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WATER DEVELOPMENT DEPARTMENT

NICOSIA

Kouris reservoir protection Action plan and Recommendations for protection ordinance enforcement

Final report - part 2/3



February 2011

NOTICE

The documents produced within the project “Reservoir Protection Zones for the reservoirs that are used for drinking water purposes” for the Water Development Department (WDD) of the Ministry of Agriculture, Natural Resources and Environment, are divided into three separate documents :

1. KOURIS Reservoir Protection Ordinance
2. KOURIS Reservoir Protection - Action plan and Recommendations for protection ordinance enforcement
3. Reservoir Protection Zones - Method for determining the zones

The Recommendations should be published by WDD as Action plan, and, the final Ordinance make reference to the Recommendations, so as they gain in regulative power.

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Table of contents

1. INTRODUCTION	5
2. ACTIONS TO BE TAKEN IN THE IMMEDIATE PROTECTION ZONES - IPZ	5
2.1. KOURIS	5
2.2. ARMINOU	6
2.3. KHAPOTAMI	6
3. ACTIONS TO BE TAKEN IN THE CLOSE PROTECTION ZONES - CPZ.....	7
3.1. WASTE WATER TREATMENT PLANTS	7
3.2. ON SITE PRIVATE WASTE WATER TREATMENT SYSTEM	7
3.3. EXISTING INSTALLATIONS OR ACTIVITIES	7
3.3.1. <i>Existing buildings which cannot be connected to public sewage system</i>	7
3.3.2. <i>Existing sand and gravel extraction, quarries</i>	8
3.3.3. <i>Existing Earth Fillings</i>	8
3.3.4. <i>Existing Burial or disposal of solid waste</i>	9
3.3.5. <i>Existing Domestic garbage dump</i>	9
3.3.6. <i>Existing industrial waste dump</i>	9
3.3.7. <i>Existing pipes, tanks or storage of liquid hydrocarbons, chemical products, industrial effluents</i> . 9	
3.3.7.1. Pipes	9
3.3.7.2. Tank or storage of liquid hydrocarbons.....	9
3.3.7.3. Activities involving hydrocarbons, chemicals, asphalt products or any material hazardous to water supply.	10
3.3.7.4. Automobile service stations.....	10
3.3.7.5. Truck terminals.....	10
3.3.8. <i>Existing Intensive animal breeding</i>	10
3.4. UNUSUAL EXISTING ACTIVITY: MONAGRI CLAY-PIGEON SHOOTING	11
3.5. ROADS IN THE CLOSE PROTECTION ZONE	13
3.6. FORESEEN FORBIDDEN USAGES AND ACTIVITIES IN THE CPZ.....	14
3.6.1. <i>Project of development in ALASSA</i>	14
3.6.2. <i>Project of Pipes, tank or storage of liquid hydrocarbons, chemical products, industrial effluents</i> 14	
4. RECOMMENDATIONS FOR CLOSE AND DISTANT PROTECTION ZONES.....	17
4.1. REDUCE THE UNAUTHORIZED WASTE DUMPING AND “FLUSHING”	17
4.2. PRIVATE GARDENING.....	18
4.3. VEGETATION AND REFORESTATION.....	18
5. MEAN OF APPLYING	19
5.1. PUBLIC INFORMATION	19
5.1.1. <i>Spill response program in case of accidental pollution</i>	19
5.1.2. <i>Soil pollution during dry season</i>	19
5.2. REGULATION ENFORCEMENT CONTROL	20
5.3. WATER QUALITY MONITORING.....	20
6. ANNEX.....	21
6.1. KOURIS - VILLAGES IN THE RESERVOIR WATERSHED - SEWAGE SYSTEM CHARACTERISTICS AND RECOMMENDATIONS	22

6.2.	ARMINOU - VILLAGES IN THE RESERVOIR WATERSHED - SEWAGE SYSTEM CHARACTERISTICS AND RECOMMENDATIONS	26
6.3.	KHAPOTAMI - VILLAGES IN THE RESERVOIR WATERSHED - SEWAGE SYSTEM CHARACTERISTICS AND RECOMMENDATIONS	26
6.4.	TECHNICAL RECOMMENDATIONS FOR PRIVATE ON SITE WASTE WATER TREATMENT SYSTEM.....	27
6.4.1.	<i>Definition</i>	27
6.4.2.	<i>Design</i>	27
6.4.3.	<i>Maintenance obligations</i>	29
6.4.4.	<i>Use recommendations</i>	29
6.4.5.	<i>Useful links</i>	29
6.5.	TECHNICAL RECOMMENDATIONS FOR THE EQUIPMENT OF ROAD BRIDGE PASSING OVER A MAIN RIVER OF THE CPZ AND RPZ	30
6.6.	COPY OF THE TECHNICAL NOTE MADE ON THE ALASSA GOLF PROJECT ON REQUEST OF WDD – SEPTEMBER 2010.....	32

Figures

Figure 1 - Kouris dam - Immediate Protection Zone	5
Figure 2 - Arminou, buoy line protection (blue line).....	6
Figure 3 – ZYGOS : Petrol tank (right) and mechanical maintenance zone (left) in solid rock quarry close to Limnatis river.	8
Figure 4 - MONAGRI main shooting platform.....	11
Figure 5 - MONAGRI - direction of shooting from the main platform directly in KRYOS valley	12
Figure 6 - Main roads to be protected to reduce the risk of direct pollution of the reservoir in case of an accident (in the yellow zones).	14
Figure 7 - TRIMIKLINI : Kouris valley seen from the B8 road bridge. At the background TRIMIKLINI Dam. The earth fill embankment for the gas station is on the left (right bank) – 180° photomontage.....	15
Figure 8 – TRIMIKLINI : The earth fill embankment for the gas station seen from the B8 road bridge showing already significant erosion of the edge (concrete ditch earth support disappeared).....	15

1. INTRODUCTION

This report establishes an Action plan and makes recommendations in order to reach efficient ordinance enforcement.

2. ACTIONS TO BE TAKEN IN THE IMMEDIATE PROTECTION ZONES - IPZ

2.1. Kouris

The plan below shows the complementary equipment to be foreseen to improve the immediate protection.

