



WATER DEVELOPMENT  
DEPARTMENT



REPUBLIC OF CYPRUS  
MINISTRY OF AGRICULTURE  
RURAL DEVELOPMENT AND ENVIRONMENT

# WASTEWATER TREATMENT AND EFFLUENT REUSE IN CYPRUS



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# 1.Legislative Framework in Cyprus

In Cyprus the use of the discharge of effluent from urban wastewater treatment plants is regulated by:

- ❑ The Water Pollution Control Laws (106(I)/2002 to 2013)
- ❑ The Water Pollution Control (Discharge of Urban Waste water) Regulations of 2003 (No. 772/2003)
- ❑The Water Pollution Control (Sensitive Areas for Disposal of Urban Waste Water) Ministerial Decree of 2013 (No. 280/2013)
- ❑ The Code of Good Agricultural Practice Decree (No. 263/2007)
- ❑ The Ministerial Decree for small – scale wastewater treatment plants < 2000 p.e. (No. 379/2015)
- ❑ The Environmental Impact Assessment Law (No. 127(I)/2018) for discharge to water bodies and for the management of the effluent for new UWWTPs

## **2. Effluent from Urban Waste Water Treatment Plants (UWWTPs) Reuse in Cyprus**

- In Cyprus around **95%** of the treated waste water is reused in accordance with Art. 12 (1) of the UWWTD.
- The effluent is mainly reused directly for irrigation or indirectly via replenishment of aquifers. In 2021 22.6 millions cubic meters of treated effluent were produced of which 64% was reused directly and 31% indirectly for irrigation.
- The cost for the construction, operation and maintenance of tertiary treatment plants carried out by the Urban Sewerage Boards is undertaken by the Government.

### **2.1 REGULATION (EU) 2020/741 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 May 2020 on minimum requirements for water reuse**

The new regulation shall apply from 26 June 2023.

Cyprus informed the EC that it will practice the reuse of treated urban waste water in all areas under the effective control of the Republic of Cyprus.

However the irrigation will not be allowed for foliaceous vegetables, bulbs and condyles that are eaten raw.

Currently the efforts of the Water Development Department focus on the preparation of the Water Reuse Risk Management Plan for the water reuse systems of all urban wastewater treatment plants (Article 5 of Regulation).

### **3. TREATMENT REQUIREMENTS UWWTPs of Agglomerations $\geq 2.000$ p.e.**

- In Cyprus, it is our policy and is implemented through the obligation for tertiary treatment, the UWWTPs effluent to be reused in agriculture. More stringent treatment requirements than the proposed ones are already applied.
- Some of the main parameters that are monitored for UWWTPs  $\geq 2.000$  p.e. are: BOD<sub>5</sub>, SS, TN, TP, conductivity, pH, heavy metals, B, Cl, E. Coli, priority substances, pesticides and toxicity.
- Usually, the limit values set for BOD<sub>5</sub>, COD, SS, total nitrogen and total phosphorus are 10 mg/l, 70 mg/l, 10 mg/l, 15 mg/l and 10 mg/l respectively.
- Further monitoring obligations are set in the permits when the tertiary effluent is recharged in aquifers or discharged into surface waters (dam or sea) taking into consideration the standards specified to Groundwater Directive 2006/118/EC and Directive 2008/105/EC regarding Environmental Quality Standards respectively.
- Additionally, discharges from urban waste water treatment plants to sensitive areas (water bodies which are eutrophic) meet more stringent requirements related to TN and TP. In such cases the limit values can be TN=10mg/l and TP=1mg/l.

## **4. REUSE OF TREATED EFFLUENT IN CYPRUS**

### **4.1 IN CYPRUS THE TREATED EFFLUENT FROM THE URBAN WASTEWATER TREATMENT PLANTS IS REUSED FOR THE FOLLOWING PURPOSES :**

- 4.1.1 IRRIGATION
- 4.1.2 ENRICHMENT OF UNDERGROUND WATER  
(Paphos and Limassol - Moni WWTPs)
- 4.1.3 DRY BED OF RIVERS FOR INFILTRATION

THE IRRIGATION IS DONE UNDER THE CODE OF GOOD AGRICULTURAL PRACTICE.

### **4.2 OTHER WAYS OF DISPOSAL (DUE TO SEASONAL DEMAND OF WATER FOR IRRIGATION AND LIMITED STORAGE CAPACITY)**

- DISCHARGE INTO THE SEA
- DISCHARGE INTO A DAM FOR AGRICULTURE IRRIGATION PURPOSES ONLY

### **4.3 CONSTRUCTION OF A DAM TO COLLECT TREATED EFFLUENT**

## 5. Benefits of Treated Effluent Reuse

### **A reliable source of water which enhances the water balance**

Domestic Sector Cities	Freshwater can be reserved to satisfy the increasing demand for potable water	Need for fewer desalination plants Lower carbon footprint Less dependence on oil prices
Agricultural Sector Farmers	Constant and reliable source of water Savings in fertilizers Increases crop yield Maintains traditional agriculture	
Environment	Reduces discharge to WBs Reduces abstraction Groundwater Replenishment Control saltwater intrusion to groundwater bodies	Keeps water prices at reasonable levels

## 6. Reclaimed Water Reuse

**The Irrigation is done under the Code of Good Agricultural Practice.**

Tertiary treatment is **mandatory irrespective of its use** (irrigation, recharge of aquifers or disposal to the sea, in order to:

- **Eliminate the possibility of any health incident**
- **Reduce the risk of possible eutrophication** when discharging to the eastern Mediterranean Sea, the most oligotrophic sea in the world
- **Reduce farmers skepticism and barriers to reusing**
- **Encourage public acceptance - enhance marketability of crops**

Provided that the land farm has access to a reclaimed water irrigation network, the end user (i.e. the farmer) applies to the Water Authority/ Plant Operator for the supply of reclaimed water, stating the type of crop and the required water quantity.

