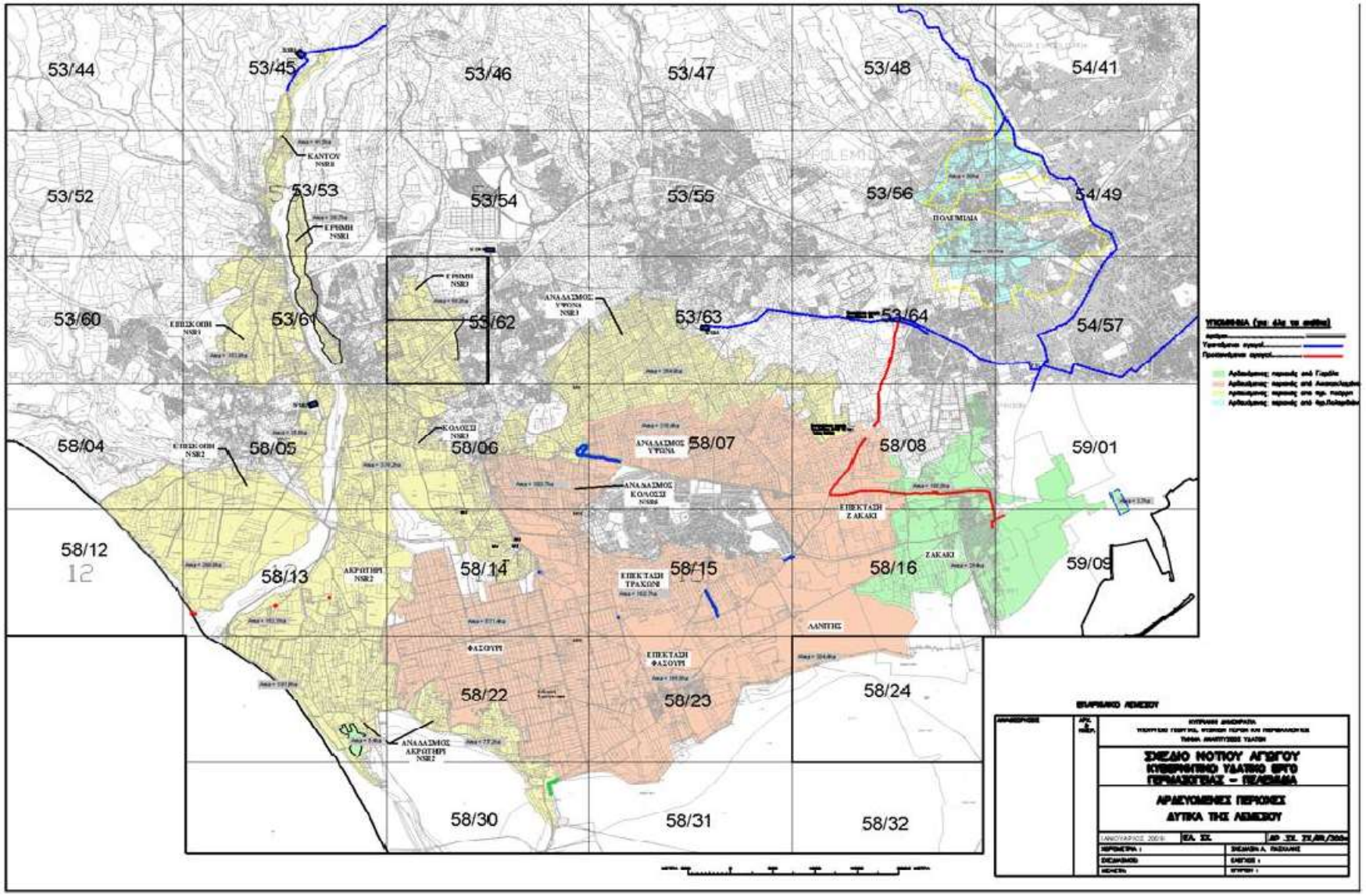
LARNACA AREA TREATED EFFLUENT IRRIGATION SCHEME

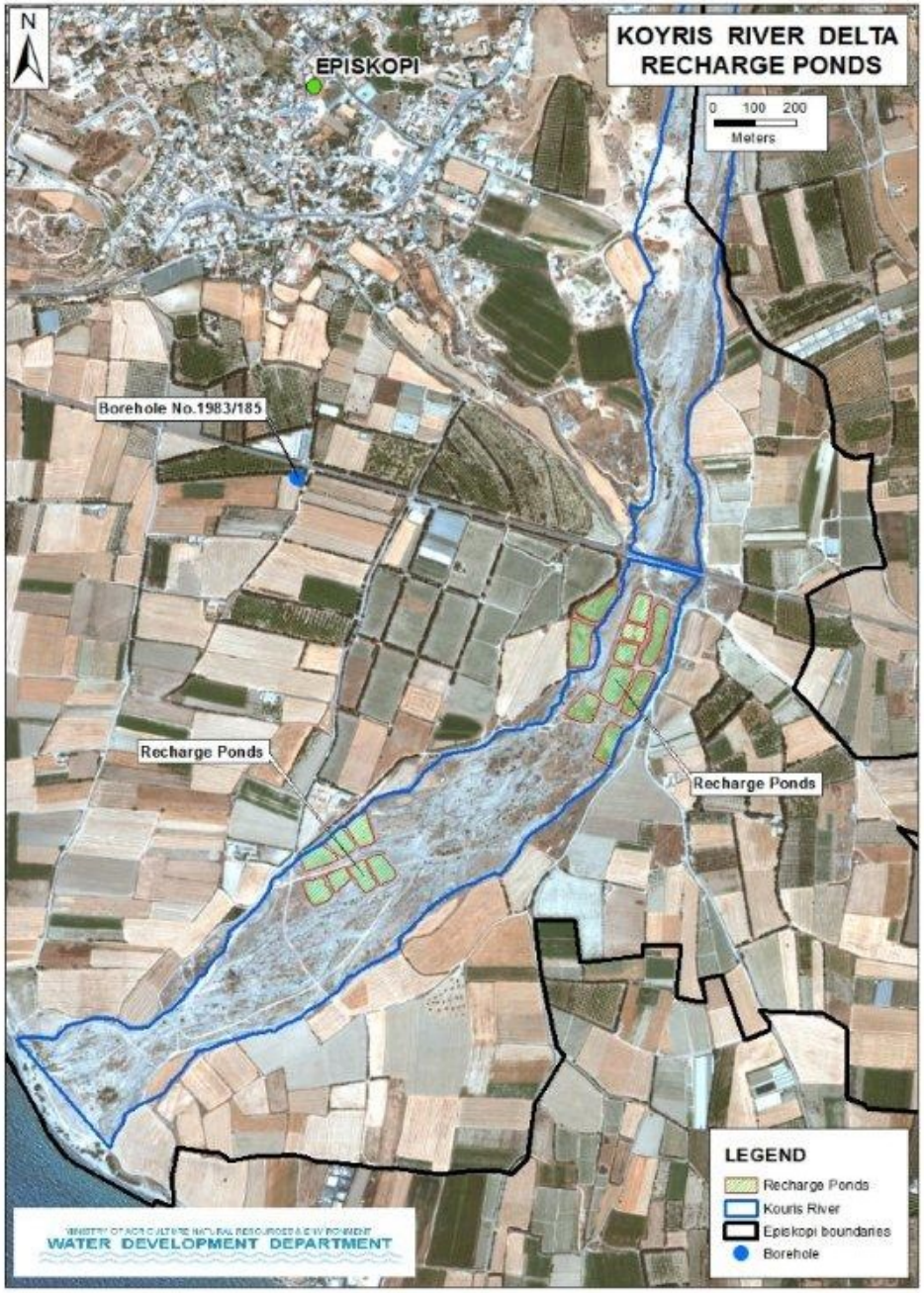