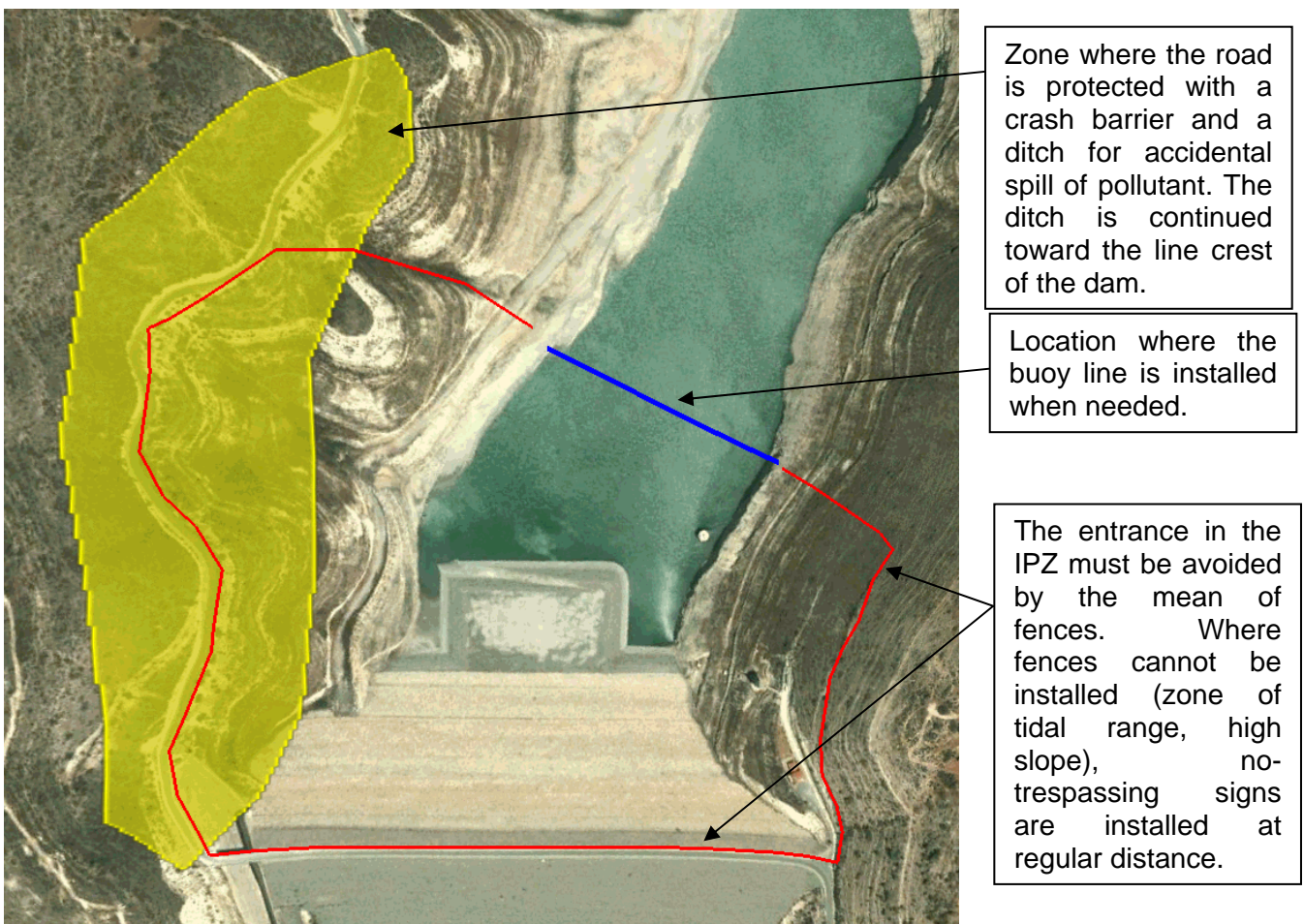



Figure 1 - Kouris dam - Immediate Protection Zone

<p> This comment will be removed in final document</p>	<p><i>Note for WD</i> <i>The above figure is a project. It must be replaced by a plan (or plans) whose legend identifies :</i></p> <ul style="list-style-type: none"> - Existing fences and gates (for example around the buildings) - Existing road crash barriers, ditches if any - Others existing safety equipment. <p><i>I'll complete this plan with eventual complementary equipments..</i></p>
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2.2. Arminou

The main point to improve for ARMINOU Reservoir Immediate protection is the installation of a buoy line across the lake in order to avoid people approaching the intake installation from the lake.



Figure 2 - Arminou, buoy line protection (blue line)

2.3. Khapotami

The whole protection system for KHAPOTAMI shaft is satisfying.

Therefore, some parts of the fence and the gate need to be repaired in order to insure safety for people.

3. ACTIONS TO BE TAKEN IN THE CLOSE PROTECTION ZONES - CPZ

3.1. Waste water treatment plants

Ordinance extract:

“A list of villages in the CPZ is established by the WATER DEVELOPMENT DEPARTMENT and indicates their wastewater management. This list shows priority for:

- *villages to be provided with a central Waste Water collection system and treatment plant: permanent plus summer population over 200;*
- *villages whose existing treatment plant does not have sufficient capacity with regard to the permanent population and/or summer population;*
- *villages whose existing treatment plant must be upgraded to tertiary process.”*

These lists are given in annex:

- KOURIS : Village waste water treatment situation in Annex, page 22 (table to be completed)
- ARMINOU : Village waste water treatment situation in Annex, page 26 (table to be completed)
- KHAPOTAMI : Village waste water treatment situation in Annex, page 26 (table to be completed)

3.2. On site private waste water treatment system

Ordinance extract:

“The WATER DEVELOPMENT DEPARTMENT is responsible for writing all technical documents concerning technical specifications, use and maintenance recommendations, control procedures.”

These Technical recommendations for On-site Private wastewater treatment system¹ is given in Annex, page 22 (table to be completed)

3.3. Existing installations or activities

3.3.1. Existing buildings which cannot be connected to public sewage system

WDD will examine the possibility of creating a list of the concerned existing buildings in the CPZ giving priority to the higher house density zones.

¹ In France, On site private waste water treatment concerns about 13 millions of people (20% of the population) and the number of installations is about 5 millions (source : French Ministry of Environment – October 2009).

3.3.2. Existing sand and gravel extraction, quarries

Only one quarry has been identified in KOURIS watershed, in ZOOPIGI territory, at ZYGOS close to LIMNATIS riverbanks.

The same inventory must be performed in ARMINOU and KHAPOTAMI watersheds.



Figure 3 – ZYGOS : Petrol tank (right) and mechanical maintenance zone (left) in solid rock quarry close to Limnatis river.

The main problem is soil pollution by hydrocarbons, oil and probably other chemicals used in mechanical maintenance, around the place where :

- trucks and earthmovers are maintained : the soil contains a large quantity of oil and petrol. There are probably some solvents used in mechanical maintenance as trichloroethylene, brake fluid...
- petrol is stored in a large tank : there is certainly an important quantity of petrol in the soil, due to a long period of pouring, filling and some leakages.

The place must be cleaned and put within the environmental norms:

- the mechanical activity and storage place (on the left side of the picture) must be cleaned of all waste materials (oilcans, old engines, ...). The polluted soil must be removed. The place must be covered by a concrete slab with a peripheral ditch connected to a oil collector basin that will be regularly emptied by an authorized company. ;
- the soil beyond the petrol tank (right) must be removed ;
- the tank must be placed on an impervious concrete basin whose dimensions are calculated so the that the can hold the total capacity of the tank, in case of total leakage.

3.3.3. Existing Earth Fillings

- KOURIS: No Earth Filling has been found or mentioned on KOURIS reservoir watershed.
- ARMINOU: The visit to the watershed was not included in the 2009 missions. This check has to be performed by WDD.
- KHAPOTAMI: idem

3.3.4. Existing Burial or disposal of solid waste

- KOURIS: No such site has been mentioned on KOURIS reservoir watershed.
- ARMINOU: The visit to the watershed was not included in the 2009 missions. This check has to be performed by WDD.
- KHAPOTAMI: idem

3.3.5. Existing Domestic garbage dump

Ordinance extract: *“Controlled and uncontrolled garbage dumps must be listed and assessed.”*

During the field visit in May 2009, domestic garbage dump areas have been seen from distance. Their exact location must be verified in order to know if they are inside the DPZ.

WDD will check if there are garbage dumps within the DPZ or in the CPZ of KOURIS, ARMINOU or KHAPOTAMI watershed and will create a list with the following information with for each of them:

- precise location;
- villages using the dumping area;
- status of the site : controlled or uncontrolled;
- the known or probable leakage pollution problems;
- sides of valleys affected by leakage.

Controlled garbage dump

The ones within the CPZ must be closed and their leakage carefully controlled and managed.

Uncontrolled garbage dump

The ones within the CPZ must be closed and garbage removed if containing an important part of hazardous materials.