The Water Authority/Plant Operator approves the application and provides the end user with the necessary information regarding the crops allowed to be irrigated as well as the irrigation methods and techniques to be used.

It has to be noted that in Cyprus, **the end users have small agricultural farms and 90% of them are smaller than 0.5 ha.**

In Cyprus the operator's responsibility is to achieve the required effluent quality **at the outlet of the reclamation facilities**. The required effluent quality is set by the Competent Authority responsible for the permitting.

# 7. Code of Good Agricultural Practice (Regulation No. 263/2007)

**Guidelines to make the use of treated effluent safe for irrigation:**The goal is the proper use of Reclaimed Water in agriculture in order to protect public health and the environment

***Restriction on the type of crops irrigated:*** Irrigation of all types of plants , seasonal and permanent **except of foliaceous vegetables, bulbs and condyles that are eaten raw.****Type of plants:** citrus fruits, fodder crops and industrial plants (cow grass and corn), olive trees, lolium and sutax, potatoes, **flowers (e.g. carnations)**, public green areas, football fields, grass production.

## ***Safety precautions for the proper use of water***

- The use is prohibited by unauthorized persons
- **Marking pipes with red line**
- Clear signaling to alert the public that the water is undrinkable
- **Hydrants and distribution system should have protection and always be in good operational condition**

Irrigation practices	Methods of irrigation	Recommendations
Irrigation for grass, green areas with limited use, and forage crops	<ul style="list-style-type: none"> <li>• groundwater irrigation,</li> <li>• drippers, low capacity sprinklers,</li> <li>• surface irrigation,</li> <li>• high capacity sprinklers - 300 m buffer zone</li> </ul>	<ul style="list-style-type: none"> <li>▼ cultivated forage, irrigation stops at least one week before harvest</li> <li>▼ cultivated forage for grazing, dairy animals are not permitted.</li> </ul>
Irrigation conditions for grass, green spaces with free use	<ul style="list-style-type: none"> <li>• subsurface drip irrigation,</li> <li>• low angle Pop-up sprinklers (&lt;15°)</li> <li>• irrigation during night</li> <li>• (no wind)</li> </ul>	
Vineyard	<ul style="list-style-type: none"> <li>• drip irrigation</li> <li>• micro sprinkler</li> </ul>	<ul style="list-style-type: none"> <li>• Where drops comes with contact with fruit, irrigation must stop two weeks before harvest</li> <li>• Collection of fruit from the ground should be avoided</li> </ul>
Tree crops	<ul style="list-style-type: none"> <li>• drip irrigation</li> <li>• Micro sprinkler</li> </ul>	<p>The collection of fruit from the ground is prohibited except in cases of nuts. Where irrigation drops comes in contact with fruit , irrigation must stop at least a week before harvest.</p>
Vegetables that are cooked before consumption	<ul style="list-style-type: none"> <li>• sub surface drip irrigation, sprinkler irrigation</li> <li>• drip irrigation</li> </ul>	



## 8. Original Assessment of the Reclaimed Water Reuse

- **Original Studies: The Ministry Of Agriculture before using the Reclaimed water for irrigation tried in 1996 to demonstrate the benefits in practice:**
  - A **Pilot irrigation** area of 30 ha close to Limassol WWTP was initiated, to demonstrate that recycled water enhances agricultural productivity and is safe to use by the farmers
  - **Sorghum, alfalfa and corn** were used as verified crops irrigated with effluent water for a period of 5 years
  - Agricultural Research Institute was responsible for the collection and analysis of all data and verification of the results
  - **Results: Crop yield increased by 30% on average**
  
- On Going studies:** After these initial tests, **further plant uptake studies** regarding the effects of water reuse irrigation **were conducted** by the Agriculture Research Institute of the Ministry of Agriculture, Rural Development and Environment. No negative results were demonstrated.

## 9. Further Research

- ❑ Research is ongoing by the Agricultural Research Institute of Cyprus and the University of Cyprus
- ❑ Research results, concerning the long-term wastewater irrigation of **forage and citrus** revealed that there are **no impacts** of wastewater reuse **on** both **soil physicochemical properties** and **heavy metal** content, as well as on agricultural produce heavy metal content
- ❑ Research concerning wastewater irrigation of **tomato crops** highlighted that there is **no accumulation of heavy metals** in tomato fruit, whereas examination of the presence of **various pathogens** related to public health revealed that **total coliform** and **fecal coliforms** were **not quantified** in both fruit flesh and fruit peel, while ***E. coli, Salmonella spp* and *Listeria spp.* were not detected** in fruit homogenates

## 10. Public Acceptance

**At the early days of implementing water reuse projects in Cyprus, there was significant reaction and skepticism from farmers, due to ignorance, misconceptions and psychological reasons**

**Acceptance issues were addressed through:**

- **Information / consultation campaigns**
- **Education of the farmers in small groups**
- **Regulating effluent reuse through the Code of Good Agricultural Practice**
- **Making recycled water much cheaper than freshwater**
  - **Rate of Tertiary Treated Effluent for agriculture: 7 cents/ m<sup>3</sup> (The price is subsidized in order to encourage and promote the use.)**
  - **Selling Rate of Fresh not filtered water from governmental water works: 17 cents/ m<sup>3</sup>**