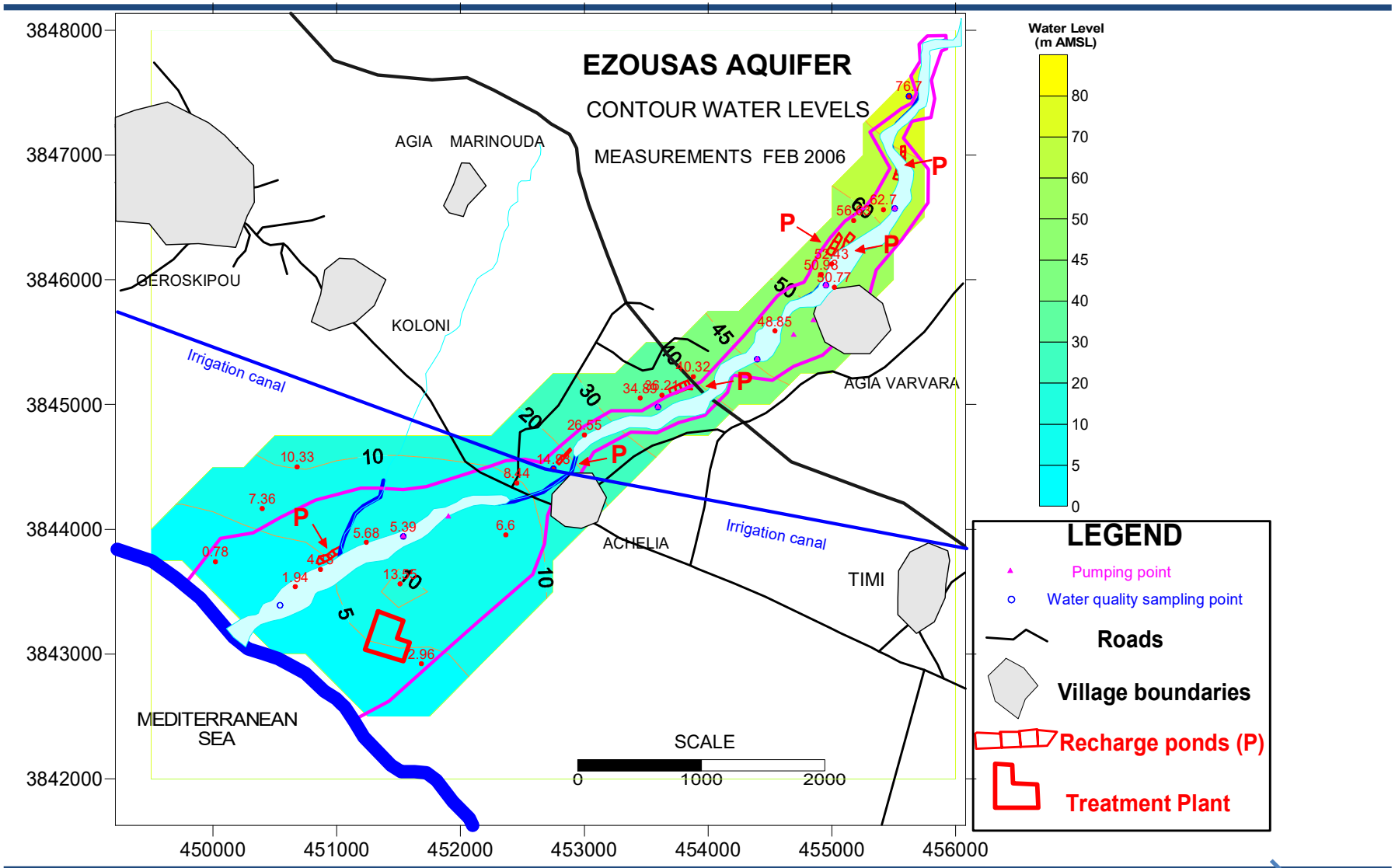
LIMASSOL AREA TREATED EFFLUENT IRRIGATION SCHEME