3.3.6. Existing industrial waste dump

- KOURIS: No such site has been mentioned on KOURIS reservoir watershed.
- ARMINOU: The visit in the watershed was not included in the 2009 missions. This check has to be performed by WDD.
- KHAPOTAMI: idem

3.3.7. Existing pipes, tanks or storage of liquid hydrocarbons, chemical products, industrial effluents.

3.3.7.1. Pipes

- KOURIS: No such installations have been mentioned on KOURIS reservoir watershed.
- ARMINOU: The visit in the watershed was not included in the 2009 missions. This check has to be performed by WDD.
- KHAPOTAMI: idem

3.3.7.2. Tank or storage of liquid hydrocarbons

- KOURIS: No such installations have been mentioned on KOURIS reservoir watershed.
- ARMINOU: The visit in the watershed was not included in the 2009 missions. This check has to be performed by WDD.
- KHAPOTAMI: idem

3.3.7.3. Activities involving hydrocarbons, chemicals, asphalt products or any material hazardous to water supply.

- KOURIS: No such installations have been mentioned on KOURIS reservoir watershed.
- ARMINOU: The visit in the watershed was not included in the 2009 missions. This check has to be performed by WDD.
- KHAPOTAMI: idem

3.3.7.4. Automobile service stations

Ordinance extract:

“The WATER DEVELOPMENT DEPARTMENT is in charge of the establishment of a list of gas stations inside the CPZ and in the watershed.”

The list of these installations, within the KOURIS, ARMINOU and KHAPOTAMI watersheds, must be created and an inspection must be performed. For each of them, the following information is to be collected:

- precise location ;
- general state of the station ;
- conformity to environmental standards ;
- destination of storm water runoff ;
- if river concerned, kind of connection to the river : directly, indirectly ;
- any other information judged to be useful.

After the analysis of these informations, corrective actions will be scheduled.

3.3.7.5. Truck terminals

- KOURIS: No such installation has been mentioned on KOURIS reservoir watershed.
- ARMINOU: The visit in the watershed was not included in the 2009 missions. This check has to be performed by WDD.
- KHAPOTAMI: idem

3.3.8. Existing Intensive animal breeding

- KOURIS: No such installation has been mentioned on KOURIS reservoir watershed. Only small animal breeding sites were found in Alassa area and were not considered intensive and do not need special measures.
- ARMINOU: The visit in the watershed was not included in the 2009 missions. This check has to be performed by WDD.
- KHAPOTAMI: idem

3.4. Unusual existing activity: MONAGRI clay-pigeon shooting

During the field visit in May 2009, a Clay-pigeon shooting center was visited at MONAGRI. This center is located on a crest and the shooting sites are located in both sides of the crest:

- on a non permanent tributary of KRYOS river;
- and on the edge of KRYOS river for the main shooting platform (see Figure 4 - MONAGRI main shooting platform and Figure 5 - MONAGRI - direction of shooting).



Figure 4 - MONAGRI main shooting platform

In both cases, clay pigeons are thrown and shot at in the direction of the valleys.

The owner of the center, questioned by WDD agents, declared:

- an average of 100 000 shots/year ;
- and that shooters use 70% of 28 gr. lead cartridges, and 30% 24 gr. ones.

This gives : $100\ 000 \times [(28 \times 0.7) + (24 \times 0.3)] = 2.68$ tons of lead per year.

This quantity is to be considered as a minimum because it is possible that the owner minimizes its declaration.

Most of the lead is scattered over the slope and the bed of Kryos tributary and Kryos river itself :

- the lead lying in slopes :
 - is probably weakly mobilized because of its low biodisponibility under dry conditions ;
 - but goes down slope to the river bed by runoff action ;
- the lead which reaches the flow of KRYOS river is certainly a source of lead contamination whose importance has to be assessed.



Figure 5 - MONAGRI - direction of shooting from the main platform directly in KRYOS valley

RECOMMENDATIONS

Considering the large quantity of lead scattered in the environment, specific actions must be performed:

- **Assessment of the pollution induced by gun cartridge lead in KRYOS river :**
 - river sediment must be sampled and analyzed at three locations :
 - one upstream the zone where lead balls fall. This upstream sample is compulsory in order to take into account natural lead in sediment in relation with geochemistry background concentration ;
 - one immediately downstream. This sample indicates the possible pollution ;
 - one in KOURIS reservoir. This sample will indicate if there is an impact on reservoir sediment.

The sediment sampled must be as fine and organic as possible.

Each river sediment sample is the mix of 3 separate samplings.

There is no standard for lead in sediments, so the only method is to assess an eventual increasing of concentration between upstream and downstream sediment.

- soil sampling at random on the slope, under the zone where lead balls falling.
 - Topsoil will be sampled in 5 different places (2 kilos / place – no stones – size max 2 cm.) ;
 - The 5 samples will be carefully mixed ;
 - Sifted (fraction over 3 mm² is rejected) ;
 - The remaining fraction below 3 mm. Is quartered till 1 kilo is obtained ;

In both cases, slope soil and river sediment lead analysis will be performed by extraction of all lead chemical forms.

- **If lead analyses are positive and show a lead contamination, voluntary actions must be taken so as :**
 - Prohibit lead loaded cartridges and allow only plastic or steel loaded cartridges (or any other non-polluting balls) ;

² Or standard size according to available sieve

- If not possible, propose the relocation of the clay-pigeon shooting centre to another not environmentally sensitive location where, for example, shooting could be performed in the direction of a hill instead of a valley.
- it is estimated that some 500 000 clay pigeons are shot per year (1 pigeon for two shots) and thrown in the same direction that lead balls, but not so far. The dangerousness of clay pigeon components must be tested: the clay and the painting.

3.5. Roads in the Close Protection Zone

Ordinance extract:

“The WATER DEVELOPMENT DEPARTMENT will identify the sections of roads judged dangerous and the following corrective actions must be taken for sections where a risk of pollution of water bodies is identified in case of an accident.”

- KOURIS: The main protection to be made on roads in the CPZ, and especially in the vicinity of the reservoir are shown on the figure below.
- ARMINOU: No asphalted and through roads are near the reservoir.
- KHAPOTAMI: idem



Figure 6 - Main roads to be protected to reduce the risk of direct pollution of the reservoir in case of an accident (in the yellow zones).

3.6. Foreseen forbidden usages and activities in the CPZ

3.6.1. Project of development in ALASSA

A copy of a note about the impact of this project is given in annex.

3.6.2. Project of Pipes, tank or storage of liquid hydrocarbons, chemical products, industrial effluents

A gas station project was mentioned in 2009 at the crossing of Kouris river and main road B8 at TRIMIKLINI village : the place where the gas station is planned is clearly visible.



Figure 7 - TRIMIKLINI : Kouris valley seen from the B8 road bridge. At the background TRIMIKLINI Dam. The earth fill embankment for the gas station is on the left (right bank) – 180° photomontage.



Figure 8 – TRIMIKLINI : The earth fill embankment for the gas station seen from the B8 road bridge showing already significant erosion of the edge (concrete ditch earth support disappeared)

Conclusion: The installation of a gas station at that place will introduce **a major risk** of contamination of Kouris river:

- It will be partly placed on an earth fill embankment encroaching on the Kouris river bank ;
- stormwater and car washing water runoff, even if correctly collected and passed through a settling tank for separating oily component will be send directly in the river. The settling system only removes floating oil and hydrocarbons, not the one in solution or emulsion : there will be an important quasi permanent hydrocarbon pollution intake into Kouris river ;
- accidents during filling the gas station's storage tanks could produce uncontrolled hydrocarbon intake in the riverbed ;
- the embankment could be partly destroyed by strong rain or flood with the danger for storing tanks to be damaged and leak into the river.