## 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	<i>Suggested Selling Rate of Fresh not filtered water from governmental water works</i>
		EURO Cent/ m3	<i>EURO Cent/ m3</i>
1	a) For Irrigation divisions for agricultural production	<b>5</b>	<b>15</b>
	b) For Persons for agricultural production	<b>7</b>	<b>17</b>
2	For sports	<b>15</b>	<b>34</b>
3	For irrigation of hotels green areas and gardens	<b>15</b>	<b>34</b>
4	For irrigation of Golf Courses	<b>21</b>	<b>34</b>
5	For pumping from an underground aquifer recharged by treated effluent	<b>8</b>	
6	For over consumption for items 1 to 5	<b>increase by 50%</b>	<b>56</b>
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 %		

## 11. IRRIGATION WITH TREATED EFFLUENT- TYPE OF PLANTS

<b>LIMASSOL PLANT</b>	<b>LARNACA PLANT</b>	<b>PARALIMNI AYIA NAPA PLANT</b>	<b>VATHIA GONIA PLANT</b>
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

## **12. QUALITY CHARACTERISTICS AND CONTROL OF THE TREATED EFFLUENT FOR AGGLOMERATIONS ABOVE 2000P.E. ACCORDING TO THE DISCHARGE PERMITS IN CYPRUS:**

According to the Laws of the Water Pollution Control of 2002 until 2013, for the urban wastewater treatment plants the Minister of Agriculture issues a Wastewater Discharge Permit for the same Wastewater treatment Plant to the following competent authorities:

- Sewerage Boards
- Water Development Department

In the Discharge Permit the following are defined:

- quality characteristics
- number and the type of analyses
- disposal of the treated effluent

For the Discharge Permit of the Water Development Department the following are included:

- Name of Authority : Water Development Department
- Type of Process: Disposal of Treated Effluent
- Type of Discharge: Treated effluent from the wastewater treatment plant.

### National Legislation

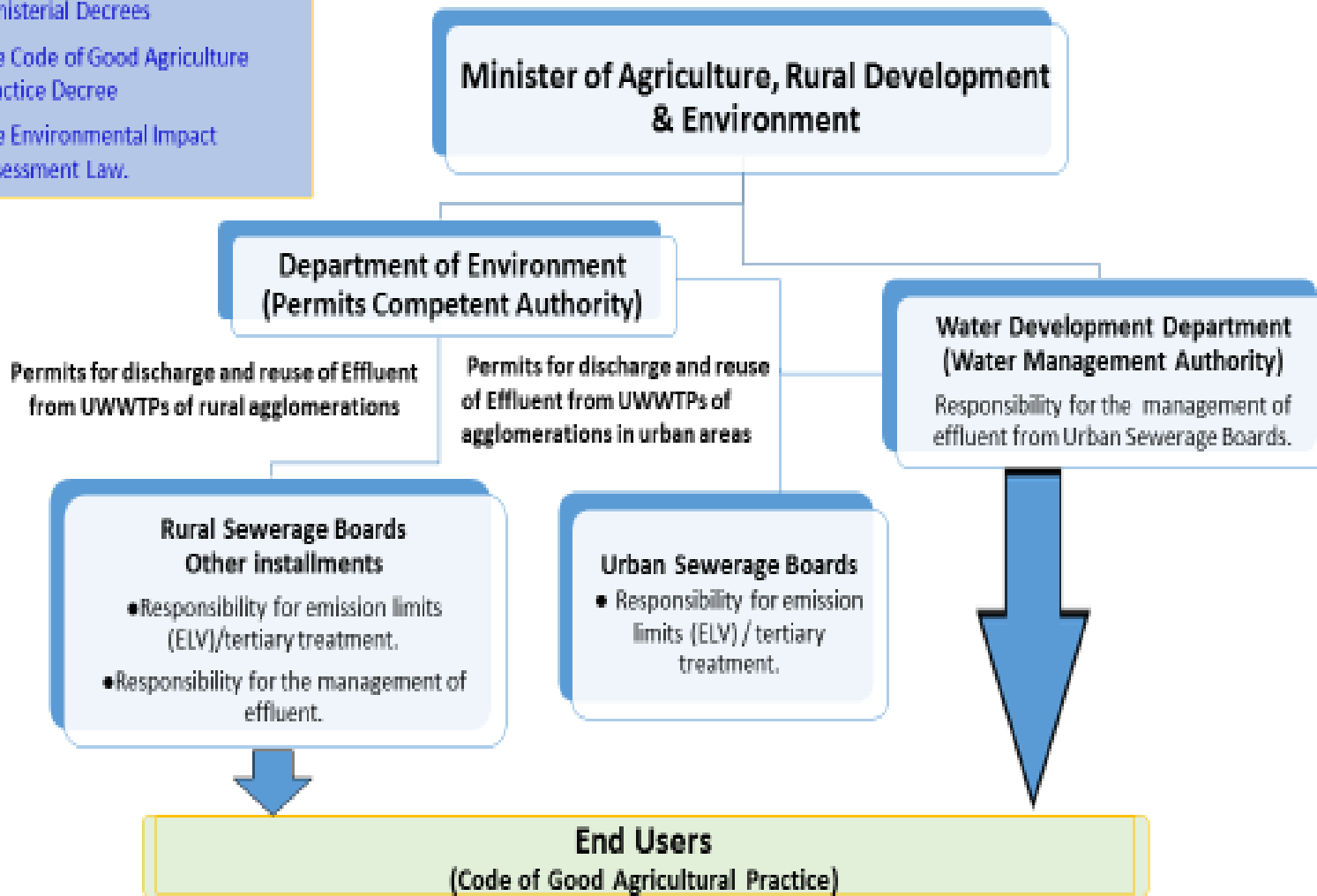
The Water Pollution Control Laws

Ministerial Decrees

The Code of Good Agriculture Practice Decree

The Environmental Impact Assessment Law.