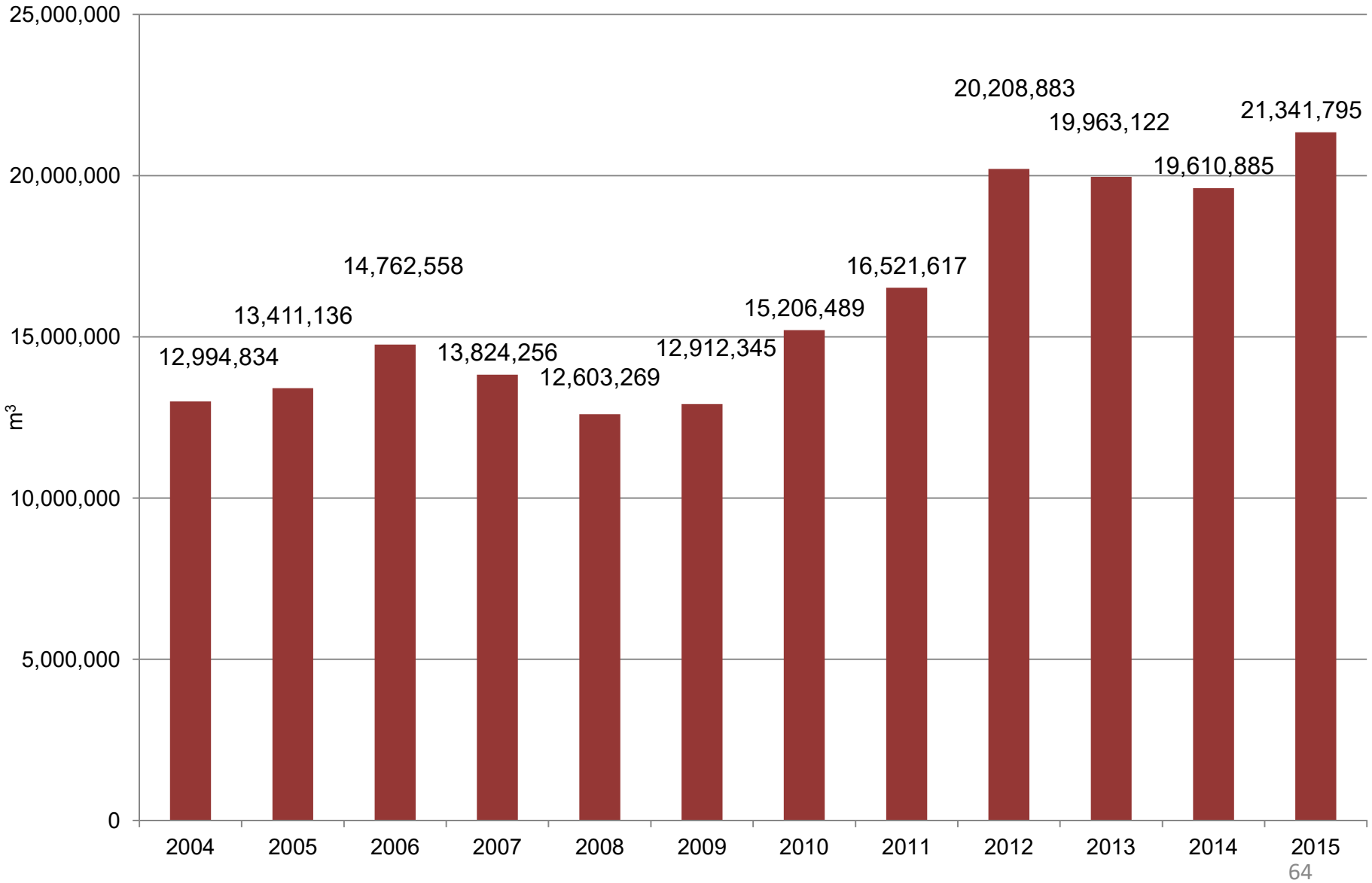
LIMASSOL AREA TREATED EFFLUENT IRRIGATION SCHEME



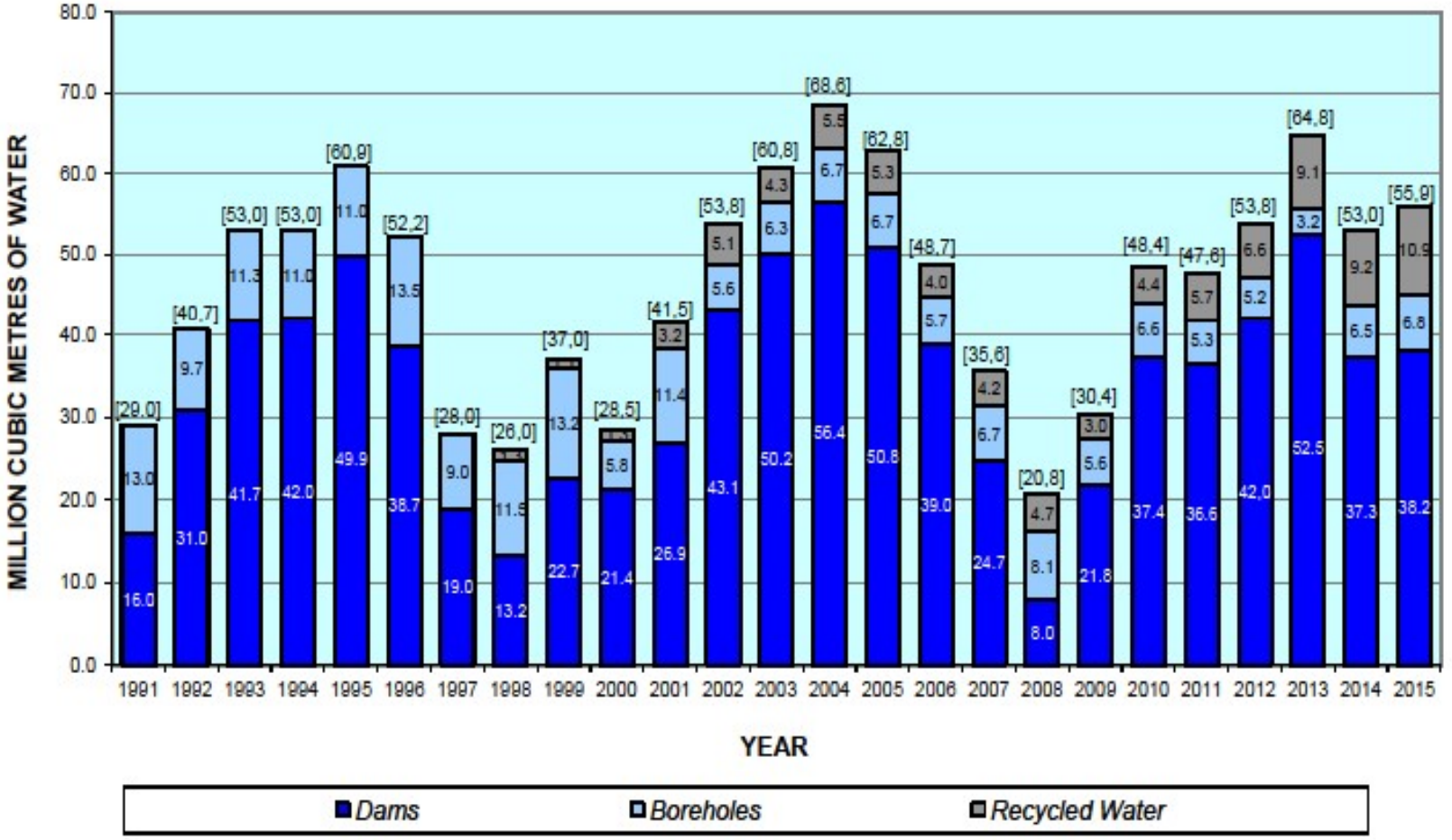

N
EPISKOPI
KOYRIS RIVER DELTA
RECHARGE PONDS
0 100 200
Meters
Borehole No.1983/185
Recharge Ponds
Recharge Ponds
LEGEND
Recharge Ponds
Kouris River
Episkopi boundaries
Borehole
WATER DEVELOPMENT DEPARTMENT