Authorization procedure must not be pursued for this gas station project.

If any administrative authorization has already been given for that project, the administration should propose a new place to the petitioner, considering that:

- the place is commercially a good one for a gas station ;
- that the petitioner losses would be very high in case of stopping the project ;
- the ordinance cannot be considered as retro-active ;

4. RECOMMENDATIONS FOR CLOSE AND DISTANT PROTECTION ZONES

4.1. Reduce the unauthorized waste dumping and “flushing”

Within the framework of the development of comprehensive waste management, sorting and recycling activities in Cyprus, the priority should be given for the installation of drop-off facilities for the following recyclable materials:

- Household Hazardous Waste Collection Facilities : for unwanted household chemicals, automotive fluids and various hazardous chemicals, materials, substances, or products that are generated or discarded by households. These materials are generally discarded in garbage cans, dumped on road side, or poured into sinks. They can pollute soils, underground water and surface water.
- Recycling-Solid Waste Collection Center : these materials (cardboard, furniture, toys, carpet, excess yard and tree trimmings, wood, lumber materials, tires, household construction debris, scrap metal items, computers, printers and other electronics) are not the most dangerous for aquatic environment (except electronics) but they are the main reason of illegal dumping and, are usually accompanied by hazardous household materials which are dumped at the same time.
- Pharmaceutical Waste Collection centres : for unwanted or over-the-counter medications. These materials are generally flushed down the toilets and most of them are not eliminated in sewage treatment plants and are then widely detected in surface waters.

It's recommended to install waste collecting facilities centres in the main villages of KOURIS reservoir watershed :

- PANO PLATRES ;
- KYPEROUNTA and/or PELENDRI ;
- AGROS.

These major villages are mainly in the north of the watershed.

So, complementary rural collection centres might be necessary in the smaller villages of the middle of the watershed :

- AGIOS AMVROSOS
- MONAGRI
- LIMNATIS

The south of the watershed is close enough to LIMASSOL facilities and does not need special priority waste collection systems.

Coordination is to be made with the Environment Department is in the process of installing the so called « green spots ». Waste water treatment plant sewage.

In the DPZ, the re-use of treated sewage for irrigation is encouraged through the storing in ponds.

4.2. Private gardening

This activity cannot be regulated. Weed killers and pesticides should be used as less as possible. Providing information and education to gardeners is more efficient ³.

4.3. Vegetation and reforestation

Reforestation advantages are well known. In the case of reservoir protection, some of these advantages are pushed forward :

- runoff is slowed down ;
- pollutant can be partially blocked by roots and partially or totally neutralized ;
- the stability of the slopes is increased and the erosion is highly reduced. This has a great importance for dams whose capacity is slowly but surely reduced by sediment capture.

³ WDD people going regularly on site might have in their car an information leaflet ready to be distributed at any opportunity. The same leaflet might be distributed in villages by town council.

5. MEAN OF APPLYING

5.1. Public information

Public information is a major step in reservoir protection. It must be done in the early phases of protection establishing.

As soon as ordinances are established they must be notified to public. The notification must contain :

- clear limits of the protection zones so as everybody will be able to know if he is within or out of the perimeter ;
- clear explanations on prohibited activities
- useful recommendations for others activities carrying water pollution risk ;
- explanations of what to do in case of accidental pollution.

Educational activities from WDD to schools or other public places in the watershed should be useful to explain to people that they live in the catchment area of drinking water source and should be careful not to produce pollution.

5.1.1. Spill response program in case of accidental pollution

Accidental pollution can occur everywhere in the protection zones.

People who are responsible or by chance witness an accidental pollution must quickly alert the authorities.

People leaving or working near the Riparian zone must be informed and encouraged to act this way. It must be explained that the misdeed resides in the fact of “non alert” and not in the “accidental pollution” itself.

A spill response program must be prepared to ensure that a communication network associated with spill occurrences is clearly defined, tested and implemented.

The method of alert must be unique (definition of the public authority and of the way of alert) and clearly explained to people in the riparian zone and to local officials ⁴.

5.1.2. Soil pollution during dry season

The same spill response program must be in use for any dangerous spilling that might occur during the dry season.

The public must be informed that :

- soil pollution on dry soil or river bed is a danger for water resources ;
- measures can be taken if necessary before the rainy season (soil removal for example).

⁴ A leaflet might be distributed in villages by town council.

5.2. Regulation enforcement control

The main weakness of protection zones is their effective enforcement. So, the protection zones implementation must be carefully monitored and controlled to ensure the respect of the regulation terms of the Reservoir Protection Zones ordinances and especially in the CPZ and the Riparian protection Strip.

The monitoring and control must be effective and continuous. It has to be carried out and be under the control of WDD district offices, in cooperation with local authorities.

5.3. Water quality monitoring

To assess the efficiency of the protection, water quality monitoring in the river and in the reservoir will inform on:

- reservoir water quality as the result of upstream water and soil quality ;
- river water quality as a possible indicator of sub-basins accidental or non-accidental pollution.

The technical characteristics of water quality monitoring (parameters, frequencies ...) will be those that will be defined by the WFD monitoring program:

- for “reservoirs protection zones” and “reservoirs” considered as protected areas for water intended to be used for human consumption: the monitoring programs shall be supplemented by the specifications contained in Community legislation under which the protected areas have been established : the Drinking Water Directive (80/778/EEC) amended by Directive (98/83/EC) ;
- for reservoirs and parts of rivers which are classified as Highly Modified or Artificial Water Bodies : because of the human consumption purpose of these waters, the good ecological potential given to these water bodies might not imply a lower monitoring level than the one given to the protected areas for water intended to be used for human consumption.

Therefore, no extra monitoring is requested for Reservoir Protection Zones effectiveness assessment. Only a few adaptations to the protection context are requested for rivers:

- a part of monitoring stations will be chosen :
 - o at the main confluence point of river and tributaries (in order to be able to determine which sub-basin could be the source of a pollution: confluence of LIMNATIS and KRYOS river with KOURIS River, downstream KHAPOTAMI RIVER, at the confluence of the 3 main rivers that feed ARMINOU Reservoir;
 - o downstream of known pollution risk areas (downstream the main villages).
- monitoring program will be adjusted to the seasonal river flow :
 - o one sampling during the first flows in order to detect eventual dry season soil pollutions ;
 - o one sampling in high flow conditions in order to detect eventual soils pollutions⁵ ;
 - o other sampling in normal or basic flow conditions.

These modifications will be implemented in the 2016-2021 RBMP.

⁵ High flows carry fine particles in suspension which are likely to have retained pollutants. This gives better indication than chemical analysis performed on filtered water.