## 13. Permitting and Management of Reclaimed Water



# 14. WASTEWATER TREATMENT METHODS APPLIED IN URBAN WASTEWATER TREATMENT PLANTS

	NAME OF WWTP	TYPE OF SECONDARY TREATMENT	TYPE OF TERTIARY TREATMENT
1	ANTHOUPOLI	ACTIVATED SLUDGE MEMBRANE BIOREACTOR , NITRIFICATION - DENITRIFICATION, PHOSPHORUS REMOVAL	MEMBRANE BIOREACTOR
2	VATHIA GONIA (WDD) (designed to receive domestic septage and industrial waste by tankers)	ACTIVATED SLUDGE EXTENDED AERATION -OXIDATION DITCHES	SAND FILTERS
3	VATHIA GONIA (SBN)	ACTIVATED SLUDGE MEMBRANE BIOREACTOR, NITRIFICATION - DENITRIFICATION, PHOSPHORUS REMOVAL	MEMBRANE BIOREACTOR
4	AYIA NAPA - PARALIMNI	ACTIVATED SLUDGE, NITRIFICATION - DENITRIFICATION, PHOSPHORUS REMOVAL	SAND FILTERS
5	PAPHOS	ACTIVATED SLUDGE, NITRIFICATION - DENITRIFICATION, PHOSPHORUS REMOVAL	SAND FILTERS
6	LARNACA	ACTIVATED SLUDGE MEMBRANE BIOREACTOR, NITRIFICATION - DENITRIFICATION, PHOSPHORUS REMOVAL	MEMBRANE BIOREACTOR AND SAND FILTERS ( for the collected water during winter in the lagoons)
7 - 8	a) LIMASSOL - MONI AREA b) LIMASSOL - WEST AREA PANO POLEMIDIA	a) ACTIVATED SLUDGE, NITRIFICATION - DENITRIFICATION, PHOSPHORUS REMOVAL b) ACTIVATED SLUDGE MEMBRANE BIOREACTOR	a) SAND FILTERS b) MEMBRANE BIOREACTOR
9	MIA MILIA	ACTIVATED SLUDGE MEMBRANE BIOREACTOR, NITRIFICATION - DENITRIFICATION, PHOSPHORUS REMOVAL	MEMBRANE BIOREACTOR



## 15. METHODS OF DISINFECTION OF URBAN WASTEWATER TREATMENT PLANTS

TYPE OF DISINFECTION		
NAME OF WWTP	TYPE	METHOD
LIMASSOL - MONI AREA	CHLORINATION	ONSITE HYPOCHLORITE GENERATION FROM SALT
LIMASSOL - WEST AREA PANO POLEMIDIA	UV DISINFECTION	-
PARALIMNI	CHLORINATION	LIQUID SODIUM HYPOCHLORITE DOSING
AYIA NAPA	CHLORINATION	LIQUID SODIUM HYPOCHLORITE DOSING
LARNACA	CHLORINATION	ONSITE HYPOCHLORITE GENERATION FROM SALT
PAPHOS	CHLORINATION	LIQUID SODIUM HYPOCHLORITE DOSING
VATHIA GONIA (WDD)	CHLORINATION	LIQUID SODIUM HYPOCHLORITE DOSING
VATHIA GONIA (SBN)	UV DISINFECTION	-
ANTHOUPOLIS	UV DISINFECTION	-
MIA MILIA	UV DISINFECTION	-

## 16. TREATMENT REQUIREMENTS FOR IRRIGATION UWWTPs serving agglomerations ≤ 2.000p.e.

According to the Ministerial Decree of small – scale wastewater treatment plants ≤ 2.000 p.e (No. 379/2015), the quality requirements for treated waste water used for irrigation are:

Parameters	BOD <sub>5</sub> mg/l	COD mg/l	SS mg/l	FOG mg/l	E. Coli / 100 ml	pH	Conductivity μS/cm	Cl mg/l	B mg/l	Residual Chlorine mg/l
<b>Frequency</b>	every 1 month	every 1 month	every 1 month	every 1 month	every 1 month	every 1 month	every 1 month	every 1 year	every 1 year	every 1 month
<b>All crops and green areas (a)</b>	10	70	10	5	5	6,5-8,5	2.500	300	1	2
<b>Vegetables eaten cooked (b)</b>	10	70	10	5	50	6,5-8,5	2.500	300	1	2
<b>Products for human consumption and green areas with limited access to the public</b>	25	125	35	5	200	6,5-8,5	2.500	300	1	2
<b>Crops for animal feed</b>	25	125	35	5	200	6,5-8,5	2.500	300	1	2
<b>Industrial plants</b>	25	125	35	5	200	6,5-8,5	2.500	300	1	2