EZOUSAS AQUIFER
CONTOUR WATER LEVELS
MEASUREMENTS FEB 2006
Water Level (m AMSL)
80
70
60
50
45
40
30
20
10
5
0
AGIA MARINOUDA
GEROSKIPOU
KOLONI
AGIA VARVARA
ACHELIA
TIMI
Irrigation canal
Irrigation canal
MEDITERRANEAN SEA
SCALE
0
1000
2000
3848000
3847000
3846000
3845000
3844000
3843000
3842000
450000
451000
452000
453000
454000
455000
456000
LEGEND
Pumping point
Water quality sampling point
Roads
Village boundaries
Recharge ponds (P)
Treatment Plant

ANNUAL QUANTITIES OF TREATED EFFLUENT IN CYPRUS FROM THE URBAN WASTEWATER TREATMENT PLANTS



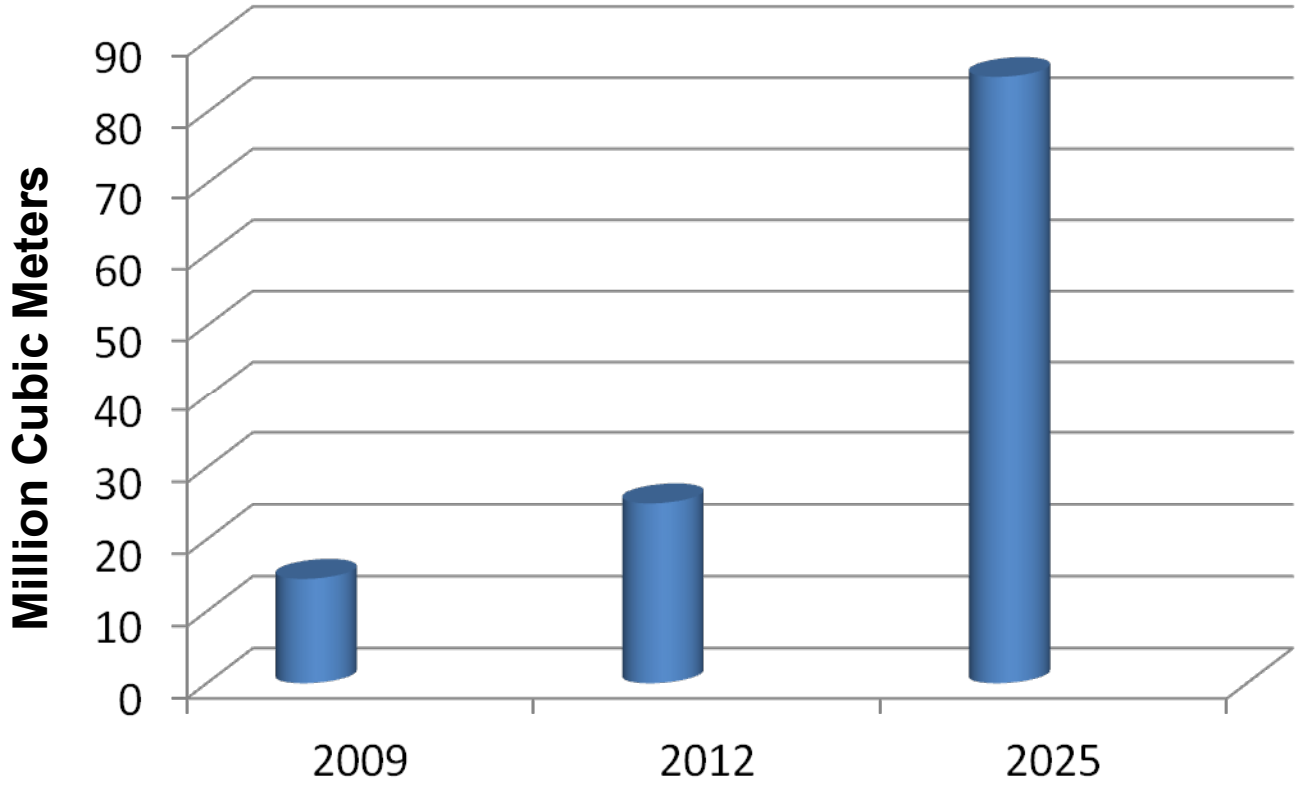
GOVERNMENT WATER WORKS - IRRIGATION SUPPLY SOURCES
(1991 - 2015)