6. ANNEX

City / Village name	% of area in Kouris watershed	In IPZ, CPZ or DPZ	Perma-nent population	Summer population	Necessity of a City Waste Water Sewage Plan (summer population >200)	Actual wastewater treatment level 0=no 2=secondary 3=tertiary	Necessary treatment level (if in CPZ)	Actual treatment plant capacity	Necessary treatment plant capacity	Actual destination of sewage effluent	Necessary destination of sewage effluent	Recommendations Comments
DYMES	100		164									
KALO CHORIO LEMESOU	21		0									
KANTOU	6	IPZ	397									No recommendation for a Waste water sewage collection and treatment system because of the small surface concerned by Kouris RPZ.
<u>KAPILEIO</u>	100		30 ?									Population is wrong (new constructions are visible on the satellite image along Limnatis valley).
KATO AMIANTOS	100		219									A Waste water sewage collection and treatment system to be developed.
<u>KATO KIVIDES</u>	100		2									-
KATO MYLOS	100		63									A Waste water sewage collection and treatment system to be developed. Kato Mylos Pond is not connected to the water treatment plant but gets water from Limnatis river, downstream Agros waste water treatment plant discharge
KOILANI	85		255									A Waste water sewage collection and treatment system to be developed.
<u>KORFI</u>	50		165									Korfi village is actually built outside Kouris watershed.
KOUKA	100		4									
<u>KYPEROUNTA</u>	100		1497			3				Pond	Pond	-
LANEIA	100		193									
LIMNATIS	100		260									A Waste water sewage plan to be developed.

City / Village name	% of area in Kouris watershed	In IPZ, CPZ or DPZ	Perma-nent population	Summer population	Necessity of a City Waste Water Sewage Plan (summer population >200)	Actual wastewater treatment level 0=no 2=secondary 3=tertiary	Necessary treatment level (if in CPZ)	Actual treatment plant capacity	Necessary treatment plant capacity	Actual destination of sewage effluent	Necessary destination of sewage effluent	Recommendations Comments
<u>LOFOU</u>	100		10 ?									The population seems undervalued. The place is probably touristy with population increasing.
<u>MONAGRI</u>	100		173									Risk of lead pollution due to Clay pigeon shooting installation.
MONIATIS	100		227									A Waste water sewage plan to be developed.
PANO AMIANTOS	100		3									
PANO KIVIDES	31		694			1						No recommendation for a Waste water sewage plan because of the little surface concerned by Kouris RPZ. The development of the village on the north slope (within Kryos watershed must be stopped).
<u>PANO PLATRES</u>	88		2000			3						The holder of the fish farming must be informed to avoid any medicament in the trouts growing operations.
<u>PELENDRI</u>	100		1185			3				Pond		
PERA PEDI	100		66									
POTAMITISSA	100		70									
SILIKOU	100		98									
<u>SOUNI ZANAKIA</u>	?											No recommendation for a Waste water sewage collection and treatment system because of the small surface concerned by Kouris RPZ. Constructing on the edge of the watershed must be constrained to the current extend.

City / Village name	% of area in Kouris watershed	In IPZ, CPZ or DPZ	Perma-nent population	Summer population	Necessity of a City Waste Water Sewage Plan (summer population >200)	Actual wastewater treatment level 0=no 2=secondary 3=tertiary	Necessary treatment level (if in CPZ)	Actual treatment plant capacity	Necessary treatment plant capacity	Actual destination of sewage effluent	Necessary destination of sewage effluent	Recommendations Comments
<u>TRIMIKLINI</u>	100		170									High risk of hydrocarbon pollution of Kouris river if the Gas station service project is pursued.
VOUNI	41		136									
<u>YPERSONAS</u>	5	IPZ	6435									No recommendation for a Waste water sewage collection and treatment system because of the small surface concerned by Kouris RPZ.
ZOOPIGI	90		160									Hydrocarbon soil pollution at the mechanical equipment maintenance platform of a quarry near Limnatis river.

6.2. ARMINOU - Villages in the reservoir watershed - Sewage system characteristics and recommendations

City / Village name	% of area in Kouris watershed	In IPZ, CPZ or DPZ	Perma-nent population	Summer population	Necessity of a City Waste Water Sewage Plan (summer population >200)	Actual wastewater treatment level 0=no 2=secondary 3=tertiary	Neces-sary treatment level (if in CPZ)	Actual treatment plant capacity	Neces-sary treatment plant capacity	Actual desti-nation of sewage effluent	Necessary desti-nation of sewage effluent	Recommendations Comments
...												

6.3. KHAPOTAMI - Villages in the reservoir watershed - Sewage system characteristics and recommendations

City / Village name	% of area in Kouris watershed	In IPZ, CPZ or DPZ	Perma-nent population	Summer population	Necessity of a City Waste Water Sewage Plan (summer population >200)	Actual wastewater treatment level 0=no 2=secondary 3=tertiary	Neces-sary treatment level (if in CPZ)	Actual treatment plant capacity	Neces-sary treatment plant capacity	Actual desti-nation of sewage effluent	Necessary desti-nation of sewage effluent	Recommendations Comments
...												

6.4. Technical recommendations for private on site waste water treatment system

This section describes one of the two proposed private waste water treatment systems the one composed of a septic tank and a disposal field.

The other system the one of cesspools remains to be developed outside of the 2009 contract.

6.4.1. Definition

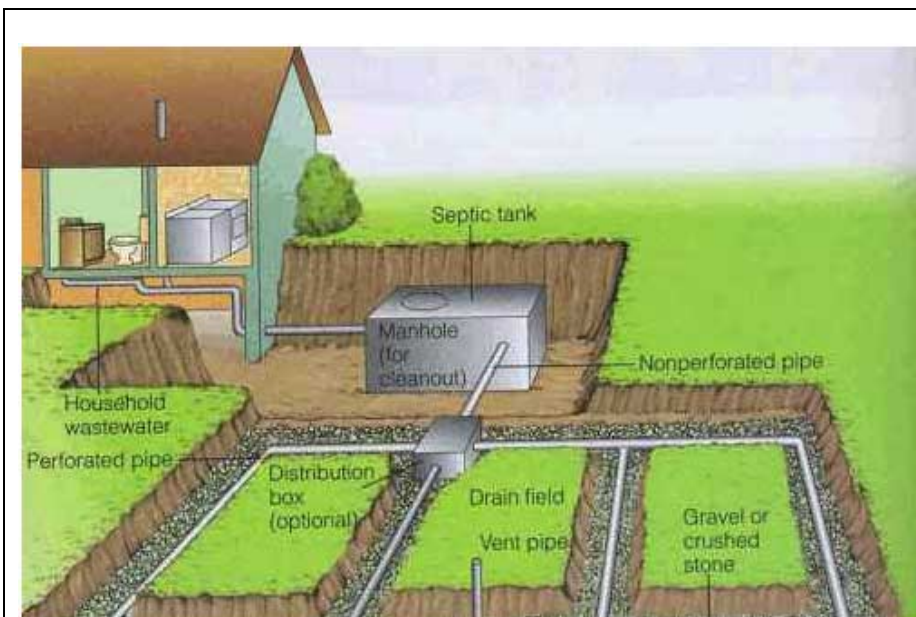
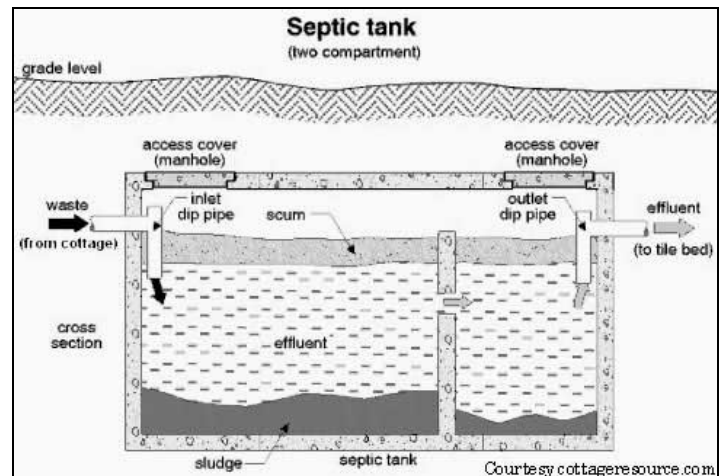
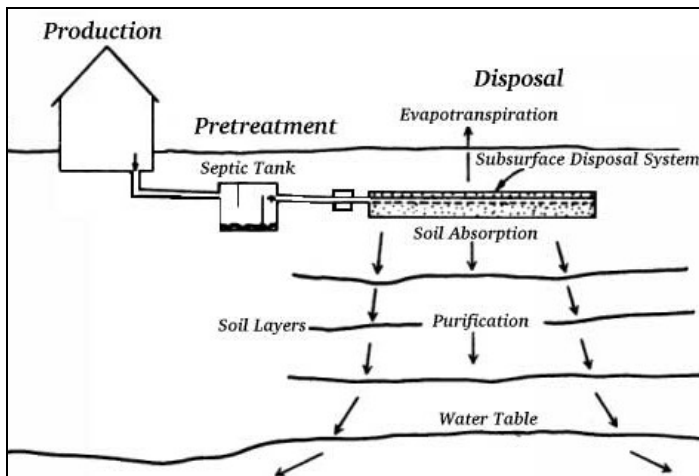
One of the two Private on site waste water treatment system whose use is recommended for Cyprus reservoir Close Protection Zone consists of two parts:

- o a septic tank ;
- o and a disposal field.

6.4.2. Design

A septic tank system treats household wastewater by holding it temporarily in the septic tank which allows heavier solids to settle to the bottom while grease, oil, soap and fat rise to the top and form a scum.

The disposal field (or soil drain field) is a series of perforated plastic pipes laid in gravel-filled trenches that allows wastewater to slowly soak into the soil. While the wastewater penetrates the soil, the biological activity in the soil treats the wastewater and reduces the pollution.

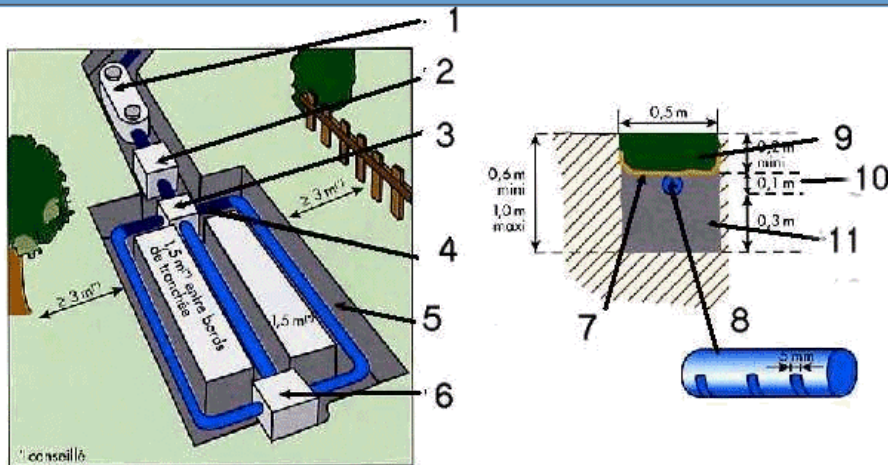


Septic tank : its volume must be at least 2 m³ (2 000 l) for a house composed of 4 main rooms, to which must be added 0,5 m³ (500 l) per supplementary main room (main room = living, dining room, bedroom, but not kitchen and bathroom).

Disposal field : Is composed of 10 cm minimum diameter underground drains which distribute liquid in soil trough holes (diameter at least 5 mm). The sewage spreading must ideally be close to the ground surface (50 cm), so as the ventilation is sufficient. Drains lie in a washed gravel bed covered by a decay resistant geotextile. The whole field covers 100 to 200 m² depending of the soil characteristics.

Deep trench infiltration drain

Χαντάκια αποστράγγισης μικρού βάθους



Selected for Aqualingua (2003) - Source : Communauté Urbaine de Lyon

Deep trench infiltration drain (principle and details) [Listen](#)

#	Technical	Usual
1	Septic tank Listen	
2	Inspection chamber Listen	
3	Flow separation chamber Listen	
4	Feed pipes Listen	
5	Trench Listen	
6	Inspection chamber Listen	
7	Anti-pollution membrane Listen	
8	Infiltration drains Listen	
9	Topsoil Listen	
10	Drainage trench Listen	
11	Gravel bed 10 to 40 mm Listen	

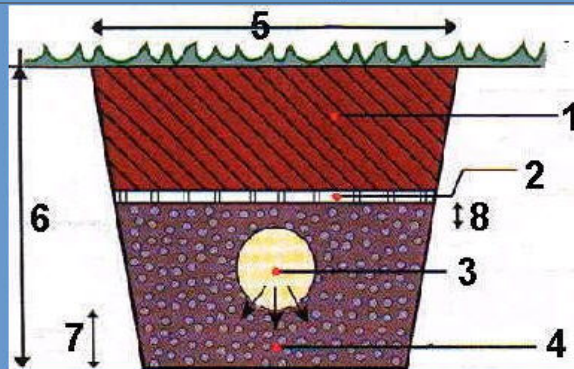
Χαντάκια αποστράγγισης μικρού βάθους (αρχή και λεπτομέρειες)

#	Technical	Usual
1	σηπτικός βόθρος Listen	
2	φρεάτιο ελέγχου Listen	
3	φρεάτιο διανομής Listen	
4	αγωγοί διανομής Listen	
5	χαντάκια Listen	
6	φρεάτιο ελέγχου Listen	
7	μεμβράνη αντι-ρύπανσης Listen	
8	στραγγιστήρια Listen	
9	φυσική γή Listen	έδαφος Listen
10	αωλήνας επιφανειακής διάθεσης Listen	
11	γαλίκι 10-40 mm Listen	

source : <http://scripts.oieau.fr/aqualingua/index.php3>

Sub-surface infiltration drain

Στραγγιστήρι υπεδάφιας διήθησης



Sub-surface infiltration drain [Listen](#)

#	Technical	Usual
1	Topsoil Listen	
2	Geo-textile filter membrane Listen	
3	Infiltration drain Listen	
4	Gravel 20-32mm Listen	
5	Trench width at soil surface 30-80cm Listen	
6	Trench depth 50-70cm Listen	
7	Drain invert to trench base - 15cm Listen	
8	Membrane to crown of drain - 5 to 10cm Listen	

Στραγγιστήρι υπεδάφιας διήθησης

#	Technical	Usual
1	φυσική γή Listen	έδαφος Listen
2	μεμβράνη-φίλτρο γεωυφάσματος Listen	
3	στραγγιστήρι διασποράς Listen	
4	γαλίκι 20-32 mm Listen	
5	30-80 mm Listen	
6	50-70 mm Listen	
7	15 cm Listen	
8	5-10 cm Listen	

6.4.3. Maintenance obligations

- The septic tank must be cleaned every 3 years by a certified professional (the dumping of the tank must be eliminated in a proper way). If the tank is not cleaned, the accumulation of sludge and scum is flushed into the disposal field, plugging holes in the pipes and the pores of the soil ;
- The disposal field is not allowed to drain to road ditches, streams, or to the ground surface of any property ;
- Pouring of toxic substances (oil, paint, etc.) into the septic tank is forbidden ;
- The area over the disposal field can be covered with lawn to promote evaporation, but it should not be planted with trees or shrubs ;
- Are not allowed over or near the disposal field : Patios, pools and tool sheds ;
- Are not allowed over disposal field : Driving or parking automobiles, tractors, or heavy equipment.