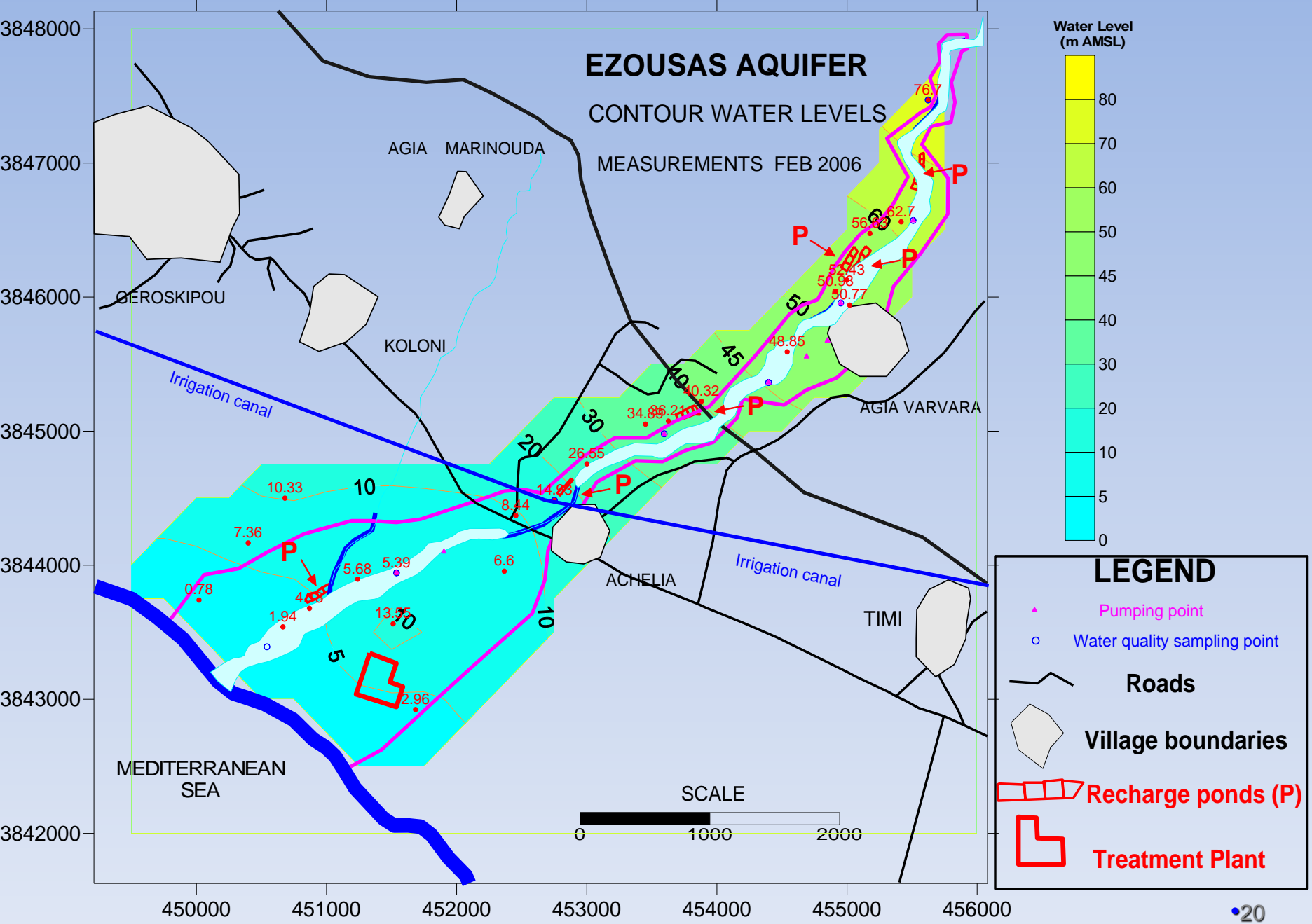
(a) Not for leafy vegetables, bulbs eaten raw and strawberries. (b) Potatoes, beetroots etc.

➤ The parameter “Eggs of Intestinal Worms” used to be monitored every year during the summer period, however they have been excluded from the Ministerial Decree No. 379/2015, as they have never been identified.

## **17. EXAMPLE FOR AQUIFER RESCHARGE - AREA OF PAPHOS**

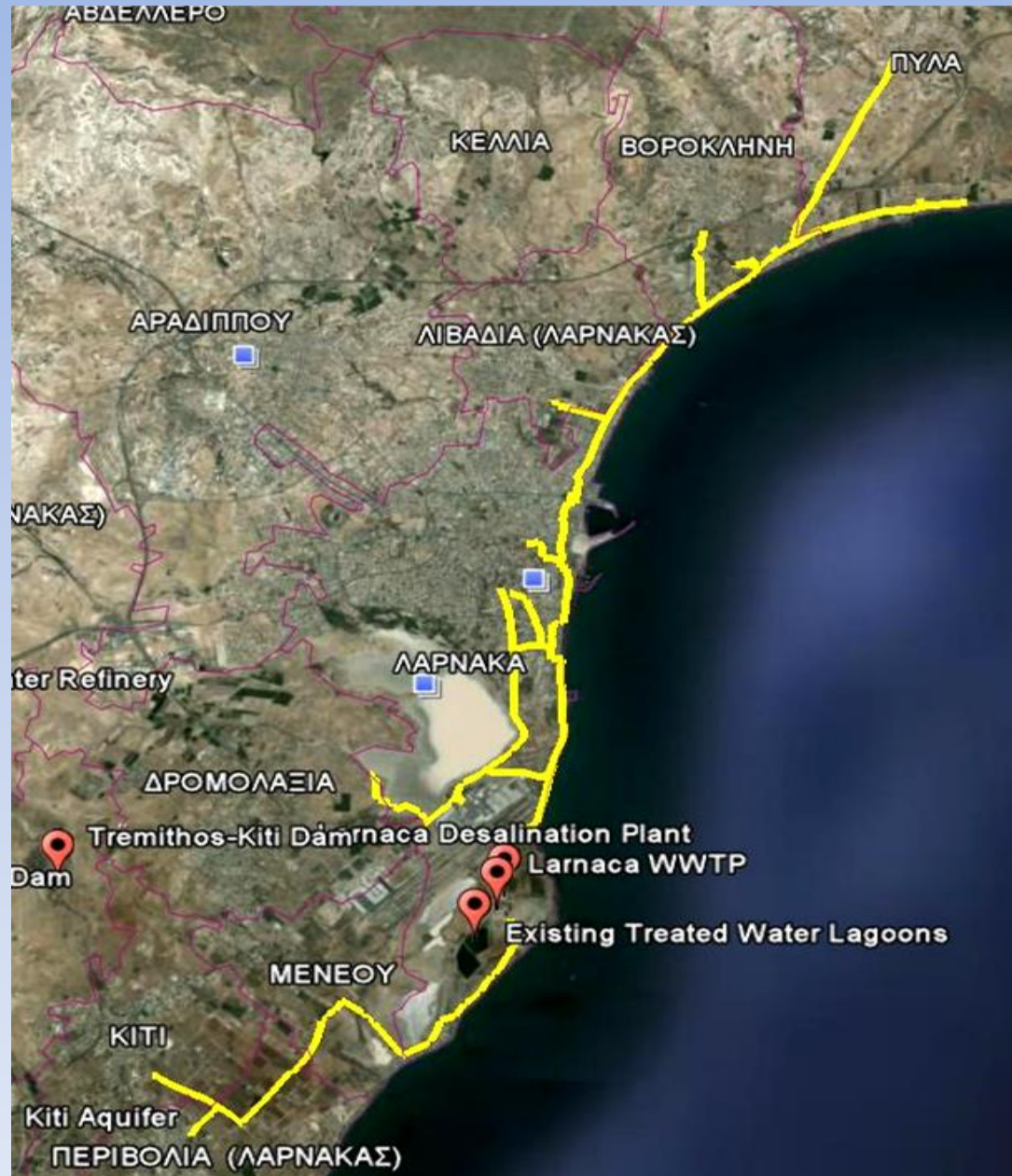
IN THIS AREA THE TREATED EFFLUENT IS USED FOR THE ENRICHMENT OF EZOUSA AQUIFER SINCE 2004