Treated Waste Water Reuse

Tertiary Treatment

Irrigation of agricultural crops and recreational areas either directly or through recharge of aquifers



Additional volumes of water for agricultural use

General Comments for the Reuse of Treated Effluent

- The treated effluent is another constant source of water
- The Government introduced the treated effluent in the Cyprus Water Balance
- The quality is under control and remains constant
- The treated effluent is suitable for the majority of the crops
- The farmers use less quantities of fertilisers because the treated effluent already contains nutrients such as Phosphorous and Nitrogen
- Almost all the Wastewater Treatment Plants in Cyprus are equipped with Tertiary Treatment, consisting of Sand Filtration and Chlorination in order to achieve higher quality characteristics and use the treated effluent for irrigation safely

Selling rates for treaded effluent are much lower than the rates for fresh water

10. SELLING RATES OF TREATED EFFLUENT FROM TERTIARY TREATMENT PLANTS

The rate of the treated effluent from the big wastewater treatment has been set by a ministerial decree as per the following table.These rates are charged by the government

		Water Selling Rate	
A/A	USE	Existing Rate of Tertiary Treated Effluent	*Suggested Selling Rate of Fresh not filtered water from governmental*
		EURO Cent/ m3	*EURO Cent/ m3*
1	a) For Irrigation divisions for agricultural production	**5**	***15***
	b)For Persons for agricultural production	**7**	***17***
2	For sports	**15**	***34***
3	For irrigation of hotels green areas and gardens	**15**	***34***
4	For irrigation of Golf Courses	**21**	***34***
5	For pumping from an underground aquifer recharged by treated effluent	**8**	
6	For over consumption for items 1 to 5	**increase by 50%**	***56***
7	For municipal parks, green areas etc for rural communities where a plant has been built within its limits and the quantity does not exceed the approved quantity of more than 10 %		

7.1.1. IRRIGATION WITH TREATED EFFLUENT- TYPE OF PLANTS

LIMASSOL PLANT	LARNACA PLANT	PARALIMNI AYIA NAPA PLANT	VATHIA GONIA PLANT
CITRUS FRUITS	COWGRASS	CITRUS FRUITS	COWGRASS
FODDER CROPS AND INDUSTRIAL PLANTS (COWGRASS AND CORN)	CORN	OLIVE TREES	CORN
VEGETABLES	LOLIUM AND SUTAX	POTATOES	BARLEY
PUBLIC GREEN AREAS	PUBLIC GREEN AREAS	PUBLIC GREEN AREAS	FODDER CROPS
	FOOTBALL FIELDS	FOOTBALL FIELDS	GRASS PRODUCTION

Limassol (Moni) WWTP

CONCLUSIONS

Water scarcity and droughts increasing in intensity and extent

- Water scarcity and droughts is a major challenge
  - Climate change is expected to make matters worse
- In Cyprus Desalination Plants cover the drinking water needs of large urban and touristic areas, eliminating dependence on rainfall and giving security and reliability of drinking water supply
- The treated effluent is another constant source of water and it has been introduced in the Cyprus Water Balance for irrigation purposes

Taking on the challenge

- There is a need to intensify efforts to prepare for and manage water-related disasters
- Water saving & efficiency measures must be a priority
- Despite the many water saving & costly supply enhancement measures, the problem remains
- All necessary measures are being taken to ensure water security now and in the future through an **integrated multi-objective approach for water management**

Thank you

From the photographic competition of Water Board of Larnaca 2015 - first prize

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