6.4.4. Use recommendations

- Pouring of non-biodegradable items (such as grease, disposable diapers, paper towels, etc) is forbidden ;
- Moderate use of bleaches, cleansers and other household products will not harm the septic tank ;
- Trouble signs indicating septic tank failure :
 - Disposal field ground is frequently wet and spongy ;
 - Sewage odors ;
 - Well water contains nitrates or fecal coli form bacteria (E. coli) ;
 - A slow flow from toilets and drains in the house ;
 - Waste water back-up into house.

6.4.5. Useful links

EPA: A homeowner's guide to septic systems.

www.epa.gov/owm/septic/pubs/homeowner_guide_long.pdf

Nord Dakota State University: Individual home sewage treatment systems

www.ag.ndsu.edu/pubs/ageng/structu/ae892.pdf

Royal Australian Institute of Architects: On-site domestic wastewater treatment and reuse.

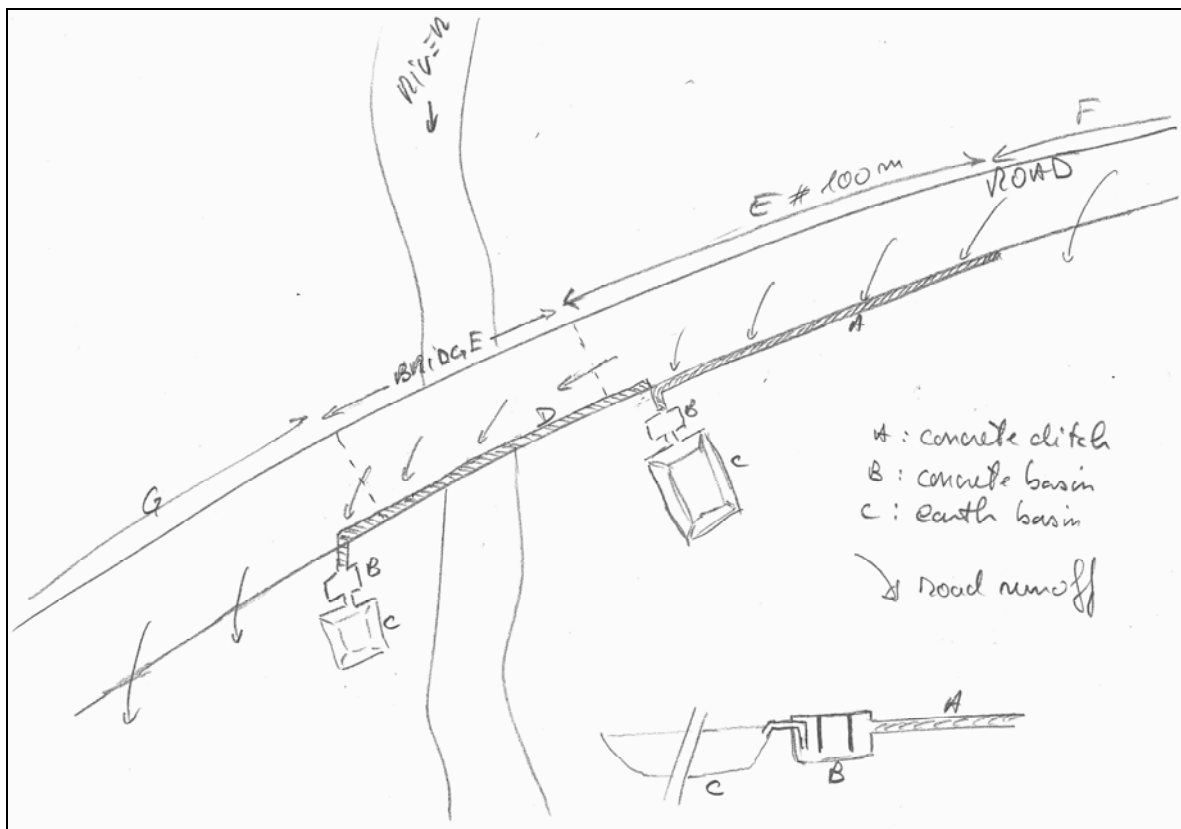
6.5. Technical recommendations for the equipment of road bridge passing over a main river of the CPZ and RPZ

The crossing of a road with a river is a place where two pollution conditions can occur:

- Semi-permanent pollution : rain run off on the roadway, bringing pollutant as hydrocarbon, lead, oil, ..., can reach the river;
- Spill of pollutant after a truck accident, can reach the river by running on the bank or falling into the river directly from the bridge.

The protection system must cover the two pollution conditions.

The above figure shows a basic system.



For simplification, the road is supposed to be steep from right to left and slightly inclined toward the bottom of the picture (because of the bend).

- Section F of the road : run off is naturally directed on the side of the road for infiltration ;
- Section E : run off is collected in a concrete ditch (A), built on the side, send in a concrete basin (B) then in an earth basin (C) for infiltration :
 - o The concrete basin B is made for collecting accidental spill from a truck. It is shaped to retain oils.
 - o The C earth basin bottom is covered with a layer of sand for retaining some pollutants before infiltration in soil.
 - o Under rain conditions, the basin B is overflowed and the basin C avoid run off water from going in the river.
 - o Under accidental pollution, the A basin is supposed to retain all the pollutant (it must be shaped to the volume of a tanker truck). It must be quickly emptied after a pollution.

- If the accidental pollution occurs under rain conditions, the basin B might overflow in basin C. In this case the bottom of the basin C must be changed on the polluted thickness.
 - The basin C must be shaped to contain the runoff of the section E under a 100mm rain in 1 hour.
 - This system cannot face an accidental pollution under long storm condition.
 - The section is protected by crash barriers.
 - The length must be approximatively 100 m. It is a safety length, meaning that if a leakage occurs from a tanker after an accident, the pollutant will go in the soil, but because of the distance from the banks of the river, there will be no risk of transfer to the river. Of course the polluted soil must be removed. In configuration of steep road toward the river, more this length is important, best it is, but more expensive it is also.
- Section BRIDGE
 - The concrete ditch D is built on the edge of the bridge and collects all the runoff of the bridge. It must be able to receive a brutal spill from a tanker.
 - A crash barrier is installed on the side of the bridge, strong enough to avoid a truck falling into the river (see crash barriers pictures below).
 - Section G, same than Section F.

If this junction is preceded by a long slope (possibility of high speed for trucks due to brakes breakdown), it might be useful to install an escape line before the river.

Crash barriers example



Exemple of strong crash barriers installed on a highway bridge which passes over a water body used for drinking water alimentation (France – Lyon).



Idem, with a net to avoid the throwing of objects into the river.

6.6. Copy of the technical note made on the Alassa Golf project on request of WDD – September 2010

The Water development department requested an expert advice on a project golf and related development near the city of ALASSA. The information used for this advice are the one made available by WDD :

- ALASSA GOLF and Related Development for the ALPHA PANARETI Company Ltd- Proposals for the Protection of the Kouris Dam water and the Environment. 10th September 2010 - NT Water-Pros LTD Water professionals. *This document is annexed in a commented version.*
- 2 plans referenced as: Plan No 1 General layout of developments and Plan No 2 Storm-water and Drainage system from the Golf Area - *These 2 plans are annexed.*

Plus some extra information collected on Internet professional sites⁶.