THE MAP OF THE POINTS OF ENRICHMENT OF EZOUSA AQUIFER - PAPHOS

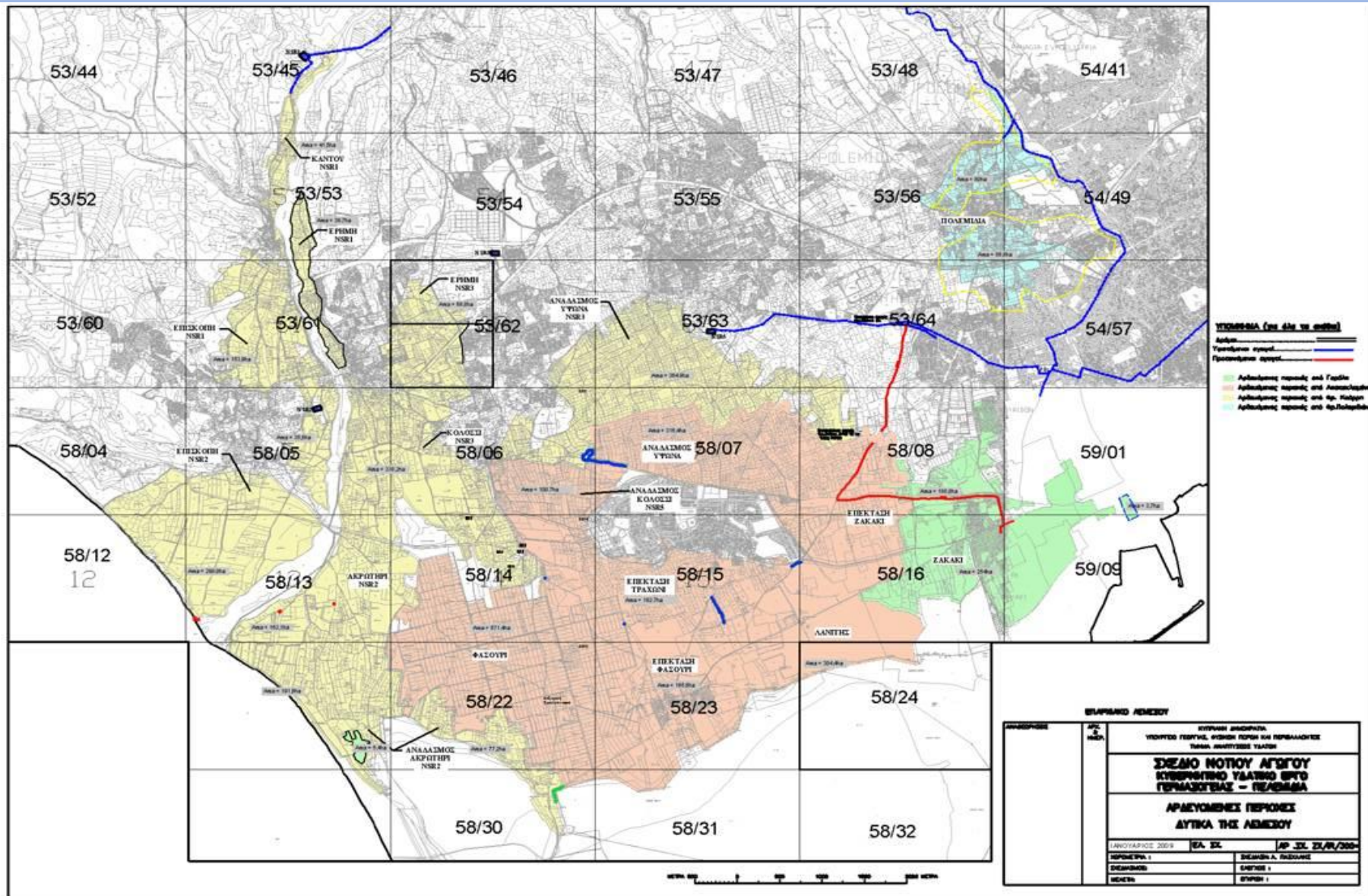


## 18. TREATED EFFLUENT IRRIGATION NETWORKS

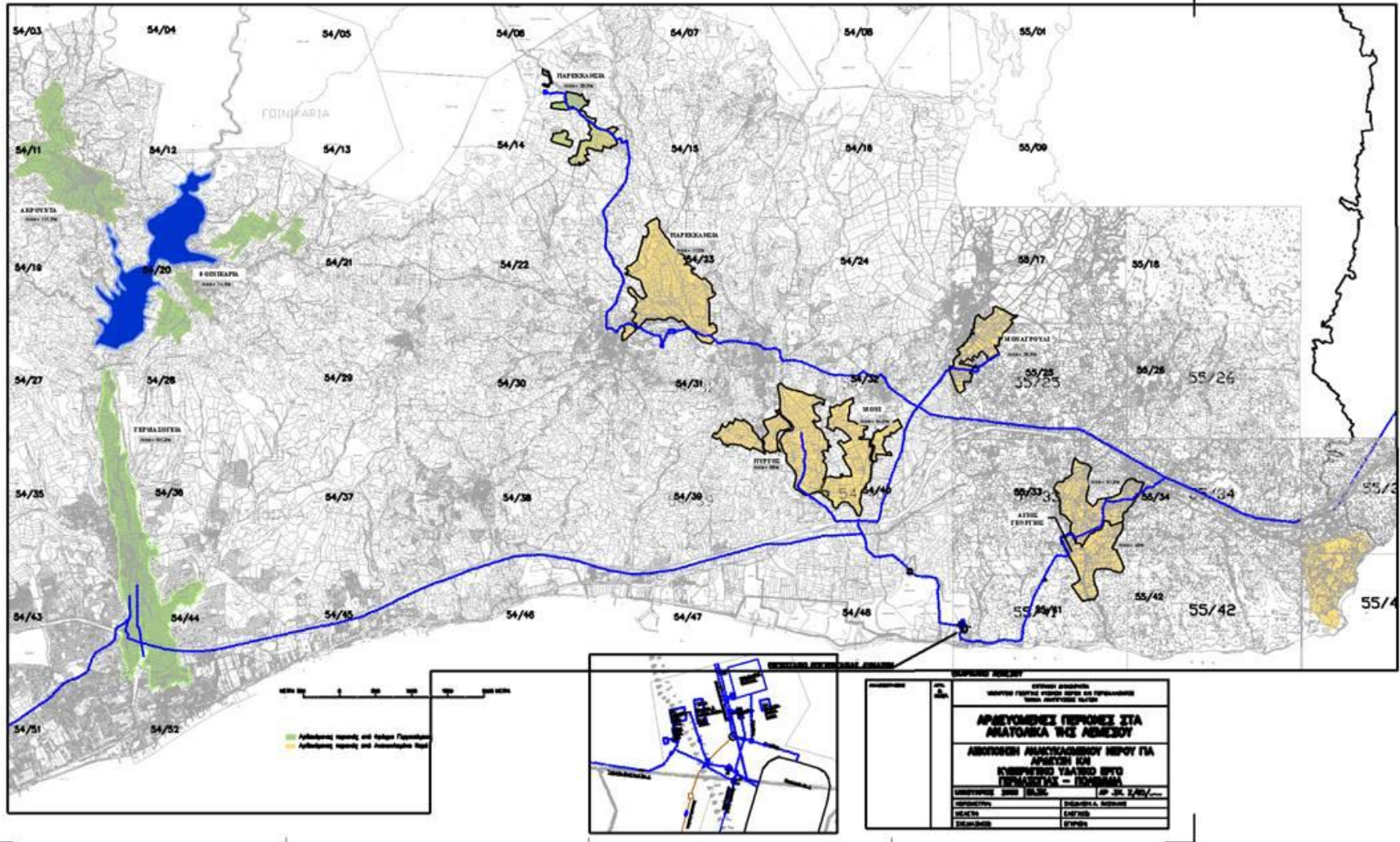
## 18.1 LARNACA AREA TREATED EFFLUENT IRRIGATION NETWORK



# 18.2a LIMASSOL AREA TREATED EFFLUENT IRRIGATION NETWORK

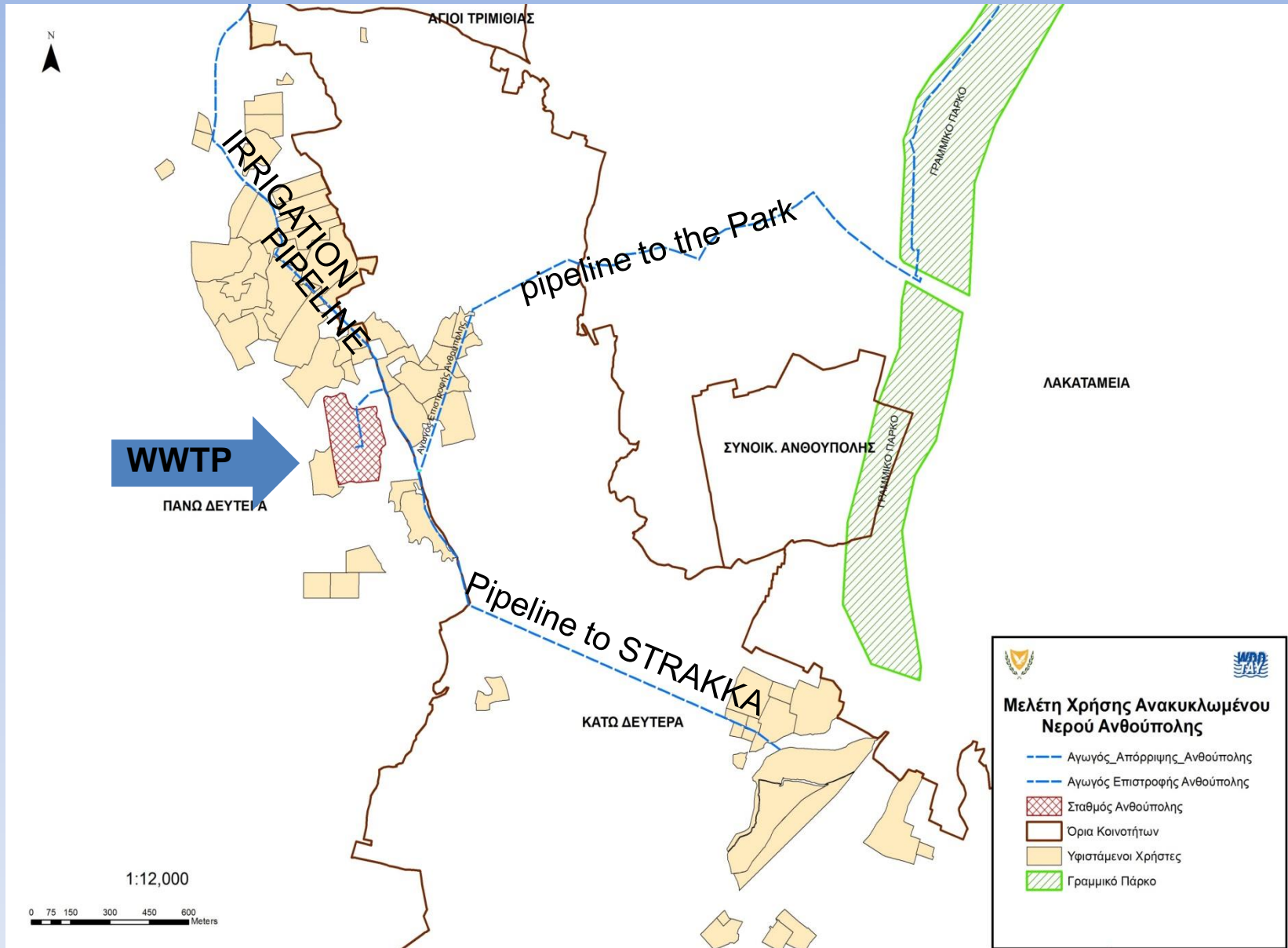


# 18.2b LIMASSOL AREA TREATED EFFLUENT IRRIGATION NETWORK





## 18.3 IRRIGATION NETWORK FOR ANTHOUPOLIS WWTP





# PRACTICES - CODE OF GOOD AGRICULTURAL PRACTICE



# PHOTOGRAPHS FROM WWTPs



• **LIMASSOL (MONI) WWTP - 40,000 m<sup>3</sup>/day**



**LIMASSOL - WEST AREA WWTP – 13,000 m<sup>3</sup>/day**



**ANTHOUPOLIS WASTEWATER TREATMENT PLANT, SBN**  
**13,000 m<sup>3</sup>/day**



## **VATHIA GONIA WASTEWATER TREATMENT PLANT, SBN**

**22,000 m<sup>3</sup>/day**





**VATHIA GONIA CENTRAL WASTEWATER (SEPTIC SEWAGE/INDUSTRIAL WASTE)  
TREATMENT PLANT, WDD - 1,320 m<sup>3</sup>/day**