1. DEFINITIONS

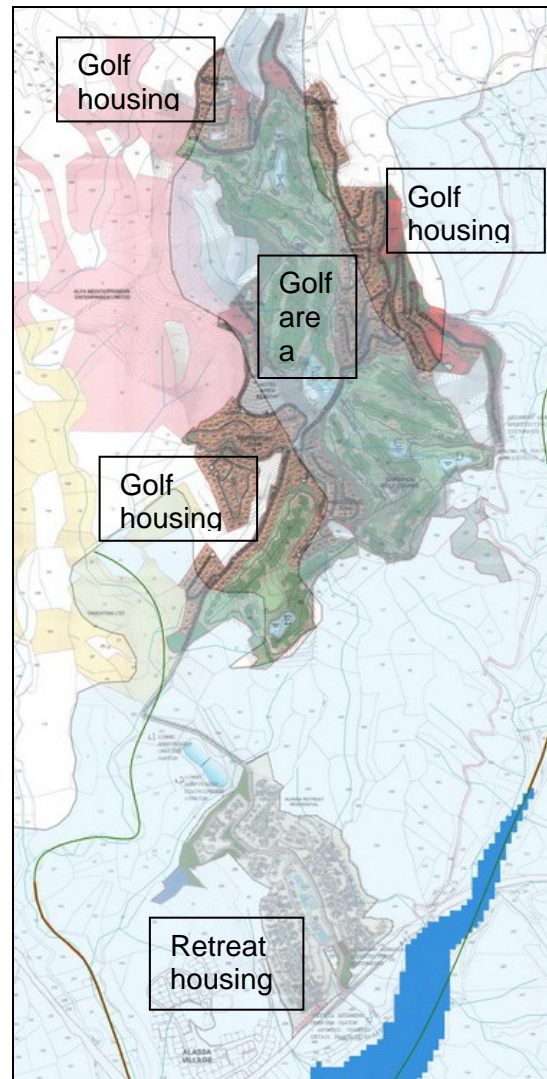
The following terms will be used in this document

- The Project: the whole development
- Golf area: the zones used for golf practice and their specific equipment (technical building, water management system ...).
- Golf housing: housing around the golf area (houses, flats, restaurants, hotel, circulation lanes and roads)
- Retreat housing: part of the development, close to Alassa village, named "ALASSA RETREAT RESIDENTIAL" on Plan 1 (houses, flats, restaurants, shops, ..., circulation lane and roads)

2. POSITION OF THE PROJECT VERSUS KOURIS RESERVOIR PROTECTION ZONES

If considering Kouris reservoir protection matter, the whole project cover a surface which lies in two kind of protection zone :

- The whole retreat housing is in the Close Protection Zone (CPZ). The bottom part where are foreseen the equipment for storm water and waste water management (Untreated effluent Storage Tank, Sewage Treatment plant and Pumping Station, Subsurface concrete tank for storm water temporary storage and Pumping Station) is at a distance of less than 300 m. from Kouris river bed, and at a distance of about only 150 m. from the bank of the reservoir in high water conditions.
- The Golf area mainly lies on the CPZ.
- The Golf housing mainly lies in the Distant protection Zone (DPZ), but some houses are within the CPZ.



Position of the Project versus the protection zones - See full map in annex

⁶ www.alphapanaretionline.com , www.scottbrownrigg.com

3. COMMENT ON THE TECHNICAL PROPOSALS MADE FOR THE PROJECT IN ORDER TO PROTECT THE RESERVOIR AND ENVIRONMENT

In details, some points would need to be developed, reinforced or explained (see document with comments in annex):

- Calculation of runoff in storm conditions: Comments N° 1, 20, 21, 25, 30
- Calculation of wastewater according to number of expected Inhabitants Equivalent: Comments N° 2, 6, 12, 30
- Quality of storm water: Comments N° 4, 16
- Quality of waste water: Comment N° 3
- The need of treatment for golf area and ponds: Comments N° 5, 17
- Groundwater: Comments N° 9, 19, 24
- Safety factor for the running of equipment: Comments N° 11, 18
- Design and running of equipment and works: Comments N° 10, 15, 23, 24, 25, 27, 30

But, in general, the measures and works proposed for the project are serious even if the level of protection of underground water is less effective.

In normal environmental conditions (which is not the case of ALASSA location), the project as designed would be very satisfying and able to bring a good protection level of surface water bodies. Still in the mainframe of normal conditions, some parts can even appear to be oversized (peripheral channel, safety on storm water equipment system ...).

4. PERTINENCE OF THE PROJECT IN THE KOURIS CONTEXT

But in the present case, the project is foreseen on an area whose close vicinity with a major drinking water resource greatly increases any weaknesses of the system. In consequence, to aim for a long term good protection, care must be taken to the following points:

- **Protection against pollution**
The Project must be designed so as even little leakages of the system are permanently suppressed.
This mean perfection in the design, building and running, which is obviously impossible to be reached.
- **Correct equipment running**
Assurance of the long term perennially of the good running of all the equipment is compulsory.
Developers cannot contract to insure it because of possible changing of owners, in economic conditions, ...
- **Risk reduction**
Risks of equipment failure and natural hazards or exceptional weather situations consequences must be dramatically reduced.
Such target implies out of proportion requirements.

In order to reach the simultaneous satisfaction of these requirements, the administration in charge of the resource protection will legitimately be led to request out of proportion equipment design and operating assurance.

5. COMPLIANCE WITH PROTECTION ZONES REGULATION

1.1. CLOSE PROTECTION ZONES

Below are listed a selection of pertinent forbidden activities:

- New constructions other than private houses: farms, industrial building, warehouse, hotels, ...
- New roads and existing road resizing to higher traffic capacity.
- Earthwork including filling and/or excavation.
- Disposal, spreading or infiltration of ... domestic waste waters even after treatment.

- Use of weed killers, fertilizers and pesticides for agriculture and infrastructure maintenance.
- Intensive agriculture as cereal growing, biofuel, lawn and grass surfaces for sport or leisure activities on more than 1.5 hectare with a limitation of once per 50 hectares.

Land regulation in the CPZ

- No modification of the Town planning zones that would favor development ...
- Furthermore, no application for development permit at deviation of the existing zoning rules should be approved by the government
- All new developments not allowed by existing zoning rules shall be located outside the CPZ.

1.2. DISTANT PROTECTION ZONE

Selection of pertinent items:

- The project must be designed so as no run off from the impervious surfaces of the development can reach directly the CPZ and rivers in the CPZ, and especially under storm conditions.
- Runoff from the impervious and non-impervious surfaces of the development must be free of pesticides, weed killers, insecticides or any entropic chemical product.

1.3. COMPLIANCE

The Project, in its actual design does not comply with the above requirements:

- The retreat housing is completely not compliant ;
- The golf housing could be compliant only for the development part out of the CPZ ;
- The Golf area is not compliant.

6. CONSEQUENCES OF AN AUTHORISATION OF THE ACTUAL PROJECT

The acceptance of the project as designed and located, specially the Retreat housing, would bring the administration to an unbearable position facing other projects or extension of this project, for which the administration would have no argument not to allow them.

Consequently, the strength of the protection zone regulation would be immediately weakened when it has just been established.

Finally, the Kouris reservoir is a Protected Area for drinking water as mentioned in the Cyprus River Basin Management Plan in appliance of the European Water Framework Directive. The non-correct protection of this Protected Area might bring the European Commission to start a legal procedure against the Cyprus Government.

ANNEXES (not attached here)

1. Plan showing the position of the Project versus the protection zones.
2. ALASSA GOLF and Related Development for the ALPHA PANARETI Company Ltd- Proposals for the Protection of the Kouris Dam water and the Environment. 10th September 2010 - NT Water-Pros LTD Water professionals.
Commented version
3. Plan No 1 General layout of developments
4. Plan No 2 Storm-water and Drainage system from the Golf Area