**LARNACA WASTEWATER TREATMENT PLANT, SBL - 18,000 m<sup>3</sup>/day**



## **PARALIMNI-AYIA NAPA WASTEWATER TREATMENT PLANT**

**31,600 m<sup>3</sup>/ day**

# WDD Website: <http://www.moa.gov.cy/moa/wdd>

The screenshot displays the official website of the Water Development Department (WDD) of the Ministry of Agriculture, Rural Affairs and Fisheries (MARAF) of Cyprus. The browser address bar shows the URL [www.moa.gov.cy/moa/wdd/WDD.nsf/index\\_en/index\\_en](http://www.moa.gov.cy/moa/wdd/WDD.nsf/index_en/index_en). The page header includes the text "Ελληνικά" and "80002244 ΚΕΝΤΡΟ ΑΝΑΦΟΡΑΣ ΒΛΑΒΩΝ" (Call Center). The main navigation menu features: "About us", "Water Resources", "Water Development and Management", "European Matters", "Press Room", and "Public Services".

The central banner area is titled "Εξοικονόμησε το!! κάθε σταγόνα ΜΕΤΡΠΑ!!" (Save!! every drop METPA!!) and features a "Water saving measures" section with a "More..." button. A sidebar on the right contains the following links: "History", "Licensing for the installation of Small Private Desalination Units", "Water saving measures" (highlighted in orange), "Governmental Water Supply Systems", and "Governmental Water Works".

At the bottom, there are four smaller informational tiles: "Reservoir storage", "Water Framework Directive (2000/60/EC)", "Floods Directive (2007/60/EC)", and "Waste Water Directive (91/271/EEC)". The Windows taskbar at the bottom shows the system time as 1:48 PM on 2/24/2013.



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# THANK YOU FOR YOUR TIME



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